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EDITORIAL

At last, here is the 1987 issue of the Journal reaching you in 1988. As I have looked forward to, we have caught up. The 1988 issue is still due. The year is not over. We might yet make it. We have moved forward and backward in time. But it is a relief to have come back to the present and to feel we are not in debt anymore.

We have caught up in another way also ; that with this issue we have given the complete abstracts of all our dissertations upto 1987. We have included in the current issue, the index of all the research abstracts indicating when they were done and when they were published in our Journal. Hopefully, this will help historians to correctly re-order the chronological sequences. I only hope that from now on we will not let a back-log develop.

We feel emboldened now to request the scholars from within India and abroad to send us articles. We hope now there shall be no delays.

CONTENTS

Auditory Brain-stem Evoked Response and Efferen[redacted]

YASMEEN YAKUB GUNJA

The assumption that the action of the efferent system innervating the outer hair cells is to increase the loudness of the post-adapted test tone is supported by many studies.

This loudness gain can be determined by using ABR audiometry. It is observed in the form of an increase in absolute amplitude and a reduction in absolute latency.

In the present study the efferent action of monaural stimulation on the periphery of the contralateral auditory system was determined using ABR audiometry.

Binaural interaction causes a loudness gain when the continuous tone is at a low intensity level.

Fourteen normal hearing subjects within the age range from 18 years to 25 years were tested. BSER were determined using an Electric Response Audiometer TA-1000. Logon stimuli of 80 dB HL were used. Then a continuous tone of 60 dB HL was presented in the contralateral ear. The tone was presented through the right earphone using a Maico MA-27 portable audiometer. The tone was presented for 7 minutes.

Even after 7 minutes the tone was continued. During the 7 to 9 minutes period (*i.e.*, in the presence of the continuous tone) BSERs were again recorded. Logon stimuli of 80 dB HL were used. The frequency of the Logon stimuli was same as the frequency of the continuous tone. The test was carried out at 2 KHz and at 4 KHz. In all subjects the left ear was the test ear and continuous tone was presented in the right ear.

Loudness gain was observed in wave-I for most of the subjects, *i.e.*, there was loudness gain at the auditory nerve.

From the present study, one can conclude that binaural interaction takes place at the level of the auditory nerve. Monaural stimulation of low intensity causes a loudness gain in the contralateral ear.

Loudness gain was also observed in wave-VI, *i.e.*, at the level of the medial geniculate nucleus. The results of the present study agree with the results observed by Gerken 1984. He reports enhancement of response amplitude in the medial geniculate nucleus to continuous tone. He observed these findings in a conscious cat.

* Master's Dissertation, University of Mysore, 1985.

In the present study enhancement of response amplitude in the medial geniculate nucleus to continuous tone was observed in humans.

Loudness gain was observed in terms of increase in the amplitudes of peaks I and VI for frequencies 2 KHz and 4 KHz.

Another experiment was carried out, where loudness gain was observed when a continuous tone was presented in the ipsilateral ear.

Four normals in the age range of 18 to 25 years were tested. BSERs were determined using an Electric Response Audiometer TA-1000.

Stimuli used was Logon stimuli of 80 dB HL. Continuous tone was then presented *via* a BC transducer using GSI-10 Bekesy Audiometer. The tone was of 55 dB HL and it was presented for 7 minutes ipsilaterally. Then without switching off the tone, in its presence, BSER were determined. Logon stimuli of 80 dB HL was used. The test was only carried out at 2 KHz.

Loudness gain was only observed in the VI peak.

Continuous tone presented ipsilaterally causes loudness gain only in the medial geniculate nucleus.

Limitations of the Study

(1) The size of the sample was small.

(2) The age range of the subjects was limited.

Recommendations

(1) To carry out the study on a larger population.

(2) To carry out the study on subjects with a wider age range and determine if loudness gain varies with age.

(3) To study if binaural interaction is present when the continuous tone is of a different frequency from that of the test stimulus.

(4) To study if loudness gain is present when the continuous tone is of a high intensity ($\geqslant$ 80 dB HL).

(5) To study if loudness gain is present in wave-I of BSER in the presence of continuous tone (contralateral ear) in cases with cochlear pathology.

The Effect of Binaural Noise and Sensitivity on Brain-Stem Evoked Response *

VIJAYASHREE

The present study was aimed at investigating whether there is any effect of binaural noise on the latency and amplitude of brain-stem response. The study was also aimed at finding out the effect on latency and amplitude of brain-stem response at different values of sensitivity.

The Electric Response Audiometer Model TA-1000 was used for the study. The study was divided into two parts. In Part I, 5 subjects (3 females and 2 males) with normal hearing in the age range of 18 to 23 years were selected. Logon stimuli were presented through the bone vibrator at 70 dB HL for 2048 samples at the rate of 5 stimuli/second in the absence and presence of the noise respectively. Narrow-band noise was presented binaurally through the earphones. Latency and amplitude of the brain-stem response were measured. S imulus frequencies employed were 2 KHz and 4 KHz at 70 dB HL. The noise levels selected were 77 dB SPL and 67 dB SPL at 2 KHz and 77 dB SPL at 4 KHz. The response latency and amplitude of I, III and V peaks of brain-stem response were noted for all the subjects. Data were analysed so as to obtain the means and standard deviations.

In Part II, 10 subjects with normal hearing (5 males and 5 females) in the age range of 18 to 23 years were selected. At different sensitivity values ($0 \cdot 2\,\mu V$, $0 \cdot 5\,\mu V$, $1 \cdot 0\,\mu V$ and $0 \cdot 1\,\mu V$) brain-stem evoked responses for the Logon stimuli were noted (Logon stimuli were presented to the right ear). The latency and amplitude of waves I, III and V were noted down for all the subjects. The stimulus frequencies employed were 2 KHz and 4 KHz at 80 dB HL. The data obtained were analysed statistically using Wilcoxon matched pairs signed rank test to find out if there is any significant effect on latency and amplitude of the brain-stem response at different sensitivity values.

Conclusions

The following conclusions can be drawn from the results obtained :

(1) There was increase in latency for peaks III and V obtained at 2 KHz in the presence of binaural noise (Noise level 77 dB SPL).

(2) There was increase in latency only for peak V obtained at 2 KHz in the presence of binaural noise (Noise level 67 dB SPL).

(3) There was increase in latency for peaks I and V obtained at 4 KHz in

* Master's Dissertation, University of Mysore, 1985.

the presence of binaural noise (Noise level 77 dB SPL).

(4) There was a decrease in amplitude for peaks I, III and V obtained at 2 KHz in the presence of binaural noise at 77 dB SPL and 67 dB SPL respectively.

(5) There was a decrease in amplitude for peaks I, III and V obtained at 4 KHz in the presence of binaural noise (Noise level 77 dB SPL).

(6) There was an increase in interpeak latency (V – I) obtained at 2 KHz in the presence of binaural noise (Noise level 77 dB SPL and 67 dB SPL).

(7) There was an increase in interpeak latency (V – I) obtained at 4 KHz in the presence of binaural noise (Noise level 77 dB SPL).

(8) The change in sensitivity values has no significant effect on latency and amplitude of the peaks I, III and V obtained at 2 KHz and 4 KHz.

(9) The change in sensitivity value has no significant effect on interpeak latency (V – I) obtained at 2 KHz and 4 KHz.

(10) There was a change in the morphology of the waveform obtained at different sensitivity values ($0{\cdot}2\,\mu V$, $0{\cdot}5\,\mu V$, $1{\cdot}0\,\mu V$ and $0{\cdot}1\,\mu V$).

Limitations of the Study

(1) Less number of subjects were used for the study.

(2) The effect of binaural noise was studied at only two frequencies and at only one intensity level (70 dB HL—Logon stimulus).

(3) The effect of sensitivity was studied at only one intensity level (80 dB HL—Logon stimulus).

Recommendations

(1) To carry out the study on a larger population.

(2) To study the effect of binaural noise at different intensity levels.

(3) To study the effect of sensitivity at different intensities.

Development and Standardization of Speech Test Materials in Manipuri Language *

TANUJADEVI, E.

The aim of the present study was to construct and standardize SRT and speech discrimination test materials in Manipuri language.

Monosyllabic and polysyllabic words from various sources such as books, magazines, newspapers and normal conversation were administered to 10 adults for familiarity testing. The most familiar words were selected to form four polysyllabic list each one containing 20 words and 4 monosyllabic word lists of 25 words each. The monosyllabic words are not phonetically balanced as studies are not available.

All the test materials were tape-recorded and fed through the speech channel. Five adults comprise the subjects used in the standardization of the speech lists. These lists were presented to the subjects at various intensity levels and articulation curves were plotted in each case. The obtained SRT of 13 dB (Ref. 0 SRT, 0 SRT = 20 dB SPL) is in close agreement with average pure tone which is 11·34 dB. Maximum discrimination score was obtained at 40 dB SL (Ref. SRT). In the clinical situation the speech discrimination test has to be administered at 40 dB above SRT. The present study resulted in standardized speech lists which are equal in difficulty and are valid.

Conclusions

(1) The present lists yield similar results like any other valid tests of discrimination.

(2) Normals obtained optimum discrimination at 40 dB SL with reference to SRT.

(3) The obtained SRT agrees well with PTA.

(4) All the four lists of each type found to be essentially equivalent and can be used interchangeably.

Limitations of the Study

(1) This study was limited to only graduate students.

(2) Population tested was very limited in number.

(3) Reliability test was not done.

Recommendations for Further Study

(1) Further standardization of the tests using a larger population.

(2) The usefulness of the speech materials developed in the present study is to be established by testing a large clinical population.

* Master's Dissertation, University of Mysore, 1985.

Sex Differences in Latency and Amplitude Changes for Binaural Stimulation in Auditory Brain-stem Responses *

ANUJ THAPHER

The study was carried out in a sound treated room of Audiology Department, AIISH, Mysore. Thirty-two normal hearing ($\leqslant$ 20 dB HL ANSI 1969) subjects in the age range of 18 years to 28 years 2 months (mean age 20 years, 9 months). Subjects were divided into 2 groups, Group-I and Group-II. Group-I consisted of 16 males and Group-II consisted of 16 females. As stated in the methodology the subjects were in supine position and 3 electrodes were used, active, ground and reference. ERA-TA-1000 was used. Logon stimulus was presented through the earphones. The frequencies of the Logon stimuli used were 2 KHz and 4 KHz. These stimuli were presented for 2048 times at a rate of 20 times/sec. 10 msec. sample time was used. The intensity of Logon stimulus was 80 dB HL.

The stimulus was presented monaurally (Right or Left ear) and bilaterally. In half of subjects from Group-I and half of the subjects from Group-II, stimulus was presented in right ear and in other half of the subjects from both the groups, the stimulus was presented in left ear for the monaural presentation.

ΔL, ΔA, ΔL_{V-I} and ΔL_{III-I} values were determined for 2 KHz and 4 KHz logon stimuli, at 80 dB HL, and these values are compared between male and female groups.

Conclusions

The following conclusions have been drawn :

(1) There is no significance of difference for $\Delta L_{2\,KHz}$ of I to VI peaks, between males and females.

(2) There is no significance of difference for $\Delta L_{4\,KHz}$ of I to VI peaks, between males and females (except for peak III).

(3) There is no significance of difference of I to VI peaks, between $\Delta L_{2\,KHz}$ and $\Delta L_{4\,KHz}$, in males.

(4) There is no significance of difference of I to VI peaks, between $\Delta L_{2\,KHz}$ and $\Delta L_{4\,KHz}$, in females.

(5) There is no significance of difference for $\Delta A_{2\,KHz}$ of I to VI peaks, between males and females (except for peak II, at 0·05 level of significance).

(6) There is no significance of difference of $\Delta A_{4\,KHz}$ of I to VI peaks, between males and females.

* Master's Dissertation, University of Mysore, 1985.

(7) There is no significance of difference of I to VI peaks, between $\Delta A_{2\,KHz}$ and $\Delta A_{4\,HKz}$ in males.

(8) There is no significance of difference of I to VI peaks, between $\Delta A_{2\,KHz}$ and $\Delta A_{4\,HKz}$ in females.

(9) There is no significance of difference for $\Delta L_{2\,KHz}$ (V – I) and $\Delta L_{4\,KHz}$ (V – I), between males and females.

(10) There is no significance of difference for $\Delta L_{2\,KHz}$ (III – I) and $\Delta L_{4\,KHz}$ (III – I), between males and females.

The Effect of Contralateral Noise on the Middle Evoked Response *

NAZNEEM YAKUB GUNJA

The present study was aimed at investigating whether there is any effect of contralateral noise on the latency and amplitude of the VI, VII and P_0 peak. Simultaneously, the study was also aimed at seeing if there was any change in the amplitude and latency of the V peak when measured using patient response interval of 10 msec. and 20 msec. And finally, the study attempted to find out if there was any difference between the combined amplitude of middle response and the binaural amplitude response.

The Electric Response Audiometer Model TA-1000 was used for the study. The study was divided into three experiments. In experiment-1, the latency and amplitude of the middle latency response was measured for eight normal females and seven normal males, in the presence and absence of contralateral noise. In experiment-2, six normal females and two normal males, who had acted as subjects in experiment-1, were taken as subjects and latency and amplitude of averaged evoked response was measured, while keeping the patient response interval at 10 msec. In experiment-3, seven normal females and three normal males having equal thresholds in both the ears were taken for the study. Amplitude of the middle response from the left ear, right ear and when both the ears are stimulated binaurally, were recorded.

Conclusions

(1) Clear VI peaks were obtained when tested at sensitivity $0{\cdot}2\,\mu V$ in :

10/15 subjects at 2 KHz 80 dB HL ;
8/15 subjects at 2 KHz 100 dB HL ;
9/15 subjects at 4 KHz 80 dB HL ;
and
12/15 subjects at 4 KHz 100 dB HL.

(2) Clear VI peaks in the presence of contralateral noise were obtained when tested at sensitivity $0{\cdot}2\,\mu V$ in :

11/15 subjects at 2 KHz 80 dB HL ;
7/15 subjects at 2 KHz 100 dB HL ;
7/15 subjects at 4 KHz 80 dB HL ;
and
10/15 subjects at 4 KHz 100 dB HL.

(3) Clear VI peaks were obtained when tested at sensitivity $1\,\mu V$ in :

6/13 subjects at 2 KHz 80 dB HL ;
6/13 subjects at 2 KHz 100 dB HL ;
5/13 subjects at 4 KHz 80 dB HL ;
and
10/13 subjects at 4 KHz 100 dB HL.

* Master's Dissertation, University of Mysore, 1985.

(4) Clear VI peaks in the presence of contralateral noise were obtained when tested at sensitivity 1 μV in :
1/13 subjects at 2KHz 80 dB HL ;
5/13 subjects at 2 KHz 100 dB HL ;
2/13 subjects at 4 KHz 80 dB HL ;
and 8/13 subjects at 4 KHz 100 dB HL.

(5) In all the subjects, except 3 subjects, for the VI peak there was either a decrease or no change in latency when measured in the presence of contralateral noise at 2 KHz and 4 KHz, with sensitivity at 0·2 μV.

(6) In all the subjects having clear VI peaks, there was a decrease, or in some no change in latency when measured in the piesence of contralateral noise at 2 KHz and 4 KHz keeping sensitivity at 0·2 μV.

(7) Clear VII peaks were obtained when tested at sensitivity 0·2 μV in :

5/15 subjects at 2 kHz 80 dB HL ;
5/15 subjects at 2 kHz 100 dB HL ;
3/15 subjects at 4 kHz 80 dB HL ;
and 7/15 subjects at 4 kHz 100 dB HL.

(8) Clear VII peaks in the presence cf contralateral noise were obtained when tested at sensitivity at 0·2 μV in :

4/15 subjects at 2 KHz 80 dB HL ;
6/15 subjects at 2 KHz 100 dB HL ;
2/15 subjects at 4 KHz 80 dB HL ;
and 2/15 subjects at 4 KHz 100 dB HL.

(9) Clear VII peaks were obtained when tested at sensitivity at 1 μV in :

2/13 subjects at 2 KHz 80 dB HL ;
4/13 subjects at 4 KHz 100 dB HL ;
None of the subjects at 4 KHz 80 dB HL ; and 5/13 subjects at 4 KHz 100 dB HL.

(10) Clear VII peaks in the presence of contralateral noise were obtained when tested at sensitivity at 1 μV in :

None of the subjects at 2 KHz 80 dB HL; 4/13 subjects at 2 KHz 100 dB HL ; 2/13 subjects at 4 KHz 80 dB HL ; and 3/13 subjects at 4 KHz 100 dB HL.

(11) Clear Po peaks were obtained when tested at sensitivity at 0·2 μV in :

1/15 subjects at 2 KHz 80 dB HL ;
7/15 subjects at 2 KHz 100 dB HL ;
3/15 subjects at 4 KHz 80 dB HL ;
and 4/15 subjects at 4 KHz 100 dB HL.

(12) Clear Po peaks in the presence of contralateral noise were obtained when tested at sensitivity at 0·2 μV in :

4/15 subjects at 2 KHz 80 dB HL ;
7/15 subjects at 2 KHz 100 dB HL ;
3/15 subjects at 4 KHz 80 dB HL ;
and 5/15 subjects at 4 KHz 100 dB HL.

(13) Clear Po peaks were obtained when tested at sensitivity at 1 μV in :

1/13 subjects at 2 KHz 80 dB HL ;
7/13 subjects at 2 KHz 100 dB HL ;
4/13 subjects at 4 KHz 80 dB HL ;
and 6/13 subjects at 4 KHz 100 dB HL.

(14) Clear Po peaks in the presence of contralateral noise were obtained when tested at sensitivity at 1 μV in :

2/13 subjects at 2 KHz 80 dB HL ; 6/13 subjects at 2 KHz 100 dB HL ; 2/13 subjects at 4 KHz 80 dB HL ; and 6/13 subjects at 4 KHz 100 dB HL.

(15) In all the subjects having clear Po peaks at sensitivity $0{\cdot}2\,\mu$V, there was a decrease in latency at high intensity levels above 60 dB HL at 2 KHz and 4 KHz in the presence of contralateral noise. Whereas at 80 dB HL for 2 KHz and 4 KHz, the change in latency in peak Po in the presence of contralateral noise was variable.

(16) In all the subjects having clear Po peaks at sensitivity $= 1\,\mu$V, there was a decrease in latency when measured in the presence of noise at 2 KHz and 4 KHz.

(17) Increase in sensation level does not bring about consistent increase in amplitude and decrease in latency in the middle evoked response.

(18) There was no significant change in latency and amplitude of the V peak when measured at 4 KHz 80 dB HL with patient response intervals of 10 and 20 msec.

(19) There was significant difference between the latency values of V peak (2 KHz 80 dB HL) obtained at 10 msec. and 20 msec ; patient response intervals.

(20) There was no significant difference between the amplitude values of peak V (2 KHz 80 dB HL) obtained at 10 msec. and 20 msec. patient response intervals.

(21) The amplitude of Po peak was greater in binaural stimulation than in monaural stimulation.

(22) Difference in amplitude for monaural and binaural response may be explained in terms of Kadobayashi *et al.* (1984) finding that for peak Po, impulses from the right and left ear, elicit the response in the brainstem.

Limitations of the Study

(1) A small population is tested.

(2) The latency range is limited to 20 msec.

(3) The age range is limited.

Recommendations

(1) To carry out the study on a larger population, using stimulus rate of 5 stimuli per second.

(2) To study the effect of contralateral noise on middle response by using patients response interval of 100 msec.

(3) To study the effect of patient response interval on V peak using a larger population.

(4) To study Binaural Interaction for peaks Pa and Pb of the middle latency response.

Comparison Between Behavioral Thresholds and Brain-stem Evoked Response Audiometric Thresholds *

MANOJ KUMAR

The present study was done with an aim to establish the relationship between behavioral thresholds and ABR thresholds, using 10 normal and 10 pathological subjects.

The frequencies tested were 2 KHz, 4 KHz and 6 KHz. The scale was set to 2,048 samples and 2 μV/Div. Sample time of 10 msec was chosen and rate of presentation was kept constant at 20/sec.

It was determined that in normals the wave V threshold had approximately 28·5 dB of the behavioral thresholds. For the mild to moderate sensorineural hearing loss subjects the wave V thresholds are approximately 22 dB of the behavioral threshold.

Implications of the Study

Several investigators have demonstrated that normal subjects yield ABRs to stimulus intensities that closely approximate their subjective thresholds for the stimulus. Patients with hearing loss now even can yield response, thresholds that are elevated by varying degrees above the normal subjective thresholds for the stimulus.

The results expressed in Audiograms 1 and 2 approximates Seitz *et al.* (1979) results who found that the wave V thresholds holds to a 4,000 Hz tone burst was " well within " 15 dB of the audiometric loss at that frequency in 80% of 10 patients with sensorineural hearing loss.

The study to a certain extent answers the question regarding the correspondence between the elevated ABR threshold and the degree of hearing loss, a patient has for audiometric stimuli.

Limitations

The study was limited to only right ear threshold for the 10 normal subjects.

The age factor was not comparable for the two populations, *i.e.*, the sensorineural hearing loss cases and normal subjects.

* Master's Dissertation, University of Mysore, 1987.

Comparison of Ipsilateral and Contralateral Recording in Brain-stem Evoked Response Audiometry *

SUNITA AHEAR

The present study was conducted to compare the ipsilateral and contralateral tracing of BSERA for AC logon stimuli.

20 subjects with normal hearing in the age group of 17 to 25 years were selected for the purpose of study. The frequency under test was 2 KHz. The scale was set to 2,048 samples and $2\,\mu V/\mathrm{Div}$. Rate of presentation of stimuli was kept constant at 20/sec. A sample time of 10 msec was chosen. AC logon stimuli was presented at 100 dB, 80 dB and 60 dB respectively. The test environment was identical for both ipsilateral and contralateral recordings.

For II peak ipsilateral and contralateral tracing, no significant difference was observed.

For III peak ipsilateral and contralateral tracing, no significant difference was observed.

For IV and V comparison in ipsilateral and contralateral tracing, no significant difference was observed at 100 dB, 80 dB and 60 dB (ipsilateral and 100 dB contralateral). But at ·05 level significant difference was observed at 80 dB and 60 dB contralateral tracings.

Implication of the Study

The principal advantage of recording ipsilateral and contralateral responses simultaneously in adults is that there is a general correspondence between waveforms from the two derivations which allows the relatively minor changes that occur to be helpful in differentiating components.

There are several possible explanations for the lack of similarity between neonatal ipsilateral and contralateral recordings as compared to adults. The intensity of the stimulus reaching the contralateral cochlea differs from that presented to the test ear by an amount known as the interaural attenuation (IA). The lower the IA the greater the likelihood of eliciting a response from the contralateral cochlea. The IA of neonate may differ from the adults. It is also possible that the generators differ for the two populations.

The contralateral responses showed minor but predictable differences from ipsilateral response. In the contralateral recordings wave I is greatly reduced in amplitude. Wave III is smaller in amplitude. Wave V latency is usually about ·1 msec to ·2 msec later thereby increasing the wave IV to wave V latency interval and allowing independent resolution of the two peaks which

* Master's Dissertation, University of Mysore, 1987.

are frequently fused in the ipsilateral recordings.

The results agree with Edward (1985) results.

The BSERA does appear to be a powerful tool for diagnosis of acoustic neuroma. Contralateral and ipsilateral recordings as indicated by research have their own place in the technique of BSERA.

It can be concluded that comparison of ipsilateral recording with contralateral recording are vital in clinical application of BSERA.

Limitations

The present study was limited to a single frequency 2 KHz and AC logon stimuli of 100 dB, 80 dB and 60 dB. The developmental course of the contralateral response is not known. The usefulness of the response as a measure of auditory brainstem maturity is, therefore, unknown. Much research is warranted in this direction.

Electroglottography in the Hearing Impaired*

MANJULA, P.

"Deafness, even profound deafness, does not prevent an individual from producing voice. However, the loss of hearing does affect the control of voice production and when people listen to the speech of a deaf person, a typical reaction is that the speaker's voice sounds 'abnormal'" (Monsen *et al.*, 1979).

In order to investigate the effect of hearing impairment on vocal function, it is necessary to observe the glottal wave form separately from the resonance effect of the vocal tract. Therefore, in the present study, electroglottography was used to investigate the vocal fold vibrations during phonation, in hearing impaired individuals.

Fifteen male and fifteen female hearing impaired with a mean age of 23·27 years and 20·77 years respectively, served as subjects. Age ranged from 15–40 years in males, and 15–29 years in females. All subjects had a hearing level of not less than 70 dB HL in the better ear, with no significant associated problems. Electrolaryngograph (Kay Elemetrics Corporation) and High Resolution Signal Analyser (B & K Type 2033) were used for measurement of the parameters like Open Quotient (OQ), Speed Quotient (SQ), Speed Index (SI), 'S' Ratio (SR), Jitter (J) and Shimmer (S).

The above parameters were studied in three vowels [a], [i] and [u], keeping pitch and intensity of phonation constant, as far as possible.

After the statistical analysis of the data thus obtained, the following conclusions were drawn :

(1) The mean OQ for the vowels [a], [i] and [u] was 0·55, 0·56 and 0·55 in males and 0·58, 0·57 and 0·56 in females.

(*a*) There was no significant difference between males and females, both in normal and hearing impaired groups.

(*b*) There was significant difference between normal and hearing impaired groups for all the three vowels [a], [i] and [u]. The mean value of OQ was lower in hearing impaired than in normal subjects.

(2) The mean of SQ for the vowels [a], [i] and [u] was 1·75, 1·97 and 1·99 in males and 1·87, 2·20 and 2·10 in females.

(*a*) There was no significant difference in the mean SQ between

* Master's Dissertation, University of Mysore, 1987.

males and females in hearing impaired, but normal male and female subjects differed significantly.

(b) There was no significant difference between the SQ of [a], [i] and [u] in normal and hearing impaired subjects.

(3) The mean SI for the vowels [a], [i] and [u] was 0·22, 0·27 and 0·30 in males, and 0·21, 0·28 and 0·30 in females.

(a) There was no significant difference in the mean SI between males and females in hearing impaired group. But there was difference in normal group between males and females.

(b) There was no significant difference in the mean SI between normal and hearing impaired subjects for the vowels [a], [i] and [u].

(4) The mean SR for the vowels [a], [i] and [u] was 1·04, 1·24 and 1·03 in males and 1·07, 1·09 and 1·05 in females.

(a) There was no significant difference in the mean SR between male and female subjects, in both normal and hearing impaired groups, for the vowels [a], [i] and [u].

(b) There was no significant difference between normal and hearing impaired subjects in SR for the vowels [a], [i] and [u].

(5) The mean values of Jitter for the vowels [a], [i] and [u] was 0·326, 0·111 and 0·199 msec. in males and that in females was 0·092, 0·094 and 0·089 msec.

(a) There was no significant difference in the mean Jitter of the vowels [a], [i] and [u] between males and females, in normal and hearing impaired groups.

(b) For the vowels [a], [i] and [u] there was no significant difference between normal and hearing impaired groups.

(6) The mean shimmer for the vowels [a], [i] and [u] in hearing impaired males was 0·445, 0·815 and 0·955 dB and that in females was 0·541, 0·571 and 0·480 dB respectively.

(a) There was no significant difference in the mean shimmer for the vowels, between males and females, both in normal and hearing impaired groups.

(b) For the vowels [a], [i] and [u] there was no significant difference between normal and hearing impaired groups.

Recommendations

(1) To investigate on a larger sample of different age groups, varying degrees and types of hearing loss and different age of onset.

(2) To include other parameters.

(3) To delineate the developmental changes in the parameters in the hearing impaired.

(4) To observe the effect of modifying the deviant parameters on the improvement of voice quality in the hearing impaired individuals.

Development of a Variable Frequency Artificial Larynx and Some Behavioral Studies*

JAYARAM, M.**

Voice, the vehicle of speech and language, is the result of the interaction of the air flow from the lungs and the vibration of the vocal cords. However, there are some people whose larynx has been surgically removed because of the carcinoma of the larynx or for some other reason. If it may be said that speech is our most important characteristic, then it follows that the surgical removal of the larynx affects the most human part of us. Developing esophageal speech or teaching them to use artificial larynx are the two major methods of rehabilitation of these patients. Though both have merits and demerits of their own (see Jayaram, 1975 for a detailed discussion), the physiological and psychological conditions of the patients sometimes restrict the choice to just artificial larynx. The presently available artificial larynges have many limitations, the limited frequency range provided being the chief among them. For example, the best of the available artificial larynges, WE Type 5A (Luchsinger and Arnold, 1965) provides for a frequency range of only 100–200 Hz which is not sufficient to bring about the needed intonational changes in speech. Second, there is no provision for changing the output intensity of the device. Third, the intelligibility of the speech produced with this artificial larynx is very poor, mainly because of the constant buzzing of the transducer when the instrument is on. Lastly, there is the problem of costs, particularly in the Indian context. For these reasons, the development of a new artificial larynx which overcomes the above limitations is undertaken.

Design Objectives for an Artificial Larynx

Though no exhaustive survey of the opinions of postlaryngectomised patients has been made so far to determine what would be an ideal artificial larynx, from the standpoint of achieving normal speech, the following attributes appear to be essential :

(*a*) For the speech to sound natural it should have pitch inflection and provision for a suitable fundamental frequency with harmonics. An artificial larynx should provide for a wide frequency range and which can be continuously changed. There should be a provision for selecting the optimum frequency of the individual because at this frequency, the vocal tract resonates. Accordingly, it was decided to design an artificial larynx which provides for a frequency range of 50 to 350 Hz (this range was decided following data from a study on inflection patterns in normal speech) from which a suitable fundamental frequency for each individual, with a rich supply of overtones to match his

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optimum, can be selected instantaneously. Another design objective was that the frequency spectrum of the tone of the artificial larynx voice should be almost similar to that of normal voice.

(*b*) Output volume should be sufficient for normal conversation and there must be facility to vary it like in normal speech to suit the situation. The output volume of WE Type 5A (70 to 75 dB at a distance of 3 feet) would be disadvantageous depending upon the background noise and the distance between the speaker and the listener. Accordingly, it was decided to provide a variable output range of 60 to 110 dB.

(*c*) The artificial lanryx should be inexpensive and have a low operating cost.

(*d*) Secondary to the above but still of great importance, the device should be reliable with simple, trouble free operation for long periods of time. Simplicity of operation is very desirable so that the subjects require only a minimum of training and get the psychological benefit of vocal communication at the earliest. In addition, the device should be as free as possible of mechanical difficulties necessitating service and repair.

(*e*) Other design objectives considered were (i) the device should be inconspicuous and hygienic. It should be unobtrusive, without visible wires, tubes or other appurtenances, (ii) the device should be small in size so that it impedes the patients little in the use of their hands. These design objectives have been discussed in some detail in Barney (1958).

Construction of a Variable Frequency Artificial Larynx

Sound Source and Circuit Design

In the present study, a sinusoidal wave was selected as the sound source. The sinusoidal wave consists of higher harmonics thus giving the quality of normal speech. The circuit diagram of the artificial larynx developed here is given in Figure 1.

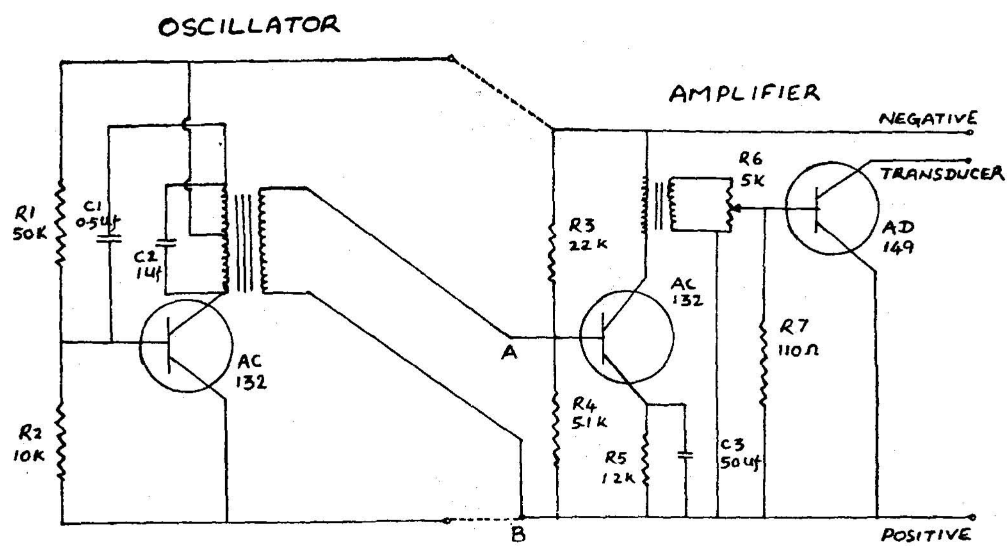

FIGURE 1

The variable frequency oscillator here consists of a simple Hartley oscillator which was preferred to a Weinsbridge Oscillator for three reasons :

(*a*) Non-availability of low voltage, low-current bulbs which act as negative feed-back elements in the Weinsbridge oscillator to control the amplitude of the oscillations.

(*b*) The output of the Weinsbridge oscillator is low and needs at least two or three stages of amplification to obtain enough signal strength to drive the amplifier. Since one of the design objectives here was to minimize both the cost and size of the artificial larynx, the Weinsbridge oscillator was rejected.

(*c*) A frequency range of 1 : 7 ratio can easily be obtained with a Hartley oscillator.

The frequency of oscillation is given by $f = 1/2LC$. Resistors R1 and R2 fix the operating point on the V — I characteristic of the transistor. Positive feedback is provided at the base of the transistor through the capacitor C1. The tank circuit acts as the load in the collector circuit. The inductance for the tank circuit is provided by the primary winding of the transformer while a suitable capacitor C2 connected across the primary provides the necessary capacitance. The output of the oscillator is obtained from the secondary of the transformer. A power interruptor is introduced in the oscillator circuit.

The frequency range of the oscillator is from 50 to 350 Hz and is stable at discrete values. The output voltage of the oscillater varies from 1·9 to 2·1 volts. The variation is oly 0·2 volts over the entire frequency range and this small variation does not bring about any large variation in the power output of the transducer.

A sinusoidal wave with higher harmonics is taken as the sound source here whereas in the WE Type 5A short periodic pulses from a relaxation oscillator were taken as sound source. The frequency variation is continuous in this artificial larynx but can also be fixed at any required value within this range. This enables us to select a fundamental frequency/optimum frequency for each subject. This is an advantage over the WE Type 5A artificial larynx.

The amplifier consists of two stages :

1. A single stage voltage amplifier using AC 132 transistor, and
2. A power amplifier using AD 149 transistor.

The operative point of AC 132 was fixed by means of R3 and R4. Necessary stability is obtained by using a suitable ratio of R3 and R4 of 4 : 1. The forward bias of the emitter section is provided by R5 and C3. The transformer is used as a load in the collector circuit. The input to the voltage amplifier is provided directly from the oscillator.

Frequency Analysis

The oscillator output at different frequencies was analyzed in the frequency bands 20–63 Hz, 63–200 Hz, 200–630 Hz, 630 Hz–2K and 2K–6·3 K. Frequency analysis was made in 10 Hz steps from 100 to 350 Hz. Analysis clearly indicated the presence of fundamental and harmonics in the respective frequency bands. Amplitude of the harmonics was generally decreasing in the higher frequency bands and generally increasing in the low frequency bands (200 Hz–630 Hz, 630 Hz–2 K) for all input frequencies.

Transducer Characteristics

In the present study the transducer of the WE Type 5A artificial larynx was used as it was readily available. The constructors of this artificial larynx (Barney *et at.*, 1959) have taken into consideration the impedance of the throat muscles and tissues in the development of the transducer. This is important because the mechanical impedance of the throat muscles is 4000 times more than that of air and hence there will be difference in the performance of the transducer when pressed against the throat. Barney *et al.* (1959) have made a number of modifications in the HA1 receiver in order to give greater amplitude of vibration into the circuit. This transducer handles a power of 400 milliwatts and it also matches the impedance of the amplifier constructed here.

The Characteristics of the Transducer for a Pure Tone

To analyze the characteristic of a transducer for a pure tone, a tone of 125 Hz was fed to the transducer at moderate power till the vibrator tone was heard. Analysis showed the presence of harmonics of uniform intensity upto 6K along with the fundamental of 125 Hz.

The characteristics of the transducer was analyzed in two other ways :

(1) The transducer's acoustical output with the original circuit of WE Type 5A was analyzed at the maximum and minimum position of the frequency control knob. At the minimum position, the analysis revealed that the components were weak in intensity over the fundamental and the fall in intensity in the higher frequency band was steep. At the maximum position of the frequency control, it was found that the harmonics were strong in intensity upto 6 K and the fall of intensity in the higher frequency band was not pronounced.

(2) The output of the transducer with the circuit developed here was analyzed for two tones of 125 and 150 Hz. The analysis revealed strong fundamental with rich components. Components were more and strong in the 1 K–4 K region. A comparison of the acoustical output of the transducer with the two circuits shows that the circuit developed here provides for a strong fundamental tone with rich and strong components whereas the circuit of the WE Type 5A gives very weak components.

The Characteristics of the Transducer for a Complex Tone

Frequency analysis of the normal voice when the subject phonated the vowel [a] at 125 Hz was carried out. The subject was instructed to phonate at this level keeping the intensity constant as far as possible. The tacho unit was used as an aid in maintaining the frequency level. Similarly, a tone of 125 Hz from the artificial larynx developed here was fed and resonated through the human vocal tract and a frequency analysis was carried out. Results of the comparison of the frequency analyses of these two tones are given in Table 1.

Table 1

Comparison of the tone spectrum of natural voice and the tone of the artificial larynx developed. Table gives the frequency analysis of the vowel [a] phonated at 125 Hz

Frequency Bands	Fundamental of 125 Hz	
	Tone of the Artificial Larynx	Natural voice
63–200	125 Hz Fundamental Components. Components at 200 Hz	125 Hz Fundamental Rich Components
200–630	250 Hz—Second Harmonic Components at 400 Hz	Second Harmonic at 250 Hz : Rich Components between 300–630 Hz with increasing intensity
630–2 K	5th Harmonic at 650 Hz 8th Harmonic at 1 K (Peak) Rich Components	Peak at 1 K. Rich Components upto 1·4 K
2K–6·3 K	Components with decreasing intensity between 2 K and 5 K	Rich Components with decreasing intensity from 2·2 to 5 K.

Results from Table 1 show that the tone of the artificial larynx developed here has a closer proximity with the normal voice of 125 Hz. The observed harmonics and their amplitude were similar in both these. It can be said that the spectrum of the transducer tone is adequate as a source of harmonics for vowel production and that the tone of this artificial larynx has close resemblance to normal voice. This is a further proof of the naturalness of the tone of the artificial larynx developed here. This also lends support to the contention that the harmonics in the source spectrum of the normal voice are strong at low frequencies but drop in amplitude at the high frequencies. However, this has to be tested at other frequencies and also more extensively.

Amplifier Characteristics and Output Intensity

To measure the frequency and power characteristics of the amplifier, a constant voltage of 0·1 volt, for frequencies ranging from 50 Hz to 4 KHz, was fed as input to the amplifier. The gain control of the amplifier was placed little above the middle value. By feeding the output of the amplifier to AF Watt meter, power output of the amplifier was measured at different frequencies. The amplifier gives a flat frequency response from 250 to 700 Hz, with a little fall on frequencies below 150 Hz and above 1 K. However, the fall is not steep. From this it is clear that the observed harmonics were not because of the amplifier distortion.

The power consumption of the whole circuit was found to be 500 milliwatts at the maximum intensity. The voltage drop was very minimal even after 15 minutes of usage. The voltage drop was found to be 0·1 volt which was ineffective in producing any change either in the oscillator output or in the amplifier in terms of power output or quality.

The output obtained from the secondary of the transformer of the voltage amplifier was fed to a 5 K Ohm logarithmic potentiometer and from here it was fed to the power amplifier. The potentiometer was calibrated with respect to the output of the transducer. The transducer output was measured at a distance of 1 foot both in free field and when pressed against the throat muscles. The output intensities of the artificial larynx in the two conditions are given in Table 2.

Table 2 shows that the output can be varied over a range of 39·5 dB in the free field condition and 33 dB in actual usage. The output range of the transducer when pressed against the throat muscles was 55 to 88·5 dB. The maximum intensity provided here is more than the peak intensity value employed by the normal speakers in their normal speech. Hyman (1955) puts the peak intensity value for normals at 79 dB. The wider intensity range provided here and the provision for varying it are the plus factors of this artificial larynx over the WE Type 5A which provides for a fixed intensity of 70 to 75 dB at a distance of 3 feet. It was also observed that the artificial larynx developed here transmits sufficient power to the pharyngeal region throughout the frequency region thereby facilitating the satisfactory development of the high amplitude region of the vowels.

Table 2

Output of the artificial larynx at a distance of 1 foot under two conditions

Frequency in Hz	Intensity (in dB's) at a distance of 1 foot			
	Free Field Condition		Transducer pressed against the throat	
	Min.	Max.	Min.	Max.
50	70	104	56	85
100	72	104	56	84
150	74	107	58	88·5
200	74	108	58	88
250	72	109	58	88
300	77	109·5	55	86
350	73	109	55	84
Range	70	109·5	55	88·5

It has been indicated that the harmonics in the source spectrum of the natural voice are strongest at low frequencies dropping in amplitude toward high frequencies (Barney, 1958).

The device works on 9 volts D.C. The battery is sufficient to drive the circuit in its normal operation and for long durations. An off/on switch was provided between the battery and the instrument. From an analysis of the power consumption of the device, it was observed that the current drain through the whole circuit at the maximum intensity was 200 mA which is more when compared to the WE Type 5A artificial larynx (22 mA in the case of WE Type 5A). However, the power consumption of the device would be lessened to some extent by using the oscillator interruptor.

Mechanical Construction

The whole circuit was mounted within a rectangular tube of $7 \times 12 \times 3{\cdot}5$ cms. The tube has a circular head to house the transducer. The frequency variation knob was provided just below the transducer on the ventral side of the tube (when the instrument is in usage) in such a way that the subjects can operate this knob with their thumb. The frequency variation knob was calibrated using a frequency counter and a frequency range of 50 to 350 Hz was marked in steps of 25 Hz. On the dorsal side of the tube, the intensity variation knob was provided just below the transducer in such a way that the subjects can operate this knob with their forefinger. The intensity variation knob was calibrated based on the output of the transducer in the free field. An intensity range of 70 to 110 dB was marked in 10 dB steps. The frequency and intensity variation knobs can be glided horizontally and the arrangement was found to be functionally satisfactory. An oscillator interruptor was provided three centimetres below the intensity variation knob in such a way that it can be operated by either the ring finger or by the little finger.

Behavioral Studies

Inflection Pattern in Normal Speech

The inflection pattern in normal speech was studied for two reasons :

(*a*) To decide about the frequency range to be provided in the artificial larynx to be developed, and

(*b*) To know the extent to which speakers can be trained to achieve the inflection pattern of normal speech with the artificial larynx developed here.

Five good speakers (those who use their optimum frequencies) served as subjects. The subjects were asked to read three sentences which were all marked for pitch levels. The frequency at the initial, medial and final position of the sentences were measured on the tacho unit as the subjects prolonged the vowels in these positions. The optimum pitch of these speakers were measured following Nataraja (1972). Good speakers were selected on the assumption that they will have good intonational patterns. The results of this experiment are given in Table 3.

Only the highest and lowest frequencies were noted down. The optimum frequencies of the speakers were almost same (range 120 to 130 Hz). The variation in

Table 3

Speaking fundamental frequency as found in normal speech

Subjects	Sentence 1		Sentence 2		Sentence 3		Optimum Frequency
	Min.	Max.	Min.	Max.	Min.	Max.	
1	100	330	105	200	100	190	135
2	125	240	100	190	120	180	130
3	110	220	100	180	120	160	120
4	105	250	110	190	115	175	125
5	100	240	105	175	110	160	125

frequency shown by the speakers on different sentences was almost the same but for 5 to 10 Hz differences. This discrepancy might be due to the difference in their optimum pitch levels. The average variation from the level of the optimum pitch was found to be 20 to 30 Hz below the optimum and 120 Hz above the optimum frequency. In general, the maximum frequency achieved was 250 Hz though one speaker reached a high of 330 Hz. However, the intonation pattern and the 'meaning' conveyed by this speaker was in no way different from that of other speakers. A trained speech therapist observed for the possible differences in intonation.

The results of this experiment are contradictory to the findings of Barney *et al.* (1959) who found that a frequency range of 100 to 200 Hz is sufficient to duplicate the inflection pattern found in normal speech. Table 3 shows that the lowest and the highest frequency achieved were 100 and 330 Hz respectively. Since all the subjects selected in this study were good speakers who were assumed to have good intonation, it may be said that the speaking fundamental frequency may even be less than the above figures in the majority of the normal speakers. However, it was decided to provide for a frequency range of 50 to 350 Hz in the artificial larynx.

Training Normal Speakers in the Use of this Artificial Larynx

The five speakers included in the above experiment served as subjects for this experiment also. The speakers were explained the function and working of the artificial larynx developed here and the operation of the device was demonstrated to them. The speakers were asked to dramatize the sentences (the sentences were the same as the ones employed in the experiment described in the earlier section) using the present artificial larynx and making necessary variations from the level of the optimum (the frequency knob was set at the optimum pitch of each speaker). The speaking fundamental frequency was measured as in the previous experiment. As Barney *et al.* (1959) recommended the introduction of the tone into the pharyngeal cavity for good speech, the same procedure was followed here also.

Only normal speakers were employed in this experiment because of the non-availability of the laryngectomy patients. All the speakers who were trained in the usage of this instrument learned to speak with this instrument within 24 hours and one speaker took just 10 hours to achieve proficiency. The only difficulty the speakers faced was in achieving the frequency variation. Also, a little practice was required to find the proper pressure and placement of the transducer on the throat that yields the best results. The results of this experiment are shown in Table 4.

The results show that the speakers could achieve the frequency variation on the three sentences to the same extent found in normal speech (see Table 3 also). The speakers used the tacho unit as a visual clue in achieving the proper frequency variation. The speakers in this study had no difficulty in using the oscillator interruptor and the intensity control. The results of this experiment indicated that the speakers could be easily trained to use this artificial larynx. However, this has to be tested with the laryngectomy patients also.

Intelligibility of Speech

Five good speakers who served as subjects in the earlier experiments spoke spontaneously for two minutes using the artificial larynx developed here. The output of the artificial larynx was kept at the middle value and the speakers made the necessary frequency variation from the

Table 4

Speaking fundamental frequency range on the three sentences achieved by the speakers with the present artificial larynx after training

Subjects	Sentence 1		Sentence 2		Sentence 3		Optimum Frequency
	Min.	Max.	Min.	Max.	Min.	Max.	
1	120	300	110	170	120	170	135
2	120	220	115	180	135	175	130
3	125	180	120	175	110	155	120
4	110	230	125	175	100	150	125
5	140	190	130	160	120	140	125

level of their optimum frequency. All responses were recorded for further analysis. The recorded material was later given to four judges (two speech-language pathologists and two laymen) to rate the intelligibility of speech on a three-point rating scale of 'poor', 'fair' and 'good'. The judges were not told of any definite criteria on which to judge, but were asked to judge the speech strictly from listener's point of view. However, they were asked to look for such factors as clarity, frequency variation, loudness, articulation, etc.

All the judges who evaluated the recorded speech indicated that the speech was intelligible. The judges considered 4 speakers to be 'good' and one subject 'fair' on the speech intelligibility ratings. The subject whose speech intelligibility was 'fair' had good articulation but his frequency variation was not considered adequate by the judges. It was interesting to note that all the speakers who were proficient in the usage of the frequency variation knob were judged to have intelligible ('good') speech on the artificial larynx by the judges. However, the judges noted that all the speakers prolonged the speech to some extent.

These results support the findings of Barney *et al.* (1959) and Hyman (1955) who found that the speech of artificial larynx was always intelligible. Barney *et al.* (1959) attributed the high intelligibility of the artificial larynx speech to the frequency structure of the transducer tone as well as to the introduction of the transducer tone into the pharyngeal cavity.

The good intelligibility of the artificial larynx speech observed in this study can be attributed to any one of the following factors or any combination of these :

(*a*) Frequency composition of the transducer tone.

(*b*) The speakers making frequency variation from the level of their respective optimum frequencies.

(*c*) The introduction of transducer tone into the pharyngeal cavity.

(*d*) All speakers had good articulation.

(*e*) The artificial larynx had sufficient output intensity.

(*f*) All the speakers prolonged the speech to some extent.

(*g*) One of the chief reasons for the poor intelligibility with other artificial larynges is the constant buzzing of the transducer during the non-articulation period. This constant buzzing of the transducer makes it difficult for the listeners to differentiate between syllables, words and phrases. In the present experiment, the speakers effectively used the oscillator interruptor thus eliminating the background buzzing during the non-articulation period.

Further Developments

The device should be tested on laryngectomees for intelligibility of speech as well as for their ability to effectively use this instrument. Further modifications are necessary to perfect this device. For example, (1) Square waves as the sound source give rich harmonics than the sine waves. This has to be attempted in future, (2) attempts must be made to develop an indigenous transducer, (3) power consumption of the device developed here should be minimised further and (4) miniaturisation of the device can be taken up.

Conclusions

A variable frequency artificial larynx has been developed. This artificial larynx has provision for changing the frequency from 50 to 350 Hz and intensity from 70 to 110 dB. A suitable fundamental for each individual, with a rich supply of overtones to match his optimum pitch, can be selected instantaneously with this device. The tone spectrum of this device is similar to that of normal speech. Wider frequency and intensity ranges provided in this artificial larynx are the new developments over the WE Type 5A artificial larynx. The intelligibility of the speech produced with this artificial larynx was considered to be very good. Introduction of the oscillator interruptor which could be the main reason for the improved intelligibility of speech with this device is another advantage of this device over the WE Type 5A artificial larynx. It has also been found here that the speakers can be easily trained to use this device.

Acknowledgements

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Oral Sensory and Motor Skills in Normals and a Clinical Population*

SHYAMALA, K. C.

A review of literature indicated controversial findings regarding the possible relationship between oral sensory–motor efficiency and speech proficiency. Hence the present study aimed at evaluating oral sensory and motor abilities on 64 subjects (30 normals, 24 stutterers and 10 subjects with misarticulations) within the age range of 13–25 years.

The two chosen tasks were : Oral form discrimination test and Lingual alternate articulatory motion rate.

The oral form discrimination test consisted of 32 stimulus pairs of 8 plastic forms belonging to 4 geometric categories. The subjects were required to indicate whether the two forms of the pair were 'same' or 'different' when the pairs of stimuli were presented successively in the mouth. The number of errors committed were scored.

The alternate articulatory motion rate (AMR) test required the rapid alternate repetition of the trisyllabic combination [b ʌ ḍ ʌ ga] for 5-seconds durations of 3 breath groups. The averaged number of syllables repeated for 5 seconds in each of the 3 breath groups recorded were analysed statistically.

The findings of the study were :

(1) There was no sex difference on the sensory task of OFD among normals.

(2) The motor task of AMR revealed sex differences. The normal females were superior performers on AMR than male subjects.

(3) The normals and subjects with speech problems differed remarkably in terms of OFD. The subjects with speech problems were less efficient than normals in the sensory ability.

(4) The normals and subjects with speech problems differed significantly in terms of AMR. The subjects with speech problems demonstrated a reduced AMR and hence deficient oral motor ability.

(5) The stutterers and speakers with misarticulations did not differ in terms of oral sensory ability as evaluated on OFD test.

(6) The stutterers and speakers with misarticulations did not differ from each other in terms of oral motor ability as evaluated by AMR.

(7) There was a negative correlation between the two sets of scores

* Master's Dissertation, University of Mysore, 1980.

obtained among normals, *i.e.*, lesser the number of errors on OFD, the greater the AMR and *vice versa*.

(8) No significant correlation was found between error scores on OFD task and AMRs among the subjects with speech problems. However, both of them were related to speech proficiency.

Recommendations for Further Research

(1) The same study can be conducted on a larger population.

(2) The effect of different variables like linguistic factors, intelligence, socio-economic status, learning abilities and others can be studied.

(3) The complexity of the OFD test can be increased by varying the shapes of the forms, so as to make it more sensitive in evaluating the adult age group.

(4) The other clinical populations can be studied using the two tests employed in the present study.

(5) The use of these two tests as prognostic indicators for the clinical populations to decide whether they need speech therapy or not, can be evaluated.

(6) The normative data for these two tests can be established.

Some Prosodic Aspects in Hindi*

CHANDRASHEKAR PRASAD SRIVASTAVA

"Intonation like everything else in language is one instrument in an orchestra." Some consider intonation as only a "peripheral part of communication", whereas according to some others "intonation is 'central' in communication"

Intonation has been considered to be functioning at different levels of language, *i.e.*, syntactic, lexical, phonological and also in providing information regarding physical condition of the speakers, emotion and others.

Intonation plays an important role in language. The role of intonation in an acquisition of language has relatively little attention, even though it is the first aspect of language to be learned by the child. Intonation has been reported to be facilitating acquisition of both speech reception and production.

Therapy for deaf and aphasics include teaching intonation as it has been found to facilitate acquisition of language. Study of intonation in a given language permits better understanding of the language. Thus there is a need for knowing the intonation used in a language for the purpose of teaching language.

The present study aimed at finding out the different intonation patterns used for different emotions by speakers of Hindi language.

Five males and five females (all Hindi speakers) b/w the age range of 18–21 years served as the subjects for the present study.

Eight emotions, *e.g.*, surprise, fear, frustration, jealousy, joy, anger, worry and grief were chosen for the study. One neutral was also included. Four sentences were constructed to express each emotion. Thus there were 36 sentences.

Speaker was asked to sit comfortably in a sound treated room and the mic was kept 6" away from his mouth. All speakers were given enough rehearsal before recording. Then the list of the sentences was given to the subject and was requested to say the sentences bringing out the emotion indicated against each sentence. Recording was done on spool tape recdorer.

One sentence out of four representing the specific emotion, which was considered as satisfactorily expressed by the experimenter and a judge, was taken for analysis.

For objective analysis these sentences from the tape recorder were fed to pitch analyzer (PM 100) and the visual display of the intonation pattern on its display screen was obtained. Then by moving the cursor of the PM 100, the frequency

* Master's Dissertation, University of Mysore, 1985.

and intensity variations for each sentence were noted.

Subjective analysis was done with the help of three judges who had linguistic background and knew about intonation. The judges were requested to listen to all the 9 sentences spoken by each of the subject and judge the emotion expressed in each sentence and also to note down the pitch contour used by the speakers in uttering each sentence.

The results thus obtained by instrumental–objective analysis and perceptual–subjective analysis were analysed further separately to note down the overall or general pattern of pitch contour used by subjects in expressing the emotion in each sentence.

Further, the results obtained by two methods of analyses have been compared to find out the similarities and differences.

Conclusions

The following conclusions have been drawn based on the results obtained :

(1) The speakers of Hindi use different intonation patterns to express different emotions.

(2) The trained listeners can identify the pitch contours occurring in uttering sentences, reliably and validly.

(3) The intensity variation does not seem to be related to the emotions expressed.

(4) The perception of pitch variation depends upon the fundamental frequency variation.

(5) The instrumental analysis (using pitch analyzer) provides even minor details of frequency and intensity.

Recommendations

(1) The study may be repeated with larger population to make generalization.

(2) The study of expression of different emotions on the same sentence can be made using both instrumental and perceptual analyses.

(3) The judges, who do not have any knowledge of Hindi may be used to judge the expression of emotion and the pitch variations.

(4) Non-emotional conditions may also be studied using instrumental and perceptual analyses.

(5) Other prosodic aspects of Hindi may be studied.

Conversational Analysis in Aphasia*

GAYATHRI, H.

The smooth flow of thoughts and ideas that is characteristic of communication between normal individuals may be absent in case of aphasics and a communication gap may exist between an aphasic person and his interlocutor. Despite this fact it is also known that the aphasic person retains the functional use of language to some extent.

An attempt has been made here to identify the pragmatic strategies, extraverbal and verbal, that anterior aphasics may employ to overcome this linguistic deficit which enables them to make functional use of the language available to them.

A number of studies have been carried out by many to study the strategies employed by aphasics ; but each of these have studied any one strategy. In contrast this study deals with several pragmatic features.

9 males and 1 female expressive aphasics were selected as a sample for the study. They were administered the first four subtests of the Western Aphasic Battery, *viz.*, Spontaneous Speech, Comprehension, Repetition and Naming, for differential diagnosis. In addition, the conversational sample was elicited through the following procedures :

— Story narration.
— Communication interaction between the aphasic subject and his conversational partner.
— Conversation with the tester.

The entire conversational sample was recorded, and along with it, the different gestural behaviours of the subjects were noted down. The data were analysed in terms of linguistic :

(*a*) The linguistic constraints encountered by the subject.

(*b*) The choices made by subject to overcome these constraints.

(*c*) The effects of the aphasic's use of language had upon his conversant.

As in published literature on expressive aphasics, syntactic errors were found to exceed phonological errors ; and few semantic errors were observed.

Extraverbal choices, particularly gestures, specifically the Pantomimes and Emblems, were used as a compensatory and supportive strategy to the defective verbal output and the extent to which they are made use of is in direct proportion to the degree of linguistic constraints.

Verbal choices, particularly Repetitions, were used in inverse relation to the degree of linguistic constraints.

* Master's Dissertation, University of Mysore, 1985.

Thus nonverbal strategies do not appear to be 'parasitic' upon speech. They can sometimes take the lead. The central organizer which is supposed to determine the complexity and clarity of both speech and gesture may retain some flexibility about which modality to employ preferentially.

In the interaction between the aphasic and his conversant, the conversant was the dominant conversational partner.

The number of morphemes/utterance used by him were more ; he took more number of turns ; he shifted the topic and/or shifted focus more often ; he was responsible for communication breakdown less often and used more conversational saves. The duration of the interaction was very short, which could be due to the fact that the "give and take" characteristic of normal conversation was missing.

The aphasic's speech came across as clear to the listener and as has been observed in the study carried out by Cicone *et al.* (1979), and so also in this study, it could have been that much of the information communicated by anteriors was inferred from questions asked by the interlocutors. So also the conversants tend to make shrewd inferences about topics and comments which the aphasics are seeking to convey. The conversants are likely to supply contexts where the aphasics can successfully exploit their meagre linguistic and gestural repertoire.

Thus this study suggests that anterior aphasics can communicate effectively to a large extent in communicative situations, because of the pragmatic strategies, they use to overcome the linguistic deficits and the contributions made by conversers to their normal capacities, in structuring discussion and supplying contexts where these expressive aphasics can successfully perform.

Acoustic Aspects of the Speech of Children*

RASHMI, M.

Speech is a neuromuscular activity. In other words, the output of this activity is the acoustic signals, which are used for communication—as speech. The acoustic characteristics of speech have been found to vary with age. These acoustic features on various aspects of speech production indicate that the accuracy of motor control improves with age until adult-like performance is achieved at about 11 or 12 years, somewhat after the age at which speech sound acquisition is usually judged to be complete.

"Today we are able to measure the acoustic or audible aspects of voice with sophisticated equipment. The voice print analyzer, sonograph, airflow meter, pressure recorder and computerized models of the vocal tract enable investigators to confirm earlier empirical findings and unearth new aspects of vowel sound characterization. The physiological aspects of sound production such as breathing patterns, vocal attack, vocal fold vibration and some resonance qualities can be revealed by acoustic means."

"The past two decades have been witness to an increasing application of acoustic analysis to the study of speech development in children."

The acoustic analysis to study the speech development in children has been found to be useful, as such studies reflect :

(1) The adjustment of phonatory apparatus.

(2) The shaping of the vocal tract, and

(3) The timing and co-ordination of articulation and thus provide evidence regarding the anatomical and neuromuscular maturation of the speech mechanism. This information is of importance in early identification, diagnosis and treatment of various speech and language disorders.

Some acoustic analyses have been considered to be useful in knowing more about the developmental disorders and thus in the treatment of developmental disorder of speech.

The present investigation was therefore undertaken to study certain acoustic and aerodynamic parameters, recommended by Hirano (1981), namely :

1. Maximum phonation duration of vowels.
2. Maximum duration of [s] and [z] and the s/z ratio.
3. Fundamental frequency of phonation.
4. Speaking fundamental frequency.

* Master's Dissertation, University of Mysore, 1985.

5. Fluctuations in the frequency of phonation.

6. Fluctuations in the intensity of phonation.

7. Frequency range in phonation and speech.

8. Intensity range in phonation and speech.

9. Intensities at harmonics.

10. Rise and fall time of phonation.

11. Vowel duration.

These parameters were studied in a sample of two hundred and twenty children, both males and females, ranging in age from four years to fifteen years, who were normal in terms of their speech. language and hearing.

Data on the maximum duration of [a], [i], [u], [s] and [z] and the repetition of the three Kannada sentences "idu papu". "idu ko:ti" and "idu kempu banna" were recorded. Each child was given three trials. One of these samples from each of the three trials was used for analysis.

The duration of the vowels and the fricatives was measured using a stop-watch, the longest of which was considered as the maximum phonation.

This sample was then fed to the Pitch Analyzer (PM 100) to obtain to fundamental frequency of phonation, fluctuations in frequency and intensity, in the initial medial and final segments of phonation, the frequency and intensity range in phonation and the rise and fall time of phonation. The three stimulus sentences were then fed to the Pitch Analyzer and the speaking fundamental frequency, frequency range in speech and intensity range in speech were obtained for each subject.

To measure the vowel duration and the harmonics, the word "idu" was fed to the High Resolution Signal Analyzer. The duration of the vowel [i] and the harmonics occurring in it were measured for all the two hundred and twenty children.

The data thus obtained was subjected to statistical analysis, in order to determine the mean, standard deviation and the significance of difference.

Conclusions

After the statistical treatment, the following conclusions were drawn :

I. *Maximum Duration of Phonation*

(1) The MPT of vowels increases as a function of age in both males and females.
(2) There is no significant difference in the MPT of vowels, between males and females, across the age range studied.
(3) The MPT of [i] is the greatest followed by [u] and finally [a].

II. *Maximum Duration of Sustained [s] and [z]*

(1) The maximum duration of sustained [s] and [z] is found to increase as a function of age.
(2) The maximum duration of sustained [z] is greater than that of sustained [s], indicating a s/z ratio that is less than one.
(3) There is no significant difference in the maximum duration [s], [z] and s/z ratio, between males and females.

III. *Fundamental Frequency of Phonation*

(1) In males, there is a lowering of fundamental frequency with advancing age upto the age of 14 years, after which there is a marked decrease in the fundamental frequency.

(2) In females, the gradual decrease in fundamental frequency with increase in age is seen across the entire age range (4–15 years) studied.

(3) A significant difference between males and females is observed only in the 14–15 year old age.

(4) The fundamental frequency of [a] is the lowest, followed by [i] and finally, [u], which has the highest fundamental frequency of the three vowels studied.

IV. *Speaking Fundamental Frequency*

(1) There is very little change in speaking fundamental frequency as a function of age in males, upto the age of 14 years, at which age a sudden decrease in the speaking fundamental frequency is observed.

(2) There is very little change in the speaking fundamental frequency in females with increase in age.

(3) The speaking fundamental frequency of males and females is not significantly different in the younger age groups upto 14 years. A significantly lower speaking fundamental frequency is present in the males of the 14 to 15 year age group compared to the females.

V. *Fluctuations in Frequency of Phonation*

(1) The fluctuations in frequency of the initial and final segments of the phonation of [a], [i] and [u] show a decreasing trend with age in males. The 14 to 15 year old group shows an increase in the range of fluctuations for all the vowels.

(2) In females a decrease in the range of fluctuations in frequency of the initial and medial segments is observed upto the age of 9 years. There is an increase in the range of fluctuations in the 9 to 11 year old females, which again drops down till the age of 15 years.

(3) The medial segment in phonation for both males and females is quite steady, and the range of fluctuations as a function of age does not show much difference.

(4) No difference in the range of fluctuations in frequency between males and females is observed in the younger age groups. The males consistently show greater fluctuations in frequency in the phonation of [a], [i] and [u] than females in the 14 to 15 year old group.

VI. *Fluctuations in Intensity of Phonation*

(1) The fluctuations in intensity in the initial and final segments of phonation for all the three vowels is greater than the fluctuations in the medial segment, for both males and females.

(2) The fluctuations in intensity of the initial and final segments of phonation do not show a systematic trend for any of the vowels, in both males and females. However, the initial segment of phonation shows significantly larger fluctuations in intensity in the age groups above 12 years in males, for all the three vowels.

(3) The medial segment of phonation shows no difference in the range of intensity fluctuations as a function of age.

(4) The older age groups of males (above 12 years) show a significantly higher range of fluctuations in the initial segment of phonation than the females of the same age group. The younger age groups do not show much difference in the range of fluctuations in intensity between males and females.

VII. *Frequency Range in Phonation*

(1) The frequency range in phonation decreases as a function of age in both males and females.

(2) A sex difference in the frequency range of phonation is inconsistent.

VIII. *Frequency Range in Speech*

(1) The males show a decreasing trend in the frequency range of speech with increase in age.

(2) The females also exhibit a reduction in the range of frequencies used in speech as a function of increasing age.

(3) There is no significant difference in the range of frequencies used in speech by males and females.

IX. *Intensity Range in Phonation*

(1) The intensity range in the phonation of vowels decreases as a function of age in males.

(2) The intensity range in the phonation of vowels show no difference as a function of age in females.

(3) A significant difference between males and females in the range of intensity used in the phonation of the vowels is seen in the younger age groups, up to about 10 years, after which the difference is no longer significant.

X. *Intensity Range in Speech*

(1) There is a significant difference in the intensity range utilized in speech by males and females as a function of age below 6 years and above 14 years which shows a greater range of intensities for the sentence 'idu pa:pu'. For the sentences 'idu ko:ti' and 'idu kempu banna', the difference is inconsistent.

(2) In females, the 9 to 11 year old children use a greater intensity range, though inconsistent.

(3) The difference in the intensity range of speech between males and females at particular age levels is inconsistent.

XI. *Harmonics*

(1) The energy level above 1000 Hz is less than the energy level below 1000 Hz.

(2) The α-parameter decreases between 9 to 14 years in females and 9 to 15 years in males.

(3) There is no significant difference in the α-parameter between males and females in the age range of 4 years to 15 years.

XII. *Rise Time of Phonation*

(1) There is a gradual decrease in the rise time of phonation of all vowels

with increasing age in both males and females.

(2) A slight increase in the rise time is seen in the 9 to 10 year old group of males and 10 to 11 year old group of females.

(3) There is no difference in the rise time of phonation between males and females in all the age groups studied.

XIII. *Fall Time of Phonation*

(1) Contrary to the decreasing trend of the rise time of phonation, as a function of age, the fall time shows an increasing trend in both males and females.

(2) There is no significant difference in the fall time of phonation between males and females.

XIV. *Vowel Duration*

(1) The males and females show a consistent decrease in the vowel duration as a function of age.

(2) The females have a longer vowel duration compared to the males, across the entire age range studied.

Recommendations

(1) The study may be carried out with a larger sample in each age group.

(2) The analysis could be extended to other vowels.

(3) The speech samples using the mother-tongue of the subjects can be studied.

(4) The same parameters can be studied in a clinical population of children to explore the clinical utility of this information.

Some Prosodic Aspects in Kannada *

Nandini, H. M.

Speech is defined as the concurrent motor functions of respiration, phonation, resonance and articulation prosody. Prosody has been viewed as decorative ornamentation, functioning to make speech more aesthetically pleasing. Intonation is one aspect of prosody, other aspects being stress and rhythm.

Intonation like everything else in a language is one instrument in an orchestra.

The literature of communicative disorder is filled with diagnostic descriptive of dysprosodic speech. Abnormal prosody is a characteristic of deaf children and is also affected in language disordered children and adults.

Successful treatment procedures to establish natural prosody requires understanding of its normal process.

The purpose of the study was to find out the kind of intonation patterns that are being used by the speakers of Kannada language, in expressing various emotions and to establish a procedure for analysis of Intonation.

Thirty sentences from 3 Kannada films audio recorded cassettes were selected randomly. It was decided to use these cassettes as :

(1) The emotions are expressed in the conversation/speech as naturally as possible.

(2) The emotions are conveyed by speakers to the listeners only through speech, *i.e.*, without any visual cues.

In the present study both instrumental and perceptual analysis were done. Instrumental or objective analysis was done using the Pitch Analyzer (PM 100). Perceptual analysis was done with the help of three trained listeners as judges to note the intonation patterns and to identify the emotions.

Analysis of these sentences showed the following results :

(1) In Kannada different intonation patterns are used in expressing different types of sentences.

(2) Terminal contours are important in determining the type of sentences or the terminal contours can be used to identify different types of sentences.

(3) The perception of pitch variations depend upon the fundamental frequency variation.

(4) Pitch is important for the perception of Intonation.

(5) Intensity variations do not show difference between different types of sentences.

* Master's Dissertation, University of Mysore, 1985.

(6) The intonation permits the identification of emotion/type of sentences even when the context sentences are not present.

(7) Trained judges can identify the pitch contours occurring in sentences, reliably and validly.

(8) The instrumental analysis provides the minor details of frequency and intensity variations.

Implications of the Study

(1) This study provides information regarding intonation in Kannada language.

(2) The procedure developed by this study can be used to study the intonation in different languages.

(3) The intonation patterns, identified by this study, can be used in teaching language to deaf and other speech and language disorder cases.

(4) Similar analysis procedure can be used to study other aspects of prosody in Kannada.

Limitations of the Study

(1) Only randomly selected sentences have been taken, the number of sentences are not equal.

(2) Only the audio-tapes of film stories have been taken. These samples may not be equal to natural speech.

(3) Speech samples as spoken by only one individual have been taken.

(4) Generalization of the results, at least, some types of sentences is limit as only one sentence has been considered for some types of sentences.

Recommendations

(1) Now, as the procedure for analysis of intonation has been developed, a more detailed study with more speech sample may be taken up.

(2) More speech sample representing other types of sentences may be taken up.

(3) Application of theories of intonation can be tried, with reference to Kannada language.

(4) Using natural speech, with procedure presently developed, the intonation pattern in Kannada may be studied.

(5) Using the procedure developed by this study the intonation in other languages may be studied.

A Study of Co-articulation in Stuttering*

SUCHITRA, M. G.

In spite of the theoretical simplicity and appeal of the notion that stuttering reflects a lack of co-articulation, it has received little recent empirical support. The purpose of the present study was to analyze the extent of first and second formant transitions in the fluent and disfluent speech of stutterers and to compare this with the fluent utterances of normal speakers. The technique of analyzing the acoustic wave was employed to test the problem selected. A list of 54 VCV nonsense disyllables consisting of short vowels [a, i, u] and stop consonants [p, t, k, b, d, g] was constructed. The subjects, 2 stutterers and 2 normal speakers, orally read this material in a random order, from the recordings of which both wide band and narrow band spectrograms were made. Altogether 432 spectrograms were prepared and analysed.

No effort was made to put the data to any statistical test but on the other hand the data were descriptively analysed. As the stutterers did not emit even a single stuttering block on any of the VCV sequences, comparison between the fluent and disfluent utterances in regard to formant transitions could not be made in the present study. However, a comparison between fluent utterances of stutterers and normal speakers was made. Results indicated that, though the rising and falling trend of the formant frequency transition was the same in fluent speech of stutterers as it is in the normal speakers (contrary to the findings of Agnello, 1966), the extent of such transitions was different in the two groups of subjects.

In general, the data obtained in the present study indicated the following trends :

(1) The fluent utterances of stutterers were not the same as fluent utterances of normal speakers.

(2) Even the fluent utterances of stutterers manifested a number of co-articulatory transitional differences when compared to the utterances of normals.

(3) The co-articulatory 'differences' found in the fluent utterances of stutterers indicated that the articulatory configurations required for the production of a phoneme in question were not fully achieved.

These observations, in general, lend credence to the notion that the fluent speech of stutterers is not the same as the fluent speech of normal speakers and is also consistent with the large body of literature on linguistic factors in stuttering.

* Master's Dissertation, University of Mysore, 1985.

Two other observations were made from the spectrograms which were not very consistent.

(1) The second formant was missing in a number of VCV sequences in the fluent speech of stutterers. Such a feature was not observed in the speech of normals.

(2) The second formant of vowel [a] was both rising and falling at the same instance of transition in some utterances of a normal speaker. The significance of this is not known at present, but this is a unique feature that has not been observed or reported in the past.

All the observations mentioned above, except the last one, warrant vigorous experimentation on the co-articulatory aspects of stuttering in the future.

Assessment of Children's Speech by Parents*

SUMA R.

The study was designed to find out, if the parents of hard of hearing children and normal children are able to assess their children's speech, using the questionnaire method.

To begin with, questions were given to 66 parents of normal children. Based on the responses obtained from the parents, the questions were modified. The revised set of questions were given to 40 parents of normal children and 15 parents of hard of hearing children.

The questionnaires were distributed to parents through the Speech and Hearing professionals. As the questions were given to the parents, child's speech was examined by the Speech and Language pathologists.

A descriptive analysis of the data was done.

On examination of the parents' responses, the following conclusions seem warranted :

1 It is feasible to collect information from parents, about their children's speech development through the questionnaire method.
2 It is possible for the professionals to know the child's level of speech based on the information given by parents.
3 Based on the parents' responses it was possible to differentiate the speech of hard of hearing children and normal children.

Recommendations for Future Research

(1) The questions can be administered on larger normal population to different age groups representing different linguistic background.

(2) The questionnaire can be administered on other speech disordered children. *Eg.* : MR, CP, BD, etc.

(3) Similar questions in other Indian languages can be constructed and used.

(4) The present questions to be modified and made more specific to the language.

(5) The grammatical categories and other structures to be dealt in greater detail.

(6) A cassette version of the questionnaire can be made and the difference in responses for the recorded and the questionnaire version can be found out.

* Master's Dissertation, University of Mysore, 1985.

3D-Language Acquisition Test (3D-LAT) *

GEETHA HERLEKAR

The objective of the present study was (i) to validate the data obtained on 3 children in terms of language acquisition on a larger population and (ii) to obtain normative data for the same population for use in evaluation of language acquisition in young children.

3D-LAT was constructed for this purpose and it was standardized on a sample of 90 children between the range of 9 months to 36 months of age. Nine age groupings were made and 10 children (5 boys and 5 girls) were tested in each age group using the informant interview approach.

The results obtained indicate that the data obtained on the 3 children is true of the general population also. However the internal order of few of the items shows some variation and this factor needs to be taken into account while the test is standardized on a larger sample.

* Master's Dissertation, University of Mysore, 1986.

Acoustic Analysis of the Speech in Normal Adults *

GOPAL, N. K.

Speech is a neuromuscular activity. In other words, the output of this activity is the acoustic signals, which are used for communication—as speech. The acoustic characteristics of speech have been found to vary with age. These acoustic characteristics on various aspects of speech production indicate the accuracy of control changes with the age.

"Today we are able to measure the acoustic or audible aspects of voice with sophisticated equipment. The voice print analyzer, sonograph, airflow meter, pressure recorder and computerized model of the vocal tract enable investigators to confirm earlier empirical findings and unearth new aspects of vowel sound characterization. The physiological aspects of sound production such as breathing patterns, vocal attack, vocal fold vibration, and some resonance qualities can be revealed by acoustic means."

The acoustic analysis to study the changes in speech as a function of age in adults has been found to be useful as such studies reflect :

1. The adjustment of phonatory apparatus.
2. The shaping of the vocal tract.
3. The timing and coordination of articulation and neuromuscular changes of speech mechanism. This information, is of importance in identification, diagnosis and treatment of various speech and voice disorders.

The acoustic analysis has been considered to be useful in knowing more about disorders in adults and thus in the treatment of disorders.

The present investigation was therefore undertaken to study certain acoustic parameters of speech, recommended by Hirano (1981), namely :

1. Fundamental frequency,
2. Frequency range,
3. Intensity range,
4. Rise time,
5. Fall time,
6. Intensities at harmonics,
7. Vowel duration.

These parameters were studied in a sample of one hundred adults, both males and females, ranging in age from sixteen years to sixtyfive years, who were normals in terms of their speech, language and hearing.

Data on the repetition of three Kannada sentences "idu pa:pu", "idu ko:ti" and "idu kempu banna" were recorded. Each adult was given three trials. Average of these samples of the nine trials was used for analysis.

* Master's Dissertation, University of Mysore, 1986.

The speech samples were fed to the pitch Analyzer (PM-100) to obtain speaking fundamental frequency, frequency range, in speech, intensity range in speech, rise time and fall time of speech.

To measure the vowel duration and the harmonics, the word "idu" was fed to the high resolution signal analyser. The duration of the vowel [i] and the harmonic occurring in it were measured, for all one hundred adults.

The data thus obtained was subjected to statistical analysis, in order to determine the mean, standard deviation and significance of difference between the sexes and different age groups.

Conclusions

After statistical treatment, the following conclusions have been drawn :

1. *Speaking Fundamental Frequency*

(*a*) 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. It increases from 139·7 Hz at 16–25 years, to 149·76 Hz at 55–65 years.

(*b*) There is a graudal increase in S.F.F. with increase in age till 55 years in females. From 56 years, the S.F.F. lowers in females. It increases from 224·5 Hz at 16–25 years to 258·7 Hz at 46–55 years and decrease to 234·73 Hz at 56–65 years.

(*c*) There is a significant difference between males and females in S.F.F. Males use lower S.F.F. than females.

2. *Frequency Range in Speech*

(*a*) Males show an increasing trend in the range of fundamental frequency with the increase in age upto age of 45 years. From 46–55 years males show decreasing trend in the frequency range of speech with increase in age.

(*b*) Females also exhibited an increasing trend in the range of fundamental frequency used in speech as a function of age.

(*c*) Females use greater range of fundamental frequency in speech than males.

3. *Intensity Range*

(*a*) There is a gradual but insignificant decrease in range of intensities in speech in males.

(*b*) Female subjects show inconsistent intensity range in speech.

(*c*) Difference in the range of intensities between two sexes is not significant.

4. *Rise Time of Speech*

(*a*) There is a gradual increase in rise time as a function of age in males is seen.

(*b*) In case of females, rise time decreases as age increases till 36–45 years, then increases upto 65 years.

(*c*) There is no significant diff rence between males and females in rise time.

5. *Fall Time of Speech*

(*a*) In males fall time increases gradually as a function of age.

(*b*) In case of females fall time decreases till the age of 55 years. After which it starts increasing.

(*c*) There is no difference between males and females with respect to fall time till 45 years of age. From 46–65 years, males show longer fall time than females.

6. *Vowel Duration*

(*a*) Males show inconsistent variability with respect to vowel duration with increase in age.

(*b*) In case of females there is a gradual increase in vowel duration from 16–65 years of age.

(*c*) Females show longer duration of vowel than males.

7. *Harmonics*

(*a*) The energy level above 1000 Hz is less than energy level below 1000 Hz in both males and females.

(*b*) The α-parameter shows no significant difference till the age of 55 years in both males and females. The age groups 56–65 years show significant difference when compared to 16–25 years. The age group 56–65 years show lower α-parameter than the age group 16–25 years in both males and females.

(*c*) There is no significant difference in the α-parameter between males and females in the age range of 16–55 years. But from 56–65 years, males show higher α-parameter than males.

Recommendations

(1) Study may be carried with larger sample in each age group.

(2) The analysis could be extended to other acoustic parameters.

(3) The same parameters can be studied with clinical adult population to explore clinical utility of this information.

The 3D-Language Acquisition Test and the Mentally Retarded *

KAMALINI PILLAI

The 3D-LAT was administered to 45 moderately retarded children, to study their performance on it and to make inferences regarding the language behaviour of retarded children.

The outstanding fact that emerged was that the children performed much below their age level in spite of the fact that they were matched with respect to their mental ages to the normal group. This emphasizes the fact that using MA to predict the language level of the child is an erroneous notion and that independent language assessment is a must.

This study also highlights the great variability of performance on the language test even when chronological age and mental age are controlled. This indicates that factors other than mental age influence level of language development. These factors need to be empirically studied as these can be artificially manipulated in the clinical and therapeutic situation to aid language growth.

Since there were time constraints on this study, the population studied was necessarily small. The results seen here should be therefore confirmed by studying a much larger population.

* Master's Dissertation, University of Mysore, 1986.

The Measurement of Mean Airflow Rate in Normals *

KRISHNAMURTHY, B. N.

The measurement of air flow has gained importance in recent years in screening, assessing, and treating voice disorders.

The study was conducted to find out the possibilities of (i) predicting vital capacity based on height and weight of an indivisual, and (ii) to predict mean air flow rate based on vital capacity and maximum phonation duration and to validate the methods.

The experiment was carried out in two parts. In Part 1, 30 normal males, age ranging from 18 to 29, with a mean age of 21·47 years and 30 normal females, age ranging from 17 to 22, with a mean age of 20·8 years served as subjects. The vital capacity was determined using expirograph. Based on their height and weight, and vital capacity measured a ' nomogram ' was constructed for males and females separately.

The maximum phonation duration was measured for each subject. Based on maximum phonation duration and vital capacity, the phonation quotient was calculated for each individual. Then mean air flow rate for each subject was calculated using the formula

$$\text{MFR} = \frac{\text{Phonation volume}}{\text{Phonation time}}$$

Further the mean air flow rate was also determined for each subject using the formula (MFR = 77 + ·236 PQ) given by Rau and Beckett (1984) for both males and females. The estimated and obtained mean airflow rates were compared.

In Part II of the experiment, 15 males age ranging from 19·5 to 30, with a mean age of 23·43 years, and 15 females age ranging from 18 to 24, with a mean age of 19·67 years served as subjects.

Based on the height and weight, the vital capacity was predicted for each subject (using nomograms derived in Part I of the experiment). Then correlation coefficients were found out between VC estimated and obtained for males and females separately. Further the phonation quotients were predicted based on the vital capacity (estimated) and maximum phonation duration (measured) for all the 30 subjects. The mean airflow rate was also estimated using the formula MFR = 77 + ·236 PQ (which was indicated as mean flow rate estimated).

Then the vital capacity and mean airflow rates were determined for all the subjects using routine procedure (*i.e.*, using expirograph) (which were indicated as vital capacity obtained and mean airflow rate obtained).

* Master's Dissertation, University of Mysore, 1986.

The phonation quotients were calculated using vital capacity (obtained) and maximum phonation duration. The phonation quotients (estimated and obtained) were compared for each subject.

The mean air flow rates (obtained) were compared with the mean air flow rates (estimated) for all the subjects. Then correlation coefficients were found out between phonation quotient and mean air flow rate (estimated and obtained). The results indicated that there was no significant difference between vital capacity estimated and obtained for both males and females. There was also a high positive correlation between the estimated and obtained PQ and MFRs. These results indicate that the vital capacity can be predicted based on height and weight of an individual and it is possible to predict mean air flow rate based on vital capacity (estimated) and maximum phonation duration.

Recommendations

(1) Using same method the study can be carried out on larger population.

(2) This study can be repeated with different age groups.

(3) This study can be carried out on clinical population to find out the clinical utility of the method.

Acoustic Parameters of Voice in Singing *

RAGINI, M.

The present study was undertaken to investigate the acoustic parameters of voice in singing.

This was done by measuring and comparing the following voice parameters in reading, reciting and singing conditions :

1. Fundamental Frequency.
2. Range of Fundamental Frequency.
3. Vowel Duration.
4. Word Duration.

Ten trained singers in classical music, 5 females and 5 males, with minimum training of 5 years were taken as subjects. The recording material was one of the popular Kannada poems which could be easily used for singing. The first stanza of this poem was selected for the acoustic analysis.

The subjects were instructed to read the poem first, then to recite and later to sing in a particular tune, after practising it. The model was provided to the subjects earlier.

The above three performances were recorded using a high speed spool tape recorder, in a sound treated room.

The sample was fed to PM-100 and the mean fundamental frequency, range of fundamental frequency and the mean word duration were measured.

The duration of the vowels [a], [i], [u] were obtained using the High Resolution Signal Analyzer (B & K).

The collected data was analysed statistically. The 't' test and Mann-Whitney U test were used to know the significance of mean difference of the above mentioned voice parameters in reading, reciting and singing conditions.

Conclusions

The following conclusions were drawn from the present study :

(1) In female group, when the mean, fundamental frequency was compared, there was no difference between :

(i) Reading and reciting conditions

(ii) Reciting and singing conditions,

(iii) Singing and reading conditions.

(2) In male group, when the mean fundamental frequency was compared, there was no difference between :

(i) Reading and reciting conditions,

(ii) Reciting and singing conditions,

(iii) Singing and reading conditions.

* Master's Dissertation. University of Mysore, 1986.

(3) There was difference between male and female subjects in reading condition when fundamental frequency was compared.

(4) There was difference between male and female group in reciting condition when fundamental frequency was compared.

(5) There was no difference between male and female subjects in singing condition, when fundamental frequency was compared.

(6) There was no difference, in female group, when the range of fundamental frequency was compared between :

(i) Reading and reciting conditions,

(ii) Reciting and singing conditions,

(iii) Singing and reading.

(7) In male group, when the range of fundamental frequency was compared, there was no difference between :

(i) Reading and reciting conditions,

(ii) Reciting and singing conditions,

(iii) Singing and reading conditions.

(8) There was no difference between male and female group in reading condition, in reciting condition and in singing condition, when the range of fundamental frequency was compared.

(9) There was no difference between reading and reciting conditions, in female group when the duration of vowels [a], [i], [u] was compared.

(10) In female group, when the duration of vowels [a], [i], [u] was compared between reciting and singing conditions, significant difference was observed.

(11) There was difference between singing and reading conditions, in female group, in terms of duration of vowels [a], [i], [u].

(12) There was no difference between male and female groups in reading condition, in reciting condition and in singing condition when the vowel durations of [a], [i], [u] was compared.

(13) There was no difference between reading and reciting conditions in female group, when the mean word duration was compared.

(14) In female group, when the mean word duration was compared, there was difference between :

(i) Reciting and singing conditions,

(iii) Singing and reading conditions.

(15) In male group, there was no difference between reading and reciting conditions when the mean word duration was compared.

(16) When the mean word duration was compared in male group, there was difference between :

(i) Reciting and singing conditions,

(ii) Singing and reading conditions.

(17) There was no difference between male and female group in reading and in reciting conditions when the mean word duration was compared.

(18) There is difference between male and female group in singing condition when the mean word duration was compared.

Thus, this study shows the trend in changes in the acoustical parameters in singing.

Implication

This study provides information regarding :

(*a*) The changes in fundamental frequency, range of fundamental frequency, vowel duration and word duration with respect to reading, reciting and singing conditions in both males and females respectively.

(*b*) The differences in the above parameters between males and females in all the three conditions.

Limitations

(1) Sample was small.

(2) The acoustic parameters considered in this study were :

— Fundamental Frequency.

— Range of fundamental frequency.

— Vowel duration.

— Word duration.

Recommendations

(1) The study should be carried out on a large scale.

(2) Further investigations of acoustical parameters like vowel spectra, the rhythm pattern and other factors in singing should be carried out.

Acoustic Analysis of the Speech of the Hearing-impaired *

RAJANIKANTH, B. R.

The speech of the deaf differs from that of normals in all regards.

In all the studies of the speech of the hearing-impaired, attention is drawn to the fact that, to a greater or lesser degree, the hearing-impaired individuals do not produce speech as well as those who hear.

To bring the speech of the hearing-impaired closer to the normals, a clear understanding of their speech is a must, which should be done by objective measurements. This would help in describing objectively the speech of the hearing-impaired and also in deciding the selection of the parameters for therapy.

But a review of literature shows studies based on subjective evaluations and very few studies on the objective measurements of the speech of hearing-impaired.

Hence the present investigation was undertaken in order to study certain acoustic parameters, recommended by Hirano (1981) and the norms of which have been given for the Indian population, namely :

1. Maximum phonation duration of vowels.
2. Fundamental frequency of phonation.
3. Frequency and intensity range in phonation.
4. Speaking fundamental frequency.
5. Frequency and intensity range in speech.
6. Rise and fall time of phonation.
7. Intensities at harmonics.
8. Vowel duration.

These parameters were studied in a sample of 53 school-going hearing-impaired children, 31 males and 22 females, ranging in age from 10–20 years. All these subjects had hearing-loss, with a minimum of 60 dB or above, in the better ear. They had no respiratory problem, no observable deformities of nasal, oral or pharyngeal cavities and no mental retardation.

The collection of sample consisted of recording the maximum duration of phonation for three vowels [a], [i] and [u] and the repetition of three Kannada sentences namely "idu papu", "idu koti" and "idu kempu banna". Each subject was given 3 trials. One of these samples from each of the three trials was used for analysis.

The phonation duration of vowels was measured using a stop-watch, the longest was considered as the maximum duration of phonation.

* Master's Dissertation. University of Mysore, 1986.

This sample was then fed to the Pitch Analyzer (PM-100) to obtain the fundamental frequency of phonation, frequency and intensity range in phonation and the rise and fall time of phonation. The three stimulus sentences were then fed to the Pitch Analyzer and the speaking fundamental frequency, frequency range in speech and intensity range in speech were obtained for each subject.

To measure the vowel duration and the intensities at harmonics below and above 1 K (α-ratio) the word "idu" was fed to the High Resolution Signal Analyzer. The duration of the vowel [i] and the α-ratio was measured for all the subjects.

The data thus obtained were subjected to statistical analysis, in order to determine the mean standard deviation and the significance of difference.

Conclusions

After the statistical treatment, the following conclusions were drawn :

I. *Maximum Phonation Duration*

(1) A significant difference between the age groups studied, both in males and females showing an increase in MPD with increase in age was noted.

(2) No significant difference was observed in MPD between males and females in 10–15 years group. These parameters showed a similar frequency as in normals.

(3) Of the three vowels studied MPD of [a] was found to be greatest followed by [i] and finally [u]. This unlike in normals had showed maximum MPD for [i] followed by [u] and then [a].

II. *Fundamental Frequency of Phonation*

(1) A significant difference in F_0 for the two groups was seen between males and females.

(2) A significant difference between the two sexes was also seen.

(3) The F_0 for vowel [a] was lowest when compared with [i] and [u], which varied in different age groups for both males and females.

III. *Frequency Range in Phonation*

(1) A significant difference was seen between males and females and also between the two age groups as a function of age.

(2) Both males and females at different age groups showed greater frequency range when compared with normals, also showed a wide individual variation.

IV. *Intensity Range in Phonation*

(1) A significant difference was seen between males and females and also between the two age groups as a function of age, except for vowel [i] where the males showed no difference between the two age groups.

(2) A large individual variation was seen in intensity range as compared with the normals.

V. *Rise and Fall Time in Phonation*

(1) A significant difference was seen between males and females and also between the two age groups as a function of age.

(2) Compared with normals the hearing-impaired population showed a lower rise and fall time, indicating an abrupt initiation and termination of phonation.

VI. *Speaking Fundamental Frequency*

(1) A significant difference was seen between males and females and also between the two age groups as a function of age.

(2) Compared with the normals, the hearing impaired in general showed a higher SFF.

VII. *Frequency Range in Speech*

(1) A significant difference was seen between males and females and also between the two age groups as a function of age.

(2) The hearing-impaired showed almost double the frequency range as compared with normals, again with large individual variations.

VIII. *Intensity Range in Speech*

(1) A significant difference was seen between males and females and also between the two age groups as a function of age.

(2) The hearing-impaired females showed a higher intensity range than normals but in males it was similar to normals. But both showed a large variation when compared with normals.

IX. *α-Parameter*

(1) A significant difference was seen between males and females and also between the two age groups as a function of age.

(2) In comparison with normals the α-ratio value in hearing-impaired indicated a slightly lower value, which may be indicative of a change in the quality.

X. *Vowel Duration*

(1) A significant difference between the males and females in the two age groups was seen.

(2) No significant difference was seen in females as a function of age in vowel duration, which could be due to continuation, in later age of using a higher F_0.

(3) A significant difference was seen between males as a function of age.

(4) The hearing-impaired showed a significantly higher vowel duration, as compared with normals.

It is clear from the present study that the speech of the hearing-impaired differed from that of the normals in the acoustic characteristics mentioned above.

In addition to the deviations from normals, there were large individual variations among the hearing-impaired individuals.

To improve the speech of the hearing-impaired, these parameters may be worked upon through the use of different feedbacks, thus improving their intelligibility of speech.

Recommendations

(1) The study may be carried out with a larger sample and also for other age groups.

(2) The analysis could be extended to other vowels and larger speech samples.

(3) A study to observe the effect of modifying these deviant features on the overall speech intelligibility of the hearing-impaired would be interesting.

Glottal Waveforms in Normals *

SRIDHARA, R.

The production of voice is highly complex. Thorough understanding of the physiology of voice production needs proper measurement techniques. Abnormal oscillatory movements of vocal cords are known to manifest in the form of phonatory disorder. The measurement and analysis of the vibratory pattern of vocal fold has the potential to provide detailed information on the patho-physiology of the vocal fold during phonation. Hence, study of vibratory movements is of great importance. Many researchers have attempted to study the vibratory pattern of vocal folds using various techniques. Electro-glottography (E.G.G.) or Electro-laryngography is one of the few methods used extensively now-a-days to quantify the glottal waveforms effectively.

Laryngograph measures the conductance of a high frequency (0·5 to 10 MHz), low voltage signal transmitted and detected by two electrodes placed on the skin adjacent to the thyroid cartilage. Changes in conductance depending on changes in the glottal area generate the laryngographic (Lx) waveform.

The bulk of the published literature in relation with EGG deals with physiological aspects, but some authors have suggested the possibility of using EGG in the clinical assessment of voice pathology (Van Michel, 1967 ; Weschler, 1977 ; Fourcin, 1981; Hanson *et al.*, 1983 ; Childers *et al.*, 1984). Recently, Dejonckere and Lebacq (1985) have used EGG with vocal nodules and they state that in contrast with ultra high speed cinematography, EGG is very suitable for absolutely physiological conditions of voice production.

The EGG provides information regarding different phases of vocal cord vibration. Basically, four major phases can be identified during a single vibratory cycle, *i.e.*, the opening time, the closing time, the open time and the closed time (Michel and Wendahl, 1971). Various kinds of indexes can be calculated by measuring the duration of different phases of vibratory cycle like open quotient, speed quotient, speed index, ' S ' ratio, etc.

Methodology

The purpose of the present study was to analyze Lx waveforms and to obtain data on various parameters of Lx waveforms in Indian population. 30 normal subjects (15 males and 15 females) in the age range of 17 to 30 years were taken for the study and the Lx waveforms were studied, for 5 consecutive cycles for each vowel [a], [i] and [u] in sustained phonation keeping the frequency and intensity constant, in terms of the following parameters :

* Based on the Master's Thesis, 1986.

(1) The number of cycles required to reach steady amplitude of the Lx waves (N).

(2) The Open Quotient (O.Q.).

(3) The Speed Quotient (S.Q.) and the Speed Index (S.I.).

(4) The 'S' Ratio (S.R.).

(5) The Jitter (J).

(6) The Shimmer (S).

Procedure

The subjects were seated comfortably in front of the instruments and the two electrodes were placed on the skin adjacent to the thyroid cartilage. Subjects were asked to phonate vowel [a] in their natural speaking voice and sustain the phonation maintaining pitch and intensity. The signal from EGG was fed simultaneously to VISI Pitch (Kay Elemetrics Corporation, type 6087 D.S.), to note the pitch (Fundamental frequency or Fo) and intensity (approximately 60 dB) of phonation and to High Resolution Signal Analyzer (B & K type 2033) to obtain the display of Lx waveforms. By moving the cursor of H.R.S.A. duration of different phases of a vibratory cycle was measured in milliseconds.

Data collected on different parameters were subjected to statistical analysis to find out the mean, standard deviation, significance of difference to vowel groups and between males and females (Mann-Whitney U test). The coefficient of linear regression correlation was also calculated to find out the correlation between different parameters.

Results and Discussion

In males, the mean 'N' for [a], [i] and [u] vowels were 7·53, 7·1 and 7·3 respectively and in females they were 9·0, 9·5 and 9·2 respectively. In a similar study Kitzing and Sonneson (1974) have found 'N' values ranging from 6 to 10 cycles. The 'N' values in the present study ranged from 4 to 12 cycles in males and from 6 to 15 cycles in females. Correlation analysis revealed that the mean 'N' did not correlate with the Fo of voice in both males and females. The results also indicated that males required more time (61 m.secs.) compared to females (39 m.secs) to achieve steady amplitude of Lx waves. While the discrepancy between males and females can be attributed to the greater mass and inertia of the male vocal folds, as put forth by Kelman (1981), it cannot be attributed to the higher Fo of females because the correlation values in the present study do not agree with his viewpoint.

The Open Quotient has been defined as the ratio of the open phase to the entire period of the vibratory cycle. O.Q. values were 0·52, 0·54 and 0·52 in males for [a], [i] and [u] respectively and in females they were 0·52 for all the three vowels. O.Q. ranged from 0·42 to 0·62 in males and from 0·44 to 0·61 in females. Comparison between male and female groups did not show any significant difference. The results also show that O.Q did not vary with the pitch of the voice, vowel or sex. However, changes in O.Q. with variation in frequency and intensity of voice (Kitzing and Sonneson, 1974), with different modes of vibration (Kitzing *et al.* 1982) and in pathological conditions (Hanson *et al.*, 1983) have been reported in the literature.

The Speed Quotient has been defined as the ratio of the opening period to the closing period of a vibratory cycle. The S.Q. values were 1·91, 1·80 and 1·80 for vowels [a], [i] and [u] respectively whereas in females they were 2·2C, 2·16 and 2·13 respectively. S.Q. ranged from 1·16 to 2·80 in males and 1·27 to 2·88 in females. Significant difference in the S.Q. values were observed with respect to sex and also between vowels. Correlation analysis revealed that Fo of voice and S.Q. were poorly correlated. However, changes in S.Q. with respect to pitch and intensity (Luchsinger, 1965 ; Timcke *et al.*, 1958 and Kitzing and Sonneson, 1974), in different voice registers (Kitzing, 1982), in abnormal vocal functions (Hanson *et al.*, 1983) have been reported in the literature. Kitzing and Lofquist (1979) used S.Q. to monitor voice therapy in their post-operative cases.

Another useful measure of Lx waveform—the Speed Index derived from S.Q. has been reported by Hirano *et al.* (1980). It is given by the formula :

$$S.I. = \frac{S.Q. - 1}{S.Q. + 1}$$

In males S.I. was 0·29 and in females it was 0·36 and the difference between the two groups were significant. There was poor correlation between S.I. and Fo of voice.

The 'S' Ratio refers to the area ratio of open phase to the contact phase of a cycle. The S.R. values in males were 1·15, 1·09 and 1·12 for vowels [a], [i] and [u] respectively, whereas in females they were 1·15, 1·10 and 1·12 respectively. In males, S.R. ranged from 0·96 to 1·24 and in females it ranged from 0·97 to 1·35. It was also found that the S.R. values did not vary significantly with pitch of the voice or sex. Dejonckere and Lebacq (1985) who used this quotient for the first time claimed that using this index it was possible to differentiate normals from vocal nodule subjects.

Cycle to cycle variation in the period a cycle has been termed as Jitter. In males, the jitter values were 0·057, 0·054 and 0·067 m.sec for vowels [a], [i] and [u] respectively, whereas in females they were 0·052, 0·030 and 0·053 m.sec. respectively. In males, jitter ranged from 0·003 to 0·145 m.sec. whereas in females it ranged from 0 to 0·130 m.sec. In other words, jitter varied with vowels and sex. However, no correlation was found between mean Fo of voice and jitter in males and females.

It is interesting to note that males had a higher jitter value (0·060 m.sec.) than females (0·046 m.sec.). It is presumed that greater mass and inertia of vocal folds in males may be responsible for the higher jitter values. Similar studies showing slightly different values of jitter have been reported in the literature in normals (Heiberger and Horii, 1982 ; Horii, 1985) and in pathological subjects (Moore and Thompson, 1965 ; Zemlin, 1962). The discrepancy in the values may be attributed to the methodological differences.

Shimmer refers to the cycle to cycle variation in the amplitude of a cycle. In males shimmer values were 0·079, 0·040 and 0·0240 dB for [a], [i] and [u] respectively, whereas in females they were 0·405, 0·325 and 0·415 respectively. The variations of shimmer values were very large. For instance, in males it ranged from 0 to 0·92 dB and in females it ranged from 0 to 1·66 dB. It was also found that shimmer varied with respect to the vowel and sex but not with the Fo of the voice.

Similar studies have been reported in the literature using normals (Heiberger and Horii, 1982 ; Horii, 1985) and in pathological cases (Kitazima and Gould, 1976). However, there is large discrepancy in the values of the shimmer reported. Further investigation is warranted in order to find more reliable results.

Summary and Conclusions

As pointed out in the literature and by the present study the measurement and analysis of various parameters of the vibratory pattern of vocal folds has the potential to provide detailed information regarding normal vocal cord movement. This information can also be used to describe and differentiate various kinds of voice disorders. Thus the present study has both theoretical and practical utility.

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T.A.T.—A Test of Articulation in Tamil *

USHA, D.

This study was carried out to design an articulation test in Tamil for diagnostic and therapeutic purposes, since no such standardized tests are available.

Ten vowels and twenty-five consonants of Tamil were selected for the present study. Two hundred and fourteen words with these sounds in various word positions, which were picturable and unambiguous, were selected and a word list was prepared. This list was administered to Tamil speakers in the age range of 15–30 years for familiarity ratings. 5 point rating scale was provided. The words which were rated as highly familiar by 75% of subjects were considered for the test. These words were picturized on cards of 4″ × 3″ size to make the test.

For obtaining the normative data this test was administered to 180 normal school children in the age range of 3–6 years selected from different schools of Coimbatore City. They were divided into six age groups of six months interval each. The cards were visually presented to elicit oral output. These responses were recorded manually. Audio recording was also done.

The data for each age group was statistically analysed. Mean and cut-off scores were obtained. ANOVA was used to obtain the variance.

It was found that performance varied from one age group to another. As the age increased the scores also increased.

The difference between males and females in terms of articulatory skills were found to be significantly different. Females exhibited superior articulatory skills when compared to males, except for a slight decrease between V and VI groups.

It was observed that all the vowels were acquired by the age of 3 years. Most of the consonants were acquired by the age of 3 years except fricative [ṣ] laterals l̲ and [ḷ], flap [r] and trill [r̲].

[ṣ] was acquired at 6 years [ḷ], [l̲], [r] were not completely acquired by 6 years even though they were found in the younger groups. [r̲] was acquired by 4½ years. Most of the misarticulated sounds were either substituted or omitted No errors of distortion were observed.

When compared with the Western studies it was noticed that Eastern population acquired speech sounds earlier.

* Master's Dissertation, University of Mysore, 1986.

The early articulatory acquisition in Tamil speaking children may be attributed to cultural differences.

The cut-off scores for all the age groups are provided.

In general the pictures used in this test were found to be of use. None of them were ambiguous which indicates that the test can be used as a diagnostic articulation test. However before using it as a diagnostic test further standardization of the same is necessary. This warrants further study in terms of the following :

(1) Standardization of the test on large population.

(2) Administration of the test to Tamil speaking children with different dialects to find out the dialectal differences.

(3) Collecting data for the test below age of 3 years.

(4) Studying further variables in acquisition, of articulation like socio-economic status, birth rank, intelligence. laterality, auditory discrimination, etc.

(5) Administering the test of articulation to the clinical population, to test the validity of the test.

It can be concluded that the present articulation test in Tamil would be found helpful in finding out the articulation problems, planning and choosing therapy techniques and in estimating prognosis.

The 3D-Language Acquisition Test and the Hard-of-Hearing *

USHA, K. R.

A brief summary of the present study and the conclusions drawn are given below :

A group of twenty-eight young, hard-of-hearing children in the age range of 18 months to 36 months were studied for their performance on the "3D-Language Acquisition Test". Six age groups, with an interval of three months between each, were considered within the age range mentioned above. Five children were included as subjects in the age groups, I, III, IV, V and VI. In Group II, only three subjects could be obtained. Language development was studied under three dimensions—reception, expression and cognition. The verbal and non-verbal modes of communication (the later actually including non-verbal and verbal language) were considered. Information was collected from the parents or a close associate. The results of the study were compared with norms obtained for 90 normal children on the same test. Performance of subjects, on the verbal scale as against the non-verbal scale, were compared too. These results are mentioned here briefly.

In the case of normals, a linear relation was seen between average age and mean scores along all the three dimensions of reception, expression and cognition. In the present study, a definite delay in overall language acquisition by the hard-of-hearing subjects was seen. On the verbal scale, a wide gap was seen in between the performance of subjects and of normals on the test items. The subjects performed comparatively better on the cognitive items. On the non-verbal scale, the wide gap referred to above was found to be considerably reduced. In addition, a good correlation was seen in all the three dimensions in the positive direction, between average age and average non-verbal scores for the entire group.

These findings stress the need for further studies on language development—verbal and non-verbal—of hard-of-hearing children.

* Master's Dissertation, University of Mysore, 1986.

Acoustic Parameters of Normal Voice*

VANAJA, C. S.

Within recent years, speech science has focussed on changes in patients' speech that accompany laryngeal pathology. Researchers have tried to show that voice of patients carry sufficient information for differentiating various laryngeal pathologies. Efforts to develop clinically feasible, objective and quantifiable methods for evaluation of voice disorder have focussed on acoustic analysis. The production of voice in the larynx is disturbed by organic or functional changes in the larynx and also by changes in the respiratory system to certain extent.

Different parameters of voice reflect different aspects of physiological mechanisms. Hence different pathologies differentially affecting the physiological mechanisms will bring about different changes in different parameters. Therefore study of different parameters of voice may aid in differential diagnosis of voice disorders. However before any parameter can be used in differential diagnosis, study on normal population is required.

Therefore the present investigation was undertaken to study certain acoustic parameters of normal voice of Indian adults.

The parameters considered were :

1. Fundamental frequency.
2. Fluctuations in intensity.
3. Fluctuations in frequency.
4. Rise and fall time of phonation.
5. Maximum phonation duration.
6. Maximum duration of sustained [s], [z] and s/z ratio.

Subjects were one hundred and forty normal adults, both males and females, ranging in age from 16 years to 65 years. They did not have any speech, hearing or respiratory problems.

Subjects were instructed to phonate three vowels [a], [i] and [u] as long as possible and sustain two fricative continuants [s] and [z] as long as possible. Three trials of each phonation were recorded in a quiet room of the building.

By feeding the recorded signals to pitch analyzer PM-100, fundamental frequency of phonation, fluctuations in intensity and frequency in initial, medial and final segments of phonation, rise and fall time of phonation were measured.

The maximum duration of phonation and maximum duration of [s] and [z] were obtained using a stop-watch.

By applying suitable statistical methods to the results obtained mean, standard deviation and significance of difference were calculated.

The following conclusions were drawn from the results obtained :

* Master's Dissertation, University of Mysore, 1986.

I. *Fundamental Frequency*

(1) Fundamental frequency of males was significantly lower than that of females.

(2) Fundamental frequency in females decreased with increase in age. No such change was observed in fundamental frequency of males.

(3) Though the fundamental frequency of [a] was lower than that of [i] and [u], there was no significant difference between the three vowels [a], [i] and [u], in terms of fundamental frequency.

II. *Fluctuations in Intensity of Phonation*

(1) The fluctuations in intensity of the initial and the final segments were significantly greater than that observed in the medial segment.

(2) Fluctuations in the initial and the final segments of phonation increased in older age group. Fluctuations in the medial segment did not change as a function of age.

(3) There was no significant difference between males and females, when compared for fluctuations in intensity.

III. *Fluctuations in Frequency of Phonation*

(1) The initial and the final segments of phonation had significantly greater fluctuations than that in the medial segment. No difference was found be ween the initial and the final segmen s of phonation.

(2) As age increased fluctuations in frequency of the initial and the final segment increased. This change was more significant in females. There was no change in fluctuations in frequency of the medial segment as a function of age.

(3) There was no significant difference be ween males and females in terms of fluctuations in frequency.

IV. *Rise and Fall Time of Phonation*

(1) There was no significant difference between males and females, when compared for rise and fall time of phonation.

(2) There was no change in rise and fall time of phonation as a function of age.

V. *Maximum Phonation Duration*

(1) Maximum pho ation duration decreased as a function of age and this change was more significant in females.

(2) There was no significant difference between males and females, when compared for maximum phonation duration.

VI. *Maximum Duration of [s], [z] and s/z Ratio*

(1) In normal adults, s/z ratio was approximately equal to one.

(2) There was no difference between males and females for maximum duration of [s], [z] and s/z ratio.

(3) There was no change in maximum duration of [s], [z] and s/z ratio. as a function of age.

Implications of the Study

(1) The results of the study can be used as norms for the purpose of comparison of clinical population.

(2) The methodology used in the present study can be used for future studies.

(3) The study of parameters, as done in this study, can be used to study normal and best voice.

Recommendations

(1) The same parameters can be studied in a clinical population, to investigate the diagnostic value of those parameters.

(2) Similar study can be carried out using a larger population in each age group and also by extending the age beyond 65 years.

Electroglottography in Dysphonics *

CHANDRASHEKAR, K. R.

As majority of phonatory dysfunctions are associated with abnormal vibrations of the vocal cords, analysis of the vibration of the vocal cords in terms of different parameters constitute an important aspect to be considered in the diagnosis and differential diagnosis of voice disorders.

Several direct and indirect methods have been developed with the object of studying the movements of the vocal cords. One of them is Electroglottograph (E.G.G.). E.G.G. has many advantages over the other techniques mainly because, it is a non-invasive technique and quantification of the vocal cord vibration is possible.

As there was very limited information available about E.G.G. in dysphonics and also no data of E.G.G. in dysphonics were available in Indian population, the present study was attempted.

In this study 34 dysphonic subjects (17 males and 17 females) in the age range of 15 to 50 years were studied using Electroglottograph (Kay Elemetrics Corpoation), and High Resolution Signal Analyzer (B and K type 2033). The measurement for the following parameters were obtained for three vowels [a], [i] and [u], phonated at comfortable pitch and loudness :

1. Open Quotient (OQ).
2. Speed Quotient (SQ).
3. Speed Index (SI).
4. 'S' Ratio (SR).
5. Jitter (J).
6. Shimmer (S).

The data obtained were compared with normative data given by Sridhara (1986), on E.G.G. parameters using the same ins ruments and procedures.

The statistical analysis using Mann Whitney 'U' test was carried out to find out the significance of difference between normals and dysphonics (as a group) and dysphonics (with particular kind of vocal cord pathology) in all the six E.G.G. parameters (Table I).

Conclusions

The following conclusions have been drawn from the results obtained :

(1) Male Dysphonics

- as a group showed significant difference from normals in terms of OQ, J and S values ;
- with vocal nodules showed significant difference from normals in terms of OQ and S values ;

* Master's Dissertation, University of Mysore, 1987.

Table I. Comparison of different dysphonic groups with normal groups on different E.G.G. parameters

Parameters	OQ	SQ	SI	SR	J	S
Groups :						
Vocal nodules						
Male	+	—	—	—	—	+
Female	+	+	+	—	+	—
Vocal cord paralysis						
Male	+	—	—	—	+	+
Female	—	+	+	—	+	—
Glottal chink						
Male	+	—	—	+	—	+
Female	+	—	—	—	+	—
Functional high pitch voice						
Male	—	+	+	+	—	+
Functional hoarse voice						
Female	+	—	—	+	+	—
*Congestion of vocal folds						
Male	+	+	+	+	+	+
Female	+	+	+	+	+	+
*Spastic dy phonia						
Male	+	+	+	+	+	+
Female	+	+	+	+	+	+
*Chronic laryngitis						
Female	+	+	+	+	+	+
*Vocal polyp						
Male	+	+	+	+	+	+
Dysphonics						
Male	+	—	—	—	+	+
Female	+	—	—	—	+	+

+ Presence of significant difference between means.

— Absence of significant difference between means.

* In these groups as the number of subjects were less, only comparison of mean values with normal mean values were done.

— with vocal cord paralysis showed significant difference from normals in terms of OQ, J and S values ;

— with glottal chink showed significant difference from normals in terms of OQ, SR and S values;

— with functional high pitched voice showed significant difference from normals in terms of SQ, SI, SR and S values.

This suggests that male dysphonic subjects (as a group) and also in different subgroups differed from normals on different parameters of E.G.G., thus permitting the differential diagnosis of different dysphonic conditions in males using E.G.G.

(2) Female dysphonics

— as a group showed significant difference from normals in terms of OQ, J and S values;

— with vocal nodules showed significant difference from normals in terms of OQ, SQ, SI and values;

— with vocal cord paralysis showed significant difference from normals in terms of SQ, SI and J values;

— with glottal chink showed significant difference from normals in terms of OQ and J values;

— with functional hoarse voice showed significant difference from normals in terms of OQ, SR and J values.

This suggests that the female dysphonic subjects as a group and also in different subgroups differed from normals on different E.G.G. parameters, thus permitting the differential diagnosis of different dysphonic conditions in females using E.G.G.

(3) Male and female dysphonics as a group showed significant difference from normals on OQ, J and S values. In subgroups (vocal nodules, vocal cord paralysis and glottal chink) the male and female dysphonics showed significant difference from normals on different E.G.G. parameters, *i.e.*, males showed significant difference on certain parameters, whereas, females showed significant difference on some other parameters. In other words, males and females with the same pathological condition did not show significant difference on the same parameters of E.G.G. For example, males with vocal cord paralysis showed significant difference from normals in terms of OQ, J and S values only. Whereas, females with vocal cord paralysis showed significant difference from normals in terms of SQ, SI and J values.

Factors contributing to this variation of E.G.G. results in male and female dysphonics were not known. Only further studies may answer this.

(4) Dysphonic subjects with different pathological conditions of vocal cords, *viz.*, congestion of vocal folds, spastic dysphonia, chronic laryngitis and vocal polyp differed from normals on all the six parameters of E.G.G. As the number of subjects were less in these subgroups, further studies are suggested to verify the results obtained in the present study.

Speaker Identification by Spectrograms *

LATHA, J.

The present study was aimed to find out the possibilities of speaker identification by verifying the spectrograms, based on acoustic features and to identify the acoustic fea ures necessary for verifying the speaker by comparing the spectrograms.

Words used in the study were extracted from five commonly used sentences, *i.e.*, 'I am fine', 'I am ......', 'What is it', 'I am sorry' and 'Thank you'.

Four adult male speakers uttered these sentences twice in the same situation. Spectrograms were obtained (Wide band and narrow band) using spectrograph VII 700 series and were randomly numbered.

A total of thirty interspeaker and four intraspeaker pairs and one pair for test-retest reliability were prepared.

These pairs were presented to three judges separately for verification. The judgements were found to be reliable.

The results indicated that the judges were able to identify the speakers correctly (95·5%).

*Master's Dissertation, University of Mysore, 1987.

Acoustic Features

The following acoustic features were found to be helpful in verifying the speakers by comparing the spectrograms :

— Overall clarity
— Total duration of the word and duration of the individual phonemes
— Frequency range of burst
— Frequency range of noise
— Energy concentration
— Voice onset time.

Implications

(1) It appears to be a promising method in identifying important acoustic features for speaker recognition.

(2) By obtaining a wighting factor for each feature, which the examiner can use for verification, speaker verification by spectrogram can be made more objective.

Limitations

(1) Rank ordering of the acoustic features was not done.

(2) Only five words have been considered.

(3) Only four subjects have been considered.

Word Class Effect on Visual Asymmetry *

RADHIKA, P. G.

Research on the visual asymmetries for word class (abstractors concrete norms) have been done in alphabetic and ideographic script, *i.e.*, English and Kanji respectively. The general finding has been that the RVF/LH shows an advantage over the LVF in processing the abstract norms. The LVH/RH processes the concrete norms. This study aimed to (1) Test if there is a RVF/LH advantage for abstract words, (2) Test if there is a LVF/RH advantage for concrete words, for Kannada.

20 (10 males and 10 females) Kannada speaking subjects were randomly selected after they passed the criteria of selection. A 3 channel Tachistoscope (Gerbrand G 1132 7-3B-2) was used. A word list of 15 abstract and concrete words was constructed. 15 pairs of abstract and concrete words were randomly made. Each word appeared once in each visual field. The stimulus card consisted of a digit in the centre and an abstract and concrete word in the two visual fields. The card size, the distance of the words from the centre and the size of the letters were based on the measurements given by Hines (1967).

The sequence in each trial consisted of a 900 m.sec. exposure of a cross followed by a 40 m.sec. exposure of the stimulus card and finally a 100 m.sec. exposure of a blank card. The subjects were asked to report the digit and then the words in any order.

The scores of each subject in the LVF and RVF for abstract and concrete words were tabulated. The t-test was applied on the data to test the visual field difference/advantage. The results show no visual field differences for the words used. The implication and suggestions for further research in this area have been discussed.

* Master's Dissertation, University of Mysore, 1987.

Acoustic Characteristics of Optimum Voice *

SREEDEVI, H. S.

The present study was conducted to determine the acoustical aspects of optimum voice.

100 subjects (50 males and 50 females) were selected for the study in the age range of 17–50 years.

All the voice samples were tape-recorded. Three judges rated all three voice samples as either being above normal, normal or below normal. The subjects were grouped based upon their perceptual ratings and they were analyzed for their acoustic characteristics. Intra-judge reliability ranged from 40–80% while inter-judge reliability was 85%.

The following parameters were studied in the present study :

1. Maximum phonation duration.
2. S/Z ratio.
3. Fundamental frequency in phonation.
4. Rising time in phonation.
5. Falling time in phonation.
6. Frequency range in phonation.
7. Intensity range in phonation.
8. Speaking fundamental frequency.
9. Frequency range in speech.
10. Intensity range in speech.

Parameters 3–10 were measured using Pitch Computer (PM–100). Parameters 1 and 2 were measured using stop-watch, using the standard procedure.

The hypothesis 1 (*a*) was accepted for all the parameters except fundamental frequency in phonation and SFF.

Hypothesis–1 (*b*) was accepted for all the parameters except fundamental frequency in phonation using time in phonation, SFF and frequency range in speech.

Hypothesis 1 (*c*) was rejected for all the parameters except S/Z ratio, falling time in phonation and intensity range in speech.

Hypothesis–2 was partly rejected and partly accepted. It was rejected for the parameters maximum phonation duration, S/Z ratio and fundamental frequency in phonation. It was accepted for the rest of the parameters.

Hypothesis–3 was partly rejected and partly accepted. It was accepted for the parameters rising time in phonation and intensity range in phonation. It was rejected for the rest of the parameters.

Thus, a measure of the parameters selected in the present study indicates the possibility of its usefulness in differentiating above normal voices from normal and below normal voices both in males and females.

* Master's Dissertation, University of Mysore, 1987

Mean Air Flow Rate in Dysphonics *

SUDHIR BANU

"Voice production involves a complex and precise control by the central nervous system of a series of events in the peripheral phonatory organs." The aerodynamic factors play an important role in phonation. The measurement of air flow has gained importance in recent years in screening, assessing and treating voice disorders.

The present study was conducted to find out the possibilities of :

(1) Measurement of vital capacity values based on height and weight of normal subjects.

(2) Measurement of mean air flow rate value in dysphonics based on vital capacity and maximum phonation duration.

The experiment was carried out in two parts. In part one, ten normal males and ten normal females in the age range of 30–55 years served as subjects. Their vital capacity, maximum phonation duration, mean air flow rate, height and weight were determined using expirograph, stop watch, weighing machine and measuring tape. Then using the nomogram vital capacity was predicted for each subject. Then phonation quotient and mean air flow rate were calculated using the formulae :

$$PQ = \frac{VC}{MPD};$$

$$MAF = 77 + 0{\cdot}236\,PQ$$

Then the estimated and obtained values of VC and MAF were compared.

In part two of the experiment, 22 dysphonic males and 13 dysphonic females served as subjects. Experimental set-up, equipment and procedure used were same as in part one of the experiment for measurement of vital capacity, mean air flow rate, maximum phonation duration, height and weight of subjects. Then vital capacity and mean air flow rate were estimated as described in part one of the experiment. Estimated and obtained values of vital capacity and mean air flow rate were compared.

Conclusions

The following conclusions have been drawn based on the results obtained and statistical analysis :

(1) There was a significant difference in estimated and obtained vital capacity, but they were highly correlated in normal males and females. Estimated values of VC were greater

* Master's Dissertation, University of Mysore 1987.

than obtained values of VC. This means that the nomograms devised by Krishnamurthy (1986) could be used to estimate VC but with precaution. The difference between VC and EVC never exceeded 300 cc in the normal subjects studied.

(2) There was no significant difference in estimated and obtained mean air flow rate in normal subjects.

(3) The PQ values were highly correlated with mean air flow rates, with PQ values being greater than MAF values.

(4) There was a significant difference in obtained and estimated vital capacity in dysphonic subjects, but VC and EVC were highly correlated.

(5) There was no significant difference in obtained and estimated mean air flow rates in dysphonics. This showed that it was possible to estimate the MAF reliably and such EMAF was valid.

(6) The PQ values were highly correlated with MAF values, with PQ values being greater than MAF values.

The Power Density Spectrum of Telugu Speech *

SRINIVAS, N. C.

The study was concerned with the power density spectrum of Telugu speech. This was undertaken to obtain the full particulars of the spectrum with respect to power at different frequencies. As far as the review carried out, no such study has been carried out with respect to Indian languages. Similar studies were reported with respect to European languages such as English, German, Russian, Swedish, etc.

An attempt has been made to carry out a similar study with respect to Telugu language. Telugu is the second largest spoken language in India and the spoken language was appreciated all over the world since centuries. The spoken Telugu is having similar tonal quality of Italian language.

The procedures adopted in the study were improved, reliable and latest when compared to the procedures adopted by others.

A large number of subjects and large samples were adopted in the study to obtain reliable results. Two more advanced steps were incorporated in the study: (1) screening the subjects for speech, hearing, ENT and psychological problems; (2) the male and female samples were obtained along with mixed samples to find out the deviations, if any.

* Master's Dissertation, University of Mysore, 1987.

Conclusions

(1) In case of female sample, highest power was concentrated from 250 Hz to 1000 Hz. The peak intensity was observed at 250 Hz. The intensity drop was 13 dB SPL/Octave from 500 Hz to 5000 Hz. The ratio of intensities at fundamental and highest frequency was 3 : 1.

(2) In case of male sample, the highest power was concentrated from 200 Hz to 1000 Hz. The peak intensity was observed in between 200 Hz and 250 Hz. The intensity drop was 5 dB SPL/Octave from 200 Hz to 5000 Hz. The ratio of intensities at fundamental and highest frequency was 2 : 1.

(3) In the case of mixed sample, the higheet power was concentrated from 150 Hz to 2000 Hz. The peak intensity was at 500 Hz with minor peaks at 200 Hz and 800 Hz. The intensity drop was 7 dB SPL/Octave from 500 Hz to 5000 Hz. The ratio of intensities at fundamental and highest frequency was 3 : 1.

(4) In case of female sample the intensity drop was 3 times higher when compared to males sample. The intensity drop started at earlier frequency in case of male sample. The mixed sample speech spectrum was more uniform and was accepting the characteristics of both male and female speech spectrums.

Recommendations

(1) The data obtained with respect to Telugu speech spectra can be utilized for any applications.

(2) Since all the three samples data was in correlation, it is recommended to use the mixed sample spectrum for all practical applications.

(3) Taking the values of power density spec rum it is possible to generate "Speech Noise" by using white noise source and equalizer. Such a speech noise generator is more reliable in speech discrimination tests with an audiometer for Telugu-speaking people.

(4) A speech noise generator gives a better source of signal for building acoustic measurements such as reverberation time, sound field distribution and acoustical insulation.

(5) The data are useful in the field of Digital Communication System.

(6) Even though the power spectrum must be considered as rather rough description of speech, it is possible that the language peculiarities of Telugu speech are so pronounced that they show up even in this spectrum obtained. It is therefore worth investigating if a spectrum analysis might be used as a criterion for the effect of, for example, speech training at the School for the Deaf, as the ability of the students to articulate speech with large content of high frequency might be disclosed with such a method.

Relationship between the Fundamental Frequency and Mean Air Flow Rate*

ASHA, G. G.

The air flow and vocal cord vibration plays an important role in determining the pitch and intensity. A single aspect of voice production such as pitch should not be evaluated in isolation but as part of the voice production system and the relationship between flow rate and pitch must be given due significance.

The purpose of the present study was to find out the relationship between MAF rate and different parameters of glottograms like OQ, SQ and SI at :

(*a*) Habitual frequency (HF),

(*b*) HF + 50 Hz,

(*c*) HF + 100 Hz and

(*d*) below HF.

Fifteen normal males and 15 normal females in the age range of 17 to 27 years were studied using Expirograph, Electrolaryngograph, VISI pitch and High Resolution Signal Analyzer.

Both MAF rate and glottograms were recorded simultaneously at different frequency levels, keeping the intensity constant.

* Master's Dissertation, University of Mysore, 1987

The data obtained were subjected to statistical analysis to find out the mean, significance of difference and coefficient of correlation.

Conclusions

The following conclusions were made based on the results of the present study :

(1) There was a significant increase in MAF rate with increase in frequency proportionately in males and not proportionately in females and proportionate decrease in MAF rate with decrease in frequency both in males and females.

(2) There was no much difference in OQ values at different frequency levels both in males and females.

(3) There was no much difference in SQ values at different frequency levels in males, whereas in females SQ at below habitual frequency was significantly different from other frequency levels.

(4) There was no much difference in SI values at different frequency levels in males, whereas in females SI below habitual frequency was significantly

different from SI at above habitual frequency levels.

(5) There was no relationship between MAF rate and different parameters of glottograms like OQ, SQ and SI at different frequency levels both in males and females.

Recommendations

(1) Using the same method the study can be carried out on larger population.

(2) Can be carried out in dysphonics.

(3) Can be carried out in different age groups.

Language Therapy and Functional Improvement in Aphasia *

HEMALATHA, B.

The major aim of the study was to check the efficacy of language therapy for aphasics based on the Linguistic Profile Therapy (Karanth, 1986) and to identify the reflection of such therapy in a patient's daily communication profile (Sarno, 1965).

There have been shifts in the approach to therapy since the two world wars. The approaches have shifted from general stimulation to programmed instructions and of late to treatment geared towards the specific problems of the subtypes of aphasia. The latter approaches are both non-linguistic and linguistic.

Despite the existence of language therapy for aphasia over several decades, its efficacy continues to be questioned. Much of this ambiguity is due to the lack of controlled studies, which in turn are due to the difficulties in matching and grouping aphasic subjects and studying them in a controlled manner over a long period of time.

Some of the many factors to be considered in controlling are cause and type of aphasia, extent of brain damage, pre-morbid language abilities, level of literacy, number of languages known.

In order to overcome some of these problems, efficacy of language therapy in aphasia is increasingly relying on single case paradigms.

In the present study, a subject of Broca's aphasia was taken. Three tools were utilized to have a baseline of his capabilities. The tools used were—Western Aphasic Battery—WAB (Kertesz and Poole, 1974) ; Test of Psycholinguistic Abilities in Kannada—TPAK ; Functional Communication Profile—FCP.

Therapy was given based on LPT (TPAK) for thirty-six sessions with the duration ranging from 30 to 45 minutes/session. Language focussed on the area of greatest deficit within which a hierarchy of items beginning with the least difficult was formed and taken up for therapy one by one.

Revaluation was carried out after 36 sessions and the results were noted in all the three tests. An increase in score in TPAK was reflected in functional improvement of the patient (FCP) with a simultaneous change in WAB scores.

The above improvement was attributed to the linguistic based therapy with a corresponding change in the patient's daily communication. However, this needs to be further documented in aphasics of different clinical subtypes and severity.

To conclude, linguistic profile therapy is a useful therapeutic method for the

* Master's Dissertation, University of Mysore, 1987

rehabilitation of aphasics. It takes into account both the modality bound deficits and those of linguistic units and complexity. It offers the language therapist a concrete base, therapeutic direction and measurable precision in terms of therapeutic progress or the lack of it.

Though LPT focusses language therapy on modality deficits and those of linguistic levels of phonology, syntax and semantics, it brings about a change in the patient's daily communication behaviour. The daily communication behaviour includes—attempt to speak, understanding movies, T.V.'s. ; reading newspapers ; handling money, calculation ability,....etc.

Suggestions for Further Research

The usefulness of specific therapeutic methods such as LPT needs to be documented carefully. Wherever possible group studies that take into consideration other factors such as age, sex, languages known, onset of therapy, duration of therapy need to be carried out. When this is not possible, as is often the case, the single case method with different subtype of aphasia and severity can be documented.

Varied single subject case designs may be used. Designs like ABAB withdrawal and reversal designs, multiple baseline design can be used to study the efficacy of aphasia therapy.

Language Processing in Bilinguals — A Tachistoscopic Study *

BHARATHI, N.

The present study aimed to find out visual field differences in processing of Kannada and English language by normal adult bilinguals.

10 concrete 4 lettered nouns and 10 bisyllabic 2 lettered concrete nouns were chosen in English and Kannada respectively. 40 word pairs were made 20 in each language so that each word appeared in each visual field twice. The presentation was bilateral with a central digit. Subjects reported the digit first and the words later. The exposure duration was 40 m.sec.

An "accuracy" paradigm was adopted for analysis. Responses were categorized into accurate, substitution and omission groups. A $2 \times 2 \times 2$ factor analysis revealed that visual field and language effect are significant for this group of bilinguals at the 0·05 level.

Subjects identified more words correctly in LVF than RVF. Subjects also identified more words in Kannada, their mother-tongue than in English.

Results are interpreted in terms of directional scanning hypothesis which suggests a LVF advantage for bilateral presentation in languages that read from left to right and in conjunction with this hypothesis, the right hemisphere's ability to recognize concrete as against abstract words is seen as contributing to the enhanced LVF effect in Kannada-English bilinguals.

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