METHODS OF LOCATING OPTIMUM PITCH

N. P. NATARAJA

Most of the therapies of voice disorders are based on the belief that each person has an optimum pitch, at which the voice will be of a good quality and will have a maximum intensity with the least expense of energy. And they concern themselves mainly with altering the habitual pitch level or making the case to use his optimum pitch (West, *et al,* 1957; Thurman, 1958; Van Riper and Irwin, 1958; Murphy, 1964; Greene, 1964).

There are several methods of locating optimum pitch, Wentworth (1940) in her study of fourteen texts found that there were eight different methods. Pronovost (1949) described and experimented with nine such methods. Basically these methods can be classified into four groups.

1. By finding out the total pitch range that a person can use.
2. By locating the 'swelling of loudness'.
3. And other methods like 'Coughing and laughing' or 'locating the pitch at which the person can produce voice with greatest ease'.
4. By finding out the 'natural frequency of vocal tract'.

1. *Methods using the total pitch range:*

There are several methods of locating optimum pitch, using the total pitch range. As a first step total pitch range that the person can produce is determined. That is, the lowest and highest note, including the falsetto, that the person can produce will be determined either by using the musical scale or piano. And then, some consider optimum pitch as a frequency one fourth above the lower limit of the pitch range that a person can produce (Pronovost, 1942; Fisher, 1942; Fairbanks, 1960; Berry and Eisenson, 1962).

Some others recommend optimum pitch as the frequency one third from the basal tone of the pitch range (Berry and Eisenson, 1962). Still others consider this as one fifth from the lower limit of the total pitch range than a person can produce (Brownstein and Jacoby, 1967). And also some others suggest the mode of the pitch range that a person can produce, including falsetto, while still others locate the optimum pitch at the median of the pitch range that a person can produce (Gray and Wise, 1959).

Pronovast (1942) located median pitch levels in six superior male voices and found they approximated with level that was about one fourth of the total

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pitch range. Linke (1953) in a similar study found that median pitch levels comprised one fifth of the total pitch range, in case of female voices.

Johnson, *et* a/(1967) while discussing the methods of finding optimum pitch consider the method given by Fairbanks (1959) asthe most satisfactory method yet devised, for estimating a person's natural pitch level. While discussing the limitations of the method, they say that 'the procedure just stated serves very well if the individual is able to sing a scale and has a pitch range that is not too severly restricted'. They suggest modifications of the method in such situations.

Even though Johnson, *et al* (1967) point out limitations and suggest modifications, it remains confusing, as there are several methods which differ from each other and as none of them have any experimental evidences. In general, these methods cannot be used with cases who do not have a concept of pitch or pitch range.

2. *Locating the swelling of loudness:*

These methods are also recommended and advocated by several people (Wentworth, 1940; Berry and Eisenson, 1962; Murphy, 1964; Fisher, 1966; West, *et al*, 1968; Van Riper and Irwin, 1958). Basically, these methods assume that when the subject produces voice at several pitch levels covering the total pitch range, at particular pitch level there will be maximum increase in resonance and as such there will be maximum increase in intensity. 'These usual procedures of locating optimum pitch by a resonance reinforcement in a fixed region was not supported by Thurman study (1958). But clinically it has been found to be useful to establish the optimum pitch level' (Johnson, *et al,* 1963) West *et al* (1968) states that for male speakers there are two such swellings. But he does not give any experimental evidence in support of his statement.

It may not be possible to locate the swelling of loudness as each individual monitors the loudness (voice) by auditory feedback involuntarily.

This phenomenon seems to be the best explanation for explaining the fallacies of the above methods. Apart frotn this, these methods are purely subjective as either the experimenter or the subjects has to locate the swelling of loudness.

House (1959) discusses the vocal swell method of estimating N. F. and demonstrates that presumably perceptible changes in overall voice level would result when a hormonic of the FF. coincides with the centre of vocal tract resonance. Thus perceptible increases in loudness will reflect this match rather than reflecting an increased laryngeal efficiency. He concludes that the vocal swell method is of little value.

3. *Methods employing 'coughing and laughing' and other methods:*

These methods are advocated by many people (Wentworth, 1940; Pronovost, 1942). These methods consider the optimum pitch as the pitch at which person coughs and laughs or the note at which the speaker experiences greatest ease (Fisher, 1966).

There are no experimental evidences in support of the above methods and it is obvious from the study of these methods that they are subjective.

4. *Method using the natural frequency of vocal tract:*

From the definitions of optimum pitch it is clear that optimum pitch is one at which maximum resonance occurs in the vocal tract of a particular individual. Nataraja (1972) has developed an objective method of locating optimum pitch by measuring the natural frequency of the vocal tract. In this experiment the vocal tract of good speakers was stimulated using an external sound source frequency ranging from 100 Hz-5KHz, with a constant intensity. It was presumed that the good speakers were using the optimum pitch. The frequency which showed maximum increase in intensity was considered as the natural frequency of vocal tract. Fundamental frequency of voice of the same good speakers was determined using the stroboscope.

A definite and consistent relationship of 8:1 was found between the natural frequency of vocal tract and the fundamental frequency of the voice in case of good speakers, males age ranging 20-25 years. The predictive validity was also tested and it was found that this method was valid. Hence optimum frequency (pitch) $= \frac{\text{Natural freq. of V-T.}}{8}$ (in case of males 20-25 yrs).

Further, this method was used therapeutically with dysphonics and they were helped to use these frequencies as their fundamental frequency of voice using the stroboscope. Follow up of these subjects has shown that they were using the optimum frequency as the fundamental frequency of their voice.

Thus the review of these methods show that the methods 1, 2 and 3 are subjective and have severe limitations theoretically as well as practically. The new method of (method 4) of locating optimum pitch was found to be free from these limitations. It is objective as it does not include any sort of judgment on the part of the subject or experimenter.

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PHONEMIC VARIATIONS IN HINDI SPEAKING APHASICS DURING THE IMMEDIATE POST-MORBID PERIOD

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'If Aphasia is defined first and foremost aa a language disorder then a linguistic analysis of the condition is a priority' (Roman Jakobson 1956).

'Aphasia is primarily an interference with language process resulting from brain damage. The interference that produces aphasia, disrupts both analysis and integration of verbal messages' (Joyce W. Safer and Robert Shaw 1962).

Aphasia in adults, usually has a well-defined and often abrupt onset. The most frequent cause of aphasia in adults is the vascular lesion. Cerebro-vascular accident is due to thrombosis (Occlusion of the vessel due to a fixed clot), embolism (a clot travelling in the blood stream until it is arrested by the narrowing bunch of the branching vessel), or hemorrhage (rupture of a vessel and oozing of blood into the tissue which gradually becomes a large hematoma).

In each case, the brain tissue is deprived of its blood supply and gets necrosed, resulting in a series of pathological changes. The disturbances can lead to functional disorders belonging to two classes, *(a)* linguistic and *(b)* non-linguistic.

In the non-linguistic class the disorders included are dysarthria, apraxia or agnosia while in the linguistic class it is described as aphasia. In vast majority of cases the lesion occurs in the left hemisphere.

Various behavioral changes observed in aphasia have been grouped differently. About 113 types of aphasia have been mentioned in the literature by various experts interested in the subject. Some classifications are based primarily on the language behavior of patients, others are based on the anatomical locus of brain injury causing aphasia, whereas, others have tried to correlate certain loci with certain behavioral deficits.

Often, there have been questions as to what sort of language disorders occur in aphasia. Various schools of linguistics have compared the view of aphasia with that in generative linguistics. In structural linguistics aphasia is considered as a breakdown of the linguistic code or the set of linguistic signs, that is some sort of disturbance of the abstract set of relations between sound and meaning. However, in generative linguistics a distinction is made between competence and performance (Chomsky 1965). Competence referring to the knowledge of language or set of abstract symbols and performance to the actual use of language in concrete situations. Linguistically a single competence underlines the major part of our ability to speak and understand, which have been considered as the

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processes of performance modalities. According to this school of thought what has happened in aphasia is that the connections between competence and the components of performance involved in speaking and/or understanding have been disturbed. Here, the knowledge of language is thought to be intact.

Joyce W. Safer and Robert Shaw (1962) agree with Chomsky that both competence and performance are involved in language and consider that the aphasic has the competence but that performance is impaired through the language disruption. Many studies of aphasia support the hypothesis that aphasics follow the same rules of language (i.e. have competence) as nonaphasics. Schuell (1960), Wepman (1956), Schuell, Jenkins and Landis (1961), Rosenzweig and Postman (1958), G. M. Siegel (1959) Soloman and Postman (1952), Howes (1964), Bricker (1964) and Safer (1966) all support the regularities of language behavior in aphasia, indicating the underlying structure of language is preserved. Lenneberg (1967) says, 'the patient with aphasia has not strictly speaking lost his language habits the way we may "lose" a poem once memorized and now forgotten, nor is he in a cognitive state that is comparable to the twenty month old infant before the advent of language learning. The language is not lost but that its proper organization in either the expressive or the receptive process or both, is interfered with. He cannot organize his cognitive activities to recruit, integrate and inhibit the many partial processes, which when consolidated are pre-requisite for speaking and understanding'.

Language disorder in aphasia has been studied at different levels -phonology, semantics and grammar. Some of the features have been considerably studied and others have been largely neglected. Among the neglected studies is the 'disturbance of phonology and its recovery'. Phonology pertaining to the smallest unit of language has got important implication for the construction of words and sentences. Phonemes and words are related in different ways to the sign function of language. While every word has its own particular and constant meaning, the phoneme performs only the function of distinguishing meaning without possessing any positive meaning of its own. Phonemes lose distinctive values, words lose lexical meaning, morphology and syntax lose grammatical meaning in aphasics (Jakobson 1941).

On this aspect certain studies have been undertaken and some laws formulated.

Jakobson (1941) put forward the theory that the phonological system in aphasia is subject to systematic disordering, the breakdown is not haphazard. He proposes general laws of phonemic pattering.

'Phonemic progress of the child and the regression of the aphasic obey the same laws of implication. The dissolution of the linguistic sound system in aphasia provides an exact mirror image of the phonological development in child language'.

The theory has been subject of study since 1941 but in general the opinion is divided.

Various studies conducted to ascertain the nature of the phonological errors in the speech of aphasic patients, had similar observations. The errors included the substitution of one phoneme for another, addition and loss of phonemes and improper sequencing of phonemes. Sound disturbance in aphasia can be traced to one or more of three different disorders:

1. a disturbance of the abstract system of phonemes,
2. a disturbance of the neuromuscular encoding of the phonological unit (the syndrome of phonetic distintegration), and
3. an associated apraxia of motor speech mechanism.

The present study was an attempt to describe the phonological disturbances and their process of recovery in the speech of aphasics. The main questions were:

1. What changes does the phonemic system undergo in aphasics?
2. Are the changes systematic?
3. Is the phonemic recovery systematic?
4. Is the recovery process sequential?

Hypotheses:

1. Phonemic loss in aphasic speech is systematic.
2. The process of phonemic recovery is systematic and sequential.

Methodology:

Five aphasic subjects were selected from the in-door patients of the Safdarjung Hospital, New Delhi. The selected subjects had to satisfy the following criteria:

1. Subjects must be adult aphasics
2. The aphasia in these subjects must have resulted from lesions of vascular origin according to the medical diagnosis.
3. They must not have experienced aphasia previously.
4. They must be 'fresh' aphasics.
5. Subjects should have been either using Hindi as their 'first language' or the pre-morbid language must indicate considerable proficiency in Hindi.
6. They must pass the screening test of 'hearing' and 'vision'.
7. They must obtain 'aphasic score' on the 'Porch Index of Communicative Ability'.

General Methodology:

1. After the selection of the subjects, information was obtained regarding their education, job, special interests, etc., to obtain some idea of the subjects' pre-morbid speech and language proficiency.

Speech sample of one of the close relations of the subject was also recorded as a clue to pre-morbid speech.

2. Physicians' reports of various investigations and examinations done for the subject were noted.

3. Any treatment given to the subject was noted.

4. Samples of the conversational speech of all subjects was tape recorded everyday for the entire period of their stay at the hospital (7-10 days).

5. Along with the recording of conversational speech,a 'say after me'test was given every day and the responses were tape recorded. Thus attempt was made to ensure the occurrence of all the phonemes in all phonetic positions, which may have been omitted by the subject during spontaneous speech.

The recorded speech included the investgators' stimulus questions, comments and the subjects' speed. However, a lot of subjects'speech telligible' because the target words were not available or could not be guessed. Only the intelligible speech samples were used for analysis.

6. Each taped interview was listened to completely and transcribed with the help of two judges. The attempted traget word was determined by the surrounding context. Analysis of each sample was made on the following basis.

(a) *Phoneme frequency distribution Randomly selected speech* samples of two subjects consisting of 1000 phonemes were analysed for the frequency of occurrence of phonemes. The frequency tabulation was based on the actual phonemes produced by the subject and not on the attempted target phonemes. This was compared with the normal phonemes frequency distributation in Hindi.

(b) Distribution of errors: With the phonemic frequency distributation established for the aphasic speech sample,it was possible to consider the relationship between the phoneme error rate and frequency of occurrence. A rank order correlation coefficient between the errors made on each phoneme and its actual frequency of occurrence in aphasic speech was computed.

(c) Total phonemic error: Total number of uttered phonemes. and target phonemes were counted and an overall error percentage was calculatedd for each sample. This gave an idea of subject linguistic recory at the recovery at the phonological level leaving quotient was computed for each subject to know the rate of recovery.

(d) Distribution of error types: All the phonemes were compared with the target phonemes and the deviations were categorized into:

(i) severe distortions

(ii) substitutions

(iii) mild distortions

(iv) omissions

(v) additions

The percentage of each error type was determined for each speech sample of every subject. Phonological recovery could be arrived at by comparing the error percentage of each type for each day.

(e) Analysis of substituted phonemes: Phoneme substitution errors were analyzed in terms of distinctive features. They were classified into errors of one or more than one distinctive features. Each phoneme substitution error characterized by a single feature change was classified according to the direction of the eiror made—whether the phonemic change was from marked consonant to an unmarked or from unmarked to marked.

Results and Discussion

All the subjects showed a similar pattern in their phonemic disturbance and its recovery, however they differed in severity. Analysis of the 'Say after me' test showed fewer errors than errors made on spontaneous speech, but the errors were made on the same direction.

Description of cases

Subject	*Age*	*Medical diagnosis*	P/CM *(overall score)*
A	35 Yrs	C. V. A.	8.37
B	45 Yrs		8.95
C	38 Yrs	J)	9.53
D	42 Yrs		8.40
E	55 Yrs		8.80

Although all the subjects obtained the scores in the range 8.00-10.00, they showed different rates of recovery from the first to the last day of the study.

1. A rank order correlation coefficient to measure the degree of concordance between the consonant distributions reflected in aphasic and normal speech was .91, highly significant at the .01 and .05 levels of confidence.

This suggests that an analysis by phoneme frequency distribution is not sufficient enough to differentiate pathological from normal speech.

2. No statistical significant relationship between the actual occurrence of phonemes in aphasic speech and the errors made was noticed.

3. All the subjects showed a gradual improvement in terms of increase in the number of 'intelligible' phonemes from the first to the last session. This gradual increase in the number of 'intelligible' phonemes each day is indicative of phonemic or phonetic recovery.

4. All the subjects showed a gradual reduction in the total phoneme error from the first to the last session. However, there were differences in the degree of error and improvement in each subject.

Learning quotient

Subject	A	218.7
	B	142.2
	C	450
	D	165
	E	185.8

5. All the subjects made following types of errors:

(a) severe distortions

(b) substitutions

(c) omissions

(d) mild distortions

(e) additions.

6. All the subjects showed a general pattern of improvement during the post morbid week.

(a) There was a gradual reduction of all other types of error except substitution.

(b) There was a gradual increase in the substitutions. This pattern shows a direction towards recovery. As the severe distortions and omissions decrease, the subjects may add some new phonemes to their phonological system which may be substituted by some other phonemes. Another possibility of the increase of the substituted sounds could be that the severely distorted sounds had been the distortions of the substituted sounds and as the neuro-muscular problem which often co-exists with aphasia improved. The substituted phonemes were identified. Or at this level of articulation the subjects may have merely made a poor attempt at the correct phoneme.

7. The following observations were made from the phoneme substitution analysis:

(a) the distinction between /e ,/r/and w/was observed to have been lost in all the subjects. The distinction is acquired late in the child's acquisition of language and the error is often observed in children;

(b) subjects had confusion between voiced/voiceless consonants. This observation does not support Jakobson's hypothesis of 'phonemic

regression' as the children acquire this distinction very early in their language acquisition period. The subjects were not aware of the substitutions they had made. The fact that subjects did not even notice most of these errors, points to a genuine error made at the level of phonemic organization of speech where the wrong unit seemed to have been selected. Alternatively there may have been a disturbance in the feedback and monitoring system;

(c) the loss of distinction between nasal/oral consonants was noticed in all the subjects. There was an equal tendency for the nasal consonants to be substituted by oral consonants and vice versa. There was great improvement noticed from the first to the seventh day in all the subjects. This observation again does not support Jakobson's hypothesis as this distinction is one of the first ones to be acquired by children. This confusion shows the selection of the wrong phonemes;

(d) the subjects had a lot of confusion between affricate—fricative, affricate—stop, continuent—stop and continuent—affricate. There was improvement noticed from first to the seventh day.
Similar observations were also made by Ombredane, Alajouanine, Luria (1966), Goldstein K. (1948) and Blumstein (1968);

(e) the distinction between aspirate/non-aspirate phonemes was observed to have been lost in all the subjects. It was noticed that till the fourth session all the subjects omitted almost all the aspirate consonants and later were substituted by their non-aspirate equivalents. During the later sessions a confusion between the two was seen;

(f) subjects also made a great number of errors in the place of articulation. Most often the front consonants substituted the back consonants though occasionally there was a tendency for the opposite direction also. /t/and /d/ were most frequently substituted for other sounds.

This type of error is often made by the children. Ombredane observed that velar sounds were pronounced as /t/ and /d/. Whereas Fry observed that /t/ and /d/ were frequently replaced by velar articulations.

8. Subjects made more errors of one distinctive feature than errors of more than one distinctive feature in the later days.

9. Subjects were unaware of the errors made by them.

These results do not support Jakobson's hypothesis of 'phonemic regression'. However, some similarities have been seen.

Alajouanine (1939) emphasized:

'These errors did not form rules of phonological change but rather demonstrated tendencies. Hence, it is not possible to predict when an error occurs, it will fall within certain specifiable limits. Moreover, sound changes are not consistently unidirectional, i.e. although there are statistical trends in one direction a sound change may occur in other direction e.g.. fricative—stop, stop—fricative'.

This implies then that there is a confusion of phonemic oppositions rather than a loss of phonemic types.

These results support the hypothesis

(a) phonemic loss in aphasia is systematic,

(b) phonemic recovery in aphasia is systematic though it is not same as the child's acquisition of phonologv Sequence in the phonemic recovery was observed. However, it is not possible to give the steps towards recovery from this date,

A SURVEY OF NOISE AND HEARING PATTERNS IN AN INDIAN INDUSTRY IN MYSORE CITY

P. MAHANANDA

Introduction

Pollution has caused so much concern here and abroad that it is becoming a public nuisance. Among various pollutions, noise pollution has attracted a great deal of attention. As nation develops, as new industries are born, as consumer and transportation facilities increase, noise inevitably also spreads to more and more people. Rightly therefore more concern is being paid to the increasing occurrence of noise and its effects upon man.

An exposure to noise either of a short duration to intense noise or of a prolonged exposure to loud sounds is known to damage man's hearing, disturb his physiology and affect his productivity.

For many people in an industrial administrative set up, these problems and the solutions contain elements outside their previous training and experience.

The field of industrial audiology deals with the noise and its effects upon workers:

Hearing acuity
Safety
Communication and
Performance.

Noise is the price We pay for being civilized, therefore it is becoming increasingly important for us to know what noise is present in our society, so that preventive measures can be taken. Despite frequent conferences and even with an extensive literature on noise elsewhere not enough information about noise picture in our country and its effects are available.

Much Work has been done in this field in other countries, whereas in our country it is yet to be started.

To assess the effects of noise and to lay down the maximum permissible limits for such noises under different conditions have been arduous and are still unfinished tasks. The problem of noise, and in recent times that of aircraft and space craft noise have attracted investigators from different disciplines like, Biophysics, Engineering, Acoustics, Medicine, Physiology, Psychology and Audiology.

The present survey is perhaps the first survey in South India on industrial noise and its effects upon human hearing.

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It was an 'Analysis of industrial noise and hearing patterns in an Indian motor-cycle factory situated in a relatively non-industrialized city—Mysore'. The study consisted of two parts:

(i) Noise analysis in all the sections of the factory.

(ii) Hearing-evaluation of all the workers taken for the survey.

Importance of the study

1. It will emphasize the need for prevention of hearing-loss and also to make constructive suggestions for hearing-conservation in that factory.
2. It will add to the slowly growing understanding of noise problems in India.
3. It is also hoped that this study will augur more such studies in this part of the country.
4. Such studies will lead to legislation to help prevent noise induced hearing loss and other problems.
5. The results of the present survey will be an additional information to the existing literature on industrial noise and its effects upon hearing.

Methodology

There are 14 sections in the factory and a number of 379 workers were selected out of the total 610.

TABLE I. Number of workers taken from the different sections for the survey

SI. No.	Name of the Section	Total Number of workers in the Section	Number of workers taken for survey
		'X'	'Y'
1.	Assembly (Engine)	30	30
2.	Chamber section	50	30
3.	Degreasing	12	12
4.	Die-castingl	32	30
5.	Electro-plating	25	25
6.	Heat-treatment	28	28
7.	Machine shop	200	50
8.	Paint shop	25	25
9.	Press shop	50	30
10.	Polishing shop	22	22
11.	Press welding	34	30
12.	Testing and general repair	7	7
13.	Tool room	30	30
14.	Welding shop	65	30
	Total	610	379

Criteria for selection

1. *(a)* Where the number of workers is 30 and below, all the workers in that section are selected.

(b) Where the number of workers is above 30, a minimum of 30 workers or 25 per cent of the total number of workers in that section, whichever is more, is selected for the survey by random sampling.

2. The selected 379 was the representative of all the sections and who work with the machine.

3. The total number of workers selected, represented all the sections.

Noise evaluation

1. *Equipment:* SPL meter type 2203 with octave band filter set type 1613 and an extension cable with 1 microphone.

2. *Noise analysis:* Noise in all the sections has been measured in all the three weighting net works A, B and C. In addition to this, spectrum analysis of the noise was done using an octave set coupled to the SPL meter.

Noise measurements in each section were repeated thrice at different times during the work schedule and their means were plotted on the graph sheets.

Audiometric evaluation

(a) *Equipment:* Transistorized Madsen portable Audiometer Model TBN 60 calibrated to ISO standards.

(b) Room for testing: One of the rooms in the administrative block was selected and altered to the requirements specified for industrial screening purposes by Glorig (1964).

TABLE II. Comparison of noise pictures as given by Glorig and as obtained by the present investigator.

Octave Bands	150-300 Hz	300-600 Hz	600 H*- 12K. Hz	1.2-2.4 K. Hz	2.4-4.8 K. Hz	4.8-9.6 K. Hz
Glorig	...	40	40	47	57	62
Present investigator		46	42	25	15	10

(c) Method of testing: A screening test was administered to all the workers at these levels:

A. C. testing 20 dB at low frequencies and
15 dB at high frequencies.

B. C. testing 20 dB at low frequencies and
10 dB at high frequencies.

Test frequencies 250—500—1K—2K—4K—6K—8K HZs.

(d) Criteria of failure: Those who failed to respond at more than two frequencies either in one ear or in both ears were considered to have railed in the test. For all those who have failed rn rreening were administered a detailed audiometric test.

TABLE III. Levels **for** p assing the **screening test**

Ear	250 Hz	500 Hz	1 K. Hz	2 K. Hz	4K. Hz	6K Hz	8K. Hz
Rt/Lt	20	20	15	15	15	15	15
B.C.	20	15	5		5		

Each worker was allowed to observe the testing situation before his turn, which facilitated an easy understanding about the testing situation.

With the cases having titinnitus pulsed tones were used.

As the study aimed at those workers who incurred the hearing loss due to noise, the following additional precautions were taken:

(i) Workers with apparent E. N. T abnormalities were excluded;

(ii) Testing was done only after the removal of wax;

(iii) Workers with congenital hearing loss were excluded;

(iv) Hinchcliffe's (1958) corrections *tor* presbyacusis were applied to the audiograms.

Audiometric analysis

Mean thresholds for each frequency or different sections were computed.

E. N. T. examination for each work: was done by an E. N T. specialist before hearing testing.

ANALYSIS

Hearing pattern.

When the mean of mean thresholdsof all the 14 audiograms were determined, following factors were observed:

(i) Bone conduction threshold rermined flat up to 2K.Hz and then had a dip at 4 K.Hz.

(ii) The industrial notch was observe at 6 K.Hz in most of the sections in both the ears (8 out of 14 sees sections).

(iv) Only in 3 out of 14 sections notches existed at 4 K.Hz.

Noise pattern

The common characteristic for all the sections was: 12 out of 14 sections had low frequency predominant noise spectrum.

DISCUSSION

1. A number of industrial surveys abroad have shown a notch at 4 K.Hz, but the present study showed notches at 6 K.Hz in most of the audiograms. (12 out of 14 sections)

2. AAOO (1957V, Baugh (1966) and Karl D. Kryter have suggested that 90 dB (A) as damage risk level, but the present study has showed that 85 dB (A) can be hazardous.

CONCLUSION

1. The noise levels seem to be higher in sections having intermittent type of noise than sections with continuous type of noise.

SI. No.	Name of the Section	Type of noise	Level of noise in dB (A]
1.	Machine shop	C*	70 decibels
2.	Electroplating	C	78 "
3.	Degreasing	C	80 "
4.	Engine assembly	I+	80 "
5.	Die-casting	I	81 "
6.	Chambers	C	83 "
7.	Tool room	C	83 "
8	Paint shop	C	84 "
9.	Heat treatment	C	85 "
10.	Polishing	I	86 "
11.	Testing and general repair	I	93 "
12.	Welding shop	I	95 "
13.	Press-welding	I	103 "
14.	Press-shop	I	104 "

*C=Continuous +I—Intermittent.

2. Noise above 85 dB (A) is hazardous.

3. The factors like long duration of exposure, more noise at dB (A) and more noise in octave bands (300-600 and 1200-2400 Hz) either individually or in consonance may have contributed to the hearing loss.

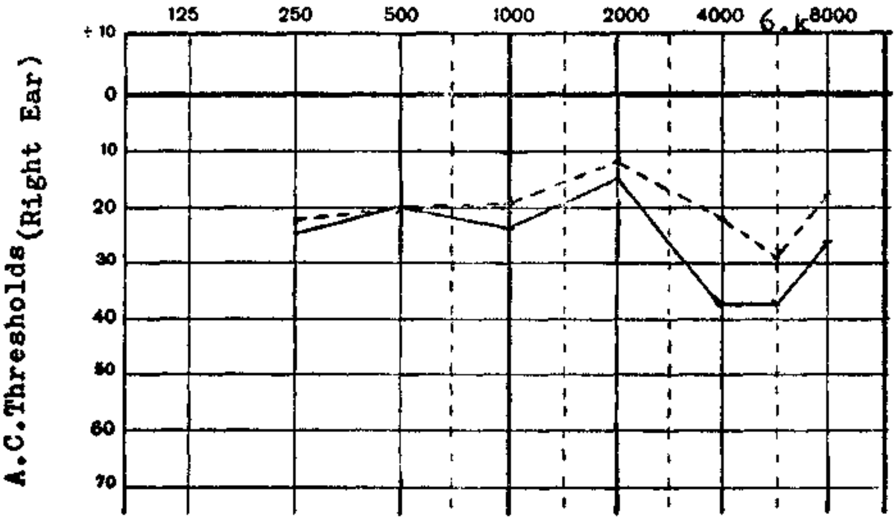
4. It was also seen that the factors other than the duration of exposure, age, type of noise and levels of noise, are also relevant.

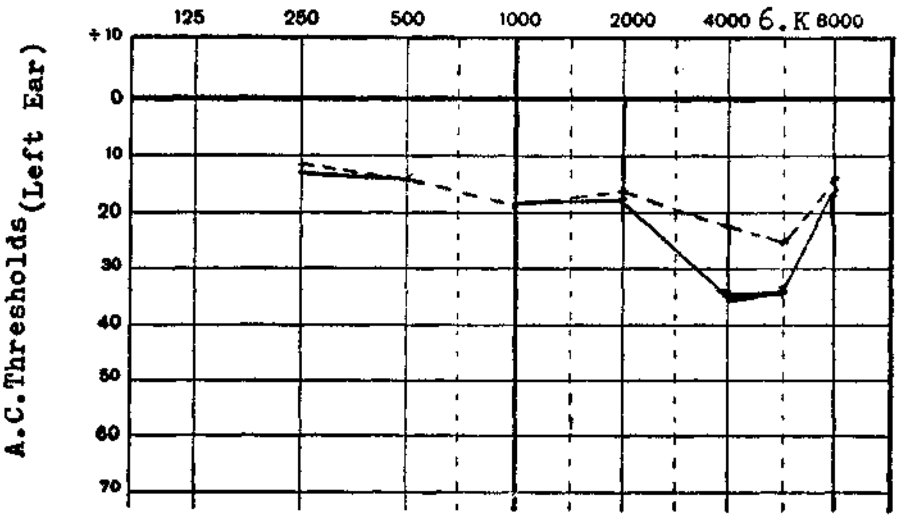
5. Noises below 82 dB may **not** be hazardous for a duration of eight years.

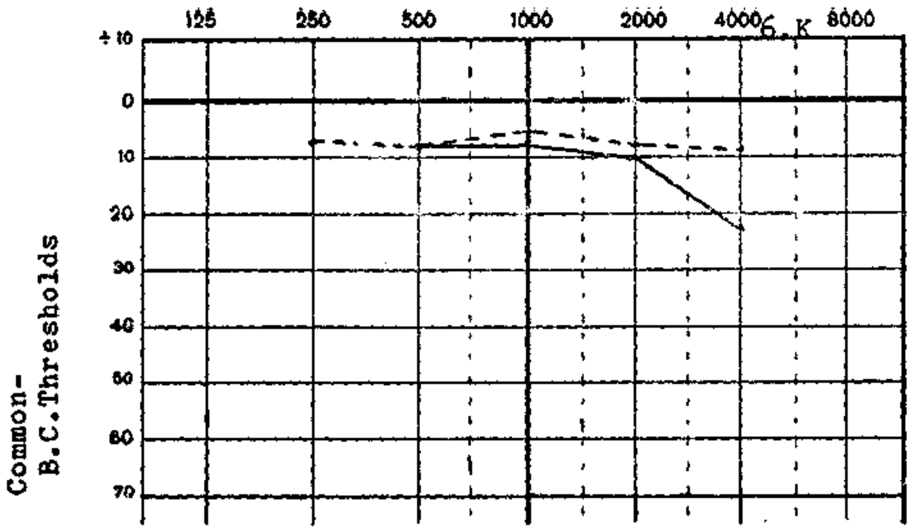
6. The factor of duration of exposure plays an important role in causing hearing loss. (Ref. Table No. V)

TABLE V

Comparison of Audiometric Patterns of Sections, Press-Shop (——) and Press-Welding (—)
Duration of Exposure (a) Press-Shop 5 yrs. (b) Press-Welding 9 yrs.
[Factors like the Level of Noise (I), type of Noise (T), and the Age (A), remains the same for these sections]
(Audiograms were corrected for the Presbycusis factor)—



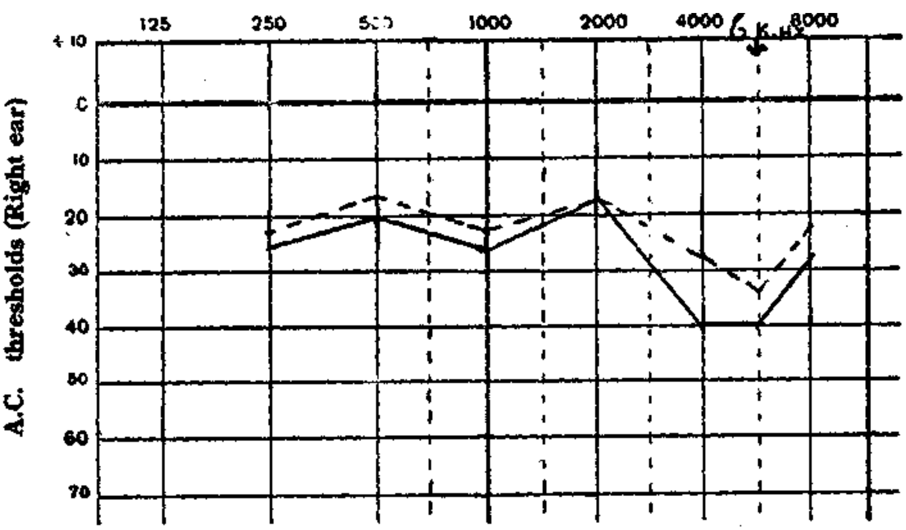


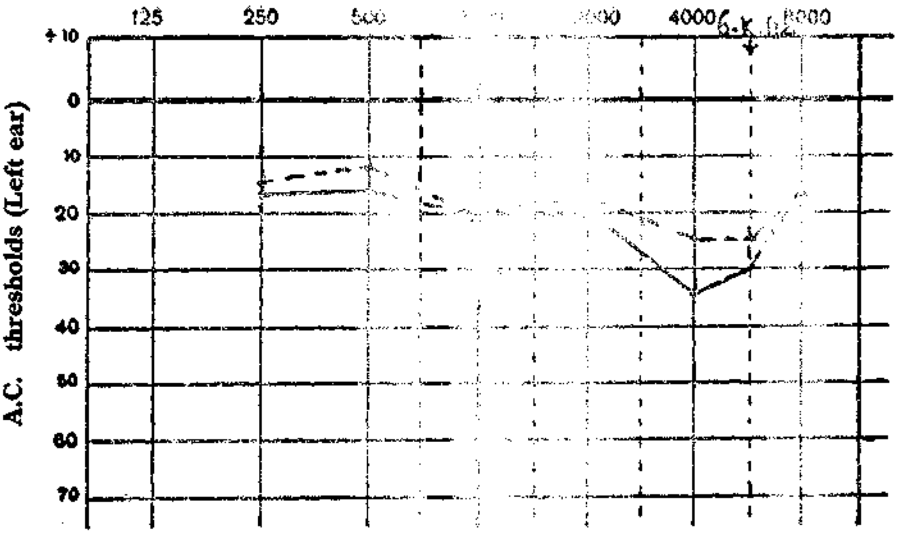


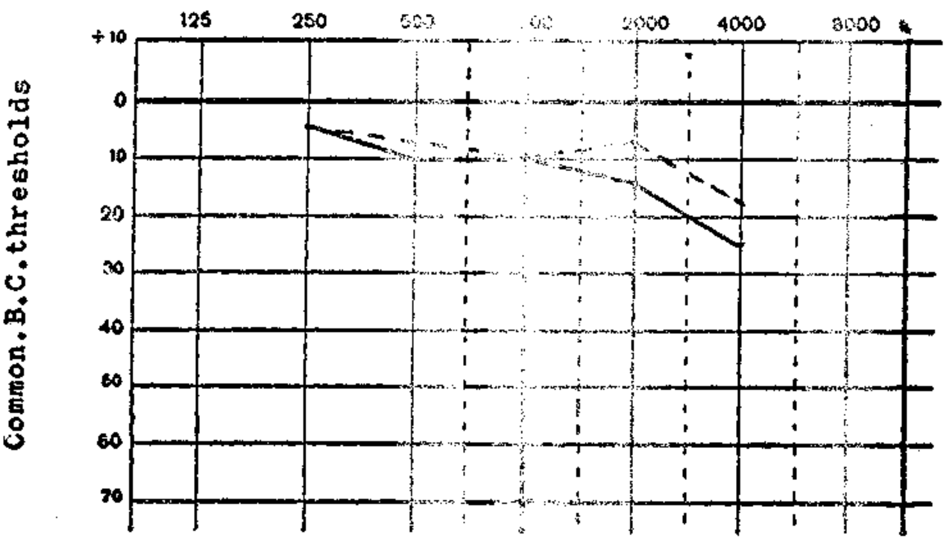
7. The factor of intensity of noise plays an important role in causing hearing loss. (Ref. Table No. VI)

TABLE VI

Comparison of Audiometric Patterns of Sections, Press Welding (—) and Polishing (——) Level of Noise (a) Press Welding 103 decibels. (b) Polishing 86 decibels. [Factors like the type of Noise (T), Age (A), and the Duration of exposure (D), remains the same to both of these sections] (Audiograms were corrected for the Presbycusis factor)







8. The Audiometric Patterns justify that the routine Pure-tone audiometry should include the testing at 6 K. *Hz,* which will be of clinical significance. (12 out of 14 audiometric patterns of all the sections showed notches at 6 K.Hz)

RECOMMENDATIONS TO THE FACTORY

1. Conservation of hearing should be an integral programme of the factory.

2. Those workers who work in the noise level of 85 dB(A) should wear ear protectors.

3. Those workers who have already incurred hearing loss due to noise, should be placed in sections having damage free levels.

4. Arrange for the periodic hearing check up for those who have incurred hearing loss.

5. The work schedule for those who have incurred hearing loss can be changed.

6. In case of new constructions, the new techniques in building industries should be followed.

7. Pre-employment audiograms are recommended.

8. An audiologist should be taken in the regular staff for the hearing conservation programme and to conduct research.

RECOMMENDATIONS FOR FURTHER RESEARCH

1. Intense research should be undertaken on the effects of noise on hearing among other industrial workers.

2. The present study can be repeated with a larger sample.

3. The same workers taken in this survey should be tested after a duration of one year to notice further changes in their audiometric patterns.

4. Studies should be done where testing schedule include testing after varied amount of rest.

5. Studies need to be made on workers who have left the factory for other professions to study whether any recovery takes place after a long period of exposure.

6. Studies need to be done concerning the temporary threshold shifts.

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EDITORIAL

In his editorial to the IV Volume of this Journal Dr. N. Rathna had already made a mention that soon I will be taking the directorship of the Institute and in virtue of that I will also be the *ex-officio* editor of this Journal. He also anticipated that we shall be able to make up for the delay in publishing our V and VI issues. Whereas his first expectation has come true as for the second we are still lagging behind. I am very happy to be associated as an editor of this Journal which at present is the only scientific mouth piece of Speech and Hearing speciality in India.

The "Silent World" which was rendering good service to this cause under the editorship of Dr. Joe V. De Sa is unfortunately silenced due to the phenomenal rise in the stationery and printing cost. Contribution of articles to this Journal will be welcome.

Every one in the field will be pleased to note that this Journal is acclaimed all over the world and that the Institute is now having exchange . agreements with a number of foreign Journals.

The Institute is situated on the Western Ghats in Mysore, a garden city of India in the scenic beauty of Manasa Gangotri and on the backdrop of Chamundi Hills. Manasa Gangotri is a University campus effervescent with youth activities!

All India-Institute of Speech and Hearing is a unique institution not only in India but also in the South East Asia dealing with all problems of Speech and Hearing arising from defects and diseases in the organs of Ear, Nose and Throat and dealing with multi-disciplinary approach consisting of Speech Patholgy, Audiology, Otolaryngology, Psychology, Psycho-linguistics, Pediatrics, Physiotherapy, Occupational Therapy, Anatomy, Physiology and Pathology, etc.

I gather from many visiting specialists in the field from the developed countries that this is really a unique Institute and they hardly have a similar type of set up in their own countries. With commencement of fulfledged department of Otolaryngology, a long felt need is being filled. The Institute can now give a composite coverage for all types of afflictions of hearing and speech. Whereas it was earlier looked after the rehabilitation part only, the Institute is now able to handle curative aspects including major and minor, routine as well as micro-surgical work. The patient can blissfully hope to have comprehensive treatment under one roof.

The job opportunities for our graduates and post graduates have been coming, though rather slowly. We find that all the State Governments, local bodies, philanthrophic organisations are now aware that deafness and disorders of Speech and Hearing are treatable and are making active efforts to institute proper services by creating posts and vacancies. Creation and filling up of posts is a time consuming affair and from this point of view the time lag is to some extent understandable. However, at present almost all of the graduates are employed and we hope that the next batch which will pass out from our Institute and additional graduates coming out from Bombay and Ahmedabad will also find employment sooner than later.

This issue of the Journal is replete with articles on Speech Pathology. Dr. Gray has indicated the successful use of programmed therapy for language problems. Dr. P. C. Ganeshsundaram and Miss Maya Devi have made an interesting linguistic analysis of a bilingual speaker and have provided us with an additional tool very useful in our country with the multitude of languages. How this problem of the many languages can be met by Speech Pathologists is discussed by Dr. Rathna. The papers by Mrs Sheela Kumar an old student, raise pertinent questions on the Optimum Frequency of Voice. Mr. Jayaram and Mr. Chandrashekar also our old students have added their thoughts to questions that have been asked several times Mr. Nataraj and Mr. Sharma add to the information on Cleft Palate.

The article by Mr. Raghavan and Dr. Abrol on "Problems encountered in measurement of vibration of human tympanic membrane using time averaged holography" and the article by Mr. Nataraja and Mr. Subramaniya on "The effect of bulldozer noise on hearing—an attempt to protect the ears from it" are interesting to read.

Among the four articles in the field of Psychology three are research studies and one is a general article. The article by Mr. Srinivasan with the title "Neuroticism and Extraversion among aurally handicapped adults" points out no essential differences between the normal and the adventitiously aurally rehabilitated group on two dimensions of personality neuroticism and extraversion, which confirms findings from some earlier studies. The finding that the adventitiously aurally rehabilitated group were more emotionally stable than normal group needs to be further corroborated The fact that verbal response rates are affected by the "Voluntary Positive Sets" and "Voluntary Negative Sets" has been brought out from the article, "The role of Volition in Human Conditioning" by the authors Dr. Rathna and Mr. Rangasayee. The effect of response contingent shock on stuttering behaviour is a controversial issue. The article with the title "Control of Stuttering behaviour through response contingent shocks" by Dr. J. Bharath Raj has pointed out that aversive shock brings moderate results with adult stutterers.

The general articles with the title "Is the concept of Mental Retardation apt?—A critical discussion" by Mr. Jayaram presents criticisms levelled against the use of 'medical model' in diagnosing mental retardation and the use of intelligence tests. In fact the well knowledged clinician and research worker is aware of all these criticisms but is still helpless as there are no other procedures that could serve as substitutes in their place. In spite of these limitations they are still in vogue because their advantages overweigh their limitations. No valid case is made or cogent arguments substantiated for the almost abrupt conclusion reached namely, that "It is better if the retarded development is viewed as a function of inadequate reinforcement and discriminative histories". This seems to be an extremistic stand. Instead of dwelling at length about limitation and criticisms of the current diagnostic procedures, the author could better have made a strong case on his above plea.

THE CHALLENGE OF LANGUAGES TO SPEECH THERAPISTS IN INDIA*

N. RATHNA

This paper is nofiUtsearch report; it only intends to underline a problem faced by Speech and Hearing therapists in India, and to indicate some tentative solutions to this problem unique to us. The stimulus for this paper came from the enquiries received by us for Speech and Hearing therapists. Many of them insisted that the person should be a native speaker of the language spoken in the area. It seems to be a tacit assumption that it is essential for a Speech Pathologist and Audiologist to be a native speaker of the language his cases speak. Corder (1966) assumes that the therapist is himself 'of course normally a native speaker of the language of his patients'. Corder was writing in the British Journal of Disorders of Communication and his assumption might be very valid in the U.K. Can we automatically transport that assumption to India? No. This assumption is not valid in India, not at least at present and as I see it, it will not be in the foreseeable future. The reasons for this are many and we will look at them later. Can we at least assert that though the therapist is not a native speaker he should at least be well versed in the language? Should we insist on this at the time of employment as is being done in several places? The answer again is no, not reasonable. Am I saying that knowledge of the language of the cases is not useful to a therapist? No, not at all. It is extremely useful and hence desirable; but it is not always possible to achieve and it is not essential.

The conditions that make this difficult to achieve are many. India is known for the diversity of its languages. What is often ignored is the fact that most of the Indian cities are cosmopolitan and a multitude of languages coexist in all cities. There is a great mobility of people across state boundaries and a mixing of languages is a necessary outcome. Speech and hearing problems are not the monopoly of any one language. That means that any therapist working in a city can realistically expect to have to work with cases from any language spoken in the city which actually means any Indian language. Would it then be realistic to expect any therapist to know all those languages! And nobody is a native speaker of all those languages! Even in a comparativaly small conservative city, Mysore, we have had to work with twelve different languages spoken by people residing in the city. If we include cases from out of the city the number goes higher. I have had most of my education and spent most of my life in the city of Mysore. And I do not know all those languages! The situation in larger cities must indeed pose a greater problem.

* This paper was presented in the VI Annual Conference of Indian Speech and Hearing Association held at New Delhi.

Dr N. Rathna, Joint Director, AIISH, Mysore.

If we insist that a therapist be a native speaker of the languages his cases use we in Mysore would have to appoint at least twelve different therapists. While this high number of therapists could be made available in an All India training institution such as ours, how many centers can be expected to do so? We need not feel despondent because as I said earlier we need not insist on a native speaker as a therapist. It is not realistic to so insist.

There is another difficulty and that *is in* terms of therapists not being available in all parts of the country so that cases w ih various languages can approach therapists near them. This, if possible, would make therapy in the cases language more feasible. The present situation is far from this. There are very few speech and hearing therapists in the country today and still fewer speech and hearing centers. There are whole states which have .no speech and hearing therapy facilities and even in those states where these facilities are available they are very scarce and can be called only nominal. Even many teaching hospitals and some with post-graduate teaching in E. N. T. do not yet have the services for Speech Pathology and Audiology.

It is at present difficult to imagine that one day all cases needing these services will have these facilities available. Letus try this task for size. There have been many surveys conducted to guage the prevalance of speech and hearing problems. Among the most conservative estimates i*s* six per cent. If we accept that six per cent of our population have speech and hearing problems needing professional attention, that gives us an astronomical figure *o*f 33 million out of a population of 550 million. How many therapists will be need to help these 33 " o n people? A speech and hearing therapist can at best work with ten cases per day and even if he on alternate days he can work with twenty cases at a time. Even if we assume that on sees his cases the average the cases need o month for effective therapy a therapist can help 240 cases in a year. Even if we boost this figure to 300 cases 13 ten years a therapist can help only 3000 people with the. kinds of therapy given now. Even if we suggest that only half of our cases need therapy this would mean that 5000 therapists will be needed to work for ten years to treat them. This also assumes that there will be no addition to these cases in ten years. At present it does not seem possible that we will be able to produce that many therapists nor that we can appoint them in the next ten years. The present output of therapists in the country is 17 (Mysore)+15 (Bombay)+3 (Ahmedabad). 35 per year. Employment absorption of these is at present not even that fast.

Nor can we honestly expect cases to travel back to places where therapy in their own languages is provided. India is a land of distances and these distances become greater here because of the inability of people to afford to traverse them.

This just means that for a long time to come each therapist will have to accept the responsibility for a large population speaking a variet of languages. Each therapist has to face the fact that he has to give therapy to cases with whom he does not share a language. This is something that all of us must accept as a reality.

If we reject the alternative of ignoring those cases who do not share a language with the therapist available to them we have but one alternative left. We have to do therapy in languages that we do not know and it is for us to develop techniques of therapy for such an endeavour. We must in our training programmes equip our students to handle therapy in languages not known to them.

Now we have the crucial question: Can this be done? One of our students surprised his interviewers by suggesting that therapy can be given without a common language between the therapist and the case. Surprise us it might; but his assertion is correct. And therapy has to be given willy nilly.

When we consider the functions of a speech and hearing therapist from this point of view we soon recognise that audiometry, hearing aid selection and fitting, ear mould making and diagnosis of voice problems, and functions not dealing with cases, are functions that do not apparently make essential a common language. However the functions of diagnosis of other speech and language problems, counselling and therapy apparently demand direct involvement of language and would apparently make it very difficult to progress without it. It is for these functions that we have to find alternate means.

Diagnosis can be viewed in two mutually dependent parts—the etiologic and the descriptive. The etiologic diagnosis is made with the help of medical personnel, the case history and direct examination and by an observation of the detailed descriptive diagnosis. The case history can be easily taken by using an interpreter who may be the parent or hospital assistant and by using limited language which can be memorized or written down in the therapist's language. If there is a language shared between the therapist and the case moderately efficiently this can be used at this stage even if therapy has to be given in a different language, the mother tongue of the case.

The descriptive diagnosis which is most useful in defining initial behaviour and hence in planning the course of therapy poses a different kind of a problem. The therapist in this case can utilise his knowledge of linguistics and he can compare the speech of the case with that of the case's parents or escorts. This is in fact more valid than absolute evaluations resorted to hy some therapists and more valid than even a comparison of the case's speech with that of the therapist when he speaks the same language. Considering the existence of dialects and inter-group variations the parents, siblings or escorts of the case are the most valid norms for descriptive diagnosis. Responses from the case can be elicited through modelling and through miming. That we can achieve all this with cases with severe hearing loss, proves this can be done. The therapist can use his trained ear and knowledge of linguistics to mark the deviations and then to discern the patterns in the deviations exhibited by the case.

Counselling involves giving the cases and parents an explanation of what is deviant in the case, an indication of the available approaches to rehabilitation and their comparative merits, mapping out the plan of action in terms of therapy and motivating the parents to follow our advice regarding the rehabilitation. The same modes of communication as are used in diagnosis can be used to counsel the cases. In addition to this, prepared counselling sheets or instructions can be handed over to the parents detailing the possible approaches to rehabilitation and their own responsibilities in following them.

Therapy poses a greater challenge and techniques of therapy need to be developed. Our greatest resources in terms of therapy lie in the parents, in the home of the case. It is becoming more and more evident to us that the best therapy, particularly in India, is that which we do not have to give. The situation in India already briefly described makes it incumbent on us to provide techniques which eliminate or reduce the dependence of the cases on direct intervention by the therapist. If the therapist can pass on the responsibility of actual therapeutic activity to the parents and takes up the responsibility mainly for special assistance and continued guidance then he will be able to handle more cases at a time than estimated earlier. This will also help the cases who cannot attend therapy away from home for long periods. Speech therapy is a slow process and takes time and this often keeps a case from seeking expert assistance. When this assistance is kept minimal and is finished in a short time it will be more economical in terms of time, effort and money both for the case and the therapist. In addition to all this, therapy at home from parents under the guidance of the therapist will reduce the need for the therapist to know the language in which therapy is given. The therapist can diagnose the case, plan out a strategy for therapy and pass this information on to the parents. He may even demonstrate therapy to them so that they can follow up with the therapy at home.

In many cases the therapist may have to provide the initial therapy and demonstrate the techniques of therapy. The initial modifications can be made by the therapist and the later systematic programme can be laid out in simple terms for the laymen to follow. In voice cases the therapist may obtain the optimum voice and leave continued therapy and stabilization to the cases or their family and friends. The parents can then contact the therapist continually for guidance and assistance with specific difficulties.

The therapist can acquire a limited language by asking others and use it in this initial therapy stage. He can, during or before therapy, obtain samples of the desired speech patterns or words, and in therapy, use them. He can use previously prepared flash cards. Even as therapy proceeds he can acquire a basic vocabulary which will help him gain more and more command over the language gradually.

The therapist can use interpreters to communicate with the case, and if necessary with the family of the cases. He can indicate to the parents what is desired and they can elicit the responses under his guidance.

He can provide therapy through mime.

He can elicit responses and indicate modifications through analogues. He can use pictures and illustrations.

He may demonstrate the desired changes and have the case follow him.

Reinforcements can be given tangibly or with easily understandable gestures and words.

Some kinds of instructions can be taped in advance and played to the cases and their parents.

There is nothing new in these techniques. These are being used with the deaf who have no language. Tapes have been extensively used with the laryngectomees. New languages are taught through recordings. What is now needed is enough imagination to use these or modifications of these to meet this challenge of therapy to cases with whom we do not share a language.

This can be done; but we must be aware that it can be, and we must be prepared for this challenge.

In actual practice what may happen is that within a short time through exposure to the local languages and through faltering attempts in the therapy situation most therapists will quickly learn enough of the languages they deal with and the need for such techniques may diminish. The challenge of languages would grow weak.

The training programme at the All India Institute of Speech and Hearing provides some attempts at meeting this challenge of languages. We have so arranged our syllabus that all our students will know English, Hindi, Kannada and at least one other Indian language. We are encouraging the students to be exposed to as many languages as possible. We expect this array of languages should stand our students in good stead in most parts of the country.

We are also exposing our students to practical therapy with cases with whom they do not share a language. They are trying out the techniques.

In addition to this we are giving our students a fairly strong background in linguistics so that they can use this in linguistic analyses of other languages and of the deviations in the cases. This linguistic knowledge and their experience should also help our students in charting out the programme of therapy for each case.

We are also trying out a variety of therapy techniques. Our hopes are to evolve simple techniques which can easily be followed by laymen at home. The use of sophisticated equipment in complicated techniques may provide great face validity; but their real utility at best can be only in the initial stages of therapy. What we need are efficient but easily followed techniques. We are also trying out new techniques of therapy to be used with cases who do not share a language with the therapist. These have to be developed in the near future.

We are now convinced that it is necessary and possible and that new techniques have to be and can be developed to suit the special needs of the country. This needs the concerted effort of all people concerned.

SYNCHRONY OF VISUAL PERCEPTION INDUCED BY VOICE VIBRATION

MARLIN SPIKE WERNER

Abstract: Under special conditions, the voice can be used to drive the visual preceptual system in synchrony with the voice's fundamental frequency. The phenomenon has been demonstrated on a number of moving objects and has been calibrated at frequencies ranging from 60 to 324 Hz. Implications for fatigue in machine operators, altered mental states, and a commercial application are discussed.

The yogis of India intone syllables which evoke distinct sensations, feelings, and images. These syllables are called 'mantras' and are used in their ritual chants[1]. The yogis ascribe unique properties to these mantras such as endowing the chanter with 'cosmic consciousness', awakening of the 'subtle body', and the acquisition of conscious control over autonomic processes[2]. Although much of yogic practice is empirical, the literature often appears to be obscure, or at best metaphorical to the Western mind, especially when it begins describing subjective phenomenology[3]. The present study arose out of an attempt to obtain direct experience of this subjective phenomenology, and describes an optical cadencing or gating effect which was experienced while phonating 'aum', 'zhzhzhzh', or 'mmmmmmmm'.

According to various yogic texts it is important to meditate on the mantra so as to heighten one's perception of the body vibrations which accompany it[4]. The procedure followed intitially in this study was that prescribed by Ma Yogashakti Saraswati, called *Ahamasmi-Yoga*[5]. By experimentation, a shortcut procedure or opening exercise was found for achieving the same effect and the associated visual phenomenon. This will be described in the procedures section of this paper.

The neurophysiological literature on epilepsy contains references to induction of seizures by sound6 and by flickered light[7]. These references give nothing on cadencing of the visual system. The literature on visual inhibition during voluntary eye movements (saccades) contains more information. Volkmann, *et al.* suggest that this inhibition is probably mediated in the thalamus, specifically in the lateral geniculate bodies[8]. Ditchburn triggered a slightly supraliminal strobe light with subtle eye movements of which the subject is usually unaware (microsaccades), and the subjects were unable to perceive the

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light because of the associated elevation of visual thresholds[8]. Thus, the saccadic inhibitor, or visual damping mechanism, tends to shut down all visual perceptions at once. It appears that it is this mechanism for synchronous shut-down which is made reactive to vocal cadencing by the opening exercise. The phenomenon does not seem to be related to translational or rotational displacements of the eyeball because direction of translation or rotation of the target does not alter the perceptual phenomenon. It is also unlikely that it is being mediated by positional or vibratory (proprioceptive) cues fed back to the brain from the eye muscles[10], or from the retinas (cf. procedures), but it may be due to direct action upon the central nervous system in the manner suggested by Volkmann for saccadic inhibition.

Equipment: A Trav-ler Radio Corporation Model TS-382D/U Audio Oscillator provided the acoustic calibration. A General Electric RP 2345 stereo phonograph was fitted with an Allied Radio Shack 4-speed Phono Strobe Disc for the visual frequency calibration. The strobe disc thus provided a photo-mechanical calibration for the optical gating effect. Matching the vocal pitch which froze the markings on a particular band of the strobe disc with the output of the TS-382D/U, the.voice's fundamental frequency could be calibrated. The RP 2345 was operated at 16-2/3, 33-1/3, 45, and 78 rpm. The frequencies with which the markings of the four bands of the strobe disc passed any given point were fixed functions of the above rotational velocities and thus yielded some irregular appearing numbers. These, and the readings from the TS-382D/U were rounded off to the nearest whole number. The accuracy of the TS-382D/U was ±1 per cent at 440 Hz. Illumination of the disc was by battery operated flashlight in a darkened room—*not* by 60 Hz powered incandescent or by fluorescent illumination.

A Uher 4000 Report L tape recorder was fitted with a b. c. transducer from a Zenith 538 audiometer. This was used as a substitute for the voice. The same vocal pitches which produced the strobing effect by live voice were recorded and were played back while the b. c. unit was held to the labial aspects of the upper first incisors.

Procedure: The subject relaxes, breathing easily. He takes a deep breath, and in mid-exhalation, begins forcibly phonating 'zhzhzhzh'. The purpose of articulating 'zhzhzhzh' appears to be the elevation of the expiratory pressure which results from that tongue position while at the same time permitting phonation without damage to the vocal folds. While thus phonating, the subject should allow his face to become flushed as if the intrathoracic pressure were acting upon the -vascular bed of the head and neck. As the tissues become responsive, the gating effect begins to take place. With a little practice, almost anyone can experience the phenomenon. There is no change in the continuity of visual awareness except for the suddenly acquired subjective ability to 'freeze' regularly repeating patterns almost as if they were being illuminated by a rapidly flashing

stroboscopic light such as **that** used for timing an automotive engine or for balancing a tire or wheel. It seems to be desirable to execute the opening exercise several times, sweeping the phonatory pitch range, if the subject is to maximize the range of frequencies over which the stroboscopic effect can be experienced.

Illuminating the. strobe disc with a dc light source, the subject phonates 'zhzhzhzh' sweeping his phonatory pitch range until he has frozen each of the calibration bands of the strobe disc at each of its rotational velocities.

The phonatory frequency was determined by matching pitch with the TS-382D/U, and matching visually on a Jetronic Industries 0S-8C/U scope.

A second procedure involved recording the pitches of 'zhzhzhzh' which were identified in the first procedure on the 4000 Report L and playing them back through the subject's head by means of a b. c. transducer applied to the labial aspects of the upper first incisors. The strobe disc was viewed in the same manner as in the first procedure, and with identical results.

Results: The results are displayed in Table 1. The frequency range of the visual gating extended from a vocal fundamental frequency of 60 Hz to 324 Hz. At one visual frequency (46 Hz) the effective vocal frequency was an octave higher. At another (240 Hz) two vocal pitches—one synchronous, and one an octave lower—succeeded in inducing the strobe phenomenon.

TABLE 1. Comparison of vocal pitch and visual stimuli

Frequency of Visual Stimulus	Frequency of Voice*
26	—
46	92+
51	—
60	60
69	70
92	90
120	120
124	124
161	160
215	215
240	240 also 120+
280	280
324	324
562	-

•Pitch-matched to Trav-Ier audio oscillator TS 382D/U.
+Harmonically related to the visual stimulus.

The foregoing results were duplicated by employing the same vocal signals, but recorded on the 4000 Report L. Other locations on the head were tried, and some at the eyeball, **but** none succeeded as well as the teeth for a point of contact.

Discussion: Although the equipment used lacks the nicety which might have been realized with a continuously variable visual stimulus and a dual trace oscilloscope, the measurements confirm the existence of this phenomenon. The phenomenon has been demonstrated on seven out of ten subjects tried. Six of these were adult males and one was a thirteen year-old female. The data given here were taken from the subject who exhibited the greatest vocal frequency range. When exhibited, the phenomenon appeared within five minutes of the beginning of the opening exercise. The thirteen year-old subject required only 30 seconds.

Head vibration, whether vocally induced or imposed by an external source, appears to gate the visual system in such a way that it will behave stroboscopically, at least for the frequencies 60-324 Hz.

This phenomenon can be observed easily outside the laboratory. Several examples are provocative: spinning wheels with spokes, hubcaps embossed with spoke-like ridges, hub-nut configurations of truck wheels, and airplane propellors can be strobed at their normal rotational velocities. The lift rotors of helicopters appear to rotate too slowly for a clear-cut effect.

As yet uninvestigated observation involves television screens. Viewed from a distance of about 100 feet, vocal tones of about 60 Hz induce an illusion of a regularly pulsating dip of the picture along its vertical axis.

If the effect described here is indeed taking place by direct action of audio-frequency vibration upon the central nervous system, then it appears likely that other sensory modes may be affected also. This may be the physiological basis of one of the procedures by which yogis tune into some of their altered mental states. A possible benefit might be the use of audio-vibration for direct intervention in times of .emotional stress, providing a means of instantaneous mood stabilization. A commercial application might be a device for timing reciprocating engines. Closer examination of many industrial accidents may identify vibratory cadencing of the central nervous system rather than muscular fatigue as a special causal factor.

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CONTROL OF STUTTERING BEHAVIOUR THROUGH RESPONSE CONTINGENT SHOCKS

J. BHARATH RAJ

Introduction

Several recent studies have brought stuttering under operant control and shown how it can be manipulated by the consequences it generates. Goldiamond (1965) and his colleagues have demonstrated through their extensive studies, that a very high degree of such control over speech, can be achieved. Using either a high intensity white noise of a 105 dB blast (Flanagan *el al.* 1958) or DAF (Goldiamond 1962) as the punishing stimuli, contingent upon stuttering it has been shown that stuttering decreases dramatically. The present study has been undertaken to validate these findings with stutterers in our cultural set up and to see the possibility of delineating those variables, which might be intimately related to stuttering, affecting improvement, positively or negatively.

The Problem: The aim was to study the effects of response contingent shocks on stuttering behaviour. For the purposes of present study stuttering has been considered to be characterised by both the primary observable behaviour features, like repetitions and or prolongations of sounds and syllables, and the secondary observable behavioural features like protrusion of the tongue, puccaring of lips, raising of eye brows, tight eye closure, etc.

The Method: The subjects were all males between the ages of 20-25, with a minimum of S.S.L.C. education, who registered at the All India Institute of Speech and Hearing for their stuttering problem.

A pretherapy evaluation done independently by a clinical staff, the student therapist and the self evaluation by the subject, on a special proforma served to give a composite quantitative estimate of stuttering rate for each subject.

On the same lines a composite quantitative estimate of post therapy stuttering rate was obtained for each subject.

In all, three base rate sessions were obtained for each subject. Base rate I refererd to the frequency of stuttered responses while reading'spontaneous speech. Base rate 2, referred to, the frequency of stuttered responses while

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reading/spontaneous speech with electrodes attached but no shock. Base rate 3 referred to the frequency of stuttered responses while reading after therapy. Each session with a subject lasted for 20 minutes.

For purposes of treatment a clearly delineated stuttering response/s was chosen and base rates being obtained on this, this chosen response/s was subjected to response contingent shock. Electric shock was preferred to the other types of aversive stimuli, because of its established aversive characteristic and that it could be varied in intensity levels over a range.

As the reading rate is intimately related to the stuttering rate of the subject, ideally speaking it would have been better to record the reading rate. But this was difficult to be achieved as it would have distracted the subject too often during the sessions. However efforts were made by instructing the subjects to maintain their reading rates constant all through the sessions.

A specially designed Electro-shock apparatus was used to deliver shocks immediately after a stuttered response was observed. It consisted of an volt-meter with a provision for step-wise increment in voltages from 0 to 120 volts, an ammeter to indicate the flow of current between the electrodes, an electro-magnetic counter to record the number of shocks delivered, and two steel elect-rodes with strapes which could be easily tied to the forearm of the subject.

Chosen passages, in English or Kannada were used as stimulus material which the subjects read. In some cases where this was not feasible the subject, was asked to speak spontaneously on a previously assigned topic.

The subject and therapist sat facing each other on either side of a table on which rested the Electro-shock instrument. With the electrodes being tied on the dorsal surface of the left forearm of the subject after application of electrode paste, each subject received contingent negative stimulation i.e., shock at every occurrence of the chosen response.

The levels at which the shock was 'just detectable', 'painful' and 'most pain-ful' were determined for each subject, but during therapy sessions, all were put at the 'painful' level of shock, as all of them showed withdrawal movement of the hand, at this level, evidencing the avoidance criterion.

Results and Discussion

The obtained results have been treated individually, as the group-wise treatment of results would dissolve the individual tendencies of each case.

Graphs have been drawn for each subject representing the cumulated frequency of responses against time in successive minutes. Curves for Stutter-ing rates, during progress of therapy have been drawn for 5th, 10th, 15th etc., sessions (at intervals of 5 sessions) to make room for appearance of perceivable changes. A comparison of differences between base rate curves for each case might be taken to represent the effect of shock on stuttering rate.

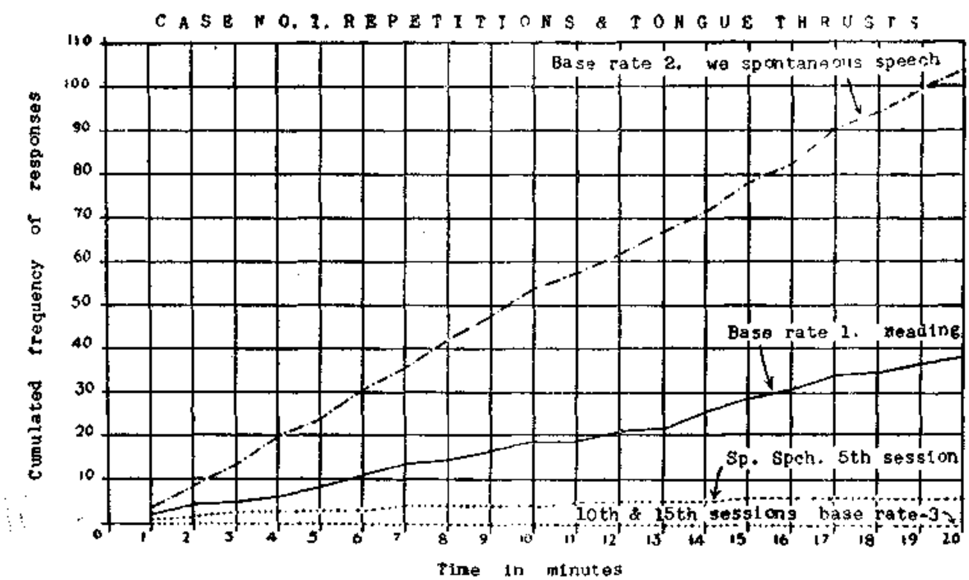
Case 1

Case 1 is 20 years of age, a student in II B.Com. Onset of stuttering at the age of 2. Father is a stutterer. He was diagnosed as a case of severe stuttering. EPI scores were N=19, E=6, L= 6. High trends of neuroticism and definite leanings towards introversion. Obtained an IQ of 113 on the short form of Bhatia's battery.

Repetition of sounds and syllables and tongue thrusts were most prominent responses, and were selected for contingent shock stimulation.

Reported shock as 'just detectable' at 10 volts, 'painful' at 20 volts and 'most painful' at 40 volts. Shocks were administered at 20 volts all through.

Graph 1 indicates results.



The curve for base rate 2 portrays increased stuttering rate as this was obtained on spontaneous speech. This is attributed by the patient to an on the spot translation of a story from Hindi to English which he felt difficult.

A perceivable decrease in responses occurred in 5th session and no responses were observed on 10th session, 15th session.

The base rate 3 on 20th session was 0 all through. This is a case where a total elimination of stuttering was achieved in the laboratory.

Pretherapy composite quantitative estimate was 56 and post therapy estimate was 23.

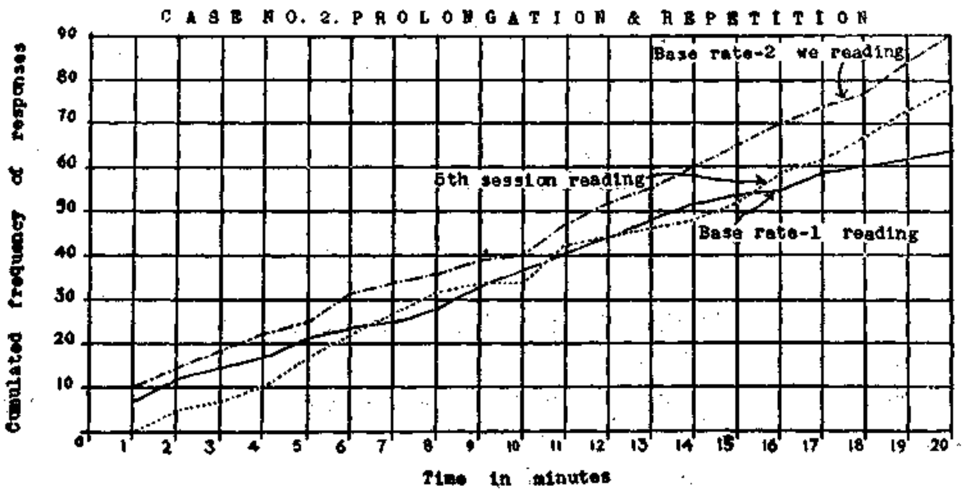
Case 2

Aged 20 years, studying in B.Sc. Final. Onset of stuttering at 6 years. Grandfather was a stutterer. Diagnosed as a case of severe stuttering. Obtained an IQ of 115 on short form of Ehatia's Battery. EPI results showed significant neurotic trends and definite leanings towards introversion. (N=15, E=6 and L=4).

Repetitions and prolongations were the most frequent observed responses and were chosen for contingent shock stimulation.

He just detected shock at 10 volts, felt painful at 20 volts and most painful at 40 volts. Therapeutic sessions were conducted at 20 volts.

Graph 2 indicates findings.



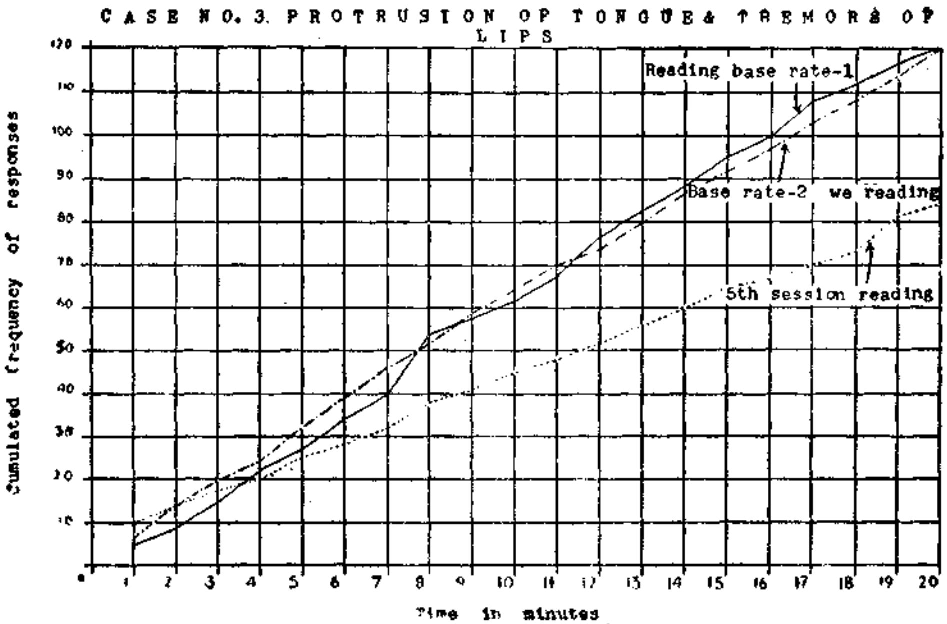
Results of 5th session do not show a consistent pattern. The case left off treatment in the middle without assigning any reason.

Case 3

Aged 21 years, studied upto P.U.C. Onset'of stuttering at 11 years. Duration of stuttering is over 10 years. Maternal uncle and maternal aunt were stutterers. Obtained an IQ of 122 on Bhatia's short form. EPI record suggests high degree of neuroticism with no definite leanings towards extroversion or introversion (N=19, E=13 and L=5).

He was diagnosed as a case of moderate stuttering, with predominant secondary characteristics like protrusion of tongue and tremors of the lips which were chosen for contingent shock stimulation.

Results are given in graph 3,



Base rate 1 and 2 show almost no differences. Stuttering rate in 5th session shows a definite decrease.

Pre-therapy composite quantitative estimate was 44 and present estimate is 32.

He is still continuing treatment.

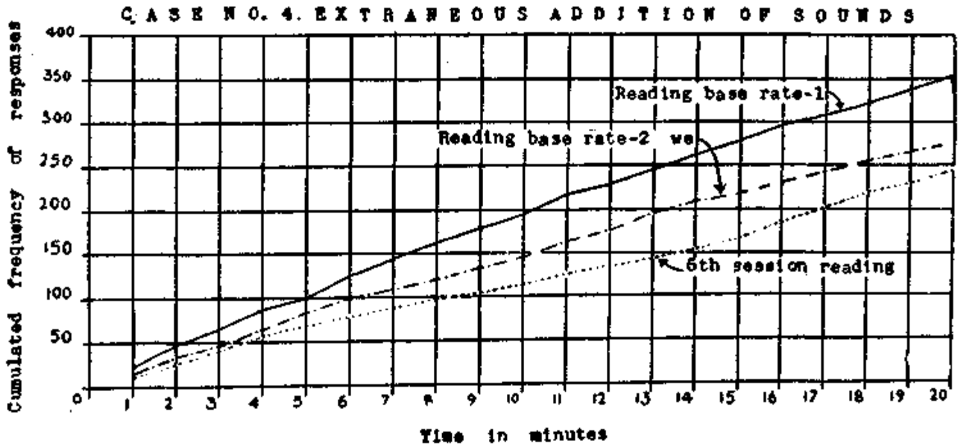
Case 4

Aged 21 years, studying in B.E. Onset of stuttering since 8 years of age. Duration of stuttering is about 13 years.

Father is a stutterer. EPI results are not significant on both the dimensions of neuroticism and extraversion. He was diagnosed as a moderate stutterer.

An observation of speech showed extraneous addition of sounds, eye closure, and repetitions. But as extraneous addition of sounds was most frequent, this was selected for contingent shock stimulation.

Results are given in graph 4.

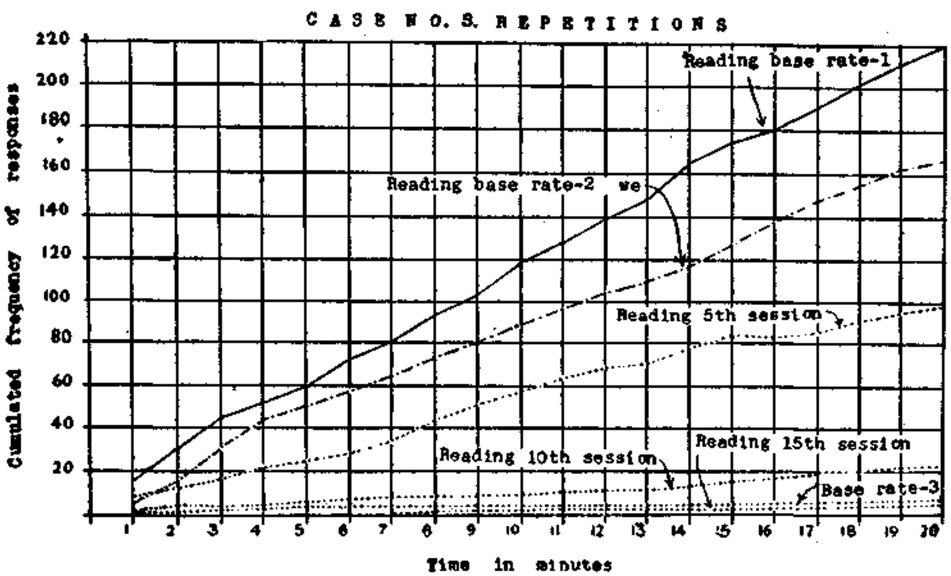


Stuttering rate decreased in 5th session as compared to Base rates.

The case was discharged at his request as he could not attend therapy in order to attend college elsewhere.

Case 5

Aged 22 years, studying B.Com. Onset of stuttering at the age of 3 years and has continued over a period of 19 years. Severity of stuttering has increased over this period. He was diagnosed as a case of moderate stuttering with secondary symptoms. EPI scores were N=10, E=10 and L=4. No signi-



ficant trends of neuroticism with no definite leanings towards extraversion or introversion. It was a reliable record. There was no family history of stuttering. Obtained an IQ of 93 on the short form of Bhatia.

The most predominant feature of stuttering was Repetitions of initial sounds and therefore this was chosen for contingent shock stimulation.

Graph 5 indicates the results.

Results portray a consistent decrease in stuttering over the sessions almost amounting to elimination of stuttering.

Pre-therapy estimate was 51 and post-therapy estimate was 27.

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A COMPARATIVE STUDY OF VOCAL PARAMETERS OF TRAINED AND UNTRAINED SINGERS

SHEELA KUMAR

Voice is the product of the most finely coordinated delicately balanced and harmonious movements of which the body is capable. Although it may be conceded that voice production is of secondary importance both developmentally and functionally, compared with the protective role of the larynx, it is nevertheless true that it has acquired unique possession in man as a main motor organ of communication through speech (Greene 1964).

Singing is a highly specialized form of using the vocal organs. We know less of the singing voice than of the speaking voice (D. Boone 1971).

The purpose of this study was to determine the various vocal parameters such as optimum frequency, fundamental frequency of the speaking and singing voice, pitch range, phonation time and vital capacity in trained singers and compare them with those of untrained singers. It was also planned to check whether parameters such as vital capacity and phonation time were inter related.

A review of literature reveals scanty data about the pitch used by singers while speaking and singing.

Studies by Greene (1972) Luchsinger (1965) and Fairbanks (1949) about the pitch range in singers reveal that trained singers tend to have a greater pitch range than untrained singers. There are no controversies about this.

It has long been assumed that the superior vocal ability of trained professional singers arose from a higher than average breathing capacity and consequently above normal vital capacity. Wissilow in his study found greater vital capacity in trained singers. Nadoleczny and Luchsinger (1934) also reported larger vital capacity values in trained singers. Heller Hicks and Roots (1965) found no significant difference in vital capacity between trained professional singers and untrained singers.

The determination of phonation time is an important phoniatric test which provides information on the functional state of the entire respiratory system (Luchsinger 1965).

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The recent findings by Ishiki, Yanigihara and Koike (1965) conclude that maximum sustained phonation is achieved by total air capacity for vocal production, expiratory power and glottal resistance.

Westlake states that increased ability to sustain phonation is one way of increasing speaking and singing efficiency.

Proctor describes the trained singer's mastery of expiration when he wrote 'Most singers are capable of sustaining single tones for more than 30 seconds'. Ptacek and Sanders (1963) report longer phonation time in trained singers than in untrained singers.

However no study has so far been done in India about the Vocal parameters in singers.

Definitions used in the present study

Trained singers: Trained singers are those who have undergone formal training in Vocal Music for more than five years.

Untrained singers: Untrained singers are those who can sing but who have not undergone any formal training in Vocal music.

Optimum frequency: Optimum frequency is the fundamental frequency of the vocal cords which elicits the maximum response of the Vocal tract.

O. *F.=Natural frequency of the vocal tract J* Relationship

Fundamental frequency of the Vowel/a/in the speaking pitch (Habitual speaking frequency)

It is the fundamental frequency measured with the help of the Tacho unit of the stroboscope in combination with the SPL meter when the subject is asked to phonate/a/in his speaking pitch.

Fundamental frequency of the Vowel/a/in the singing pitch (Habitual singing freqnency)

It is the fundamental frequency measured with the help of the Tacho unit of the stroboscope in combination with the SPL meter when the subject is asked to phonate the vowel/a/in his singing pitch.

Pitch Range: It is the measure of the musical interval (in terms of octaves) between the highest possible and the lowest possible pitch the subject phonates.

Phonation Time: Sustained phonation time means the time a subject holds a note comfortably at a given pitch after taking a deep breath.

Vital capacity: It is the total volume of air which the individual expels from his lungs after they have been filled to the greatest extent possible. To measure this quantity the subject inhales as deeply as possible then expels as much air as possible into the expirograph. The volume measured on the scale is known as vital capacity.

Methodology

Thirty trained singers (trained for Karnatic Music) and thirty untrained singers constituted the two groups studied. There were 24 females and 6 males in both the groups. The age range was 19 to 57 years. The two groups were matched for age, sex, height and weight. The subjects selected were free from speech and hearing problems.

Procedure: The first step was to determine the optimum frequency of both the trained and untrained singers.

To determine the optimum frequency of the vocal tract the following principle was used. Constant acoustic output over a range of 100 c's to 5000 c/s was fed into the vocal tract. The reflected sound was measured. The maximum peak of this measurement was the natural frequency of the vocal tract which when divided by five in females and eight in males resulted in optimum frequency. Hence the two problems in this experiment were:

(i) Obtaining a constant acoustical input over the considered range of frequencies.

(ii) Simultaneous recording of the reflected output at the Voeal tract.

(i) Obtaining a constant acoustical input over the considered range of frequencies:

A hearing aid receiver was used as a probe speaker fed from a Beat frequency oscillator to get a constant output at the speaker. A portion of the output was fed to another hearing aid receiver. This was mechanically coupled to the condenser microphone. This receiver microphone coupling was kept in an anechoic enclosure (hearing aid test box) to prevent ambient noise. The condenser microphone was connected to a measuring amplifier through a pre amplifier. The output of the measuring amplifier was fed to the compressor circuit of the beat frequency oscillator. This arrangement gave an acoustical output which was treated as the baseline of the experiment.

(ii) Simultaneous recording of the reflected output in the Vocal tract:

The reflected sound from the vocal tract was picked up by the condenser microphone, which feeds a sound level measuring instrument. The output of this instrument was fed to the level recorder. The motor of the recorder which drives a calibrated paper was used for synchronous scanning of the desired frequency range of the Beat frequency oscillator. The graphical representation was in terms of frequency versus intensity changes over the frequencies scanned.

The subject was asked to adjust his mouth around the probe speaker and condenser microphone in the vowel/a/position without any change and be relaxed. In this position the scanning was started from 100 to 5000 Hz. Comparing the response with the base line. The maximum response was taken as the natural frequency of the vocal tract which was divided by the relationship factor and the optimum frequency was determined (set up used and validated by N. P. Nataraj 1972 and George Samuel 1973).

After determining the optimum frequency the next step was to determine the fundamental frequency. The fundamental frequency of the speaking voice was determined by asking the subject to phonate/a/in his speaking pitch and the reading was directly obtained from the Tacho unit of the stroboscope. Similarly the fundamental frequency of the singing voice was also determined.

Then the pitch range of the subjects was determined by instructing the subject to phonate the lowest possible and the highest possible pitch, and the reading was obtained from the Tacho unit of the stroboscope.

After sufficient rest, the subject was asked to sustain phonation as long as possible in one breath. The time the subject maintained phonation was noted down using the stop watch.

The vital capacity of the subject was determined by using the expirograph. The subject was instructed to take a deep breath and expel as much air as possible in to the expirograph.

The graph of the expirograph represented the vital capacity.

All the above experiments were carried out with trained and untrained singers.

Results and Discussions: In order to study the comparison between the two matched groups the following hypotheses were advanced and the results were tested by using the Wilcoxon Matched Pair Sign Rank Test and the Spearman's Rank Correlation Test.

1. "Significant differences exist between the optimum frequency and the fundamental frequency of the speaking pitch". The hypothesis was rejected at 0.01 level of significance and in untrained singers it was accepted at 0.01 level.

This indicates that trained speakers studied, tend to use their optimum frequency while speaking unlike the untrained singers.

2 "Optimum frequency is neither used by trained singers nor untrained singers while singing."

This hypothesis was accepted at 0.01 level of significance both in trained and untrained singers. Both trained and untrained singers did not use their optimum frequency while singing.

TABLE 1. *Showing the data of optimum frequency, fundamental frequency of speaking and fundamental frequency of singing—in trained singers*

Optimum Frequency (c/s)	F. F. (speaking) (c/s)	F. F. (singing) (c/s)
Females		
225	220	230
245	250	240
200	195	160
180	140	310
150	180	160
255	175	200
190	210	260
290	230	260
235	210	260
245	200	230
260	220	320
240	270	520
245	215	210
260	320	310
225	210	200
220	310	400
255	240	250
240	300	180
250	200	200
235	230	200
205	210	200
250	250	230
255	200	260
255	210	240
Males		
145	155	110
120	120	110
145	135	130
160	100	120
140	125	125
155	105	112

Trained singers used optimum frequency while speaking and not while singing whereas untrained singers did not use their optimum frequency for both speaking and singing.

Usually trained singers use a pitch pipe or some other instrument for their pitch reference when they sing.

TABLE II *Indicating the Data of O.F. F.F. (speaking) F.F. (singing) in Untrained singers*

Females		
245	200	250
230	240	240
250	230	220
245	220	350
335	240	240
260	240	235
240	270	310
255	230	300
265	220	280
235	200	240
265	220	220
260	240	260
225	210	210
240	250	290
275	250	260
235	230	320
265	220	250
260	200	240
288	210	240
320	220	220
260	200	230
250	240	290
225	200	190
255	260	280
Males		
180	140	145
125	160	200
130	120	160
'130	110	160
120	110	130
120	120	130

The pitch pipe or the reference instrument may be tuned a little higher or lower when compared to optimum frequency of the subject. Hence the possibility of not using the O.F. while singing may be explained. While speaking no such reference is used and hence they tend to use their O.F. for speaking.

3. "Trained singers possess significantly greater pitch range than untrained singers."

This hypothesis was accepted at 0.005 levels of significance.

Pitch range was greater in trained singers than in untrained singers.

TABLE III. *Pitch range of Trained Singers and Untrained singers*

	Trained	Untrained
Females		
	2.00	1.50
	2.00	1.25
	2.00	1.25
	2.25	1.25
	2.75	1.00
	3.50	1.25
	3.25	1.75
	3.25	2.25
	2.25	1.75
	2.00	1.25
	1.75	1.25
	3.50	1.25
	2.00	1.25
	1.25	1.25
	2.00	1.00
	2.50	1.00
	2.50	1.25
	3.00	1.00
	3.00	1.00
	4.00	2.25
	2.00	1.00
	3.25	2.00
	4.25	1.25
	2.25	2.00
Males		
	2.75	1.25
	2.50	1.25
	2.75	2.75
	2.25	1.25
	2.75	1.00
	2.25	1.00

It is largely agreed by various authors (Vennard, Greene, Luchsinger and D. Boone) that trained singers possess greater pitch range than untrained singers. The explanation for this may be that trained singers are trained for expanding or improving the pitch range as a part of vocal education and this in return depends upon the number of years of vocal training and hours of practice.

4. "Trained singers possess significantly longer phonation time than untrained singers."

This hypothesis was rejected at O.005 level of significance.

No significant difference was observed in the phonation time between trained and untrained singers.

TABLE IV. *Data indicating the phonation time (in seconds) in trained and untrained singers:*

	Trained Singers	Untrained Singers
Females		
	15	19
	19	15
	18	14
	18	20
	16	20
	IS	11
	19	25
	20	25
	19	10
	16	15
	17	13
	20	18
	21	20
	20	15
	21	27
	22	16
	20	20
	18	16
	16	16
	18	13
	14	14
	18	16
	24	10
	18	18
Males		
	19	28
	18	23
	21	29
	22	15
	19	12
	18	14

In this study trained singers did not van/ significantly in phonation time from the untrained singers.

The trained singers selected for the present study were trained for Karnatic music where the demands on a singer may be different when compared to Western musicians. In the latter type sustained phonation is highly essential whereas it may not be so essential in Karnatic music.

However this should be tested with more singers.

There is a lot of controversy about the idea that phonation time and vital capacity are inter related.

Luchsinger (1965) Boone (1971) Greene, M. (1972) and others believe that in order to maintain phonation expiratory power is necessary which depends on vital capacity.

As a part of the study, it was also tested whether vital capacity and phonation time were inter-related.

5. It was hypothesized that "vital capacity and phonation time were inter-related."

To test this hypothesis the Spearmans Rank Correlation was used as the statistical method.

Hypothesis was rejected both in trained and untrained singers.

Low correlation was observed between phonation time and vital capacity.

Some of the earlier studies report that vital capacity was more in trained singers and recent studies indicate no significant differences in vital capacity between the two groups.

6. In order to study this it was hypothesized that "significant differences exist in vital capacity between trained and untrained singers."

Hypothesis was rejected at 0.01 level significance.

No significant differences was observed in vital capacity between trained and untrained singers.

The reliability was checked by conducting all the experiments again on five randomly chosen subjects and the scores were obtained. High correlation was observed between the scores obtained during the first experiment and the second.

Conclusions

1. Trained singers in the study used their optimum frequency while speaking and not while singing.

2. Untrained singers did not use their optimum frequency either for speaking or singing.

3. Trained singers were observed to have greater pitch range than untrained singers.

4. No significant difference was observed in phonation time between trained and untrained singers.

TABLE V. ***Data of vital capacity (in c.c.) in trained and untrained singers***

	Trained	Untrained
Females		
	1500	1650
	2550	1800
	2010	1410
	1440	1560
	2100	1650
	1920	1710
	1350	2220
	1260	1560
	2400	2100
	1740	1560
	1650	1508
	1920	1350
	2250	1950
	2400	1530
	1740	1650
	2100	2100
	1860	2700
	1800	2100
	1400	1350
	2310	1650
	1740	2000
	2010	2100
	1650	1350
	1950	19S0
Males		
	3300	3450
	2600	3000
	1800	3300
	2040	2100
	2490	2360
	2100	1900

5. No significant difference was observed in vital capacity between trained and untrained singers.

6. Low correlation was observed between phonation time and vital capacity

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PROBLEMS ENCOUNTERED IN MEASUREMENT *OF* HUMAN TYMPANIC MEMBRANE USING TIME AVERAGED HOLOGRAPHY

M. V. RAGHAVAN, B. M. ABROL, K. K. PUJARA

Abstract

During the study of vibration of human tympanic membrane using time-averaged holography, the problems like stability of the object, coating of membrane, and measurement of intensities of laser light were encountered. This paper reports steps taken to overcome these problems in order to obtain clear and consistent holograms. Further, the factors like intensity of illumination, resolution of holographic plates, exposure time are briefly discussed in relation to the authors' work.

Introduction

In holography the brightness of the scene, film speed and shutter speed are interrelated factors. The movements of the object and the film resolution, however, limit the quality of the holograms btained. Unlike in photography, the spatial frequency components are recorded on a hologram. Several factors such as intensity of illumination, stability of the object, resolution of the holographic plates, intensities of object and reference beam and exposure time, influence the quality of a hologram.

The present authors adopted the technique of time-averaged holography in the measurement of vibration of human tympanic membrane, as this is more accurate than the methods used by Bekesy, (I960) Gilad, (1966), Brask, (1969).

By adopting this technique, the vibratory amplitude at all points on the membrane was assessed. The method is self-calibrating due to the extreme consistency of the wavelength of the laser light. However, in the application of this method, problems such as stability of the object, coating for the good reflectivity of the membrane, measurement of the relative intensity of reference beam and object beam were encountered.

This paper is a report on the methods adopted to overcome the difficulties in obtaining good quality holograms. Further, factors affecting the quality of holograms are reviewed, with reference to the present study.

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1 Experimental Specimens

Temporal bones were removed from the autopsy room of All-India Institute of Medical Sciences, New Delhi. Care was taken to choose only those cases that had expired from diseases unrelated to their ears. After gross trimming, the external canal was radically resected by means of dental drills until the tympanic membrane formed the bottom of a very shallow funnel. The picture of the exposed membrane along with the bony wall for the experiments is shown in Figure 1. These membranes were preserved in isotonic merthiolate solution, (Raghavan, *et al.*, 1974c), so that the observed properties did not depend upon the time interval elapsing between death and measurement in the laboratory.

FIG. 1

3. Problems encountered in carrying out the Study

Since the human tympanic membrane is of very small dimension (8.9 mm 8.1 mm) and thickness (0.06 mm) as explained by Raghavan *et al* (1974 d), it gave rise to some problems during the study. Twenty-five specimens were used at different stages for perfecting the holographic technique. The details are shown in Table 1.

TABLE 1. Number of specimens and the purpose for which utilized

No. of specimens	Used for
10	Fixing up the optical components on holographic table and for stability of object.
8	Fixing up the technique of coating materials.
7	Lost due to ground vibration problems.

3.1 Stability of the object

The location and the geometry of the different optical components used for the experiments is important (Raghavan *et al* 1974b). To minimize the mechanical rocking of any optical component and accidental shifts in their position, all components were mounted on heavy bases. Mechanical vibrations were minimized by placing the holographic set-up on a granite block which was placed on a wooden table. The table in turn was suspended on a combination of rubber and spring isolation mounts. This combined system considerably attenuated the mechanical vibrations reaching the holographic set-up for all frequencies above a few Hertz.

The tympanic membrane has very low stiffness (Raghavan *et al* 1974 d), compared to the metal plates on which the vibration studies by means of holography had been made previously by Powell and Stetson (1965). This low stiffness of the tympanic membrane introduced several problems and were resolved by modifying the experimental technique as detailed below.

(a) Since the tympanic membrane is very sensitive to any acoustic signal, all irrelevant noise had to be eliminated in order to record responses to the signals applied. In the absence of a sound treated room, external noise was minimised by conducting the experiments in a quiet room. In spite of this precaution, consistent holograms for the same acoustic signal were not obtained due to the ground and air vibrations in normal working hours. Thus, the experiments were conducted either late in the night or very early in the morning.

(b) Because of its low stiffness, minute air currents also displace the tympanic membrane. A good high-resolution hologram requires that the average position of the vibrating object be stationary within fractions of a wavelength of light during the time of exposure (Powell and Stetson, 1965). Movements of the tympanic membrane due to air currents were therefore very undesirable. This was minimized by mounting the experimental membrane in a three-walled acoustic chamber whose design details are mentioned elsewhere (Raghavan *et al* 1974a).

(c) Temperature changes may cause the air-volume in the middle-ear to change, displacing the tympanic membrane. To overcome this problem, the experiments were conducted immediately after the specimens had been mounted in the acoustic chamber.

3.2 Coating the tympanic membrane

The tympanic membrane is almost transparent. In order to obtain a hologram, it should be possible to reflect laser light from it. For this purpose, the tympanic membrane had to be coated with a material that had to meet several criteria.

3.2.1 Criteria for Selection of Coating Material

(a) It should not be toxic. Toxic material may cause severe damage to the tympanic membrane, such as drying or chemical alterations of the fibers of the membrane. Each of these changes affect the vibratory characteristics of the membrane.

(b) It should not load the tympanic membrane mechanically, i.e. the total mass of the coating should be small.

(c) It should not stiffen the tympanic membrane. If the coating layer is too thick or too stiff compared to the properties of the tympanic membrane, one would be observing the properties of the coating rather than those of the specimens.

3.2.2 Reflectivity

The material should have good reflectivity. The tympanic membrane is very small. If reflectivity is poor, the total amount of light reflected from it will be very small, requiring long exposure times.

Further, poor reflectivity causes greater absorption of laser light over longer periods of exposure time. This results in the heating up of the membrane.

3.2.3 Coating materials

Tonndorf and Khanna (1968, 1972) conducted their experiments by coating the tympanic membrane with 1 microme thickness of bronze powder. They also ascertained experimentally that this would not load the tympanic membrane nor change its properties. Due to the non-availability of such a finite thickness of bronze powder, a variety of other materials and solvents were tried. The details are mentioned below.

(a) Quick drying paints: Paints were applied to the tympanic membrane with the aid of a fine brush. This gave good reflectivity, but it was found that the paint solvents were generally toxic for the tympanic membrane. Also, it was observed that the amount of paint dispensed with even the smallest brush available was too much, resulting in an uneven coat on the membrane. Thus the holograms obtained were of very poor resolution.

(b) Vacuum coating: It was thought that the uniform coating of aluminium on the tympanic membrane could be obtained by adopting this method. But this was not possible, since the membrane did not withstand the amount of high pressure needed to create the vacuum in the chamber (set-up) prior to coating.

(c) Aluminium powder: Fine aluminium powder was tried because of its excellent reflectivity. The main problem was to find a suitable way of dispensing these materials, so that a thin uniform coat could be obtained. In the beginning, experiments were conducted by suspending the particles in liquid alcohol, but it was found that the particles lumped together during the drying process and non-uniform coats were obtained. Then it was concluded that

liquids of low surface-tension were required to suspend the particles because of their small size. Ether was found most suitable for several reasons. It evaporated quickly leaving behind a very uniform coat adhering directly to the tympanic membrane. There was no binding material that might become stiff nor was it toxic to the tympanic membrane. Coating was done by using a hand sprayer, so that a thin uniform coating could be obtained on the surface.

3.3 Substitute for Exposure Meter

According to Leith and Upatnicks (1967), ratios from 10:1 to 2:1 between the intensities of the reference beam and of the object beam are satisfactory in general holography. These intensities are measured with an instrument known as 'Exposure-Meter.'.

Due to the non-availability of the above instrument, the number of fringes were recorded by trial and error method. However, it was found in the reconstruction, that the exposures were not uniform and most of them were of poor quality. This necessitated designing a set-up as a substitute for the meter. The circuit diagram of the set-up is shown in Fig. 2. The photo-conductive cell (PC) was connected in series with a micro-ammeter (A) and an energister (B). The photo-conductive cell was selected in such a way that its sensitivity matched the beam power of the laser. The light beam falling on the photo-conductive cell was converted into corresponding electrical energy and this was recorded on the micro-ammeter. The readings were used to adjust the relative intensities of object beam and the reference beam, but they were not used in the calculations of vibratory amplitude.

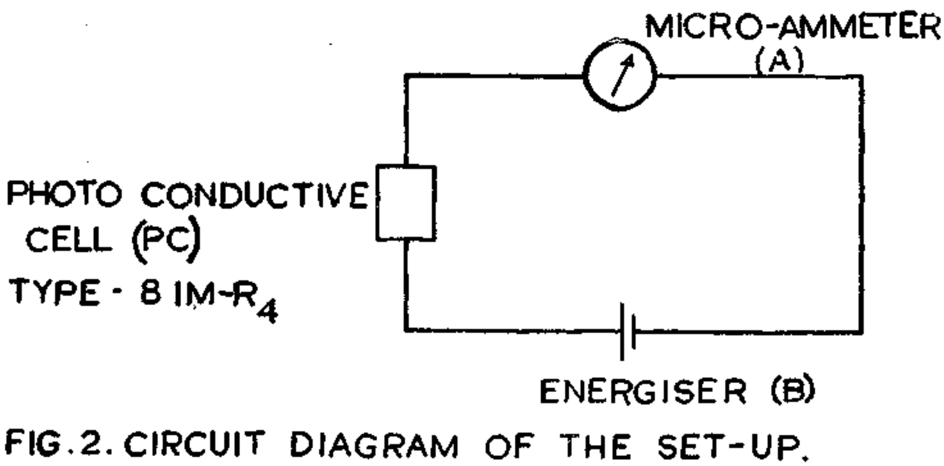

FIG.2. CIRCUIT DIAGRAM OF THE SET-UP.

The object beam intensity was measured with the above set-up. The reference beam intensity was then adjusted with the aid of the continuously variable attenuator. A ratio of 2:1 gave the best time-averaged holograms. This ratio was maintained in all holographic experiments.

4. Factors Affecting the Quality of Time-Averaged Holograms

Several of the factors which influence the quality of a hologram are discussed below:

(a) Intensity of illumination: Raghavan *et al.* (1974) found that higher order power laser decreases the exposure time and relaxes the stability requirements. However, it is to be noted that higher intensities increase the temperature of the object under study. In an earlier experiment (of authors), a laser of power 1.5 milliwatts was used. This was found to be too low a power, requiring exposure periods of 90 seconds. Also, it was found that the intensity was insufficient for clear observation during reconstruction. A 3 milliwatt power laser was employed in all subsequent experiments. The use of this laser reduced exposure periods to 40 seconds.

(b) Stability of the object: According to Brown (1969), for general holography, movements of the object should be less than $\lambda/5$ ($\lambda=$ wavelength of laser light) or approximately 10^{-5} cm during the time of exposure. For time-averaged holography, the tolerance may be even smaller. Details of the steps taken to achieve this order of stability are mentioned in 3.1.

(c) Resolution of the holographic plates: According to Leith and Upatnicks (1967), the plate resolution requirements for holography are set by both the field and the object dimensions. Diffusely scattering objects contain spatial frequencies in the order of 1,000 lines/mm. Since the dimension of tympanic membrane is much smaller than holographic plate, the plates of minimum order resolution have to be used. In the present study, Ilford He-Ne/1 plates of resolution 2,000 lines/mm were used. These gave holograms of good sensitivity.

(d) Exposure time: Optimum exposure time was determined experimentally, by varying the exposure time and judging the quality of the resultant holograms. It was found that an exposure time of 40 seconds was ideal. This period of time was maintained in subsequent experiments.

5. Conclusions

The quality of hologram is dependent upon a number of factors, such as, intensity of illumination, resolution of holographic plates, exposure time, stability of the object. These factors are independent of each other. Each factor needs to be given appropriate attention for obtaining holograms of good quality. Considerations which led to the selection of laser power output, holographic plate and the exposure time have been explained. Further, problems such as the stability of the object and the coating of the membrane were resolved. This resulted in substantial improvement in holographic reconstructions.

Acknowledgements

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NEUROTICISM AND EXTRAVERSION AMONG AURALLY HANDICAPPED ADULTS

K. P. SRINIVASAN

Summary

There are many studies in the literature on the personality characteristics of the hearing impaired. This study compares the adventitiously aurally rehabilitated with the normal hearing on two dimensions of personality, viz., Neuroticism and Extraversion. The Eysenck Personality Inventory was administered to 100 subjects of normal hearing and 78 subjects of adventitious aural rehabilitation.

The aurally rehabilitated group differs significantly from the normal hearing, in the positive direction of lesser neuroticism. It does not differ significantly on the extraversion dimension, both the groups being nearly equal.

This study does not indicate negative dimensions **in the** personality of **those** who underwent **aural rehabilitation, adventitiously.**

Introduction

There have been innumerable studies on the personality characteristics of individuals with hearing loss. Stephens (1973) described the interactions of hearing loss and related clinical conditions with personality by dividing them into four main headings. The personality changes found in adventitious hearing losses were studied by researchers in terms of specific disease entities (Hinchcliffe, 1965, 1970; Gildston and Gildston 1972). Hearing loss occurring among adults, after their acquisition of language functions may be due to different pathology. But they can be covered under the general rubric of the term 'adventitious hearing loss'.

The adult who has developed communication skills in life, if faced with hearing loss, is likely to suffer psychologically. Oyer (1966) has described in detail the factors which influence the adjustment pattern of individuals with hearing loss. A person with hearing loss, who could not be treated surgically or medically, is usually rehabilitated through hearing aids and related procedures. The mode of rehabilitation one receives, largely influences his adjustment pattern in life. O'Neill (1964) believes that no major psychological differences exist between the hearing and the hearing impaired.

The present study hypothesized that persons wearing hearing aids in life, do not differ negatively from normal hearing persons on the two dimensions of personality, viz., Neuroticism and Extraversion which measures both these dimensions with fairly high reliability and validity indices, was used. Further, the efficacy of the instrument was found to be satisfactory by several researchers (Bharath Raj and Pranesha Rao, 1970; Cattell, 1973).

Method

Subjects

Employees and relatives of clients attending the Hospital in Odense, formed the normal hearing group of 100 subjects. Their age range was, 20 to 75 years, and the mean age was 58.4 years. The aurally rehabilitated group with hearing aids, had 78 subjects from the clinical population of the State Hearing Centre. They ranged in age between 30 to 71 years and their mean age was 54.5. They varied in the period of use of hearing aids from a duration of minimum one year to maximum twenty years. 67 subjects had bilateral hearing losses, eleven had unilateral hearing loss. Five subjects had binaurally fitting hearing aids. Their distribution in terms of SRT and DL parameters is represented in Table 1.

Both the groups had an equal sex ratio.

TABLE 1. Degrees of hearing loss distribution in the hearing aid using group

Degree of hearing loss	*SRT range*	*DL range*	*Frequency of subjects*
Slight 1.	11-30 dB.	11-30%	10
Moderate 2.	31-60 dB.	31-60%	39
Severe 3.	61-80 dB.	61-80%	18
Profound 4.	81-100 dB,	81-99%	11

Procedure

After checking the hearing audiometrically, the normal hearing subjects were administered with the Danish translation of the Eysenck Personality Inventory (EPI), individually. The same was administered personally to every Subject of the adventitiously hearing aid using group, after routine audiological evaluation and other follow-up procedures.

The Lie score distributions were drawn for both the normal hearing and the rehabilitated groups. The criterion limit of M+I. S. D. on the lie scale for the normal group was adopted to eliminate individuals showing a 'Desirability response set'. The normal and rehabilitated groups were compared on the E and N scales, after that.

Results and Discussion

The criterion limit was calculated to be 6 and above on the Lie scale score of the EPI. Eliminating on this basis, there were 85 subjects of normal hearing and 53 subjects of the rehabilitated groups. They were compared on the Neuroticism and Extraversion scales of the inventory. The means and standard deviations scored by the two groups on these dimensions of personality, are represented in Table 2.

TABLE 2. Analysis of the scores of the normal hearing and aurally rehabilitated groups on the N and E scales of EPI.

Group	*Neuroticism scale* Mean	S.D.	*Extroversion scale* Mean	S.D.
Normal hearing (N=85)	8.50	4.60	10.00	3.87
Aurally-rehabilitated (N=S3)	6.00	5.56	10.27	3.46

Applying the test of significance between the two group means, the critical ratio (C R) was found. On the Neuroticism scale, the CR was 2.74, suggesting a significant difference between the two groups at the 0.01 level. On the extraversion scale, the CR was 0.42, suggesting no significant difference at 0.01 level.

The aurally rehabilitated group differs significantly from the normal hearing, in the positive direction of lesser neuroticism while it does not differ significantly on the extraversion scale. Both the groups are nearly equal on the extraversion dimension.

, To identify the neurotic and extravert-introvert, criteria may vary in the Danish context and hence they were established from the normal hearing subjects in this study. As per this criterion, a person whose score on Neuroticism exceeds 13 (Mean+1 SD) and above was identified as neurotic and a person whose extraversion score exceeded 14 (Mean+ISD) and above was identified as an extravert. Subjects scoring 6 (Mean—1 SD) and below were considered as introverts.

Neuroticism was identified in 17:64 per cent of the normal hearing group and 15 per cent in the rehabilitated group. Extraversion was found in 15 per cent of the normals, while it was 20 per cent in the rehabilitated. In both aurally and handicapped groups 14 per cent identified as introverts.

The results indicate support for the hypothesis. The aural rehabilitation services play an effective role in shaping or maintaining an individual's adjustment, though he may be confronted with hearing loss. In Denmark, every domicile is entitled for free aural rehabilitation including related otological and audiological services. Hearing aids of various categories are all given free and about 140,000 clients are under continuous hearing aid treatment. The consumption rate of 7 per 1000, is the highest in the world. Besides vocational guidance and placement, any deaf or hard of hearing adult is entitled for a disablement pension (Rojskjser, 1973). These factors vouchsafe for an effective aural rehabilitation service prevalent in the country. The findings of this study, indicate no negative differences in the personality of the adventitiously hearing impaired adults. It will be relevant to consider the role of aural rehabilitation in behavioural studies of individuals suffering adventitious hearing loss.

Persons with disabilities scoring higher on personality traits testing, than their 'normal' controls, is not unprecedented in the literature (Arluck, 1941; Siedenfeld, 1948).

It may be worth comparing with similar studies on personality characteristics of the aurally rehabilitated individuals in other countries.

Acknowledgement

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THE EFFECT OF BULLDOZER NOISE ON HEARING—AN ATTEMPT TO PROTECT THE EARS FROM IT

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Effect of noise on hearing either in terms of T. T. S. or P. T. S. has been a subject of interest of many people. A number of studies have been conducted to study this phenomenon, around the country and around the world *(Larsen,* 1939; *Rosenblith,* 1942; *Me Coy,* 1944; *Urposurala and Eniolahikainen,* 1948; *Kryter, K. D.,* 1950 *and* 1963; *Coldner.,* 1953; *Cox, Mansur and Williams,* 1953; ASA, 1954; *Gangoli and Prakash Rao,* 1954; *Lindquist, S. E., Neff, W. D., and H. F. Schuknecht,* 1954; USAI, 1954; *Webster,* 1954; *Adiseshaiah, et al,* 1959; *Ward, W. D., A. Glorig, and D. L. Skian,* 1959; *R. E. Fleer and A. Glorig,* 1961; *Gallo, R. and A. Glorig,* 1964; *Mahananda, P.,* 1972). This may be the first report on effect of bulldozer noise on hearing.

Noise, for the present purpose, has been defined as an acoustical signal which is injurious to hearing. Noise produced by the bulldozer which was levelling the field in the premises of the All India Institute of Speech and Hearing was used as a noise source.

Experiment 1

To study the pattern of noise that was produced by the bulldozer, the noise level in the driver's cabin was measured using an SPL meter with an octave filter set (B and K Type 1220). The microphone of the SPL meter was held at the level of the ear of the driver. The readings were taken on two days, five times each day with an approximate interval of one hour between each reading. Table 1, shows the comparison of the average intensity of noise at different frequencies, produced by the bulldozer, with the Damage Risk Criteria given by Glorig, Ward and Nixon (1961). It ranged from 44 dB at high frequencies to 110 dB at low frequencies. The noise was above the Damage Risk Criteria given by Rosenblith and Stevens (1953) and also ASA Subcommittee (1954). Even though the noise was predominent in low frequencies, the average level exceeded the Damage Risk Criteria (Glorig *et al* 1961) more in higher frequencies (12 dB) than in lower frequencies (by 2 dB). Hence it was expected to cause a hearing loss in drivers, who would be exposed to this noise for more than eight hours a day.

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FREQ.	D.R.C. GIVEN BY GLORIG, A..W. D. WARD & J.NIXON	PRESENT READING	DIFFERENCE
63	102	107	**5**
125	95	94	
250	91	98	7
500	87	96	9
1000	85	97	12
2000	82	94	12
4000	80	92	12
8000	79	87	8

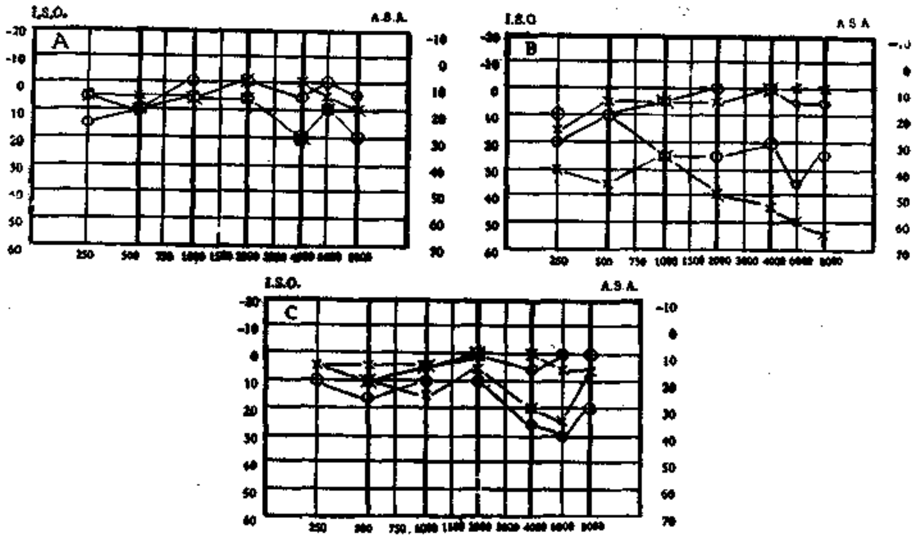
TABLE 1 showing the comparison of the average intensity of noise at different frequencies, produced by the Bulldozer with damage risk criteria given by Glorig, Ward and Nixon (1961)

Experiment 2

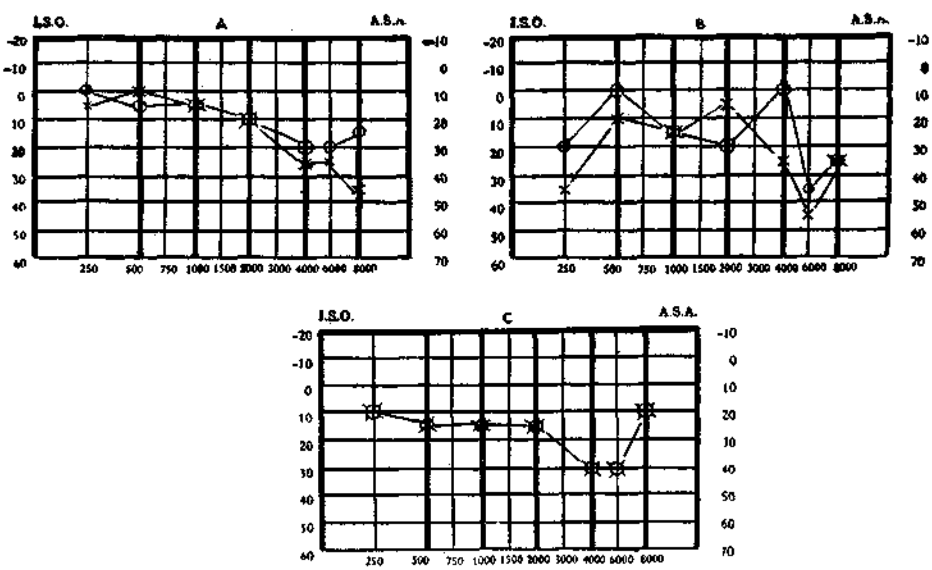
To study the effect of this noise on hearing three normal hearing adult males, who volunteered themselves were taken for the study. All the hearing measurements, on these subjects were carried out in three audiometric rooms, which satisfied ISO standards. A. C, B. C. and SRT measurements were done by three qualified audiologists on these three subjects using three audiometers (Beltone-12D, 15 CX and Arphi) which were calibrated to ISO standards, by standard procedures. Each subject was tested by the same tester on the same audiometer in the same situation throughout the study.

After the initial measurements of hearing were made the subjects were made to sit in the driver's cabin of the bulldozer, which was levelling the ground. They were exposed to noise for 1 hour and 2 hours, with an interval of 11/2 hours. In both the instances, immediately after the exposure to noise pure tone thresholds were measured, to see possible shifts in thresholds. There was a lapse of less than 2 minutes before these measurements could be made as the subjects had to cover a short distance from the bulldozer to the test rooms.

There was a definite shift in thresholds for pure tone in all the three subjects. The maximum shifts were observed, as usual, at 4 KHz and at 6 KHz in all of them in both the conditions. Graph 1 and 2 show the results. There was a shift ranging from 15 dB to 45 dB at 4 KHz, with ±5 dB difference between the two ears



GRAPH 1 showing shift in threshold after one hour of exposure to the noise



GRAPH 2 showing shift in threshold after two hours of exposure to the noise

of the same subject, except in case of subject B, who showed a difference of 25 dB between two ears. A similar shift was observed at 6 KHz with a range of 5 dB to 50 dB. Again, there was only a difference of ±5 dB between the two ears of the same subject except in the case of subject B, who showed a difference of 20 dB between the two ears. And he also showed a shift of 60 dB at 8 KHz, in left ear only.

The shift in threshold was expected to grow logarithmically with time (Ward, W. D., 1963), that is, more shift in threshold was expected after two hours of exposure than in one hour exposure. Only in case of subjects A and C more shift in threshold was observed, but in the case of subject B the shift was less than the shift that was seen in one hour exposure, by 5 dB. And a lesser shift of 35 dB at 8 KHz. To check this variation from the rule, the experiment was repeated. But again, the same results were observed. This may be because of inconsistent responses given by the subject, as reported by the tester or there may be some other explanation for this variation. From this experiment it was evident that the noise of the bulldozer, which was above the Damage Risk Criteria, would cause a shift in threshold in higher frequencies (at 4 and 6 KHz) even for an exposure for one hour.

Experiment 3

After the initial measurements for shifts in thresholds, after both the exposures, the subjects were tested once in 1 hour to study the complete recovery pattern. The recovery was faster in first \ hour of rest period than in second ***i*** hour of rest, in case of subjects A and C. And they took one hour to recover completely, after both the exposures. Whereas subject B again as an exception, took one and a half hours to recover completely and only in case of one hour exposure he showed a gradual recovery. But in two hour exposure recovery study he did not show any recovery in first two *k* hours, that is one hour after exposure, but a sudden recovery was seen when his thresholds were measured at the end of the third 1/2 hour rest after exposure. Thus shifts seen in the thresholds for pure tones after one hour and two hours of exposure to bulldozer noise, was only temporary. The recovery pattern for all the subjects have been shown in Table 2.

Experiment 4

This experiment was conducted to find out an effective means of attenuating the (intensity of) noise that was reaching the ears and thus to stop or to reduce the shifts in thresholds that were observed in experiment 2.

Guild (1958)'records the attenuation provided by A. F. ear muffs, and A. F. ear plugs and by the two worn together. The results show that the combination of the two types provides the greatest amount of attenuation and that the total attenuation of the two together is far less than the simple addition of the attenuation provided by each of them.

Studebaker and Brandy (1971) while discussing the methods of ear protection say that "other sound transmission pathways limit the total amount of attenuation that can be achieved by simple covering and plugging the ears. . . . Sound

(a) Recovery after 1 hour of exposure

	sub	4KH2		6KH2	
		Rt.	Lt	Rt	Lt
after 30 minutes of rest	A	15	10	5	10
	B	15	45	15	15
	C	5	15	5	10
after 1 hour of rest	A	5	10	0	5
	B	5	0	10	10
	C	5	5	5	5

TABLE 2. Showing the recovery patterns after one hour and two hours of exposure to noise

energy may pass through the ear plug material, it may move the ear plug as a whole and set up pressure waves within the ear canal, or it may enter the ear canal through air leaks around the edge of the ear plug. In order to reduce transmission through the ear plug itself, it should be made of material with low compliance and high mass. However, a complaint material is needed for good fit and comfort, this makes compromises in ear plug construction necessary. A substantial increase in mass above that currently used is required in order to produce a significant effect. Furthermore, greater mass increases discomfort and creates a problem in keeping the devices in the ear. An ear leak can cause a significant reduction in attenuation at all frequencies but, particularly in the lower frequencies (Zwislocki, J., 1951). For this reason, a flexible material that conforms to the shape of the individual ear canal, a good initial selection of ear plug size, and the proper use of the ear plug by the employee are all required" (p. 458).

Several other methods, for this purpose have been tried and suggested and yet no satisfactory method has been evolved (Zwislocki, 1957; USASI, 1957; Mass, R. B., 1961.)

To achieve this purpose, ear moulds using acrylic material were prepared for each individual and using free field testing the effect of these moulds in attenuating sound was determined for each individual. It gave only an attenuation of 20 to 40 dB and in high frequencies only. Even when the ears were covered with head phones (of speech trainers) with these ear moulds there was no attenuation in low frequencies. Hence, ear moulds using typing metal (an alloy of lead),

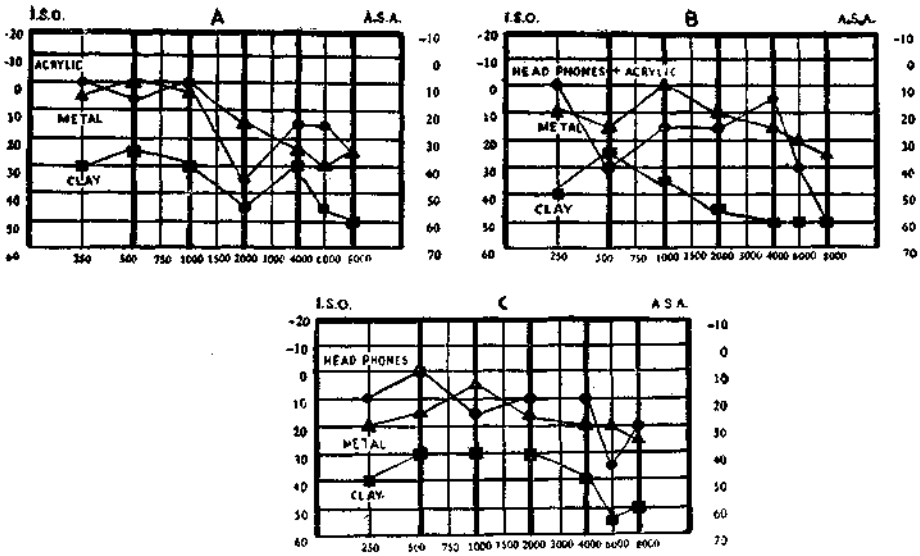
(b) Recovery after 2 hours of exposure

	SUBJECTS	4KHz		6KHz	
		Rt	Lt	Rt	Lt.
after 1 hour	A	15	5	10	10
	B	0	10	10	40
	C	10	15	5	25
after 1 hour	A	0	10	5	5
	B	0	10	10	40
	C	5	10	5	5
after 1J hour rest	A	-	-	-	-
	B	0	5	10	0
	C	-	-	-	-

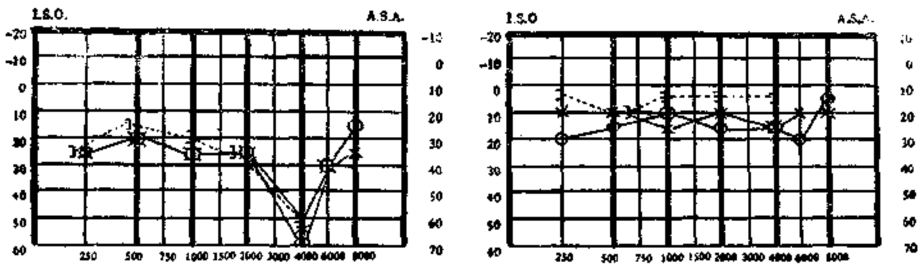
were prepared for each individual. Again this also showed an attenuation of high frequency sound and not of low frequency sounds. And the subjects reported difficulty in wearing these moulds because of their weight. Ears were packed with modelling clay and its effectiveness in attenuating sound was determined using free field testing. This packing gave an attenuation of 15 to 40 dB in low frequencies and 30 to 60 dB in high frequencies. Graph—3 shows the thresholds for pure tones under free field testing, with different ear moulds. Again the subjects were exposed to noise for one hour with the packings of clay in the ears. After one hour exposure their pure tone thresholds were measured. And no threshold shifts were observed in each case, proving the effectiveness of plasticine modelling clay in attenuating the noise of the bulldozer and protecting the ears.

However, the process of packing the ears is cumbersome and therefore this cannot be taken for routine use to protect the ears of the drivers.

Audiograms of the two drivers, who had been working for a duration of 22 years, and 2 years, respectively, have also been given in graph—4. The driver who



GRAPH 3. Showing the thresholds for pure tones under free field testing with different ear moulds



GRAPH 4. Showing the audiograms of the drivers

had been exposed to this noise for 22 years showed a loss of 55 dB and 30 dB at 4 and 6 KHz. The driver who had been exposed to this noise for 2 years responded to 15 dB and 20 dB at 4 and 6 KHz.

Summary and Conclusions

The noise produced by bulldozer, which was levelling the ground, was predominent in low frequencies and it exceeded the Damage Risk Criteria. An hour of exposure to noise showed a threshold shift of 5 to 50 dB at 6 KHz and 15 to 45 dB at 4 KHz, in the subjects under study. After one hour of rest there was complete recovery. Packing the ears with plasticine modelling clay has been found to be useful in protecting the ears from this noise. An exposure to this noise, for a long time, will cause a 'Noise Induced Hearing Loss'.

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OPTIMUM FREQUENCY AND PITCH RANGE

SHEELA KUMAR

'Most of the therapies of voice disorders are based on the belief that a person has an optimum pitch at which the voice will be of good quality and will have a maximum intensity with the least expense of energy and they concern themselves mainly with altering the habitual pitch level or making the case to use his optimum pitch' (N. P. Nataraj 1972).

It is often hypothesized that by making the case to use his optimum pitch different types of voice disorders can be treated. (Y. S. Shantha 1973).

Dorothy and Sherman (1962) in treating hypernasal cases found that, when optimum pitch was below the habitual pitch and when the case was made to use his optimum pitch, nasality decreased.

Wilson (1968) while discussing the treatment of hyperfunctional voice disorders says that a considerable improvement may be achieved by lowering the habitual pitch towards optimum.

Fischer (1966) while treating pitch problems states that optimum pitch is the best pitch for speaking.

Williamson (1944) in his study of hoarse Voice concluded that the principal cause of the trouble was tension resulting from speaking at a level far below optimum pitch.

Lewis (1936) and Appleman (1953) found that a change in the pitch towards optimum is associated with optimal adjustment in the resonator thereby changing the quality.

Thus a review of literature on voice therapy shows that there is a great need, for finding the optimum frequency as it is so frequently used in treating voice problems. (Y: S. Shantha 1973)

Even if we take this as an overstatement it is still true that finding the optimum frequency is the crux of most therapies. We now have objective methods of locating optimum frequency. However this involves sophisticated equipment and therefore many practising clinicians are still stuck with less objective means.

In an attempt to objectify as far as possible, many therapists have used the pitch range and have prescribed an arithmetical relationship between the pitch range'and optimum frequency.

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There are several methods recommended for locating optimum frequency using the total pitch range. Usually the lowest and the highest note the person can produce are determined and taken as the pitch range. Some consider optimum pitch as a frequency one fourth above the lower limit of the pitch range (Pronovast 1942; Fisher—1942; Fairbanks—1960 and Berry and Eisenson—1962).

Pronovast (1942) located median pitch levels in six superior male speakers and observed they approximated with a level that was about one fourth of the total pitch range.

Brownstein and Jacoby (1967) consider the optimum pitch as one fifth from the lower limit of the pitch range.

Linke (1953) found that median pitch levels comprised one-fifth of the total range in case of female voices.

Johnson *et al* (1967) consider this method given by Fairbanks (1959) as the most satisfactory method yet devised for estimating a person's natural pitch level. They suggest modifications to cope up for the limitations of this method, which still remain confusing.

This paper is a report on the bi-product observations made during another study, 'A comparative study of vocal parameters of trained and untrained singers' (1974).

Thirty trained and thirty untrained singers constituted the two groups studied, and they were matched for age, sex, height and weight.

As a part of the study the optimum frequency and the pitch range were determined in both the groups.

$$\text{Optimum frequency} = \frac{\text{Natural frequency of the vocal tract}}{\text{Relationship}}$$

Optimum frequency was determined by feeding a tone of variable frequency ranging from 100 Hz to 5000 Hz having a constant intensity generated by the beat frequency oscillator into the vocal tract which was maintained in the vowel/a/ position by means of a probe speaker.

The response of the vocal tract was picked up by a condenser microphone and the output was graphically represented on the calibrated paper of a level recorder. The maximum peak was taken as the natural frequency of the Vocal tract and this was divided by the relationship factor i.e., 5 in females and eight in males, for obtaining the optimum frequency. (This method was used and validated by N. P. Nataraj in 1972).

In the present study trained singers used their optimum frequency while speaking unlike the untrained singers.

Next the pitch range was determined by instructing the subject to phonate the lowest possible and the highest possible pitch and the reading was directly obtained from the tacho unit of the stroboscope.

Pitch range was defined as the measure of the musical interval between the highest possible and the lowest possible pitch the subject phonated. As the subjects were singers, trained and untrained it was assumed that they correctly identified the lowest and highest points [To check what arithmetic relationship (J, *i*, or I) should be used]. The relationship between the optimum frequency and the pitch range determined in the present study are worked out and are presented in Table 1 for trained singers and in Table 2 for untrained singers.

Position of optimum frequency in relation to pitch range
(Expressed as % above the lowest frequency)

$$= \frac{\text{Highest frequency — lowest frequency}}{\text{Optimum frequency — lowest frequency}} \times 100$$

TABLE 1. Trained Singers

Optimum frequency (in cjs)	*Pitch range* *Lowest frequency*	*Highest frequency*	*Position of O.F. in relation to the P.R. expressed as X% above the lowest pitch*
225	150	650	15%
145	50	360	31%
120	105	600	3%
245	200	800	7.5%
200	120	450	24%
180	100	550	18%
150	60	400	26%
255	75	1000	19%
145	100	750	7%
190	50	500	31%
290	50	500	53.3%
235	150	690	15.7%
160	60	300	41.6%
245	120	450	37.8%
140	75	500	15.5%
260	170	600	21%
240	200	2400	1.8%
245	150	650	19%
260	210	660	11%
225	150	600	19%
220	150	750	11.6%
255	150	750	17.5%
240	150	1200	9%
250	140	1300	9.4%
235	110	1100	21.6%
205	100	1200	9.6%
250	160	600	20.5%
155	60	350	32.7%
255	90	1750	9.3%
255	160	850	13.7%

TABLE 2. Untrained Singers

245	110	350	56.25%
180	100	260	50%
125	110	310	7.5%
230	200	550	8.6%
250	170	325	51.6%
245	200	500	15%
335	200	.550	90%
260	176	450	30.6%
130	90	500	10%
240	220	550	6.1%
255	150	900	21%
265	210	950	7.4%
110	90	260	11.7%
235	100	260	85.5%
120	100	90	4.2%
265	110	350	62.9%
260	210	510	16.6%
225	180	420	19.7%
240	240	550	0.3%
225	150	600	16.6%
235	200	350	23.3%
265	190	550	28.8%
260	200	425	26.6%
280	200	425	39%
320	110	450	68%
260	110	550	36.8%
250	200	510	16.1%
120	110	210	10%
225	120	350	46%
255	240	900	2.3%

TABLE 3. Summary Table

	Trained	Untrained
0—10	8	9
11—20	10	5
21—30	6	7
31—40	5	1
41—50	—	4
51—60	1	—
61—70	—	2
71—80	—	1
81—90	—	1
91—100	—	

it is noticed that there is no consistent relationship between the two features (P. R. and O. F.) in either the trained group or the untrained group.

Therefore the pitch range cannot be used to locate the optimum pitch arithmetically.

A comparison of the pitch ranges between the trained and untrained singers reveals that the trained singers have greater pitch range than untrained singers (Sheela Kumar 1974). This is in keeping with the review of literature.

Luchsinger (1965) studied the voice of a female singer and found the range as 41/2 octaves. Greene M. (1972) states that pitch covers one to one and a half octaves in untrained voices and 2 to 21/2 octaves in trained voices. Wolfsohn reported to have trained his pupils to break away from convention and recover a range of 6 octaves.

Luchsinger and Dubois (1965) analysed the singing voice of singers whose singing range was found to be from 64 c/s—2960c/s.

In his examination of 600 trained singers Priessler encountered differences in vocal ranges ranging from 24-54 semitones, (i.e. 2-41/2 octaves)

These findings reported in the literature and the observations made during the present study reveals that the pitch range is a variable and can be extended by vocal training.

Optimum frequency by definition is related to the vocal tract and is therefore more constant. Therefore the optimum frequency apparently cannot be related to the variable pitch range.

Perhaps the best resource for a therapist without the sophisticated equipment is still the subjective esthetic evaluation.

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ESOPHAGEAL SPEECH OR ARTIFICIAL LARYNX—A CRITICAL DISCUSSION

JAYARAM M.

'Communication has long been recognised as one of the most fundamental components of human behaviour' (Peterson, G. E., 1958). Man's primary method of communication is speech.

When one analyses good speech, the speech that most adequately contributes to social interaction, it is discovered that it possesses certain characteristics. Each of these characteristics makes its peculiar contribution to the total impression. These important characteristics of speech are pitch, loudness, voice quality, accent, style, articulation, stress, level and kind of language.

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. The patient who has lost his larynx, and who makes an otherwise satisfactory physical recovery presents a number of problems, that are always puzzling and sometimes discouraging. Baker (1954) puts the situation most succintly: 'The loss of the larynx in humans produces an obliteration of the speech function that is unique because it is so complete. The absence of the phonating mechanism makes production of voice for speech impossible. More than this the surgical interaction of the upper air way also makes it difficult for the patient to produce those speech noises, which are important components of many speech sounds'.

There are two major methods of rehabilitation of these patients: that of teaching thermesophageal speech or recommending them artificial larynx. There are many other modes of rehabilitation of these patients. But it is the purpose of this paper only to review the controversy existing between the artificial larynx and esophageal speech. It has remained as a highly debatable point in the rehabilitation of these patients as to the better mode of rehabilitation among these two approaches. Arguments have waxed and waned, with each side having its own limitations and good points, but no agreeable point has been reached. It is not the scope of this paper either to find a definite solution for this, but only to review each sides claim with reference to the characteristics of the good speech cited above.

Snidecor (1968) says 'by having developed the technique of esophageal speech, the Speech Therapist has greatly lessened the degree of disability incidental to the total removal of the larynx'. In the 20th century and until few years ago, surgeons and Speech Therapists were somewhat over enthusiastic concerning

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the relative number of persons who could learn esophageal speech. However, more recent and realistic studies indicate that from 12 to 40 per cent of those surveyed I could not or did not develop esophageal speech (ACS, 1951; Putney, 1958; Gardner and Harris, 1961; Horn, 1962; Van Riper and Irwin, 1966; Greene, 1968; Snidecor, 1968). Some of the factors which render the acquisition of esophageal speech difficult or impossible are: Poor post operative results (Levin, 1952); Damage to the nerve supply of pharynx and tongue (Greene, 1964); Old age and frailty accompanied by lack of drive to learn (Greene, 1964); Deafness and inability to monitor speech (Levin, 1952 and Lauder, 1968); Low intelligence and real distaste for esophageal speech (Greene, 1964); Suspected recurrence of the cancer, metastasis and multiple lesions (Levin, 1952) and complications arising after the operation such as edema, infection, necrosis etc., (Parnell, 1968). Since reinstating communication is the most important thing, the argument for an artificial larynx is quite natural and logical.

I Other factors which make esophageal speech difficult like extensive surgery, for example, gross neck dissection—unilateral and bilateral; removal of the cricopharyngeus muscle; laryngectomy with glossectomy; pharyngectomy; mandibulectomy also make necessary the acquisition of artificial larynx. '

Though not all the patients are affected by the above factors, we still know that not all laryngectomees are able to develop esophageal speech, the reason for which is not known in spite of the vast amount of knowledge about these patients at our disposal. In the words of Finklebeiner (1968) 'despite the amount of knowledge regarding the esophageal speech which has accumulated in the past 50 years, one of the important questions which has remained to be answered is why some individuals are able to learn to use the new voice without undue difficulty, while others who appear equally motivated fail in their efforts to acquire it'. Under these circumstances the choice of an artificial larynx seems to be justified.

Many Speech Pathologists, Physicians, Laryngectomees and para-medical specialists claim that the early introduction and use of the artificial larynx following laryngectomy is a psychological as well as economic necessity; that esophageal speech can be developed later when the patient has recovered from traumatic experience.? -They assert that the artificial larynx is much more understandable than esophageal speech and it enables the user to communicate much sooner and more effectively, particularly in situations involving emotional stress or when more volume than is normally possible with the esophageal voice is required/ Heaver and Arnold (1962) are the ones to advocate the use of artificial vocal aids during the time the patient is learning esophageal speech. This seems to be logical particularly because reinstating communication as early as possible, as said earlier, is the most important thing that we can do to a laryngectomee.

However, the opponents of the artificial larynx are quick to point out that the use of this instrument is an unnecessary crutch and interferes with the development of esophageal speech j(Hyman, 1955; 1968; Broadnitz, 1962; Furn, 1968; Edelman, 1968; Grant, 1968). Edelman (1968) says that the use of artificial larynx is a crutch in developing good esophageal speech because of the following reasons: (1) The pattern of air intake in that is not the same needed for esophageal speech and "(2) if a greater part of the person's communication effort is dependent on a button instead of on the coordinated movements of the oral structures, that person will be establishing habit patterns for voice production which are opposed to those needed for esophageal voice. It is the general opinion that the too early introduction of them may discourage patients from learning esophageal speech/ Further Broadnitz (1962), Furr (1968) and Hyman (1955) contend that artificial larynx takes away the motivation of the patient to learn esophageal speech.

However, considering that 40 per cent of all laryngectomees do not acquire esophageal speech, it becomes necessary to provide artificial larynx as soon as possible.[1] It is interesting to observe Martin (1963), who after an evaluation of all the above surveys says 'despite the optimistic claims (sometimes as high as 80 per cent) I would estimate that half of all laryngectomees never acquire a reasonably adequate and socially acceptable esophageal voice, that is better than 'indifferent', 'poor', 'offensive', or 'absent'. Lueders (1956) is in conformity with Martin and maintains that approximately 1 /3 of all the patients do not learn to speak and that in his judgement of some patients, who consider themselves able esophageal speakers, the proficiency of the remaining 2/3 might be questioned'.

'Kallen (1934) reports of the acute depression which often interferes with speech progress/. A pathological reactive depression is the usual sequela to the doctors dictum that the larynx is cancerous and that it has to be removed at once, and thit natural speech will no longer be possible (Heaver and Arnold, 1962). And even after the operation when the patient can't speak, this depression will persist, however effective our counselling may be. This is further supported bylLueders (1956)|who says/'the psychological importance of an early return or communicative ability should be considered, speech being the most important social function, should be restored to the patient as soon as possible. The psychological effect of enforced silence during a protracted learning period for the esophageal speech is the building up of resentments and frustrations that tend to make the patient uncooperative. It is better perhaps, to offer him the help of.electrolarynx, with which he can at least satisfy his all important sense of speech'.]

In this connection Martin's (1963) argument seems- to be logical. He says 'furthermore, contrary to the pronouncement of many esophageal voice teachers, resorting to such a device promptly after operation, in my experience, does not preclude or discourage the patients from later efforts to the attainment of esophageal speech, nor does it lessen the chance of ultimate success in that endeavour. It can serve, however, as a stopgap, in all the cases and give the laryngectomee an unprejudiced eventual choice between the two methods. Also it makes possible the use of either one as a supplement to the other, depending upon the requirement of the occasion. Elimination of any unnecessary delay in achieving practical means of communication transcends any and all other considerations'.

Claim made by the opponents of the artificial larynx, is that the use of an artificial larynx is an unnecessary crutch and interferes with the development of esophageal speech, seems to/lack experimental evidence for no research has yet shown that /artificial larynx precludes or slows down the learning of esophageal speech (Diedrich, 1968; Grant, 1966; Lauder, 1968). Further Diedrich (1966) says 'it might show that the artificial larynx as a means of communication, the clinician should feel rewarded that he has provided a means by which this was accomplished and not feel guilty that he was unable to teach the person esophageal speech. It was a decision for the client to make, not the clinician'. And the advocates of the artificial larynx claim that the use of the artificial larynx need not interfere with the development of the esophageal speech, so long the patient's teacher perseveres in teaching the proper technique for esophageal voice.

However, it may be true that in some cases the use of artificial larynx may become a crutch which may dissuade some laryngectomees from acquiring esophageal voice; but/if his communicative and psychological needs are satisfied thereby, why should we insist that the patient communicate by other means? As Kneflar (1962) points out that our goal for laryngectomee's should not be 'acquisition of esophageal speech', but rather 'the development of that level of speech proficiency that as nearly as possible meets the communicative needs of each laryngectomized individual'.

Till some experimental evidence is forthcoming to prove that artificial larynx is a deterrent to the learning of esophageal speech, we shall presume that this is not so. In fact it may be an aid, inasmuch as it permits the person to keep his communication alive and the hazardous task of writing to communicate with his teacher does not arise; to return sooner to his job; it helps keep his morale high and tension low and thus helps establish a favourable climate for learning esophageal speech.

Diedrich (1966) says that articulation is an additional speech benefit which might occur from the use of the artificial larynx during immediate post-operative period. The user,of the artificial larynx must precisely articulate or the speech will be unintelligible./ He must learn, for example, to make voiceless consonant sounds with intrapharyngeal air pressure and not with pulmonary air. The learner of esophageal speech must also learn to articulate voiceless sounds in alike manner. Another secondary benefit of good articulation is its influence on air intake precision in articulation. This movement aids in the injection process especially during the syllable pulse of plosives and sibilants.. Hence, in this way artificial larynx helps learning esophageal voice and it is not a crutch as contended by its opponents. Diedrich (1966) says because of these possible speech gains through the use of the artificial larynx, it is suggested that the esophageal speech learning period can be shortened not lengthened'.

Other criticisms of the artificial larynx put forth by the proponents of the esophageal speech are:

(1) that it has got too many limitations, not the least of which is the unacceptable sound it makes.

(2) that t he user of such an instrument cannot produce speech as intelligible as esophageal speech.

Lauder (1970) contends that the principal reason for the continuing unpopularity of the electrolarynx is that it is not a satisfactory substitute for the human voice because it sounds too mechanical and it is therefore unnatural. Barney *et ah,* (1959) are also of the opinion that the sound so produced with the artificial larynx sounds somewhat mechanical.

In comparing esophageal voice, with the electrolarynx speech, Martin (1963) asserts that the Electrolarynx voice tends to be of uniform quality, that it is far rasping in tone than many acceptable esophageal voices and furthermore, that it is always devoid of intake burps, facial grimaces and concomitant forced expulsions of air from the stoma. Martin claims that even the best esophageal voice is monotonous and hoarse. Now let us evaluate the characteristics of esophageal voice and its effectiveness.

Greene (1964) says 'the esophageal speaker can become so fluent that strangers do not realise the true nature of the disability and may ask whether the patient has cold or laryngitis. This is tribute indeed to the naturalness of the voice which upto this time no artificial larynx has been able to emulate'.

However, it seems as though Greene is exaggerating the issue, for a number of studies (Damste, 1958; Snidecor and Curry, 1965; Rollin, 1967; Shipp, 1967, Curry, 1968; Snidecor and Nichols, 1968; Snidecor, 1968) have shown that even the superior esophageal voices lie far below than normal speakers, with respect to frequency, rate of speech (in terms of number of words per minute), loudness, quality of the tone, etc. And according to the criteria of Berlin (1963), which are indeed very simple, no esophageal voice will be rated as good. And further we know that many laryngectomees suffer from presbycusis which prevents them from being able to adequately evaluate the intelligibility of the esophageal speech that they can producer This together with the often unheard high frequency noise produced by pulmonary air from their stoma (stomablast) often mitigates against what speech intelligibility they can master.

' No esophageal speaker so far has been found to fulfil the following criteria (Leuder, 1970) in order to come nearer to the normal speech level at least.

(1) Sufficient volume to be comfortably heard by a listener with normal hearing at a reasonable distance in fairly quite surroundings.

(2) Intelligibility supported by clarity of articulation, expressiveness, pitch variation, phrasing and adequate visual cues.

(3) Phonation produced with breath control resulting in a smooth speech airflow, naturalness of expression and avoidance of stoma blast.

(4) A reasonable speech rate of at least 80-100 words per minute.

(5) Few distracting speech mannerisms, facial grimaces and inappropriate body movements during phonation.

One of the best measures of efficiency in speech, is rate in words per minute. (Snidecor, 1968). In Snidecor's (1955) study no speaker could achieve a rate that would be satisfactory according to Darley's (1959) and Franke's (1939) norms.

According to Black (1942), Hanley (1951) and Snidecor (1944) normal speakers phonate from 60 to 75 per cent of the time during continuous speech. In Snidecor's (1955) study, all the laryngectomees lie far below this level of phonation time, which is thought to give some measure of vocal efficiency.

The results of the studies (Hyman, 1955; Snidecor and Isshiki, 1965; Snidecor, 1968; Van Den Berg, Moolenaar-Bijl, Damste, 1958; Nichols, 1968). On the relative loudness of esophageal speech and electrolarynx speech indicate that the esophageal speakers lie far below than that of normal speakers. Evaluating all these studies with respect to loudness and effectiveness of esophageal speech, Nichols (1968) says 'only the rare esophageal speaker can "turn up the volume" of his voice so that he can project to everyone in the room or in some busy place'.

The pitch of the effective esophageal speaker is substantially lower than that of normal speakers. A spectrographic study of the esophageal voice by Arslam and Rossi (1972) showed the complete absence of the regular succession of fundamentals and harmonics with a typical aspect of 'noise', even if there is a fairly regular arrangement of vocal formants.

With reference to quality or waveform information spectrographs analysis of esophageal voice (Snidecor, 1968) revealed that although the voice contains a noise component upto a high frequency region (6000 Hz), the harmonic components are still clear and easily distinguished from each other. The voices of esophageal speakers are often hoarse and they are frequently thought to have cold.

Coming to the effectiveness of the artificial larynx, it is interesting to review the results of Hyman's study (1955). He found, in comparing the voice of the electrolarynx and esophageal speakers, that the artificial larynx speakers are always preferred. This study indicates that acoustically speech production by means of the artificial larynx was preferred over esophageal speech.

Further in the case of the artificial larynx, the adequacy and effectiveness of pitch, loudness and to some extent quality depends on what we provide in the artificial larynx. With all this progress in electronic research, we can now give speech through an artificial larynx which simulates the normal speech in all respects. Electronic larynges produced in 1960's have considerably better quality. With the electrolarynx loudness is a matter of adjusting power to an adequate level or trying a more powerful instrument. Barney, Haworth and Dunn (1959) studied this problem at length. The loudness of the artificial larynx they produced (75 dB fixed) was felt adequate for conversational purposes, although in situations in which the normal speaker would increase his intensity, they advised that the speaker move closer to his listener. Recently the present author (1974) has developed an artificial larynx the output of which can be varied from 55 to 88.5 dB (when the transducer is held pressed against the throat) and can he fixed at any particular level of intensity also. This maximum intensity of 88.5 dB provided in this artificial larynx is more than the peak intensity values of normals, which Hyman (1950) puts at 79 dB. This is one advantage over the WE TYPE 5A artificial larynx.

The experiments of Barney *et al.,* (1959) show that the introduction of the vocal source into the articulatory system in the pharynx produces a better voice than the same source introduced into the oral cavity and it has been further supported by Jayaram's (1974) study. Barney *et al.,* (1959) also conclude that the spectrum of the vibrator was on the average, adequate as a source of harmonics of vowel production.

Jayaram (1974) has developed a variable frequency artificial larynx where the frequency can be continuously varied from 50 to 350 Hz and the intensity from 70 to 110 dB (in the free field condition). , The frequency is continuously variable but can be fixed at any level also. Further it has the possibility of selecting a suitable fundamental frequency, with needed supply of overtones, for each individual to match his optimum frequency.

Other advantages of the above variable frequency artificial larynx are:

(1) Frequency spectrum of the artificial larynx voice is almost similar to that of the normal (natural) voice.

(2) By means of an oscillator interruptor, the patient can stop the oscillator working either between the words or phrases or sentences. By this the speech was found to be extremely intelligible as it minimised the constant background buzzing noise.

Jayaram (1974) in his study has also shown that using this artificial larynx, intonation pattern |found in normal speech, can be approached by varying frequency, thus making the speech less monotonous and more natural.

The intelligibility of speech produced with this artificial larynx was studied with normal subjects and was found to be extremely intelligible (as reported by the judges). All of the subjects had good articulation. They all could effectively use the oscillator interruptor, which minimised the background noise and thereby increased the intelligibility of the speech. All the subjects could be trained to use this artificial larynx.

So with all these recent developments in electronics, the situation is now entirely different than that existed in 1950's and 1960's. With the artificial larynx one can give a speech which is as effective as normal speech. The situation being this, one cannot understand the insistence on esophageal speech, which is after all hard work. And also the problem of esophageal voice requiring a substantial expenditure of energy on the part of the patient, which many older patients cannot sustain for their everyday communicative needs, speaks against the use of esophageal speech. Also when taking into consideration the time taken to learn esophageal speech, one can't be blind to the frequently tragic emotional an financial impacts of such unnecessary long periods of voicelessness. After taking all these factors into consideration one is inclined to consider the artificial larynx as a more effective mode of rehabilitation of laryngectomees than esophageal speech/

However, with the advent of the Asai Technique which of course results in better speech than the above two, the importance attached to either artificial larynx or esophageal speech has been lessened. The advantages and disadvantages of this technique are beyond the scope of this paper.

But one can't ignore Diedrich and Youngstorm (1966) who have summarised the entire subject. They say 'The philosophy which the speech clinician should maintain does not appear to be a simple decision between esophageal speech or artificial larynx. They are not mutually exclusive. The question is not which method is better, but which methods are best, not only for any given patient, but for all patients, at any time within the rehabilitation time. What might be appropriate right after surgery may or may not be appropriate after one year. What is adequate speech at home may not be adequate at work. Also the clinician's method of choice may not be in harmony with the wishes of the patient's. Herein lies a professional ethic which should not be ignored—the patient must have the freedom of choice after he has been provided with the best available information about his problem'.

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A FIELD STUDY ON A PROGRAMMED THERAPY FOR LANGUAGE PROBLEMS

BURL B. GRAY

Problem

Introduction

Programming and educational technology represent teaching procedure which maximize the educational outcome by defining and operating a systematic" sequence of the basic learning elements—stimulus, response and consequence. One of the basic considerations in such an instructional equation is the deliberate and correct use of information about human learning. Indeed, the efficacy of teaching strategies which adhere to these principles is well substantiated in the literature. It would appear that any attempt at designing a teaching strategy must incorporate these basic elements. In fact, it is doubtful if it is possible to' avoid it. At the moment the only choice appears to be whether or not to go about it in a systematic way.

This basic observation would appear to apply to language teaching as wett Yet in our field very few teaching strategies look upon the teaching of language as a programmatic educational technology. The reasons are many but probably include at least the fact that to become technically precise in language teaching is difficult and also, to many, the technological and or learning approach, at the philosophical level, is humanistically repugnant and individually degrading.

In the final analysis the worth of any particular teaching system is usually determined by the appeal of the underlying theoretical assumptions, or by personal dislike, or by its effect upon the child's language performance. Indeed some language programmes are designed to meet the emotional needs and self-image of the teacher, some are designed to achieve changes in language performance of the student, and some are a mixture.

Teaching strategies which utilize a large amount of programmatic detail usually view language from more of a topographical point of view than do less programmatic procedures. That is, more attention is paid to performance and there is a deliberate attempt to base decisions about teaching activity upon some observable performance. In fact, definition of the goals of the procedure **are** based upon performance.

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Language, in this context, can be viewed as a definable, and thus teachable, performance. The act of talking is an observable performance on the part of the receiver. The phonemic and morphological components describe the constraints of the sounds used and the way in which they are clustered (words). The grammatic component describes the temporal ordering of and the relationship between words and classes of words. The semantic component describes the meaning or intent of the message (Gray and Ryan, 1973).

This inclination to describe language as a learnable skill frequently causes concern among those who prefer not to use programmatic-learning strategies for language teaching. The concern appears to be that learning theorists and behaviorists have not been able to develop a theoretical model which accounted for or explained the normal development of language. However, the central question in teaching language to a non-language child is not whether or not learning principles and programming do participate in the normal development of the language but, rather, can learning principles and programming be used to teach language.

If a child does not develop language normally then for the language teacher there is no other alternative but to teach it. The magical influence of the passage of time and the event of readiness have not produced it. Even those teachers who ascribe most ardently to the developmental philosophy of language instruction must end up teaching it. There is currently no way we can go inside the child and alter the developmental biology in a manner to cause language to begin to develop. After all the talk about differentia! diagnosis, etiology, natal history, natal development, language surface and base structure is finished the ultimate reduction is what is the child *doing*, what do 1 want him to *do*, and finally how do I *teach* him to do it.

Method

Programme

In 1968 we began to develop a language teaching strategy which relied heavily upon education programming and basic learning algorithms. The procedure itself was termed programmed conditioning (Gray & Fygetakis, 1968 a, b; Fygetakis & Gray, 1970). It became the basic instructional equation in the Monterey Language Programme (Gray & Ryan, 1970). That programme was developed to teach linguistic grammar rules as well as vocabulary. The target for the programme was normal language performance.

The Monterey Language Programme consists of a curriculum of 40 specific individual programmes each designed to teach a specified grammar usage or vocabulary performance. The curriculum and the design of individual programmes for teaching syntactic performance included child selection procedures for student-programme compatibility, locater procedures for optimal placement within a ' given programme, automatic branching to maintain high levels of response accuracy, carry over procedures to insure use in the natural environment and continuous data monitoring of programme run characteristics to ascertain proper programme administration and student progress.

Field Application

This programme, like others of this general type, was developed in a laboratory setting. This had both disadvantages and advantage?.

A distinct difficulty with laboratory developed procedures is that they are developed in an environment which is different from the one in which they are intended to operate. Thus, it becomes important to field test such programmes extensively in order to determine if the programme, operation and therapeutic benefit noted in the early testing continues to hold up in the field.

Since 1970 the Monterey Language Programme has been carefully taught to more than 1200 teachers and therapists located in 40 public school or clinical operations throughout the country[1]. This has involved in excess of 30,000 students.

During the therapy activity the teachers and clinicians maintained data sheets on which they recorded programme step, number of responses, accuracy, amount of therapy time by student, by lesson and pre and post programme criterion tests. Whenever a student finished a programme the completed data sheets were turned in. The information on the sheets was converted into data statements about the operational characteristics of the programme run and its administration.

These data are called run data (Gray, 1974). Four major categories of run data are student responding accuracy, number of responses needed to complete a programme; amount of therapy time needed to complete the programme, and pre-post programme criterion tests. These categories indicate the proficiency with which the procedure was carried out.

Results

Field Data

One advantage of this type of programme development is the opportunity to study the programme closely and to develop a set of data notations which will indicate both the adequacy of teacher and programme operation as well as student progress. Table 1 presents the overall run data for the Monterey Language Programme from the sample of data which was analyzed in 1973-74.

Table 2 presents a substrata of that data organized according to 6 general geographic regions. The bottom set of figures labeled BSI represent the Behavioral Sciences Institute's laboratory established norms for run data which indicate appropriate operation.

[1] Monterey Learning Systems, 99 Via Robles, Monterey, California 93940.

Table 1

Run data in mean values for total sample of students on whom data sheets were returned

Total Language

Run Data

% Accuracy	Hours	Responses	Criterion Tests	
			Before	After
90.5	3.6	911.0	11.6	94.7
Totals				
Students	1,545			
Hours	9,309			
Responses	2,469,866			

Table 2

Run data in mean values for selected subsample of total sample. Selection was by 6 geographic areas. BSI entries represent the Laboratory established norms for adequate program operation

Different Sites

Run Data

Site	% Accuracy	Hours	Responses	Criterion Tests	
				Before	After
California	89	3,1	820	12	95
Iowa	95	2.9	700	10	97
Minnesota	91	3.4	760	9	97
North Carolina	95	3.1	660	18	96
Oregon	92	2.5	670	8	98
Pennsylvania	91	2.6	690	7	96
BSI	90	3.7	800	22	93
Totals					
	1,331				
Hours	7,800				
Responses	1,911,316				

Table 3 shows the run data for 4 etiological subclassifications.

Table 3

Run data in mean values for selected subsample of total sample. Selection was by 4 general etiological classifications. Hearing group was comprised primarily of profoundly deaf subjects

Different Children

Run Data

Type	% Accuracy	Hours	Responses	Criterion Tests	
				Before	After
Non-English	91	1.7	513	14.6	97.2
Hearing	91	3.4	471	14.9	95.2
EMR	91	2.S	606	11.0	92.4
TMR	86	4.9	1052	12.4	92.3
Totals					
Students	303				
Hours	1,879				
Responses	399,960				

Table 4 shows the results of pre-post language tests. A variety of generally recognized tests were used. The approximate therapy time between pre and post test was 10 hours.

Table 4

Pre and Post test scores on 7 different language tests. The PCLT entry is the criterion referenced test which is specifically keyed to the Monterey Language Program itself. Instructional time between pre and post test is 10 hours

Test Scores

230 Children 6 month period

Test	Before	After	% Improvement
PCLTp	37.2	57.3	54
PPVT	S.3	6.0	13
ACLC	75.9	85.7	12
NSSTt	19.9	22.8	15
NSSTe	9.6	13.3	35
BCI	63.8	57.3	17
BOEHM	24.6	28.9	17

Summary and Conclusions

From the foregoing data two conclusions appear warranted. First, programmatic procedures for language teaching can be used by teachers and therapists in the field in a manner equivalent to that observed in the laboratory. There were no remarkable differences in run data among regional locations or among noted etiologies.

Second, therapeutic impact was reflected in a variety of criterion referenced and norm referenced tests which accounted for both expressive and receptive language performance. This outcome suggests that programmatic procedures can result in clinical gain in the field as well as in the laboratoiy.

If the Monterey Language Programme and other similar programmatic language teaching procedures continue to demonstrate clinical efficiency, therapeutic gain and educational accountability in the field then perhaps it is time to consider that programming and techniques of educational technology do have a valuable place in the delivery of services to children with language handicaps.

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THE ROLE OF VOLITION IN HUMAN CONDITIONING

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Introduction and literature

The importance and application of Behaviour Therapy is well established in the treatment of learning disorders. However, the principles of Behaviour Therapy are borrowed from animal experiments based on learning theory which were originally and mainly patterned after animals experiments. The reasons for this preponderance of animal experiments over human experiments are obvious. Animal experiments are cheaper, faster and most importantly they are most practical because it is easier to control the subjects, the conditions or environment and the experimental procedures in animal experiments than in human experiments. Also animal experiments involve fewer ethical and moral questions. There are now a number of human experiments which are being conducted; in fact it has even been held that each controlled therapy session is an experiment.

However, the question has often been mentioned as to whether animal learning and human learning can be equated? Watson (1920) was the first to show that human beings can be conditioned in the same manner as animals.

Some experiments have taken the position that 'set' is always present in conditioning and that verbal instructions are just one way of producing sets.

Motivation affects performance, but there are arguments over the extent to which it affects the learning of habits or cognitive structures. The goals of the learner almost surely affect both learning and performance. An important aspect of motivation long neglected in learning theories is the relation of the given circumstances to the more persistent goals of the individual (Seward, 1952).

Often Set, Motivation and Readiness have been mentioned in the literature. However, the connotations in which these terms have been used are varied. Physical and Physiological maturity has been referred to as readiness, hunger for 'set' drives resulting from deprivation have often been attended as motivation.

However, Behaviour Therapy has run into some difficulty to explain these positions. In this context the point of interest to us is Stuttering. Several behaviour therapy techniques have been tried with stuttering and no technique has yet been satisfactory. Eysenck, (1965) has reported that Behaviour Therapy failed with a few stutterers and states that stuttering and conduct disorder have not responded well to Behaviour Therapy techniques in use. Wolpe *et al.,* report

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that a stammerer aged 13 years did not respond to desensitization being unable to obtain vivid visual images (1961). Earlier Wolpe (1958) found a 14 year old stammerer relapsed under stress after showing considerable improvement in the first few months of treatment. Relaxation and Breathing exercises had been used in this case. Lazarus (1963) found that panic states, anxiety states and stammering yielded the least satisfactory results. Only 20 per cent or one out of five stutterers showed improvement.

So the present paper reports a pilot study to check the importance of a Volitional Positive Set (VPS) or willingness to learn as a factor in 'success' of a learning experiment. The study is designed to verify the hypothesis that 'the subject's volition has no effect on conditioning'.

Methodology

. Two undergraduate speech and hearing students with good vocabularies in English were selected as subjects. The subjects were instructed to come out continuously with different words spontaneously for a duration of 15 minutes in each session. It is well known that nouns are the most frequently occurring words under such choice. So they were subjected to verbal conditioning of noun responses with two different instructions. Care was taken to keep the subjects unaware of the purpose of the study.

The total number of sessions were three. The first session was base rate. The second and third sessions of 15 minutes each were spaced into three intervals of 5 minutes each. The latter two sessions were arranged as 5 minutes base rate, 5 minutes stimulus and 5 minutes base rate again. The verbal stimulus 'no' was-the stimulus for verbal conditioning of nouns.

The instruction for the base rate session and the first five minute? of the second and third experimental sessions was to come out continuously with different words spontaneously. At the end of first five minutes of the second session the instruction (A) read was 'during the remainder of the session you will sometimes hear the word "no". As you are aware the word "no" refers to dissatisfaction or disapproval'. At the end of the first five minutes of the third session the instruction (B) read was 'during the remainder of the session you will sometimes hear the word "no". Just ignore it. We are trying to condition you and don't be conditioned'. Through 9uch an external stimulus as the instruction read an attempt was made to make the subject respond accordingly.

The verbal stimuli 'no' was presented contingently by the experimenter. All the proceedings of the three sessions were tape recorded and the word out put was counted for each five minutes. The number of nouns occurring in each session was recorded.

Results and Discussion

Table 1 and 2 provide the figures about the total word out put, noun out put and per centage of occurrence of nouns in each five minutes of the three sessions.

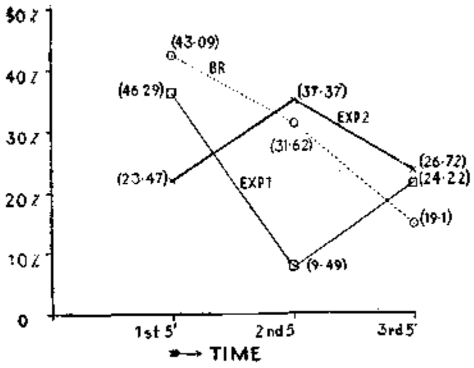

Fig. 1

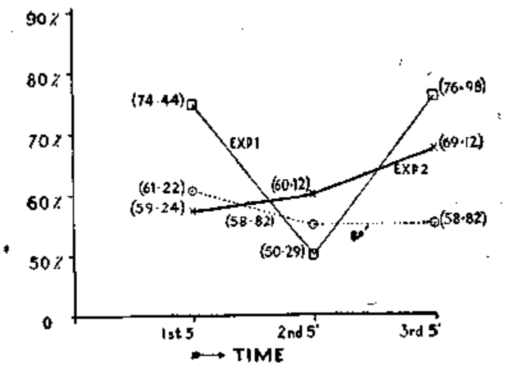

Fig. 2

TABLE 1. *Subject A*

Conditions		1st 5 mins.	2nd 5 minutes	3rd 5 mins.	Total
Base rate	Total word out put	239	142	89	470
	Nouns	103	45	17	165
		43.09%	31.62%	19.1%	
Experiment-1	Total word out put	216	158	161	535
	Nouns	100	15	40	155
		46.29%	9.49%	24.22%	
Experiment-2	Total word out put	190	209	156	555
	Nouns	45	78	42	
		23.67%	37.37%	26.72%	165

Table l and 2 shows the percentage of occurrence of nouns out of total word out put for Subjects A and G respectively at three different times in each session.

TABLE 2. *Subject G*

Conditions		1st 5 mins.	2nd 5 mins.	3rd 5 mins.	Total
Base rate	Total word out put	104	85	98	287
	Nouns	77	50	60	187
		61.22%	58.82%	58.22%	
Experiment-1	Total word out put	180	169	139	488
	Nouns	13'	85	107	326
		74.44%	50.29%	76.98%	
Experiment-2	Total word out put	184	163	136	483
	Nouns	109	98	94	301
		59.24%	60.12%	69.12%	

Considering Table 1 of subject A, in the base rate the percentage of occurrence of the nouns has a decreasing trend from 43.08 per cent in the first five minutes to 19.1 per cent in the third five minutes (Fig. 1). In the experiment-1 the first five minutes base rate was 46.29 per cent. During the second five minutes there was a steep fall with the occurrence of nouns reducing to 9.48 per cent when the nouns were contingently stimulated with the verbal stimuli 'no' under the instructions (A) as mentioned earlier. In the third five minutes there was a gradual increase in the occurrence of nouns from 9.48 per cent to 24.22 per cent a period possibly of spontaneous recovery. In experiment-2 the first five minutes base rate was 23.67 per cent a possible continuation of the last five minutes of the second session which was less than that of the first and second sessions. During the second five minutes there was an increase in the percentage of occurrence of nouns when contingently stimulated with the verbal stimuli 'no' under the instruction 'B' 'during the remainder of the session you will hear the word "no". Just ignore it. We are trying to condition you but do not be conditioned'.

In the third five minutes of the session the percentage if nouns was once again decreased, and the results obtained in this session is quite opposite to that of the second session, strongly indicating the effect of volition on conditioning brought about by the external source.

Table 2 of subject G shows that the BR readings of the percentage of occurrence of the nouns are almost constant in all the three intervals as 61.22 per cent, 58.82 per cent and 58.22 per cent respectively (Fig. 2). The instructions read were similar for both the subjects. In the first five minutes of the second session the nouns were 74.4 per cent; when contingently stimulated with 'no' in the second five minutes it decreased to 50.29 per cent and in the third five minutes it once again raised to 76.98 per cent. The explanation given for the subject A holds good for the subject G also. In the third session, first five minutes had 59.29 per cent and second five minutes had 60.12 per cent. The figure confirms that conditioning was not established as it was in the second five minutes of the second session, these two sessions being comparable except for the instructions read at the end of first five minutes. In the third five minutes the occurrence of nouns was 69.12 per cent. With the nature of the data obtained, this increase in the third five minutes of the third session seems to be unexplainable except to state that the increase from the first session to the second session continued. However, these findings agree with those of Table 1 of subject A with respect to the role of volition in human conditioning.

The two subjects of this experiment had Volitional negative set (VNS) as to respond according to the 'Negative set' brought about by the external source namely the instructions 'B'. Thus it is possible for an external source to bring about VNS hindering conditioning. Therefore, conversely if any conditioning technique on which most of our therapies based has to succeed, a Volitional positive set (VPS) has to be established. The absence of VPS may be one of the factors in the failure of many of our attempts at therapy. While in our study an externally influenced VNS hindered conditioning, it is feasible to assume that VNS could be internally influenced also. This would suggest that therapists should devote some attention to the establishment of VPS. This takes us right back to the stress on motivation. It is planned to study the importance of VPS in conditioning of autonomic activities and to study the effect of VPS or VNS on stronger aversive stimuli. Confirmation of the present findings in those studies also would caution us against equating animal learning and human learning.

Summary

An attempt was made to verify the hypothesis that 'the subject's volition has no effect on conditioning'; in other words to test the role of volition in human conditioning. Two under graduate speech and hearing students with good vocabularies in English were selected as subjects. The task was to come out continuously with any word spontaneously for a period of 15 minutes. Out of this nouns were subjected to verbal conditioning contingently stimulated with the word 'no' with two different instructions in two sessions. Instruction 'A' was similar to instruction in learning experiments. Instruction 'B' led to a 'Volitional negative set'. The obtained data is analysed and discussed. The findings suggest that there is a definite effect of the subjects volition in human conditioning.

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IS THE CONCEPT OF 'MENTAL RETARDATION' APT?—A CRITICAL DISCUSSION

JAYARAM M.

A Word on Categorisation as Introduction

Categorisation has evolved from the models of psychopathology. However, the concept of categorisation had more contacts with the medical model rather than with the other models. In the medical model the labelling of deviant behaviour is termed diagnosis and till 1960, it almost appeared a fashion to label behavioral variations separately and to characterise them. The categorisation process has done predominant havoc in the field of psychology. It is very true that the categorisation process and/or the medical model brought in certain amount of reformation. However, it may not be wise to say that since it has brought in reformation, it is an effective model and/or procedure. Recent empirical investigations are making obvious the statement that the medical model is inefficient in explaining behavioral disorders. We will now examine the truthfulness of this statement with reference to 'Mental Retardation'.

From 1900 to 1920 Binet dominated the field of child development with interest centered on classification and psychometry. During that period the presumed 'lower level of intelligence' was termed 'Mental Retardation'. After this the interest of the child psychologists was in growth studies and the interest was expressed in terms of so called 'Normal Growth' and 'Mental Retardation' was of peripheral interest. Under these circumstances the 'low level of intelligence' concept of retardation was not disturbed (Wortis, 1970). However, the proponents of this categorisation have severely been criticised for their stand on the following lines. What they have forgotten is that classifying several individuals into one group because of some similarities will obscure the many important differences. The aim of categorisation is classifying or labelling rather than understanding and modifying the patient's behavior. It also creates the impression for the user that just because he has a name he has understood it and knows all about that. Added to these problems is that no two persons behavior are the same and categorisation permits us to equate two or more people as equal and identical In the categorisation process there will be no 'inner silence' as Korzybski calls it and the clinician's evaluation will be biased because of his implicit assumption of categorisation.

A word does not say everything about anything. Above all categorisation misleads the clinicians. We frequently hear therapists exclamate 'oh! he is an "MR", after all what can he learn'. Thus it creates unwarranted limitations on **what** might be achieved with so called 'Mental Retardates'. This argument

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does not actually say anything about the aptness or otherwise of the term 'Mental Retardation' but tackles a more basic issue.

With this preamble, before embarking upon the aptness or otherwise of the term 'Mental Retardation', it is worthwhile to have a critical examination of the definitions of 'Mental Retardation'.

In science, the most fundamental level of a phenomenon is the definition of it. 'Mental Retardation has been traditionally defined as follows:

(1) 'The mentally retarded individuals, who as a result of inadequately developed intelligence, are significantly impaired in their ability to learn and adapt to the demands of the society' (President's panel on Mental Retardation, 1962).

(2) 'Mental Retardation refers to subaverage general intellectual functioning, which originates during, the developmental period and is associated with the impairment of adaptive behavior' (AAMD, 1961).

(3) Doll includes six criteria which he considers essential for an acceptable concept of retardation. (1) Social incompetence (2) Due to mental subnormality. (3) Which has been developmentally arrested. (4) Which is obtained at maturity. (5) Is of constitutional origin and (6) Which is essentially incurable.

In general the term 'Mental Retardation' is a simple designation for a group ofcomplexphenomenonstemmingfrom many different causes, but the one common factor found in these definitions is that they all emphasize the presumably inadequately developed intelligence. The proponents of this idea argue that intelligence is a constant and basic feature and without a radical effect on the sphere of intelligence the child cannot be considered mentally defective, no matter how ignorant and illiterate he may be or abnormal in his emotional, instinctive, volitional or more relations.

But this seems not to be true. Retardation should only mean 'a limited repertoire of behavior'. For example, if an individual 'A' has 'XYZ' behaviors and individual 'B' has only 'XY' behaviors, the individual 'B' is definitely said to be retarded. On the other hand one cannot say that the behavior 'X' is important and hence as the individual 'B' possesses it, he is not retarded.

Another factor which has been emphasized in these definitions is that the condition is essentially incurable and unremediable through treatment except as training instills habits which superficially or temporarily compensates for the limitations of the person so affected. However, a simple objection at this level is that the term incurable has not been defined. Based on the result of many studies and our clinical experience we can say that the so called 'Mental Retardates' will show improvement after treatment. It is evident further through these investigations that the improvement seen are not compensatory actions but are actual improvements in tke present behaviors and that these changes are 'fairly' permanent.

The proponents who consider that 'Mental Retardation' exists from birth or early age have not been able to explain why there were greater changes in the rate of growth, the greater the changes were made in the environment (Blatt, 1971). However, they give an answer that such changes are more likely due to errors in original diagnosis. But this it nothing but begging the intriguing questions.

The contention that 'Mental Retardation' is of hereditary nature is based on the administration of routine intelligence tests. Hence we are not justified to say so, till we understand the nature of the human genetics and intelligence and that in any case this is possible only when we go beyond just speculations and bias (Blatt, 1971).

Those who contend that it is a physical or constitutional defect argue that 'Mental Retardation' is a symptom of some constitutional defect. But a review of literature on this shows that 'Mental Retardates' do not exhibit any deficiencies of brain structure or somatic organization (Blatt, 1971). Sarason and Gladwin (1958) sum up that the retarded do not exhibit any central nervous system pathology. Though the validity of these findings is not known, but still such evidence is forthcoming and for any other reasons described here 'Mental Retardation' should be assumed free of constitutional disturbances.

Regarding 'Social Competence' and Impairment of adaptive behavior', these may be due to anything, that is, even the sc called normals exhibit this. What is that which is showing retardation in social behavior in normals? The term a social competence and adaptive behavior have taken into consideration the behaviors which are found commonly and through 'Rating Scales' and 'Questionnaires' they have been quantified. If this is the case, it appears fallacious to talk of 'Impairment of adaptive behavior' in normals. But the point is that adapting to the environment comes more as the individual moves with the society than anything. Moreover this term 'impairment of adaptive behavior' has not been properly defined in the sense that it reflects either can delay in maturation, or a delay in gaining or learning knowledge from his experience and social maladjustment—ability of an individual to sustain himself in a manner consistent with the standards and requirements of the society. But, what happens when an individual changes to a new society! People with introverted characteristics or tendencies will certainly feel it difficult to adjust to a new society. This doctrine explains that all individuals adapt to the new society, however, difference is seen in terms of latency or time taken by the individual to adapt to the new environment. This poses many questions, however, it is quite possible. But empirically we do not know how true it is. The crux of the matter is that an individual who has an IQ of 75 or 80 and who reveals no significant impairment in adaptive behavior is not labelled 'mentally retarded' (AAMD Manual, 1961). However, it is not the contention of the author here to bring a correlation between the IQ and the social competence nor to say that social criterion is not essential. One important limitation of the IQ approach by Tredgold and others is that IQ approach either overestimates or underestimates the problems. Hence social criterion is essential but the focus should not be only on the social criterion.

Some people claim that social competence reflects intelligence. Considering this we will be landing in one more problem, that is, we do not know the nature of intelligence, precisely. We can't take intelligence as what an intelligence test measures. However, we know that intelligence is an hypothetical concept that ultimately refers to the cognitive processes of the individual (Memory, Abstract reasoning, etc.). But we do not know whether intelligence represents a single cognitive process which permeates all other cognitive processes or whether it represents a variety of relatively discrete cognitive processes which can be sampled and then summated to yield an indication of a person's total intelligence. In the words of Ziegler (1968) 'social competence does not inevitably reflect normal intellectual functioning any more than its absence in the emotionally unstable, criminal or the socially misfit reflects intellectual subnormality'. It is much too heterogenous phenomenon and reflects too many non-intellectual factors to be of great value in understanding mental retardation. The basic problem is that the concept of social competence is so laden with value and its definition is so vague that it has little empirical utility'. And further the social criteria are just as arbitrary as the IQ, if not more so, and have not even have the advantage of being based on norms for an entire population (A. M. Clarke, 1958). The problem is that the social competence construct is ambiguous and the measures of it are not available.

One common aspect of all the above definitions and also various approaches to the study of 'Mental Retardation' is that they all emphasize some hypothetical concepts such as social competence, low level intelligence and biological abnormalities such as clinically inferred brain injury. Skinner (1953) says that 'emotions are excellent examples of the fictional causes to which we commonly attribute behavior'. Likewise in 'Mental Retardation' the limited repertoiry of behavior is said to be caused by low intelligence. The 'Mentally Retarded' individual is deficient in overt behavioral instrumental responses and whose function is to control 'what happens', to prevent undesirable happenings and to insure or at least encourage desirable ones and this observed deficiency is due to the fact that he has not been taught. Whether the hypothetical concept of intelligence is inferred from behavior alone or from behavior in combination with stimulating conditions, its level is said to be built in processes such as heredity, familial, constitutional, intrinsic or endogenous factors and modified by determental environmental extrinsic or exogenous factors (Tredgold and Soddy, 1956). Differences in the observed learning rate in any given situation are a joint result of individual differences in elementary capacities and in cumulating results of past learning in the same and other situations. This capacity may be determined either genetically or by some combination of genetic factors and developmental processes which are independent of previous learning.

As man is the product of the biological and social heritage and the capacity and also what to learn is biologically given, in this frame of reference, one should ask the question as to how one is retarded instead of why one is retarded. And so his personality, or his social and other experiences lie outside the scope of the learning theory. Though the congenital mechanisms are necessary for complete understanding of the human personality it is doubtful whether with such knowledge alone one can deduce or predict the development of personality of an individual. Learning makes a man changeable.

In 'Mentally Retarded' individuals there is observed a change in their performance because of inadequate learning or acquiring. But the why of this phenomenon has not been explained by bahaviorists. Differences between normal and retarded groups with respect to previous learning experiences may have important bearing upon the differences observed (Estes, 1970).

Mowrer (1960) refers to this as learning sets or learning to learn. It is well known that learning of language by a human infant opens up for him further learning capacities or at least opportunities. It is also well known that not having learnt a behavior may well influence and interfere in the acquisition of other behaviors. One difficulty of explaining 'Mental Retardation' in hypothetical terms is that, it is common practice to infer causes from the observed behavior, of which we are not justified. If this is the case, then in 'Mental Retardation', low intelligence will be the cause and at no point we make contact with any event outside the behavior which justifies our casual connection. The inefficient performance of the 'Mentally Retarded' in a task reflects to a major extent his retardation in the development of various habits of selective attention, search and rehearsal, coding and recoding of stimulus information. When the task is simplified to reduce the possible contribution of these various auxilliary processes, he performs better. Individual differences in their habit systems may reflect difference in capacities and/or strongly determined by variation in motivation systems and previous opportunities to learn.

But it may be true that the so called 'Mentally Retarded' children will perform better when they are focused to 'ideal' environment. However, Ziegler assumes that the differences between the 'Mentally Retarded' and the normals is not quantitative but qualitative. Behaviorists including Skinner argue that 'mental retardation' is not existing taking into consideration the repertoire of behavior. But Ziegler says that it may be true that the mental retardates behavior repertoire is narrowed because of the non-availability of the environment or reinforcement, but even when these individuals are focused to the normal environment and even when they acquire similar relations as a normal individual and even though they become equal in terms of number of behaviors, they do differ qualitatively. He concludes 'mental retardation is a qualitative disorder rather than a quantitative one'

(Ziegler, 1968). However, Ziegler has been criticised on the following grounds. It appears that many of the differences between retardates and normals of the same mental age are a result of motivational and emotional differences which reflect differences in environmental histories and not in innate capacities.

A normal child learns discriminations, to respond differently to different stimuli and so he gets the maximum reward and this generalises to new situations. This type of correct scanning of different responses are conspicuously absent in 'mentally retarded', whom are termed 'impulsive', 'distractable' etc. This lack of ability to scan responses is attributed to localised brain lesion but these defects are largely a result of absence of necessary conditions for learning the habits of stimulus scanning and inability to learn. Unless these are learnt the question of generalization is beyond the scope.

For the development of any behavior motivation is necessary and for normal motivational development an environment relatively free of punishment is important. However, with the 'Mentally Retarded' this reinforcement paradigm is not proper because it is a vicious circle here. Estes (1970) states that none of the retention or learning processes that have been analysed in normal human behaviour in the laboratory differ qualitatively in the mentally defective. The reader is referred to Bijou in Ellis (1966) who has extensively dealt with this. Bijou (1966) stresses, that, in 'Mental Retardation' the main object should be to analyse the observable conditions which produce retarded behaviour and not retarded mentality. The concept of IQ or intelligence does not serve any important rehabilitative interest in the retardates.

We have seen so far, that in 'Mental Retardation', intelligence is the prime factor and it has been given the utmost importance, so that some clinician's find it shocking even to imagine any other approach to the study of this condition, we know many disadvantages of the concept of IQ and of intelligence tests. Though yet the main tool of clinicians in the diagnosis and classification of retardates is intelligence test.

The ratio of the mental age over the chronological age (usually multiplied by 100 to get rid of the decimal point) is referred to as IQ. This concept of IQ has got many disadvantages. This IQ does not remain constant and this consistency is essential to make any prediction about the child. There are research reports which have dispelled the norms showing that the IQ varied with the type of test administered, maturation and experience, emotional stability and education. And Eyesenck (1960) says that IQ's obtained before the age of six are of very little use and hence a diagnosis of retardation based on this criteria, before the age of six years becomes totally invalid. However, granted that IQ's are reasonably constant then it will be again a problem in determining the IQ's of older children and adults. The growth and decline of the mental ability with age has been studied by many and from this we know that the growth of intelligence is reasonably linear only between the ages 6 and 12 and it follows from this that we cannot properly calculate the IQ beyond the age of 12 or 15 at the most. However, it is possible in this purely statistical world. The concept of intelligence has been thoroughly misguided by the test constructors and the psychometricians.

The validity of the IQ should also be questioned at this stage. The prediction of an individual's IQ just based on intelligence tests has many disadvantages. To start with, these tests do not consider the individual's special abilities, and interests. So the IQ is just the average of his performance in different tasks. They do not take the effect of practice and coaching, his motivation and anxiety, his physical and or psychological conditions. And the administration of intelligence tests has also got many disadvantages. We ordinarily do it this way: we look at the profiles; we call to mind, what the various test dimensions mean for dynamics; we reflect on other patients we have seen with similar patterns; we think of the research literature; then we combine these considerations to make inferences (Corah, 1971). Our aim is just to have seme quantitative data.

To conclude, viewing 'Mental Retardation' as low level intelligence does not serve any rehabilitative purpose. It is better, if the retarded development is viewed as a function of inadequate reinforcement and discriminative histories. Inadequate performance, whether in daily life situations, or in intelligence tests or in any other situation should be viewed as, that appropriate behaviours have not been selectively strengthened by differential reinforcement in the past. IQ is a very poor predictor (Eyesenck, 1970).

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SYNTACTIC DESCRIPTIONS OF BILINGUAL PATTERNS

P. C. GANESHSUNDARAM AND MAYA DEVI

1.0 Introduction

1.1 *The psycho-Sociological problems of Bilingualism for study by the Application of Computational Linguistics*

Language contact is a Universal phenomenon, having a tendency towards cultural harmony as one of its manifestations. This brings into effect the operation of phenomenon which is of Sociolinguistic importance. One of the resultants of this phenomenon which is of significance to psycholinguistics is 'Interlinguistic Interference'.

A study of bilingualism as a non-structural factor of interference has been taken up by many linguists, psycholinguists (Weinreich, Epstein and Stern, 1954) and speech pathologists (Berry and Eisenson, 1957).

With the advent of the computer, there are now precise and rapid mean? of analysing a large mass of data related to speech and language.

Bilingualism, referring to the co-occurrence of two languages in an individual (Gumperz, 1964) has been hitherto dealt with as a phenomenon of interference. Here interference refers to 'those instances of either language which occur in the speech of bilinguals as a result of their familiarity with more than one language contact' (Weinreich, 1954). This also implies the rearrangement of patterns that result from the introduction of foreign elements into the more highly structured domains of language, such as the bulk of the phonemic system, a large part of the morphology and syntax and areas of the vocabulary. Consequently, there have emerged interferences at the phonemic, grammatical and lexical levels.

The above formulations lead us to ways of analysing the types of interferences within a bilingual individual or in a bilingual community, making use of the methods of computational linguistics.

Structural relationships between two languages and the concept of language universale (Chomsky, 1965), have led to the development of mechanised translation as a branch of computational linguistics.

Mechanised translation, as the name itself implies, would seek to arrive mechanically at the structural equivalents of the two languages analysed.

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Utilizing this principle, it would be feasible in the same way to find the structural equivalents in the languages spoken by the bilingual individual. These data when compared with the structual analysis of the speech of a monolingual speaking any one of the languages spoken by the bilingual, would give a comparative account of the languages of the bilingual and the monolingual and also would describe the interferences met with at several levels of language structure.

1.2 *The Linguistic Study of Bilingualism*

This complex problem has so many factors involved in it, that, for any detailed study of some of these factors, all other factors have to be eliminated by making certain simplifying assumptions and through proper selection of the subject, his environment and the situation and style of his discourse.

(a) We have taken for our study one Subject, whose background is as given below:

1. Age: Fifty five years.
   Sex: Female
   Class: Middle class.
   Caste: Hindu—Brahmin
2. Educational Background:
   Lower Secondary—Kannada Medium
3. Bilingual Background:
   LI—Telugu (Mother-tongue)
   L2—-Kannada (Language of the region and medium of school education)
   There is no demarcation in the sphere of use of these two languages in the individual.
4. Linguistic background: All members of the Subject's family speak both Telugu and Kannada.

(6) To eliminate the effects of inter-class and inter-caste linguistic manifestations, we have chosen the Subject's discourses restricted to the following situations:

1. One of the authors of this paper, who is a bilingual in Telugu and Kannada and who is of the same social group as the subject conducted the informal interview, in quite a normal and natural conversational set-up (as if, she were merely having a chat with the Subject).

2. The subject's speech was in the form of a series of spontaneous refsponses to a series of questions posed in the course of the informal conversations.

3. Since the subject prefers to speak in Telugu with those who speak Telugu and in Kannada with those who speak Kannada, the investigator, being a bilingual,

spoke in Telugu to get Telugu responses and in Kannada to get Kannada responses.

4. The subject was asked to give her views on some day-to-day topics spontaneously in the two languages on different occasions.

(c) Since most other such studies have dealt with mainly phonological peculiarities or with vocabulary, we have chosen syntax as our main concern.

(d) We use the 'Practical Theory of Syntactic Structure' as our frame-work for our study.

2.0 *Method*

2.1 *Method of obtaining data*

In accordance with the principles outlined under 1.2 above, the data were obtained by eliciting answers for a set of questions (in the course of a conversation). The questions asked were:

1. NIMMA UURU YAVUDU?
2. BENGALXUURIGE ADU BAHALXA DUURAANA?
3. NIIVU ELLIYATANAKA OODIDDIIRI?
4. NIMAGE BENGALXUURINA VAASA ISXITXAVAA?
5. SNEHITARA BAGGE NIMMA ABHIPRAAYAVEENU?
6. NIIVU KATHE PUSTAKAGALXANNU OODUTTIIRAA?
7. NIMMA MANEYALLI YAARU YAARU LDDXAARE?
8. II UURINA BAGGE NIMAGE EENUANISUTTADE?
9. NIMAGE SANGIITADALLI BAHALXA AASAKTI IDEYAA?
10. NAMMA DEESHADA RAAJAKIIYADA BAGGE NIIVU EENU HEELXUTTIIRI?
11. VIDYAARTHIYAVARA GALAATXE BAGGE EENU HEELXUTTIIRI?
12. NIMAGE SINEMA NOODXUVA ABHYAASAVIDEEYAA?
13. NIMAGE HOLIGE EENAADARUU BARUTTAA?
14. BENGALXUURINALLI NIMMA VAASASTHALXA YAAVUDU?
15. SANJE VEELXEYANNU HEEGE KALXEYUTTIIRI?
16. REEDXIYO KEELXUVA ABHYAASA IDEYAA?
17. INDINA YUVAJANAANGADA BAGGE NIIVU EENU HEELXUTTIIRI?

The answers to these questions were obtained independently in the two languages.

2.2 *The Practical Theory of Syntactic Structure and its Metalinguistic Symbolism*

Any surface level sentence in a language has an underlying 'amorphous sentence' S' which is the result of the operation of the 'semantic determinant'* on the amorphous proposition S. This proposition S is made up of a Verb V (taken as a 'primitive concept') and its various 'agruments' collectively represented **as J.**

We have the following relations among the various components of the amorphous sentence S'.

The sentence S' ceases to be amorphous and takes definite linear shape on the application of language specific rules of word-order.

The amorphous sentence is given by:

(1)	S'	—	*S
(2)	S	—	('J' 'V')
(3)	J	—	Z 'Z''
(4)	Z'	—	J
(5)	Z	—	[P $\times$ 'Q'
(6)	Q	—	P
(7)	P	—	{ [$\Sigma P_{(i)}$] [Z]
(8)	$P_{(i)}$	—	{ [C] [NO] [AO] [DO]
(9)	C	—	($\Sigma C_{(i)}$)
(10)	$C_{(i)}$	—	('$J_{(i)}$' '$V_{(i)}$')
(11)	NO	—	[$\Sigma NO_{(i)}$]
(12)	$NO_{(i)}$	—	{ ['T' NA] [R_1] [R_2]
(13)	T	—	{ [T_1], [T_2], . . . }
(14)	NA	—	['[AO]' N], . . .
(15)	N	—	{ [N]$_1$ [N_2], . . . }
(16)	AO	—	[$\Sigma AO_{(i)}$]
(17)	$AO_{(i)}$	—	['[DO]' A]
(18)	DO	—	[$\Sigma DO_{(i)}$]
(19)	$DO_{(i)}$	—	[D $\times$ 'Y']

(20)	Y	— $DO_{(i)}$
(21)	A	— {[A_1], [A_2], . . .}
(22)	D	— {[D_1], [D_2], . . .}
(23)	R_1	— {[PR_1], PR_2], . . .}
(24)	R_2	— {[RR_1], [RR_2], . . .}
(25)	{T_1, T_2, . . }	— {Lexical determiners like: *a*, *the*, *this*, *my*, etc.
(26)	{N_1, N_2, . . }	— {Lexical nouns}
(27)	{A_1, A_2, . . }	— {Lexical adjectives}
(28)	{D_1, D_2, . . }	— {Lexical adverbs}
(29)	{PR_1, PR_2, . . }	— {Lexical pronouns}
(30)	{RR_1, RR_2, . . }	— {Relative pronouns}
(31)	V	— {VC VO
(32)	VC	— [X J]
(33)	X	— {VC VO
(34)	VO	— {VK VI VT
(35)	VK	— {VK_1, VK_2, . . . }
(36)	VI	— {VI_1, VI_2, . . . }
(37)	VT	— {VT_1 VT_2, . . .
(38)	*	— +′ ‘+’
(39)	+′	— {The ‘modalities component’ of the semantic determinant *, including psychological and logical associations and formal presentation
(40)	+	— {The extended Fillmore ‘case-role’ components

Where the various brackets stand for what is written within each of them below:

(S-structures, C-structures or Conjunct verbs),
[P-structures],
{Alternatives} and
‘Optionals’.

If by the repeated application of rules (3) and (4), twice (each time choosing the optional element Z'), we get:

$J \rightarrow Z\ Z\ Z$

$\rightarrow Z_1\ Z_2\ Z_3$

then

$S' \rightarrow *S$

$\rightarrow *(Z_1\ Z_2\ Z_3\ V)$

$\rightarrow *_s(*_1 Z_1\ *_2 Z_2\ *_3 Z_3\ *_v V)$

where $*_s$ stands for the way S' is presented (namely: indicative, interrogative, imperative, active, passive, etc.), $*_1$; $*_2$, $*_3$ are respectively case 1, cat,; 2, case 3 the nouns (real or 'virtual') and is the tense and aspect of the verb. As an example, we may have (in English):

$S' \rightarrow *_s(*_1 Z_1\ *_2 Z_2\ *_3 Z_3\ *_v V)$

$\rightarrow *_s(*_1 Z_1\ *_v V\ *_2 V_2\ *_3 Z)$

— ([John] hit [the bird] [+with a stone]).

2.3 *Transcription of Kannada and Telugu Utterances in the Roman Script*

VOWELS

Kannada:	ಅ	ಆ	ಇ	ಈ	ಉ	ಊ	ಋ	ಎ
Telugu:	అ	ఆ	ఇ	ఈ	ఉ	ఊ	ఋ	ఎ
Roman:	A	AA	I	II	U	UU	RX	E

K	ಏ	ಐ	ಒ	ಓ	ಔ	ಅಂ	ಅಃ
T	ఏ	ఐ	ఒ	ఓ	ఔ	అం	అః
R	EE	AI	O	OO	AU	AW	AX

CONSONANTS

K	ಕ	ಖ	ಗ	ಘ	ಙ
T	క	ఖ	గ	ఘ	ఙ
R	K	KH	G	GH	GW

K	ಚ	ಛ	ಜ	ಝ	ಞ
T	చ	ఛ	జ	ఝ	ఞ
R	C	CH	J	JH	JW

K	ಟ	ಠ	ಡ	ಢ	ಣ
T	ట	ఠ	డ	ఢ	ణ
R	TX	TXH	DX	DXH	NX
K	ತ	ಥ	ದ	ಧ	ನ
T	త	థ	ద	ధ	న
R	T	TH	D	DH	N
K	ಪ	ಫ	ಬ	ಭ	ಮ
T	ప	ఫ	బ	భ	మ
R	P	PH	B	BH	M
K	ಯ	ರ	ಲ	ವ	ಶ
T	య	ర	ల	వ	శ
R	Y	R	L	V	SH
K	ಷ	ಸ	ಹ	ಳ	ಕ್ಷ
T	ష	స	హ	ళ	క్ష
R	SX	S	H	LX	KSX
K			ಜ್ಞ		
T			జ్ఞ		
R			JJW		

2.4 *Simple Sentence Patterns*

For convenience in our discussion, we have classified sentences in their increasing order of complexity in accordance with our system of syntactic demarcations. The major patterns are:

1. (V)
la. ([ ])
2ft. ([ ] [ ])
3a. (V[ ])
3b (V[ ]...[ ])
4. (V [(. . .)])
5. (V [(V [(V . . .)])])
6. (V[(V[ ])] [(V[ ])])

3.0 *Results and Discussion*

3.1 *Analysis and Discussion of Date.*

All the answers to the above questions in both the languages were compared, and the sentences which were found similar in their structure were grouped under one category. These sentences were then classified as examples of the major sentence patterns (given in § 5). The sentence demarcations are according to the 'Practical Theory of Syntactic Structure', where the structure for structure matching between the two languages from the outermost to the innermost structures to the extent they are manifest is brought out through these demarcations.

TYPE 1 (See § 5 above):

None in the data collected.

TYPES 2A AND 2B

Kl : ([[Namma] uuru] [Shriinivaasapura])
Tl : ([[Maa] uurv] [Shriinivaasapuram])
El : ([[My] place] is [Shrinivasapisram])
K2 : ([[Tumba] duuraane])
*T2 : ([[Saanaa] duuramee])
E2 : (([It] is] [[really] [[too] far]])
*K2' : ([[[Tumba] duuraa] [nee]])
T2' : ([[[Saanaa] duuram] [ee]])

(K2' and T2' indicate an alternative syntactic demarcation that matches, them with the English structure E2),

K3 : ([L.S. +tanaka])
T3 : ([L.S. +tanakam])
E3 : ([+Upto L.S.])
K14 .: ([Raajaajinagara+dalli])
T14 : ([Raajaajinagaram-j-ulo])
E14 : ([+At Rajajinagar])
K7 : ([[Maga], [sose], [mommaga]))
T7 : ([[Kadxaku], [koodxaalu], —malxlxi— [manamudxu]])
E7 : ([[My] [[son], [daughter-in-law] =and= [grandson]]])

In all the above:

Type 2a is represented by: K2/T2, K2'/T2', K3/T3, K14/T14 and K7/T7.
Type 2b is represented only by Kl/Tl Here the English equivalent has a link verb *is, (to be),* in it.

All the above type 2a structures are elliptical. Since they are answers to questions, the verb in the question is not repeated in the answer.

In K7/T7 we have the logical 'AND' relation. The equivalent of *and* in English may be omitted as in K7. (Rule (11) of § 3, namely NO is the one that deals with this logical 'AND' relation among coordinate elements).

TYPE 3

K6 : ([Aaaw])$_r$ ([Aadare] ([tumba] alia))
*T6 : ([Aunu]). ([Aite] ([saanaa] leedu)).
E6 : ([Yes]). ([But] (not [much])).
K13 : (([Summane] boliyuvudu), ([asxtxe])),
*T13 : (([Uurake] tecceedi), ([ante])).
El3 : ((([I] like [+to (stitch)]) [a little]), ([That] is [all])).
*K13 : ([([Summane] holiyuvudu)] ([isXtXa])).
T13': ([([Uurake] tecceedi)] (isXtXamu])).
E13' : (([I].like) [+to (stitch, [a little])]),
K16 : ([[Svalpa] svalpa] ide).
T16 : ([[Kowca] kowcam] undi).
E16 : ([Sometimes] ([I] do)).
K4 : ([Nanage] halxlxiine) ([isxtxa])).
T4 : ([Naaku] [palxlxiine] ([isXtxam])).
E4 : ([I] prefer [the village])
K8 : ([Eennu] anisuvudilla)
T8 : ([Eemii] anipicceeleedu)
E8 : (([I] don't feel) [anything])
K9 : ([Aasakti] ide)
*T9 : ([Aasakti] undi)
E9 : (([I] have)]interest]): 'I am interested' (idiomatically).
*K9' : ([Huuw]). (Adaralli] ([[bahalxa] aasakti] ide)).
T9' : ([Aunu]). ([Daaniloo] ([[ninxdxa] aasakti] undi)).
E9' : ([Yes]). ((([I] have) [[great] interest]) [+in it])
(Idiomatically): I am very much interested in it.

In all the above, we have the telescopically repetative structure (V [.;.;.]), where V is often a 'conjunct verb' given by: V—VC, where VC—(V [...]).

TYPE 4:

*K6' : ([Haudu]). ([Aadare] ([[([tumba] oduvudu)] [eenu]] ilia)).
T6' : ([Avunu]). ([Aite] ([[([Saanaa] cadived)] [eemi]] leedu)).
E.6' : ([Yes}), ([But] (([I] don't) (read [much]) [anything]) ,

E6" : ([Yes}).([But] (([I] don't do) [[any] [(reading:[much])]]))
(Idiomatically): I don't read Much,

K12 : ([([[Ol X l X eya] sinema] aadare)] nood X uteene).

*T12 : ([([[Manci] sinema] aite)] cuustaanu).

*K12': ([([[([Cennaagi] iruva)] sinema] aadare)] nood X utteene).

T12': ([([[([Manciga] un X d X e)] sinemaa] aite)] cuuseedi).

E12' : ([+If (([it] is) [a film [([that] is [good])]])] ([I] see[it})).

Kll : ([([Shantiyutavaagi] [(galaat X e] maad X idare))] paravaagilla).

*T11 : ([([Shaantiyutamugaa] ([galaat X aa] ceestee))] paravaaleedu).

Ell : (([It] is [all rightj) [+if (([they] strike) [peacefully])]).

*K11': ([([[Shaantiyutavaada] galaat X e] aadare)] paravaagilla).

T11': ([([[Shaantiyutamaina] galaatxaa] aite)] paravaaleedu).

Ell' : ([X lf (([It] is) [a [peaceful] strike])] ([it] is [all right]))

K15 : ([([Horagad X e] suttaad X uttaa)] kal X eyutteene).

T15 : ([([Bait X a] cut X t X aad X ikoni)] kad X ustaanu).

E15 : (([I] Spend [my time]) [(roaming [about])]).

K10 : ([([[Raajakityada] vyavahaaraane] ([sariyaag] ilia))] enisuttade].

T10 : ([([[Raajakiiya] vyavahaaram.ee]
([sarigga] leedu)) +ani) kanapadxistundi).

E10 : (([It] appears) [+that ([the [political] affairs]
(are not [sound]))]).

K17: ([[([[Ket X t Xa] gun X agal X] ul X l X) a-var] = u u =
[ol X l X eyavar] +uu] iruttaare).

T17 : ([[([[Ced X d X a] gun X am] un X d X e) vaal X l X] = u u =
[mancivan X 1 X] X ua] un X t X aaru).

E17 : (([There] are) [[people [(having [[bad] qualities])]]
=and— [[good] people]]).

In Type 4, we have the general structure: (V [(VC)]), where VC—(V [(VC)]) or (V [. .]).

N.B. In the case of the examples marked*, the Subject originally gave patterns that were not exact translations but could give an exactly similar pattern in the other language when the pattern of one of the languages was again presented to her.

3.2 *Deviation in the pattern between the two languages:*

TYPE 5

The one example we got of this pattern from the subject does not fully match in the two languages.

K5, : ([([[Ol X l X e] sneehitarannu] maad X ikol X 1 X alu)]
([nanage] ([isx t X a]))).

T5 : ([([([mancigunXamu] unXdXe) vaalXni] sneehinceedi)] ([[naa] isXtXam])).

E5 : (([I] am (fond [of])) [(making [[good] friends])]).

Here the Subject did not give the exact translated versions in the two languages. The use of the word *maadxikolxlxalu* in the sentence K5 does not have an equivalent form in the Telugu language. Similarly, the word *sneehinceedi* in T5 does not have an equivalent form in Kannada.

4.0 *Conclusion and Prospects*

4.1 *Conclusions*

The analysis of these data indicates that the subject has, in her language repertoire, equivalent forms in both the languages. So, it seems that (at least in languages belonging to the same linguistic family) a bilingual speaker can make use of structurally equivalent forms in the languages that he uses.

The analysis also revels that in the examples K5 and T5, the subject does not find the equivalent lexical forms for substitution in either language. Thus 'interference' in the speech is possible when equivalents are not found.

In those instances in the subject finds equivalent forms, interference is easily avoided. When there is 'interference' the sentence pattern itself is different, even when an identical situation is described.

4.2 *Prospects*

Tabulation and counting of equivalent forms in any two languages could also be done on a large scale by computational methods. Such a method would be a precise tool for the comparison of the two languages used by a bilingual.

For such a study vast data have to be gathered under different situations that would include:

(1) Conditioned situations

(2) Spontaneous speech.

or

(3) Free discourse.

We hope to present an analysis of spontaneous speech and free discourses in the two languages of a bilingual on a larger scale and in greater detail in the near future, using the computer.

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ANALYSIS OF CLEFT PALATE CASES

N. P. NATARAJA AND A. K. SHARMA

This paper is intended just to report the problems seen in palate and lip cases who had reported to our Institute. The information given in this paper is collected from the case histories. All cases of cleft lip and palate here undergo E.N.T., Audiological, Speech and Psychological examinations, after giving a detailed case history. If necessary, the cases also are referred to the paediatrician or physician for further examinations.

The following Table shows the age and sex distribution of 108 cases that reported to our clinic:

TABLE 1

Age in Years	0-5	5-10	10-15	15-20	20-24	25-30	30-40	40 & above
No. of Cases	35	29	18	12	8	3	1	2

Males 61 and Females 47.

The cases were classified using Veaus' classification, that is

I.	Cleft of the Soft palate only	12
II.	Cleft of the Soft palate and Hard palate upto incisive foramen	47
III.	Complete Unilateral alveolar cleft associated with lip	10
IV.	Complete Bilateral alveolar cleft associated with lip	37

The problems seen in the cleft lip and palate cases, as reported by many people are pathologies or abnormalities of ear, nose and throat, heariflg loss, speech problems and Psychological problems.

Prather and Kos (1968) (in Cleft Palate and Communication by Spriestersbach and Sherman) report, infected adenoids and tonsils, nasal obstruction, allergies,

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upper respiratory infection and middle ear pathologies as commonly seen problems in cleft lip and palate cases. The following Table shows the E.N.T. Problems and other problems seen in case? of the present series:

TABLE 2

Irregular teeth-7	Collapsed Premaxilla-l,	High arched palate-3
Constricted allae-2	Retracted mandible-1,	Infected T & A-6
Allergic conditions-2	D.N.S.-13,	Perforation of drum-5
Ear discharge-7,		

Goodstein (1968) gives a good summary of the studies related to the development of intelligence in cleft palate children. The following Table shows the percentage of cases scoring on intelligence tests. (In this study only intelligence is discussed under Psychological problems).

TABLE 3

I. Q		Below 5O	50-70	70-90	90 and above
s	U		1	2	5
p	PR				
	P		1	1	2
H +	U		2	3	12
S	PR		1	2	1
P	R	1	1	6	18
B	U		1	1	1
L +	PR		3	1	1
P	R	2	2	6	10
U	U				
L +	PR				2
P	R			3	5
Total		3	12	25	66
Percentage		2.76	11.04	23.00	.63.00

Most frequently seen hearing loss among cleft palate population is conductive type, as reported by Drettrer (1962), Masters *et al.*, (1960), Spriestersbach .(1962). 11.96 per cent of the cases studied have shown bilateral conductive hearing loss and 8.28 per cent have shown unilateral conductive hearing loss. The following Table shows the per cent of hearing loss in different types of clefts.

. TABLE 4

		Cond		Mixed		S. N. Loss.	
		U	B	U .	B	U	B
Soft Palate	U	2		1		1	
	PR						
	R						
Hard + soft Palate	U	2	3	1			
	PR	1		1		1	1
	R		3				2
Bil. Hard + Soft	U						
. Palate	PR		1				
	R		6		1		

Only 28 per cent of the total population showed hearing loss. Out of this 8.28 per cent showed unilateral conductive hearing loss and 11.96 per cent of them showed bilateral conductive hearing loss.

It seems not possible to have a separate class as cleft palate speech, under the classification of speech disorders, but still there are some speech problems which are seen in cleft palate population. The present analysis reveals following speech problems. This has been shown below:

TABLE 5. *Speech Problems*

S	U	Nasality	Misart	D. lang	Others
S	U	4	3	2	
Pt.	PR				
	R	4	3		1
S+	U	11	10	3	1
H	PR	4	3		
Pt.	R	19	21	5	1
Bil	U	3	2	1	
Lip +	PR	7	4	3	
Pt.	R	24	20	7	3
Uni.	U				
Lip +	PR	1	1	1	
Pt.	R	4	4	3	
Total		81	71	25	6
Percentage		74.52	65.32	23	5.52

Hagerty (1954) studied 44 cases with repaired cleft palate and found that nasality was present only in some of them, with varying degree. In our series we have found 74.53 per cent of cases as having nasality. And also 65.32 per cent have shown misarticulation among which majority was substitutions and distortions. In 23 per cent of the population delayed speech and language was also seen.

The intention of the present paper is to show that it is possible to collect useful data regarding the cases. Such data collected from cases reporting to a particular clinic is limited in value because it depends upcn biased, self-reported cases. We cannot generalize from such data because we cannot ever be certain how many other people with similar problems have not reported to the Institute. Therefore such data cannot be generalized for whole cleft palate population. However, this paper is presented with the conviction that similar data from different parts of the country will add to giving a more comprehensive picture of larger population.

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Acknowledgment: The authors are grateful to the Joint Director Dr. Rathna, Prof, in Sp. Path. of A.I.I.S.H. for his valuable suggestions and guidence in carrying out the study.

'THE MISCHIEF OF CATEGORIZATION IN SPEECH PATHOLOGY'

S. S. CHANDRASHEKAR AND P. RAMANJANEYULTJ

Categorization is a term which is evolved from the models for the study of psychopathology. There are different models for the study of psychopathology. But the medical model, the behaviour model, the moral model and the statistical model are the important ones. However, out of these, the concept of categorization has more contacts with the medical model than with the other models. Till 1960, the medical model enjoyed a vogue in the behavioural sciences and also in its allied fields which applied the concepts of behavioural science, like the field of Speech Pathology. During those periods it almost appeared as a fashion to label behavioural variations separately and to catagorize them. A bewildering array of over 700 labels were attached to the various types of speech variations. Examination of these terms shows that in this mass of terms, some are descriptive in nature, some have etiological implications or assumptions, some are both descriptive and etiological, and some are idiosyncratic pedantries.

Any system of categorization in Speech Pathology is inherently fallacious, because the determinants of the speech behaviour of any two persons are so complex, that classifying several individuals into one group because of some similarties in their speech behaviour, will obscure the many important differences. Thus, when two patients are diagnosed in the same way since they both present variation in their speech behaviour, one may not be justified in assuming any similarities other than the one which was used to put them into that particular category. The process of categorization in Speech Pathology primarily preoccupies the specialist with labelling of the disorder rather than understanding the person and his speech variation with a view to modify his deviant speech behaviour. It creates an impression for the user that because he has a name for a variation, he understands it. But this attitude stifles the attempts of the specialist to look deeper into the problem and the factors that may be contributing to the deviant behaviour.

In Speech Pathology the system of categorization may create an environment within which a professional may feel naive because the terms which are used, are not consistently descriptive or etiological. Further, the labels which are given by the specialist are static in nature and does not reveal the dynamics or the ongoing changes within the person having the problem. Labelling

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of a disorder can be a very deceptive practice since it lumps together the similarities and disregards the differences. However, it is possible in the medical science because, here the class of phenomena which has been reffered as the 'disease' will be clearly defined. But this has not been attempted in the field of Speech Pathology and hence here labelling of a disorder becomes deceptive. Some examiners, in speech clinics jump to an inferential level and label the client's speech as defective after a superficial observation of the client.

Through categorization the specialist will often compartmentalize the knowledge and information in such a way that one may begin reacting to the categories as if they are isolated and unchanging valid pictures of 'reality'. But the trouble with this is that the fact that any event, process or person is being acted upon by other forces will not be taken into account. Consequent to this ignorance there will be 'poor' predictability. A clinician's evaluation of speech behaviour may be more biased of his implicit assumption of categorization. The observational process may get intruded on by the labels and the Categories.

Categorization makes a clinician to react as if he has understood all of the facts and characteristics of an event or person by his labelling. But a word cannot say everything about anything. In the scientific literature it has been demonstrated repeatedly that no two things are alike in every respect. However, the most unfortunate thing is that the language of categorization with its subject-predicate structure, will equate two or more things as equal or identical. Articulation problems are not simply articulation problems, unique individual may have unique variations under unique conditions even though there are also striking similarities. Consequent to use of categorization one may be more tempted to disregard differences and to 1ook only for similarities. This not only is the limitation of the clinician's drive to perceive similarities but is also more tempted of the structure of the language of categorization, which facilitates the limitation of non-identical items.It should be remembered that differences can make a gross difference in the way of approach of the clinician towards the cleint. The clinician's hypothesis concerning the speech variation in question may be modified by the extra information gathered about the unique differences.

The language of categorization encourages the separation of things which cannot be separated in 'reality'. This artificial splitting is reffered as 'elementalism' by a general semanticist. Unlike the field of medicine, where a diagnosis frequently implies an etiology and a specific therapy, the field of Speech Pathology deals with problems which for the most part, have neither a single cause nor a specific remedy' (Ptacek, 1970). If this is so, when the clinician is modifying the speech behaviour of a person with a speech problem, the goal should not be a taxonomic categry or a diagnostic label, from which he is going to be misled, but an understanding of the client and his problem with a view to securing prognosis and therapeutic planning.

The following procedure may help the speech clinician to be more effective to rehabilitate the client. Greater emphasis should be given to the observational part when a person with a speech problem visits the clinician. There should be 'inner silence' in the observation of the clinician and it should not be intruded on by the diagnostic iabells. Accurate descriptions of the observations is more fruitful and convincing than using a single word i.e., the diagnostic label. Inferences can be later drawn on the speech behaviour. Depending on the inferences, suitable measures could be taken in order to help the individual. (See Fig. 1)

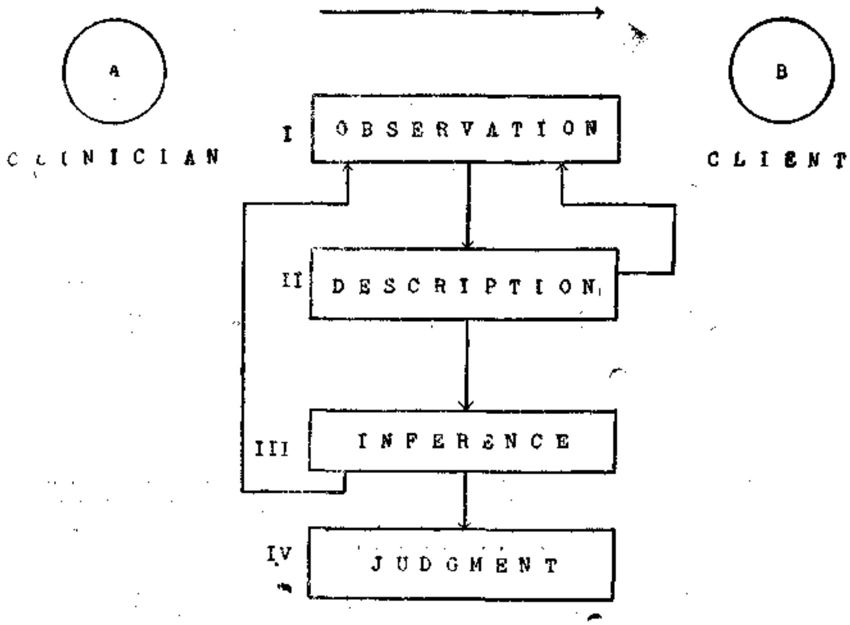

FIG. 1

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MANASAGANGOTHRI, MYSORE-570006 (INDIA)

EDITORIAL

WITHER AUDIOLOGY AND SPEECH PATHOLOGY?

I am glad that the VII volume of the Journal of the All India Institute of Speech and Hearing is coming out of the press. It has been a painfully slow process to bring out the Journal which is due to several constraints on the editors and the printers.

This Institute is 12 years old. There has been a raging controversy in our field regarding the roles of audiologists, speech pathologists, otolaryngologists and other medical men. It is unfortunate that this controversy which has been going on for some years is stepped up at a time when the Institute is making significant progress towards an integrated approach of total rehabilitation to the handicaps of speech and hearing. There is tremendous satisfaction derived by patients and lot of confidence built up in the community. In a few developed countries there has been some controversy. This is directed to get due professional recognition to speech and hearing and not to let it relegated to a level of technician. This controversy has never lost sight of the fact that it does not adversely affect the new speciality of Speech and Hearing and the good of the patient.

There are many individual ASPs (Audiologists and Speech Pathologists) and many individual Otolaryngologists who have had mutually beneficial professional relationships. If the ASPs should have full professional knowledge and status, it is necessary to build a firm educational and professional foundation on a broad base and to create a large cadre of individuals trained primarily. to provide clinical service. Medical environment provides the principal employment milieu for such clinicians and they should be fully equipped for this. Speech Pathology and Audiology have grown much beyond the scope of the Teacher of the Deaf, the Audiometrician, the Pedagogue and the Technician. It is a para-medical field with the levels of graduation and post graduation and even doctorate making its individual contribution in the field of health care.

As a result of breakthrough in knowledge and information, during the third quarter of this century, there have been astounding developments in science and technology resulting in knowledge explosion. Because of this, a specialist 'knows more and more of less and less'. This per force necessitates a group of scientists and specialists in the allied fields to work together. What was an individual approach 2-3 decades ago is now an organisational or a team approach. Each member of the team stands to benefit from the expertise of other members and the accrued benefit naturally goes to the patient. Without the active co-operation and in many cases sponsorship of otolaryngology, the growth of a true profession of Speech and Hearing from a Scientific nucleus might not have occurred. Simultaneously, the profession of Otolaryngology has been a benefactor from the pro-

fession of Speech and Hearing. Otolaryngologists would depend upon the Speech **and** Hearing profession as allies in the common concern of deafness and speech handicaps. The Speech and Hearing professionals are more knowledgeable and more proficient in their subject and give valuable support in the health care, especially in the sensory handicaps. It is the prime duty of medial and para-medical personnel to have common endcavours towards *total rehabilitation* of disabilities and disorders. Partial rehabilitation is not meaningful.

The assumption that Speech and Hearing speciality starts where the medical field has finished is mostly erroneous. Obviously, Audiology is more importantly investigative in nature. For qualitative and quantitative evaluation of hearing as well as speech, their diagnosis and treatment, the medical and para-medical fields are complimentary to each other. Only in few conditions does the Audiologist and Speech Pathologist take full charge of the patient after medical attention is over.

'Speech Pathology and Audioingy in Medical Settings', a book written by Rapheal M. Haller, Ph.D. and Neil Sheidam. Ph.D). with chapters from seven other writers, has given a balanced philosophy of the relation between several allied fields.

Bobby R. Alford, M.D. and James Jarger, Ph.D. of Houston.have written an 'eye opening' editorial (in Archives of Otolaryngologygy—Vol. 103 may 1977) on the subject of 'Audiology and Otolarryngology—A Continuing .Partnership'. They have, with an experience of 25 years, come to mature conclusions and have suggested the following principles

1. Audiology, as a profession. most accept the principles that *(a)* any hearing problem is a potential health problem and theref*ore (b)* the otolaryngologist is the appropriate individual to assume initial responsibility for primary care of anyone with a potential hearing disorder,

2. Audiology, as a profession, must reject the concept that theaudiologist be viewed as a point of entry into the health a re system.. It must accept the principle that, because medical and or surgical treatment takes precedence over non-medical, non-surgical rehabilitative measures, the oitolaryngologist must serve as the point of entry into the health care system of an one with a hearing problem.

3. Otolaryngology, as a profession must accept the principle that audiologists are professionals trained to serve as useful partners on the health care team. It must eschew efforts to reduce them to a subservient role.

4. Otolaryngology, as a professionmust accept the principle that audiometry is best carried out by properly trained audiologists. It must oppose efforts to have audiometry carried out by medical technicians without full clinical audiometric training. It must accept theprinciple that an appropriate individual to carry out or to supervise audiometry is a certified audiologist.

5. Otolaryngology, as aprofession must accept the principle that, after medical and/or surgical treatment for hearing loss has been exhausted, the audiologist is the appropriate individual to assume the responsibility for subsequent

primary care. It must accept the principle that the responsibility for co-ordination of the hearing-impaired individual's subsequent rehabilitation is best assumed by an audiologist.

This is equally true of the field of Speech Pathology, particularly with the disorders of voice and articulation, such as organic conditions of the larynx, pharynx, palate and nasal and oral cavities in relation to otolaryngology, in aphasias with neurology in hearing loss (especially sensorineural type) with electronics and hearing industry and it has intimate relationships with psychology, linguistics and psycholinguistics, and medical rehabilitation, dentistry, psychiatry, vocational training, guidance, job placement, etc. In such a multi-disciplinary field unitary approach is retrograde and detrimental.

The acceptance of these principles will mean a good bit of understanding and co-operation on the part of many groups. In a developing country like India, we have miles and miles to go. We have to realise that in a health care system, isolation of any field is detrimental to itself. Each field has to understand its responsibilities and limitations and its inevitable need for a partnership with team mates and work in cordial and harmonious atmosphere of co-operation for achieving the ultimate goal—giving the best service to the patient, who is all important.

Individual bickerings will always be there. But, interest of science is supreme and should not be sacrificed or jeopardized at any cost.

CORRIGENDUM, Vol. V & VI, 1975

Please read as indicated below:

Page 28: Title be read as "Problems encountered in measurement of vibration of human tympanic membrane using the time averaged holography".

Co-author—Please read as: Dr K. K, Pujara, Ph.D., Asst. Professor, Dept. of Mechanical Engineering.

Page 30: 3.2 The tympanic membrane is almost transparent. In order to obtain.......................had to meet several criteria. (Tonndorf and Khanna 1970)

Page 34: Conclusions:

Please add at the end of the paragraph: "Most of the problems described above have also been discussed by Khanna (1970) and Tonndorf and Khanna (1972) during their studies on tympanic membrane vibrations of cats".

Page 34: References:

Please read the following under references:

11. Tonndorf, J. & Khanna, S.M. (1968): Submicroscopic displacement amplitudes of the tympanic membrane (Cat) measured by a laser interfensmetei *J. Acoust. Soc. Amer.* 44: 513-521.

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SPEECH REHABILITATION OF CLEFT PALATE CASES WITH SUPERIORLY PROJECTED DOME PROSTHESIS AND INTENSIVE SPEECH THERAPY

R. K. OZA, A. S. CHITRE, L. H. HIRANANDANI AND F. D. MIRZA

Plastic surgery of cleft palate cases has made remarkable advance and many cases benefit from it. For many unknown factors, in spite of this advance in plastic surgery, there are several cases which do not acquire proper functional closure of the nasopharynx and the result is nasal speech with poor articulation and intelligibility. It is therefore necessary to evolve some other useful method of achieving the velopharyngeal closure. In this paper we have dealt at length with the usefulness of a 'custom-made' prosthetic device.

DETAILED REPORT OF WORK DONE WITH PARTICULAR EMPHASIS ON MATERIALS, METHODS AND RESULTS

1. Subjects

Post-operative cases of cleft of the palate and/or lip with short palate and hypernasal, unintelligible speech were accepted for this study. These cases were originally seen at Nair Dental College or at B. Y. L. Nair Charitable Hospital, Bombay-8. They were either unfit for further surgery or unwilling to go for it. All these cases were operated more than twice in past before their inclusion in this study.

Total No.

Fifty eight subjects were originally considered for this study but only forty two came for fitting of the SPD. From these 42 we were able to follow up on regular basis 26 cases as the rest did not turn up either to take the prosthesis or were not able to come for follow up due to distance.

Sex and Age

Out of these twenty six subjects there were ten male and sixteen females whose minimum age was six years and maximum twenty six years with mean age of 16.6 years—Table I.

B. Y. L. Nair Charitable Hospital, Bombay-8

TABLE 1: Sex age group and average age of patients

Age Group	Male	Female	Total
6 to 10 yrs.	4	5	9
11 to 15 yrs.	1	1	2
16 to 20 yrs.	1	6	7
21 to 25 yrs.	2	2	4
25 to 30 yrs.	2	2	4
Total	10	16	26
Average age	16.5	16.6	

Palatal Defects

Above subjects were operated for cleft of the lip and/or palate at different times Without much improvement in their speech performance. There were 4 cases of severely scarred palates, one had curtain palate, three had fistula of the palate (5mm to 12 mm in diameter), one had mental retardation of moderate degree with IQ 70—Table II. Remaining had short palate of not less than 5mm antero-posteriorly.

TABLE II

(a) Palatal anomalies.		(b) Dental problems.	
Short palate	18	Irregular Alignment	17
Scarred palate	4	Dental Carries	3
Fistula in palate	3	Poor Hygiene	5
Curtain palate	1	Collapsed Maxillary Arch	1
Total	26	Total	26

Hearing

Detailed audiometric assessment revealed six cases with conductive loss (23 per cent) in the range of average 30db to 60db.

Speech

It was observed that speech was partially intelligible with difficulty in twenty four cases (92.3 per cent) and not at all intelligible in two cases (7.7 per cent), as shown in table III. Speech errors of various nature are given in table IV.

TABLE III: Speech Intelligibility

Rating	Before fitting SPD Prosthesis	After fitting SPD Prosthesis
Good	0	12
Partly Unintelligible	0	7
Poor	24	5
Unintelligible	2	2
Total	26	26

TABLB IV: Nasality Ratings

Rating	Before fitting SPD Prosthesis	After fitting SPD Prosthesis
Nil	0	8
Mild	1	10
Moderate	20	**7**
Severe	5	1
Total	26	26

Nasality

Pre-prosthetic nasality as assessed by the judges revealed five cases (19.2 per cent) with severe, twenty cases (76.8 per cent) with moderate and only one (4 per cent) with mild nasality—Table-V.

TABLB V: Types of Speech Errors: (Before Fitting SPD Prosthesis).

Substitutions	7
Substitutions and Omissions	3
Substitutions and Distortions	6
Substitutions, Distortion and Omissions	10
Total	26

Dental Structure

Examination of dental structure showed seventeen cases **(61.5** per cent) with irregular alignment, five cases (19.3 per cent) with poor dental hygiene, three cases **(11.5** per cent) had carried and only one case (7.7 per cent) had collapsed maxillary arch.

2. Speech Testing Methods: **Each** case was assessed as follows:

(a) Articulation test was done and defective sounds in any position in a word were noted. The test consisted of common words in the vocabulary of the language spoken by the subjects covering all the consonants and vowels in the initial, medical and final positions. Passages adequately representing the phonemes in the respective languages and in their natural frequencies were selected to be used with the subjects. Tests were given prior to fixing the SPD and every three months after SPD was fixed and case taken for therapy.

(b) Tape recording was done for every case before and after therapy—with and without SPD.

(c) Palatography was done wherever possible. It was done with a view to assess the AP distance between soft palate and posterior pharyngeal wall while saying m, n, n, and mouth closed and palate in normal resting position.

This was repeated after SPD was fitted to check its contours and aligment with the nasopharynx and palatal plane.

(d) A panel of judges evaluated the nasality and intelligibility of speech from the recorded samples. The panel comprised of a speech therapist, a linguist and a psychologist. All of them were explained the procedure of evaluation. For this evaluation a *Four Point* rating scales (severe, moderate, mild and nil) was used. Intelligibility was assessed as *Poor, Partly Unintelligible, Fairly Intelligible and Intelligible.*

(e) Detailed audiometric assessment was done to rule out any hearing impairment. This was done in a sound treated room by a qualified audiologist.

(/) Intensive speech therapy was given to each case after SPD was fitted-Re-evaluation was done after every three months and results noted. Those cases who were irregular were sent letters at regular intervals of one week.

Results

Final assessment of 26 cases who were fitted with SPD and given intensive speech therapy gave encouraging indications about the usefulness of the SPD prosthesis when designed to suit each case according to his/her palatal abnormality.

It was observed that poor closure laterally contributed to hypenasality and poor speech intelligibility. Escape of air through nasal passage contributed towards poor learning of velar, alveolar stops and plosives and fricative sounds. In most of the cases we had to rebuild lateral surfaces with green stick material on the prosthesis until we felt improvement in intraoral pressure on blowing cheeks. Little nasal escape was still noticed on mirror clouding test but this was also observed in normal individual and hence not considered significant when not of continuous nature. Since X-ray palatography could not show the lateral relationship, we had to depend on the above method of greenstick material and the mirror clouding test.

Hypenasality was reduced and was occasional but insignificant in eight cases, mild in ten and moderate to severe in eight cases. Last category of eight cases were most irregular in attendance and poorly motivated. This included the patients with mental retardation. Thus more than two thirds of the cases (69.3 per cent) had shown appreciable change in nasality while less than one third (30.7 per cent) did not respond to our satisfaction. Poor motivation of the patients and their guardians is responsible in three cases. Maximum efforts were made to educate and counsel them. For other three cases attendance to clinic was not possible due to household work or job. One case was mentally retarded.

Speech intelligibility improved significantly in nineteen cases (73.1 per cent) while remaining seven (22.9 per cent) did not reach satisfactory level. If we break up nineteen cases twelve had already good intelligibility and seven had occasional errors which did not contribute to any unintelligibility. Prior to SPD fitting and speech therapy, 92.4 per cent had partial unintelligibility.

In two cases SPD was removed within three months as they learned to speak well without it.

Summary of Results

1. SPD type of prostheses have proved most effective to minimize nasality and improve the intelligibility of speech in cases with postoperative velopheryngeal incompetence.
2. Multiple surgical failures result in a very deficient palate and in such cases prosthesis is the treatment of choice.
3. Periodic dental and prosthetic examinations in addition to speech therapy have to be done for successful rehabilitation of the patient.
4. SPD prostheses could be used pre-operatively to form correct habits of speech so that post-operatively speech rehabilitation would be more effective. Separate studies on this aspects should be carried out.

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ACOUSTICS OF HOARSENESS

R. VAIDYANATHAN AND R. K. OZA*

1. Introduction

Hoarseness is a symptom of laryngeal pathology. An acoustic analysis of the voice may provide the first accurate information about the pathologic changes in the larynx or voice disorders. The word 'hoarseness' includes several kinds of vocal abnormality. It is assumed that normal voice results from normal vibration of the vocal folds and hoarseness is the result of some sort of abnormal vibrations. Normal phonation requires complete approximation, adequate tension and regular vibrations. If any of these requisites are disturbed for any reason, resultant condition could be hoarseness. Approximation, tension and vibrations could be disturbed by growth in the vocal folds, by paralysis, by thickening of the cords etc. In hoarseness the production of voice is disturbed because the vibratory behaviour of the cords are altered. The vibratory irregularities will be reflected in the acoustic analyses of such voice.

2. Review of Earlier Research

Liberman (1963) has observed the pitch perturbations i.e. the small measureable deviations in successive pitch period and suggested these irregularities might be useful in the detection of laryngeal disease. He also noted that speakers with pathologic larynges had larger pitch perturbations than normals.

Moore (1962, 1968), *Moore* and *Thomson* (1965) have filmed the vocal cord vibrations of normal and hoarse individuals. In normals the vibratory pattern is characterised by three phases. (1) opening (2) closing of the vocal cords and (3) closed, during which the air flow is interrupted and subglottal pressure increases. He has discussed that in abnormal cases the vocal cord movement vary in atleast five ways.

Yanagihara (1967 a, 1967 b) conducted the spectrographic analysis of hoarse voice and categorized four degrees of hoarseness ranging from slight hoarseness Type I to severe hoarseness Type IV. He has observed the major acoustic factors relating to hoarseness as noise components in the main formant regions of vowels and loss of harmonic components.

Iwata and *Vonleden* (1970) have analysed the hoarse and normal voice taking contour spectrograms and have recommended spectrographic analysis as an objective measure for the acoustic quality as well as degree of hoarseness.

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Cooper (1974) has analysed spectrographically the vowels /a/, /i/ and /u/ and has observed that in dysphonic patients before therapy, higher pitch is accompanied by less hoarseness and low pitch by more hoarseness.

3. Aim

In this paper an attempt is made to analyse the acoustic characteristics of various pathological laryngeal vibrations with an emphasis on the noise components.

4. Subjects

15 Adults, 7 males and 8 females with various laryngeal pathologies were selected for this study. All the subjects were examined by otolaryngologists and the pathological nature of the larynx was specified. All the subjects were examined in the speech clinic by speech pathologists and were assessed as having hoarse voice.

5. Recording and Analysis

The subjects were asked to phonate three vowels /a/, /i/ and /u/ for a period of one second approximately at their comfortable level with no restriction imposed on pitch or loudness. Their utterances were recorded in a sound treated room on a tape using OKI-300 tape recorder. Broad and Narrow band spectrograms of these samples were taken using Kay Electric Sonagraph 6061-B under constant conditions.

6. Results and Discussions

When a narrow band filter setting is used in the analysis of vowels, transverse striations corresponding to fundamental frequency and harmonics are portrayed. In a normal voice there may not be any notable additional sound components in the space between each transverse striation. In contrast to this spectrograms of hoarse voice provide abnormal findings consisting of harmonic changes and noise components.

6.1 *Fundamental Frequency:* The fundamental frequency of the males with hoarse voice varied from 120 Hz to 208 Hz. The fundamental frequency of the females with hoarse voice varied from 210 Hz to 290 Hz. A comparison for fundamental frequency with normal adult males and females showed that patients with hoarse voice tend **to** have a moderate high pitch. The statistical analysis of the results were not carried out because of the limited number of subjects involved in **this** present study.

6.2 *Noise Component:* Of the 15 cases analysed, in two cases there was no noise present in the main formant regions of the three vowels but all showed loss of high frequency harmonic components, a characteristic acoustic property **of hoarse voice (Breathy voice). In** the other cases noise was very predominant in the low vowel /a/ in the F_x and F_a regions. In the case of /i/ the noise component mainly occurred in the F_2 region. While in 7 cases normal harmonic structure was present in the F_2 region, it was replaced by noise in cases which could be labelled as severe hoarseness. Of the three vowels, the high back vowel /u/ was least affected. But it was also noted that in very severe hoarse voice all the main formant structures of the three vowels was replaced by noise component.

7. Conclusion

Change in the harmonic structure and replacement of harmonic structure by noise component in the main formant regions are the acoustic characteristics of hoarse voice. The presence of noise component was more predominant in low vowel /a/ than in other vowels.

8. Recommendations

(a) Spectrographic analysis of hoarse voice is recommended as an objective way of measuring the severity of hoarseness.

(b) To establish the correlation between the acoustic hoarseness and perceived hoarseness.

(c) To find the change in the fundamental frequency and the noise change in post therapy voice samples.

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PHONOLOGICAL ANALYSIS OF APHASIC SPEECH

NEENA SURI*

The phonological research in aphasia has been undertaken using different theories of phonology and probably that is the reason why a clear distinction between phonetic and phonological disturbance has not always been made. Sound disturbance in aphasia can be traced to one or more of three different disorders.

(1) a disturbance of the abstract system of phonemes
(2) a disturbance of the neuro muscular encoding of the phonological unit (the syndrome of phonetic disintegration), and
(3) an associated apraxia of motor speech mechanism.

It is rather difficult to distinguish them while analysing the data due to the overlap of these disorders. In this aspect certain studies have been undertaken and some laws formulated. (Jakobson's law).

The present study was an attempt to describe the 'Phonological disturbances and the process of phoneme recovery in the speech of aphasies'.

The main questions were:

(1) What change does the phonemic system undergo in aphasies?
(2) Are the changes systematic?
(3) Is the phonemic recovery systematic?
(4) Is the recovery process sequential?

It was hypothesized that:

(1) Phonemic loss in aphasic speech is systematic.
(2) The process of phonemic reovery is systematic and sequential.

Method

The aphasic population represented in this study was selected from the indoor patients of the Safdarjang Hospital, New Delhi.

The selected subjects had to satisfy the following criteria:

(1) Subjects must be adult aphasies.
(2) The aphasia in these patients must have resulted from lesions of vascular origin according to the medical assessment.

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(3) They must not have experienced aphasia previously.

(4) They must be 'fresh' aphasics.

The reason being to analyse the speech from the 'no speech' to 'little speech' to 'more speech' period. Observations were made on the immediate post-morbid speech. Many authors—(Wep 66, Jones, Servo, Levita '71) agree that a majority of the dramatic changes in aphasia are confined to the immediate post traumatic period. Culton (1968) states that rapid spontaneous recovery of language function is noted in the first month following the onset of aphasia and that the later improvement is not very significant. It was initially planned to study the speech samples of each subject taken every day for the first one month after the onset of stroke but it was not possible to get the subjects for such a long period due to shortage of beds in the Government Hospitals. Therefore the speech samples of the subjects were studied for the entire period of their stay at the hospital, which was about 10 days.

(5) Subjects should have been either using Hindi as their 'first language' or the pre-morbid language must indicate considerable proficiency in Hindi.

(6) Finally all the selected subjects must obtain 'Aphasic Score' on the 'Porch Index of Communicative ability'.

Five subjects were selected for this study and—

(a) Information was obtained regarding their education, job, special interests etc., to obtain some idea of the subjects' pre-morbid speech and language proficiency. Speech samples of one of the close relations of the subjects was recorded as a clue to pre-morbid speech.

(b) Samples of the conversational speech of all the subjects was tape recorded every day for 15 minutes.

(c) Along with the recording of 'conversational speech', a 'say after me' test was given every day and the responses were tape recorded. This attempt was made to ensure the occurrence of all the phonemes in all phonetic positions, which may have been omitted by the subject during spontaneous speech.

Recording situation and equipment

Each subject was individually seen in the ward. A comparatively quiet corner in the ward was selected during the recording sessions. The speech samples were recorded on a 'Midland' tape recorder at the speed of seven and one half inches per second.

The raw data for this study was obtained by recording the conversational speech of all the subjects. The session consisted of an open ended conversation regarding subjects' personal history, family history, work hobbies, etc. Questions asked were used only as a means of eliciting as much speech as possible.

Analysis of Data

Each tape recorded interview was listened to completely and those phonolo gical errors made by the patients were transcribed. The attempted target word was also noted. Only those errors whose target words could clearly be determined by the surrounding context were used in this analysis.

The transcription was done with the help of 2 post graduate students of Speech Pathology and Audiology having sufficient knowledge of Hindi language.

The transcribed data was analysed in the following manner:

(a) Phoneme frequency distribution: Randomly selected speech samples of two subjects consisting of 1000 consonant phonemes were analysed for the frequency of occurrence and compared with the normal phoneme frequency distribution in Hindi. The rank order correlation coefficient was .91 highly significant at the .01 and .05 levels of confidence.

(b) Distribution of Errors: With the phonemic frequency distribution for the aphasic speech sample it was possible to consider the relationship between the phoneme error rate and frequency of occurrence. A. rank order correlation coefficient between the errors made on each phoneme and its actual frequency of occurrence in aphasic speech showed 'no' significant relationship.

(c) Total Phonemic Error: Total number of uttered phonemes and target phonemes were counted and an overall error percentage was calculated for each sample, to get an idea of subject's linguistic recovery at the phonological level. There was a gradual reduction in the total error from the first to the last day in all the subjects. All the subjects showed a gradual improvement in terms of increase in the number of intelligible words.

(d) Distribution of Error Types: All the phonemes were compared with the target phonemes and the deviations were categorized into:

(i) Severe distortions
(ii) Substitutions
(iii) Mild distortions
(iv) Omissions
(v) Additions.

The distribution of errors made within each group was examined. The mean percentage of each error type was determined for each sample.

(i) There was a gradual reduction in all the types of error except substitution from the first to last day.
(ii) There was a gradual increase in substitutions from the first to last day.

(e) Analysis of Substituted Phonemes: Phoneme substitution errors were analyzed in terms of distinctive features. They were classified into errors of one or more than one distinctive feature. Then each phoneme substitution error characterised by a single feature change was classified according to the direction of the error made—whether the change was from the marked consonant to unmarked or vice versa.

(t) The distinction between /l/00,/r/, and /w/ was observed to have been lost in all the subjects and not much improvement was seen in this type of error till the last day. This distinction is also acquired late in the child's acquisition of language. Often /t/, /d/, /n/ were substituted for these liquids.

(it) They made confusions between voice/voiceless consonants, e.g., */t/, /d/; /k/, /g/*etc. There was a marked reduction of this error in the last speech sample. This observation does not support the concept of 'Phonemic regression' as the children acquire this distinction very early in their language acquisition period.

(iii) The loss of distinction between the nasal and their oral homorganics was noticed in all the subjects. There was an equal tendency for the nasal consonants to be substituted by the oral consonants and vice versa. This confusion shows the selection of the wrong phonemes.

(iv) The subjects showed a lot of confusion between affricate-continuent fricative, affricate-stop, continuent-stop and continuent-affricate.

(v) The distinction between aspirate/non-aspirate phonemes was observed to have been lost in all the subjects. The aspirate was added to the phoneme inventory not before the 4th speech sample.

(vi) Subjects also made a great number of errors in the place of articulation, *jt/* and /d/ were most frequently substituted for other sounds. A consonant changed its place of articulation to the one nearest the target sound.

(mi) The distinctive feature analysis for the last day of observation demonstrates that in all the subjects, significantly more errors were made of one distinctive feature than errors of more than one distinctive feature.

(rait) Subjects were unaware of the errors made by them.

Conclusion

The most consistent finding in the phonological analysis condu cted was the relative uniformity of error types and error direction in each subject. Included in the speech pattern of these subjects were errors of type i.e., distinctive value of phonological system—-phoneme substitution, omission, addition as well as patterns of phonetic distortion super-imposed on the subject's entire speech production. The subjects were not aware of the errors made of substitution. It seemed that a wrong phoneme was selected. However, this confusion seemed to be within certain limits.

These results support the hypothesis:

(a) Phonemic loss in aphasia is systematic.

(b) Phonemic recovery in aphasia is systematic though this is not the same as the child's acquisition of phonology.

BEHAVlOUR OF CONSONANTAL PHONEMES IN AN ADULT DYSLALIC

R. VAIDYANATHAN, V. V. ATHAVALE AND R. K. OZA*

1. Introduction

William Hass (1963) who has done the Phonological analysis of a dyslalia case of a six and half year old boy with normal hearing, and free from any Physiological handicap found the Phonemic system of the boy varied quite a lot in comparison with the standard English. In this article an attempt is made to bring out the consonantal Phonemic system of an adult dyslalic and is compared with standard Marathi. The vowel system of the patient is not considered since it was observed in screening articulation test that he had no defective vowels. Moreover vowels (Mcdonald, 1968) are produced by relatively simple articulatory movements.

2. The Problem (Dyslalia) Defined

Dyslalia can be defined (Ann Stewart 1968) as 'Defect of articulation or slow development of articulatory patterns including substitutions, distortions, omissions and transpositions of sounds of speech'. The articulatory sounds used in speaking can be accurately described through the science of Phonetics. They may be defined according to their mode of articulation, place of articulation and so on—

3. Subject

The subject selected for this study is an adult aged 23 years. The subject's mother tongue is Marathi. The Ear, Nose, Throat examination of his oral cavity is normal. Audiological examination shows his hearing is normal. He has no psychological problems.

4. Procedure

To arrive at the consonantal Phonemic system of the subject nearly 1000 words were collected and responses were recorded in a close phonetic transcription. Words containing the defective sounds in various phonetic context were recorded using a OKI tape recorder for further verification.

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5. Discussion

The analysis suggests that the vowel system of the subject is not defective. Most defects are concerned with only consonants. The consonantal phonemes of the subject were arranged according to their phonetic characteristic.

The consonantal system is comparatively simpler with the affricates being completely absent. Simple comparison of his phonemic system with that of standard Marathi (Kalelkar 1965) reveals that the subject's system lacks certain Phonemes which are characteristic of Marathi. The comparison is done in a systematic way below.

5.1 *Plosives:* In the Plosive series the subject has only labial and velar plosives both voiceless and voiced. Dental and Retroflex plosives are absent in the subject's system and they are substituted by velar plosives, the substitution being one of the characteristics of Dyslalia. It is interesting to note the strange behaviour of (d) when it occurs medially and finally. In the initial position it is substituted by (g). Medially the phoneme (d) which is phonetically a flap (r) is substituted by (g) in intervocalic position, while it is retained as (r) when it occurs as the 2nd or 3rd member of the consonant cluster. Finally it is substituted by the Alveolar flap (r).

5.2 *Affricates:* The Alveolar and Palatal affricates characteristic of Marathi are absent in his system. The Alveolar affricates (c) and (j) are substituted by velar Plosives (k) and (g) respectively. The Palatal voiceless affricate predominantly has the tendency towards becoming Palatal Plosive, while its counterpart is being substituted by velar voiced plosive (g).

5.3 *Nasals:* The subject has only two nasal phonemes (m) and (n) as against the four (m), (n) and (ij) and (y) of standard Marathi. The Retroflex and Velar nasals are substituted by Alveolar nasal. Dental and Palatal nasals which can be analysed as the allophones of Alveolar nasal in standard Marathi are absent in the subject's system even at the phonetic level.

5.4 *Fricatives:* While the subject retains the Phoneme (h) it will be interesting to note the Phonemes (s) and (v/ s) have merged into a.single phoneme viz. (>) which can be described as Post alveolar fricative.

5.5 *Laterals:* The only lateral phoneme found in the subject's system is Alveolar lateral (1). The retroflex (1) one of the characteristic sound features of Marathi is substituted by Alveolar lateral (1) in the subject's system.

5.6 *Flap and Semi Vowels:* The two semi vowels which are found in the standard Marathi are retained in the subject's system. The Alveolar flap (r) is also retained.

5.7 *Aspiration:* Aspiration which occurs with all Plosives, affricates, nasals except (q) and laterals, semi vowels and flap behaves in a strange way in the subject's system. Here also the aspiration is considered only with reference to Plosives and Affricates since aspiration with other sound categories was not observed. In the subject's system the aspiration was observed to occur only with (p), (b) and (k) while the subject has unaspirated (k), the aspirated (k') is substituted by (^{s}>). The other interesting thing is while the voiceless aspirated plosives such as (f), (t') and affricates are substituted by (>), their voiced counterparts are substituted by (g').

6. **Conclusion**

The consonantal Phonemic system of an adult dyslalia is analysed and is compared with standard Marathi language. The subjects system is found to be simpler than the standard Marathi. Place substitution is observed to be more predominant than manner substitution (Singh 1972).

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AN INDIGENOUS ARTIFICIAL LARYNX

VIJAY A. SHAH, ASHOK RAJE AND PRADEEP WAGH

Usually laryngectomised patients are advised by their surgeons and speech therapists to learn Esophageal Speech. However not all laryngectomees can master esophageal speech. An alternative is to use an artificial larynx.

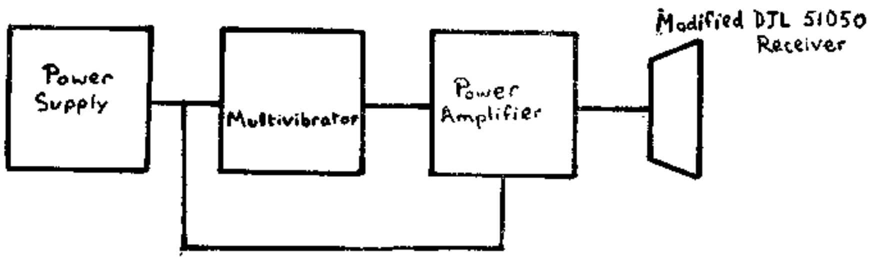
The electronic artificial larynx made by Bell Telephone Laboratories is presently being used in India by some laryngectomised patients. However, most patients cannot afford the imported larynx and also it is not readily available. It was decided that the construction of an electronic layrnx based on the Bell model and made of locally available parts would solve the problem of price and availability and would be a very useful tool for restoring the speech of laryngectomised patients in India.

The primary requirement of the artificial larynx is that the artificial speech be loud and natural enough so that the speaker can be easily understood. For the speech to sound natural, it should have pitch inflection like the natural voice, should have a suitable fundamental pitch accompanied by harmonics that can be used to produce the various vowel sounds.

Secondary to the above, but still of great i mportance to the user, is the objective that the device be inconspicuous and hygienic.

Other important characteristics are simplicity of operation and reliability. Simplicity of operation is very desirable so that the patient will require only a minimum of training and as soon as possible, gain the psychological benefits of local communication with his family and friends. Portability is another necessary feature the unit must have.

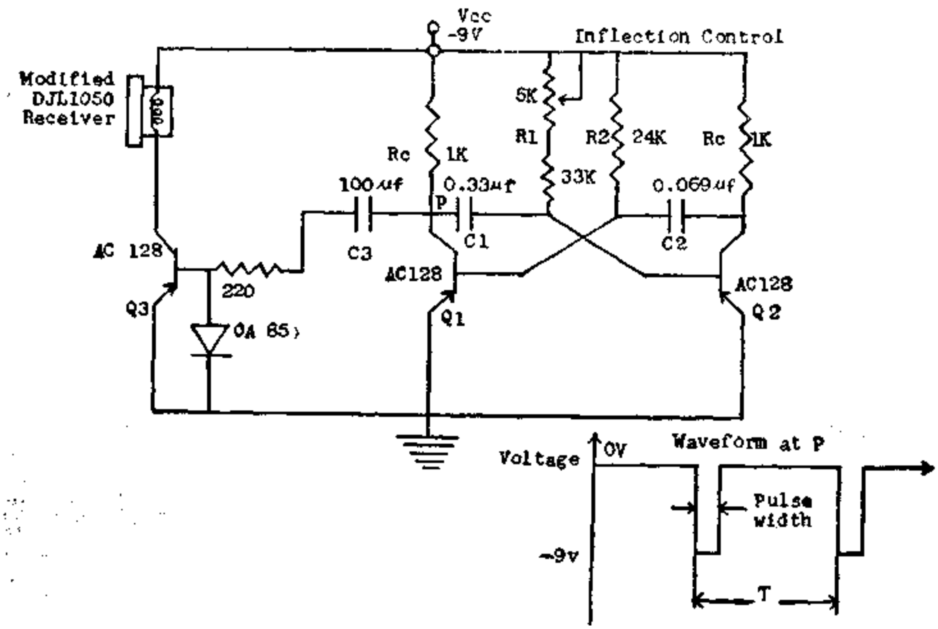
Lastly, a vital factor is low cost. In India, a Bell unit which is obtained only with great difficulty, cost above Rs 1000. This is beyond the means of most of the Indian laryngectomees. Hence the cost price of the indigenous unit should be much lower.



Block Diagram of the Electronic Artificial Larynx

The unit is seen to consist of power supply, a stable multivibrator, power amplifier and electromagnetic transducer.

The stable multivibrator produces pulses which are power amplified and fed to the electromagnetic transducer. This causes its diaphragm to vibrate. The vibrating diaphragm is held against the throat and the vibrations are transmitted through the throat wall into the pharyngeal cavity. Speech is produced by articulating the resultant tone by lip, tongue and jaw movements.



Circuit Diagram of an Indigenous Artificial Larynx

The circuit essentially consists of a power supply and a multivibrator feeding a power amplifier with negative pulses.

The DJL 51050 bipolar electromagnetic telephone ear piece (manufactured by ITI, Bangalore) used in operator's head sets was found after several modifications, to work satisfactorily.

Performance Loudness Test. The point of application of the artificial larynx on the throat corresponding to best out-put speech volume of the artificial larynx is measured with a sound level meter.

The test was conducted using a sustained phonation of 'ah' (as in father) i.e., normal voice with the artificial larynx.

!

The results :

(Loudness with normal voice... 108phondb.)

(Loudness with artificial larynx... 105phondb)

We observed that the loudness of the –artificial larynx is satisfactory.

Test for Frequency content. The words 'Hello, how do you do were said in the natural voice and then using the electronic larynx. A sound spectrogram analysis was made in either case.

Natural voice. (*a*) Overall speech amplitude vs time

(*b*) Spectrogram .

Artificial larynx (*a*) Overall Speech amplitude vs time

(*b*) Spectrogram.

In both the cases, the duration of the speech sample analysed was 2.4 seconds. On comparison of the two spectrograms we conclude that the artificial larynx does not transmit sufficient power into the pharynx to permit satisfactory development of the higher formants.

Natural voice has a bandwidth from about 80-8000 Hertz. From the spectrograms we observed that artificial larynx has a bandwidth extending to 2,5 K Hertz. This means that the artificial speech lacks fidelity..

By comparing distances between vertical striations, we see that the artificial tone has a higher fundamental frequency than the normal vocal tone. This suggests that the fundamental frequnecy of the artificial larynx should be decreased.

The output recorded at the extremes of the artificial larynx spectrogram corresponds to the sound radiated by the artificial larynx when the subject's mouth was closed.

If all but the diaphragm as the larynx is enclosed in sound absorbent material, less radiated sound is produced when the larynx is used. We observed that the intelligibility of the speech was better when this was done.

The amplitude vs time plots of material and artificial voices show close correspondence intelligibility as the artificial larynx is fair. It is also noted that as one listens to more and more artificial speech it. becomes more intelligible, just as one would come to understand strangely accented English increasingly well by coming' into contact with it often.

Conclusion

An electronic artificial larynx modelled as the unit made by Bell Telephone Laboratories has been made out of indigenoes components at considerably reduced cost and the performance of this unit has been studied,

This first model of the Electronic artificial larynx gives reasonably adequate intelligibility but the quality of speech produced has still to be improved. Apart from its use for laryngectomized patients there are other applications for it especially in the field of voice therapy.

SPEECH CONSOLE

S. S. MURTY* AND N. RATHNA*

Introduction

Speech and Hearing professionals require many electronic equipments for diagnostic and therapeutic purposes. Any speech therapist practicing in a clinic require at least a few instruments like Speech Trainer, Noise Aversion Apparatus, Shock Aversion Apparatus, Click Aversion Apparatus, Loop Induction System etc. At present as this field is not well developed in our country, the above said instruments are not available in the market. For a newly practicing professional to have all these equipments at a time would be very expensive and sometimes impossible to obtain for various reasons. Alternatively if there is a single instrument available which provides all the above said facilities it will be easier for anybody to procure and use in the profession.

An attempt was made at the Electronics Laboratory of the All India Institute of Speech and Hearing to develop a console which provides all the facilities for a comprehensive use in speech therapy. This paper is about the construction, features and operation of the 'Console' developed at the All India Institute of Speech and Hearing, Mysore-6.

Speech Console: Type—EA 723: *Features (Figure 1).*

This is a versatile instrument with the following features,

1. A Stereo Speech Trainer.
2. Shock Aversion.
3. Noise Aversion.
4. Click Aversion and
5. Loop Induction System.

Construction

The Instrument works on 230 volts A/C *(Figure 2).* **All** the **circuits** are detachable separately for servicing, to cut short the time. A mirror is provided inside the top corner for facilitating Speech Reading. The details of construction are as follows.

* All India Institute., of Speech and Hearing, Mysore-6.

1. *Stereo Speech Trainer {Figure 3)*

Two identical amplifiers are used with a provision for stereo balance. For a broad frequency response a transformerless, complementary and symmetry type of output power stage is provided. Separate treble and bass are provided for both the channels. A V.U. meter is introduced to control the balance of the input signal.

Two identical Japanese make microphones are provided for both the channels.

2. *Shock Aversion Apparatus (Figure 4)*

The 'Console' provides a shock aversion voltage between 0 and 100 volts with a duration of 0.5 seconds controlled by a pulse circuit. A counter is provided to count and record the number of pulses presented. A visual indicator (light flash) is provided during each preseutation of the shock pulse to check whether the pulse is being presented or not. A voltmeter is provided to know the level of the shock potential.

The shock circuit is well insulated and low blow fuse is provided lo safeguard the patient from getting severe shock. The pulse circuit provides shock only for a duration of 0.5 seconds. The therapist cannot give more than one pulse at a time even though he continuously presses the switch. For a second shock pulse, one has to release the switch and press again.

3. *Noise Aversion Apparatus (Figure 5)*

White masking noise is obtained from a noise diode and fed to the above said amplifiers. The intensity can be adjusted separately using the same gain controls of channel I and channel II amplifiers.

4. *Clicks Aversion Apparatus (Figure 6)*

The click sound of equal intensity of 100 dB is presented through the head set by a D/C pulse of 0.5 seconds duration. The same counter used in the Shock Aversion Apparatus counts the number of clicks automatically, presented to the patient.

5. *Loop Induction System (Figure 7)*

Provision is made to give therapy for a group of cases using hearing aids through loop induction system. The out puts of the stereo amplifires are fed to twin loops of 150 feet length wire, of resistance 8 ohms, fixed at a height of above three feet from the ground inside the room. The effective range of induction loop system in an open field is 100 meters. In case of induction loop system the patients would not get the stereo effect.

Applications

This is a very comprehensive and compact instrument having many functions This 'console' is an asset to all the specialists concerned with the rehabilitation of speech and hearing handicapped in general and to,allthose concerned with speech therapy in particular. Specialists concerned with the rehabilitation of deaf and hard of hearing, can utilize the functions of the stereo speech tramer mducnon loop system and speech reading. This instrument has wide applicability in he treatment of stuttering problems, where the specialists can make use of aversion stimuli. Not only with the above mentioned problems, but also with skill and imagination many of the functions in the 'Console' can be utilized with most of the other speech and hearing problems. Clinical Psychologists and Psychiatrists similary can utilize the aversive functions in their practice with psychological problems, namely, ensuresm (bed wetting), homosexuality, frigidity, alcoholism etc Hence this 'Console'becomes an interdisciplinary with wide range of applicability where imagnation is the only limit of the applicability of the instrument.

Acknowledgement

The authors are grateful to the All India Institute of Speech and Hearing, Mysore-6 for giving opportunity to design and develop the instrument in the Electronics Laboratory at the Institute. The assistance rendered by Mr P. D. Manohar and Mr M. Jayaram and all the Staff and students of the Institute is gratefully acknowledged.

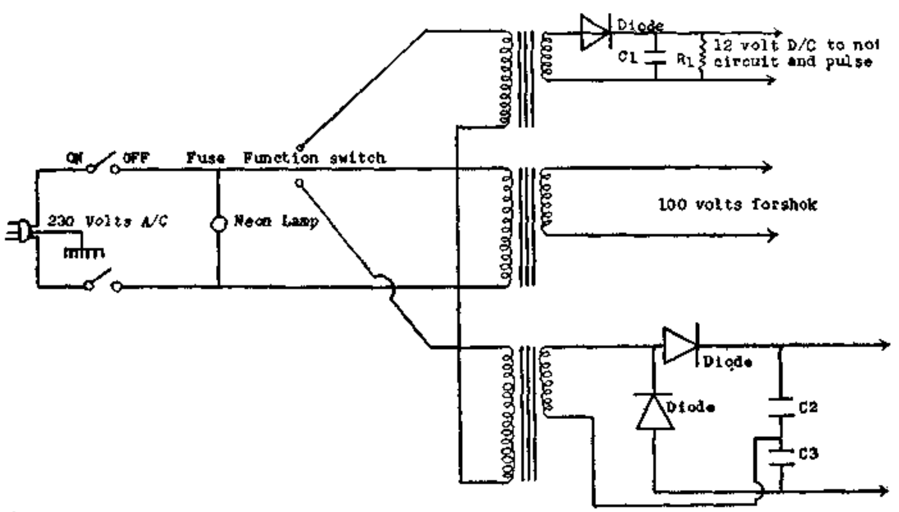


FIG. 2. Circuit Diagram for Power Supply

FIG. 1. Block Diagram

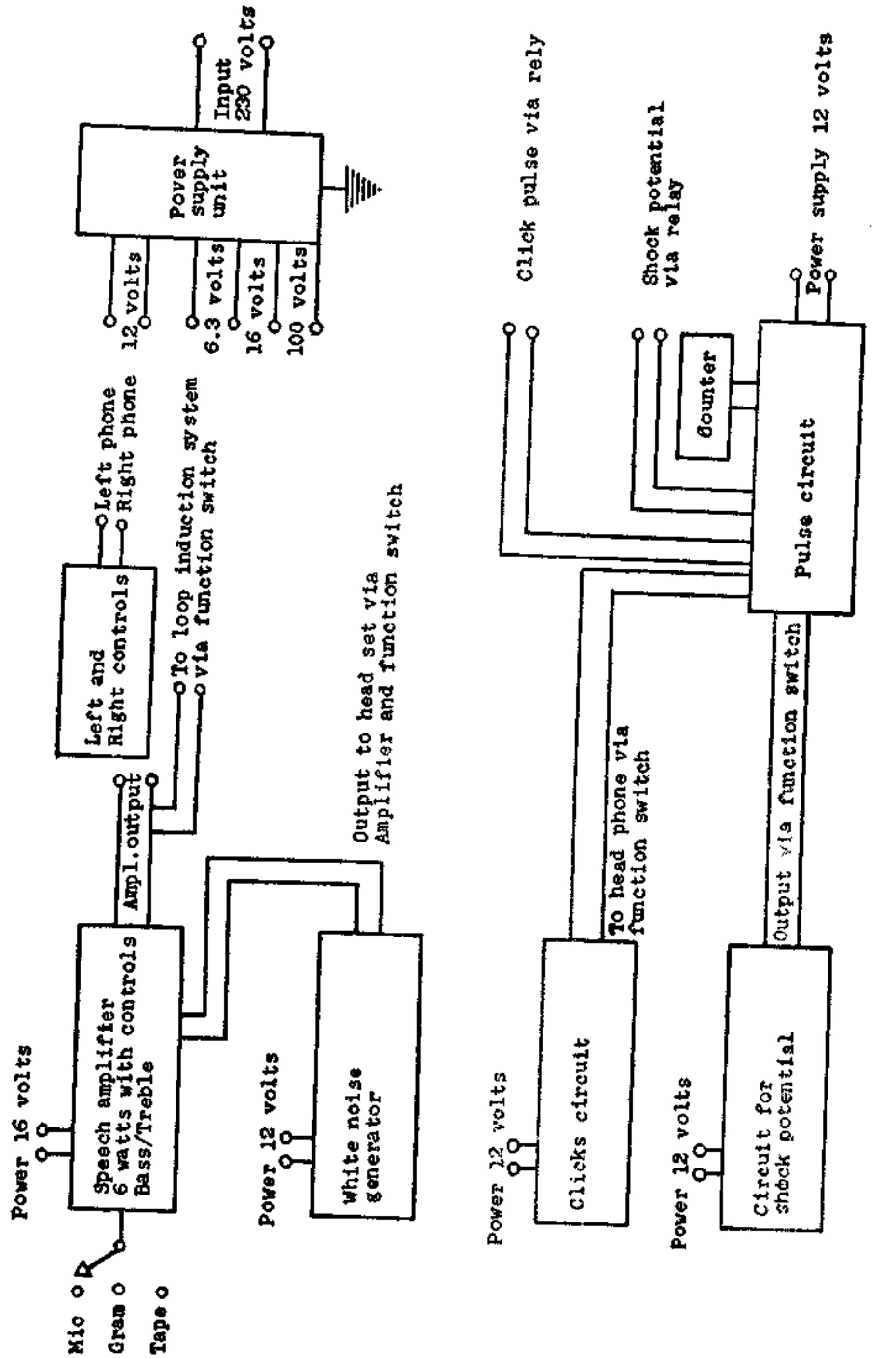
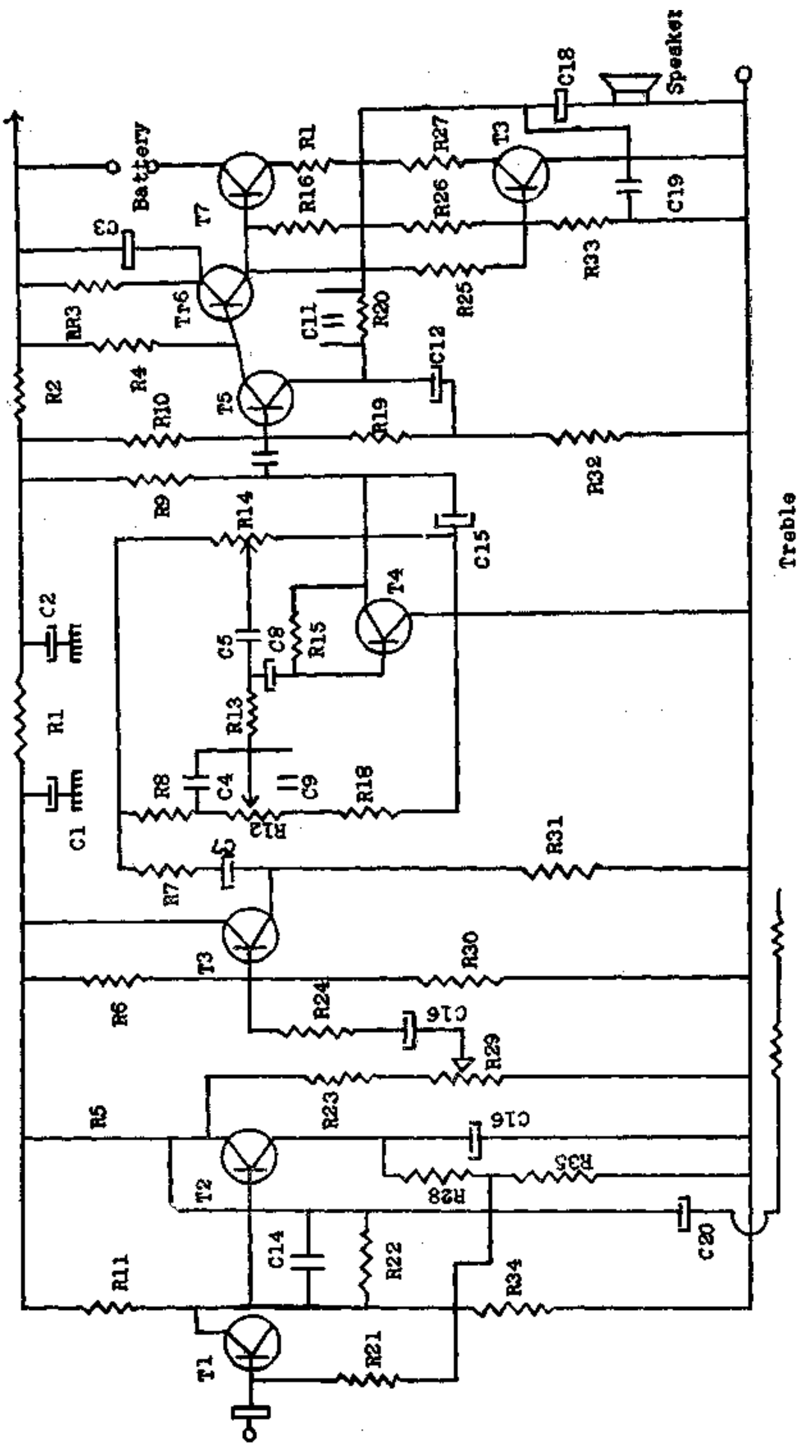


FIG. 3. Circuit for the Stereo Amplifier



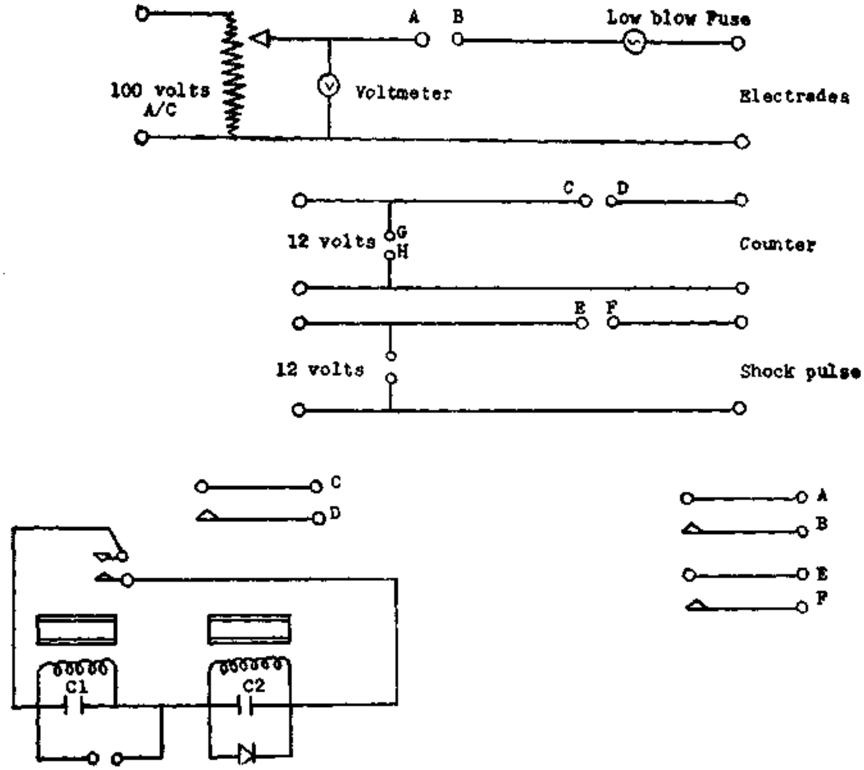


FIG. 4. Circuit Diagram for Shock Apparatus

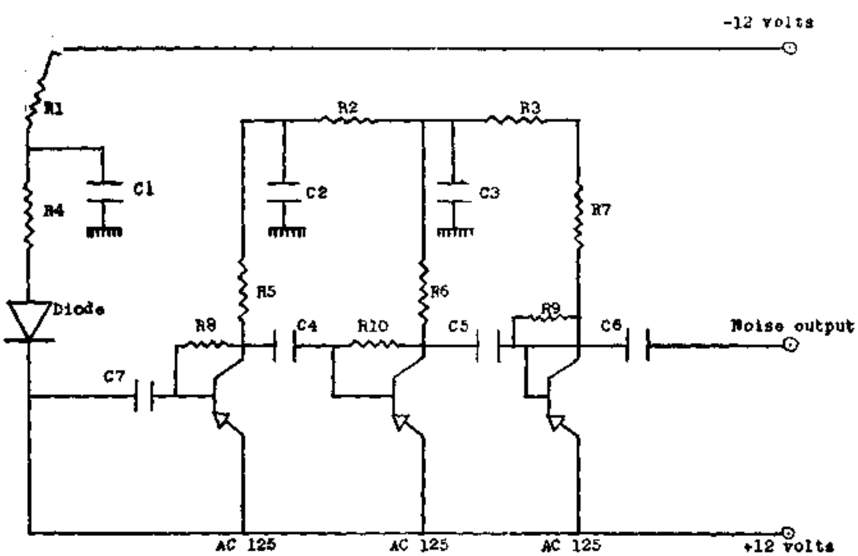


FIG. 5 Circuit Diagram for Noise Generator

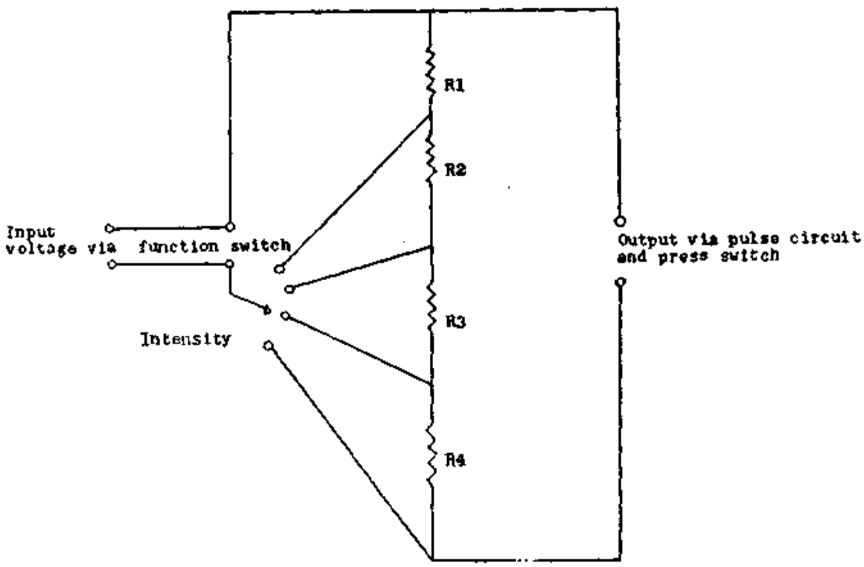


FIG. 6. Circuit for the Clicks

FIGURE 7. Panel Design of Speech Console Type-EA 723

SHOCK VOLTAGE SHOCK VOLTAGE COUNTER CLICK PULSE V.U. METER

LEFT CHANNEL BASS TREBLE PILOT TREBLE BASS RIGHT CHANNEL

GAIN GAIN

STEREO BALANCE FUNCTION SWITCH SHOCK INTENSITY

PRESS PANEL ON/OFF

BACK PANEL

LEFT TO RIGHT

HEAD PHONE ELECTRODES MIC.S GRAM/TAPE FUSE

THE USE OF AIDES IN A PUBLIC SCHOOL ARTICULATION THERAPY PROGRAM

BURL B. GRAY*

Problem

Introduction

It is not an uncommon experience to find nonprofessionals working in the area of education. These aides (paraprofessionals, subprofessionals supportive personnel, etc., etc.) assist the teacher in the routine classroom activity. In the area of speech pathology there is not a commnon utilization of aides. However, in recent years there has been a growing intrest within speech pathology concerning the utilization of aides in the direct delivery of speech and hearing services (Alpiner, Ogden and Wiggins,1970, Ptachek, 1967).

In 1973 Landis reported a successful outcome in the training and utilization of one aide. She concluded that it was possible to train nonprofessionals to provide basic remedial speech and hearing services (Landis, 1973). Unfortunately, her positive conclusions were based on only one subject.

It would appear that while there is interst in and encouragement for the use of aides there is very little substantive information about whether or not they can reliably and effectively provide services to children. Yet the advantages of a successful aide program would present a most compelling argument in terms of improved efficiency indirect services utilization of professional resources and cost effective therapy.

Purpose

In an effort to gain more substantial information about the utilization of aides in public schools a study was initiated in a rural midwestern 3 county area. The study, involving aides in articulation therapy, was exploratory in nature. The two major questions were:

1. Can trained aides carry out therapy procedures as correctly as professional clinicians.
2. Can children who receive therapy from trained aides produce the target phoneme correctly in conversation after training.

Method

In an effort to obtain answers to the two questions posed by this study a comparative procedure was designed. This involved training both the aides and clinicians in the use of the Monterey Articulation Program. After attaining equivalent

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skills in the program operation both clinicians and aides administered the program to selected students during the school year. At the end of that time data were gathered on the administration of the program and on clinical improvement of the students. A comparison between data for teachers and clinicians was designed to yield answers to the questions of this study.

Subjects

The subjects for this study were 19 adults who were employed by the local school system. Ten of these persons were aides who were selected from respondents to a public announcement for speech therapy aides. The remaining 9 persons were regularly employed speech therapists for the school system.

Each aide was screened by personal interview and standardized test. Selection was based upon interest and motivation, lack of speech or hearing defects and general aptitude and ability.

Program

A programmatic articulation procedure was chosen for this study. The Monterey Articulation Program (Baker and Ryan 1971) was the specific program selected. One of the prominent characteristics of this particular program is the explicit detail with which it describes and sequences the teacher activity. In addition, the program has a substantial data history which defines both the programmatic operation and anticipated therapeutic impact upon the student.

The Monterey Articulation Program, described in detail elsewhere (Gray, 1974), provided a clear cut method of procedure and a substantial performance history. Both of these characteristics are desirable and necessary in any attempt to compare therapeutic activities.

Students

The students in this study were selected from 651 regular public school pupils who had been identified through routine articulation screening procedures as needing articulation therapy. From this general population 84 students were selected for the present analysis. Those selected satisfied four conditions. These were (1) had more than 1 defective sound on the McDonald Deep Screening Articulation Test, (2) had two defective sounds that were within 2 points of each other on the McDonald pre test, (3) had only 1 of these 2 equivalent defective sounds worked on via the articulation program, (4) had both sounds retested on the McDonald post test at the end of the program.

The 84 students who met these requirements were comprised of 56 males and 28 females with a mean age of 7.5 years, S.D. = 1.8. The 64 students who were stimulable on their misarticulated phonemes were assigned to the aides and the remaining 20 were assigned to clinicians. The specific phonemes which were involved were /s,/ /s/ ,/S/,/e/,/ l/,/s/, /+/, /+S/./p/, and s-blends

Of the two sounds for each studenlt, one was randomly selected to be the target phoneme for the articulation program. The other sound was not worked with but rather was to serve as a control.

Training

The distributors of the Monterey Articulation Program[1] held a training work_ shop for the aides and clinicians. It provided basic skills in evaluation of phonemes and in the administration of the program itself. Both aides and clinicians passed performance and written tests on the operation of the program and were judged competent to run the program.

The clinicians were to act as supervisors for the aides in the school. Aides were not trained to administer or interpret any diagnostic tests. All such activities and subsequent therapeutic decisions were carried out by the professional clinicians.

Data Analysis

During the therapy activity the aides and clinicians maintained data sheets on which they recorded program step, number of responses, accuracy and amount of therapy time by student, by lesson. Whenever a student finished a program the completed data sheets were turned in. The information on the sheets was converted into data statements about the operational characteristics of the program run and its administration.

These data are called run data (Gray, 1974). The major categories of run data are student responding accuracy, number of responses needed to complete a program, amount of therapy time needed to complete the program and response rate. These categories indicate the proficiency with which the procedure was carried out.

The Behavioral Sciences Institute, the program developers provide standards values for each run data category. These standard values provide a reference by which clinician and aide performance can be evaluated.

The Monterey Articulation Program itself has a built in criterion referenced pre and post test. The change in accuracy between pre and post test serves as a measure of clinical impact resulting from the programmatic procedure. In addi_ tion to this intra program measure, the McDonald Deep Screening Test of Articu- lation was administered to the students prior to and upon completion of the Monte_ rey Articulation Program. This outside measure of articulation was used to access the clinical impact of the procedure. Also, difference scores were used to compare clinical gains obtained by students seen by aides with those obtained by students of teachers.

Results and Discussion

Table 1 presents the run data values for the various categories. The Behavioural Sciences Institute standard values (BSI STD.) are presented in addition to the mean values for clinicians and for aides.

[1] Monterey learning systems, 99 via Robles, Montorey, California 939110.

TABLE 1. Run data in mean scores for Monterey Articulation Program. Data are presented for aides, clinicians and the BSI Standard.

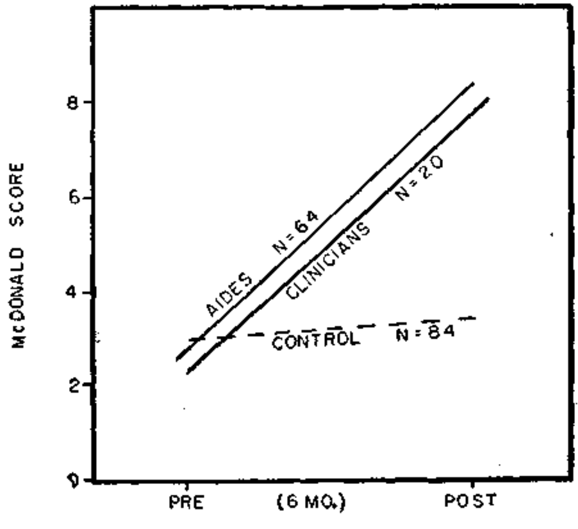
	% Correct	# Responses	Time	Rate	CRITERION TEST Pre %	Post %
Aides	95.6	578	1.8 hrs.	321	44	96
Clinicians	96.4	531	1.9 hrs.	280	42	97
B.S.I. Standard	92.4	575	2.2 hrs.	350	34	95

It can be seen that both clinicians and aides had run data values which were equivalent to or better than the standard. The notable exception was the response rate category in which the aides and the clinicians were slower. It can be noted that there were no remarkable differences between the values for clinicians and aides. These observations hold for the programmatic run data as well as for the program pre and post criterion tests.

From these results it can be assumed that there were no substantial differences between clinicians and aides in run data for any listed category. In addition, it can be assumed that both clinicians and aides operated the program in a manner which was equivalent to the standard values presented for the program.

Figure 1 presents the results of the pre-post McDonald test comparison. The difference between the pre McDonald and the post McDonald test scores was

FIGURE 1. Pre and Post mean scores on the McDonald Deep Screening Articulation Test for students of aides, clinicians and a control sample.



significant beyond P=.01 for both aides (t =5.30, DF= 166) and clinicians (t == 5.07, DF=38). The control group of sounds demonstrated no significant change.

Finally, there was no significant difference between aides and clinicians on either the pre McDonald scores or the post McDonald scores. Thus, from these data it would appear that both aides and clinicians achieved equivalent clinical gains with their respective students.

Summary and Conclusions

The purpose of this study was to obtain information about the ability of trained aides to carry out programmatic articulation procedures successfully with students in a public school setting. The Monterey Articulation Program was used by both aides and clinicians with their respective case loads.

The data on administration of the program, termed run data, indicated that aides could carry out this particular articulation program in a manner equivalent to that of clinicians and to the BSI standard. Data on the pre program McDonald test and the post program McDonald test suggest that aides did achieve therapeutic gains equivalent to those obtained by clinicians.

It would appear from the findings of this study that aides can be successfully utilized to administer the Monterey Articulation Program with the anticipation of no loss in programmatic efficiency or in clinical impact. However, several considerations should be pointed out in an effort to keep generalizations of these findings in proper perspective.

First, the Monterey Articulation Program is a highly detailed and specific procedure which requires no individual creativity. Also, it minimizes as much as possible the opportunity for individual teacher decisions concerning procedural decisions. Clinical judgement and therapeutic logic are both imbedded in the operational instructions to the teacher.

Second, the aides were carefully selected. In addition they attended a rigorous training workshop and were required to pass practicum and written tests. They had no responsibility for child or phoneme selection. Also they made no clinical decision other than those minimal ones concerning student response accuracy which were necessary for administration of the program.

Third, they met frequently with their supervising clinicians. These supervisors made all the clinical judgements about student selection and dismissal and general case disposition.

Fourth, the aides worked with only sounds that were stimulable. Students with non-stimulable sounds were assigned to clinicians. This tended to make the two comparative groups not necessarily equivalent in severity. However, with respect to the Monterey Articulation Program, this difference was not considered to be detrimental to the outcome of the study. This particular aspect was included as a cautionary measure since this was a public school setting rather than a laboratory setting.

These considerations are not meant to disallow the findings of this study. However, the results should be viewed in light of the constraints of the situation. The role and activity of the aide was highly described, monitored and restricted. Thus, casual generalizations to therapy in general or to equivalence between aides and clinicians is to be avoided.

The study does point up rather clearly that, in a carefully defined situation, aides can work in portions of articulation training with efficiency and clinical impact which is equivalent to that of clinicians. The findings suggest that aides can be utilized effectively and with confidence in these carefully structured situations.

Finally, the findings point up the need for further study. The results of this study should be verified by others using other procedures and other constraints. These findings do not answer questions concerning non-stimulable sounds or articulation disorders of a more severe nature. They do not answer questions concerning necessary attributes of aides or amount and degree of required training. These questions and many more should be answered before any general statement of encouragement, can be made about the use of aides in public school articulation programs. However, the potential value and contribution of aides in programmatic articulation therapy holds great promise in the improvement of delivery of services to children.

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CLASSIFICATION OF STUTTERING PATTERNS BY COMPUTATIONAL MEANS

P. C. GANESHSUNDARAM*, MAYADEVI AND G. C. KOTHARI*

Abstract

This paper aims at using the computer for classifying patterns of stuttering on the basis of observations of cases noted at different times under different conditions.

These different conditions and observations of stuttering peculiarities are punched on cards and processed according to the program outlined in this paper.

The results obtained enable one to group cases in different ways for 'Group Therapy'. Marked stuttering under different conditions could be isolated for being handled through what is called 'Condition oriented therapy'.

1.0 Introduction

A descriptive classification of the stuttering patterns is attempted to facilitate the development of efficient therapeutic methods. The theoretical formulations that are in existence do not speak of a cohesive classification of the stuttering problem. Certain terms like primary stuttering, secondary stuttering and tertiary stuttering have been in use (Van Riper 1963), pertaining to age of onset. But they have not yet been brought into general conventional use. A broad categorization based on learning principles has not yet been done. The accumulation of knowledge on therapeutic approaches based on learning principles calls for the descriptive behaviour of the case. After the descriptive data are obtained, the therapeutic reliability and validity have to be established to confirm the generalisation of the corrected behaviour in all situations.

Here an attempt is made to classify the stuttering patterns in all their multidimensional aspects, viz., the conditions under which stuttering manifestations are observed, the modes of stuttering, the types of the primaries and secondaries, occurrence of the types of stuttering and lastly the severity of the problem.

Such an extensive table would facilitate a comparison between any two cases and also make it possible to evaluate the efficiency of the therapeutic approaches usually adopted at present.

• **Indian Institute of Science,** Bangalore.

2.0 *Methodology*

General: A table prepared including all the above mentioned criteria would be extensive in itself and would provide for the inclusion of further delimiting criteria.

The table in the form of the input is given to the computer together with the data pertaining to a given Case and the final output would be the classification of the given case under the categories mentioned in Table 1.

Conditions	Modes of Stuttering	Types under each Mode	Occurrence of Types	Severity Scale
1—10	A and B	**A: 1—12**	0	Normal
		B: 13—20	1	Mild
			2	Moderate and Severe Stuttering

The types of stuttering patterns are classified under the primary Mode (verbal acts—prolongations and repetitions) and the secondary Mode (non-verbal manifestations), falling within specified ranges.

2.2 Check Lists

The numbers given in Table 1 mean the following

Conditions

1. With strangers
2. With superiors and officials
3. With acquaintances
4. With parents
5. With friends
6. While speaking to a big audience
7. With kith and kin
8. While alone
9. While singing
10. Others

Modes of Stuttering

A. Primary: 1
B. Secondary: 2

Types under each Mode of Stuttering

A. Primary

1. Repetition of stops
2. Repetition of fricatives
3. Repetition of syllables
4. Repetitions of hums and grunts
5. Repetition of vowels
6. Other repetitions
7. Prolongation of stops
8. Prolongation of fricatives
9. Prolongation of vowels
10. Prolongation of syllables
11. Prolongation of hums and gru ts
12. Others

B. Secondary

13. Tics
14. Facial grimaces
15. Jaw biting
16. Tongue thrusting
17. Trembling of lips
18. Shrugging of shoulders
19. Head shaking
20. Others

Occurrence of types

0. Never
1. Sometimes
2. Always

2.3 Method of Computation of the Types of Stuttering Patterns

The given values of the occurrence of types, for a particular Case, are summed up for all the ten conditions and divided by 400 (being the **total** number of the occurrences of all types in all the ten conditions).

The total sum under each condition and also the sura in each of the modes of stuttering pertaining to the respective condition are also obtained by just totalling the values falling under these categories.

The classification of stuttering patterns follows the classification criteria given in Table 2.

TABLE 2. Classification Criteria*

Types of Stuttering Pattern	Normal	Mild	Moderate	Severe
1. Primary (in a given condition)	Less than 4.0	L.E. 10 & G.T. 4.0	L.E. 18.0 & G.T. 10.0	L.E. 24 & G.T. 18.0
2. Secondary (in a given condition)	L.E. 2.0	L.E. 6.0 & G.T. 2.0	L.E. 12.0 & G.T. 6.0	L.E. 16.0 & G.T. 12.0
3. Primary and Secondary (in a given condition)	L.E. 10.0	L.E. 20.0 & G.T. 10.0	L.E. 30.0 & G.T. 20.0	L.E. 40.0 & G.T. 30.0
4. Overall stuttering pattern in all the conditions taken together	L.E. 15%	L.E. 45% & G.T. 15%	L.E. 75% & G.T. 45%	L.E. 100% & G.T. 75%

Index: L.E.—Less than or equal to.
G.T.—Greater than

* These criteria have been chosen arbitrarily.

3.0 Results and Discussion

3.1 Results

Illustrations of three typical hypothetical cases

The data cards illustrating the description of three hypothetical cases were punched according to the order indicated in Table 1, as:

Case No, Conditions, Modes, Types and *Occurrence of Type*

Each data card represented the description of the case for the given type with the given value pertaining to a given mode in one condition.

(See the Computer Output for the Three Cases)

The results printed out by the Computer after processing the data for all the cases are tabulated as follows, for further discussion see Table 3.

TABLE 3: Classification of Stuttering Pattern

Case No.	Condition	Primary	Secondary	Primary and Secondary	Stuttering Pattern (based on % of occurrence)
1	1	Mild	Mild	Mild	9.50 % Normal Stuttering
	2	Mild	Mild	Mild	
	4	Mild	Mild	Mild	
2	1	Moderate	Severe	Moderate	
	2	Moderate	Moderate	Moderate	
	4	Moderate	Moderate	Moderate	
	5	Moderate	Moderate	Moderate	50.50 % Moderate Stuttering
	6	Severe	Severe	Severe	
	7	Mild	Moderate	Mild	
	8	Moderate	Moderate	Moderate	
	9	Moderate	Mild	Mild	
3	1	Mild	Severe	Moderate	
	3	Moderate	Severe	Moderate	21.75 % Mild
	4	Mild	Severe	Moderate	
	5	Mild	Mild	Mild	

3.2 Discussion

From the results analysed by the computer, it is clear that for a given case, the degree of severity of the primaries and secondaries may vary in each condition. Their effect together in one condition is in turn different from the overall effect in all conditions. The general classification of the individual case, considering the values of occurrence of types in all the possible conditions, gives the total picture of the Case's performance, as indicated by the 'Percentage of Stuttering'.

In Case 1, though the classification of primary and secondary is 'Mild' in the given conditions, still the overall effect is 'Normal' and the case is classified under the 'Normal Stuttering' category. The term 'Normal Stuttering' here implies that the form of stuttering is within normal limits. That is, even normals do stutter when they are amidst superiors, officials or are facing any new situation causing nervousness. When their speech (verbal) acts are accounted for, together with the non-verbal manifestations, their speech characteristics have the form of stuttering. Yet, this type of defect is within normal limits and such individuals, when they undergo desensitization therapy for the pertaining condition, will be able to overcome the problem.

This category includes all those people who stutter under certain circumstances of stress and tension. Here therapy should take into account the condition under which the problem manifests itself. This could also be compared with the stage of normal non-fluency among children (Van Riper 1963).

In a similar way, in the other two cases, the variation in the overall effect is obvious, when we compare that with the individual effects of the primaries and secondaries under each condition.

InCase 2, despite the overall effect being Moderate, there are conditions where the effect of the primaries and secondaries is severe. This is an indication for the therapist to choose that pait for therapy first, which manifests lesser severity. When their effect is equal, both could be taken together for therapy. These results suggest the concept of 'condition orientated therapy' in the case of the stuttering problem.

The stuttering manifestations have to be tackled in relation to each condition, which will later lead to a better generalisation of the newly learned patterns.

4.0 Therapeutic Importance

The classification of stuttering patterns over a larger number of its manifestations is an important step in our approach to therapy. A prior classification of the case and his evaluation will enable the therapist to proceed with therapy in a systematic way. The therapist can arrange the conditions in the form of a hierarchy (Wolpe 1958) and proceed with the therapy on these lines, utilizing the desensitizing techniques. Further on, depending on the severity of the occurrence of primaries and secondaries, therapy can be given for the elimination of individual mal-learned behaviour. The projective validity of the therapeutic approach could be established by comparing his percentage of stuttering before and after therapy. The results obtained by computational means themselves would provide face validity in view of the case's improvement.

5.0 Prospects

Based on these lines, the programme could be further extended to sort out cases having similar characteristics and to group them together for 'Group Therapy'. Data collected on a large sample covering stuttering problems could also be analysed for the most common type of stuttering patterns, including the commonest condition under which it occurs. The same program could be modified for comparing two similar cases in terms of their performance after therapy. This will prove to be an efficient technique for justifying the therapeutic approaches which in turn will speak for the practical utility of the above classification method.

The 'condition oriented therapy' based on the above criteria could be evaluated by the following method: Two groups of stutterers falling into a main group according to the same criteria under any given condition could be taken. For one group (taken from this main group) 'condition oriented therapy' is given and for the other group any other usual therapeutic methods are followed, keeping certain factors like therapist, place, etc., unchanged. A comparision of the performance of the two groups after some period of time could then be made to determine the therapeutic efficiency of the 'condition oriented therapy'.

Foot **Note:**

•f The numerical criteria chosen for classification (1), (2), (3) and (4) of Table 2 as Normal, Mild, Moderate and Severe correspond to the respective percentages given under (4).

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Appendix: Computer Output

Case No	Conditions	Modes	Types	Occurrence
1	1	1	1	2
1	1	1	2	2
1	1	1	7	2
1	1	1	8	2
1	1	1	9	2
1	1	1		10
Primary Mild				
1	1	2	13	1
1	1	2	14	1
1	1	2	19	1
1	1	2		3
Secondary Mild				
1	1			13
Primary and Secondary Mild				
1	2	1	1	2
1	2	1	2	2
1	2	1	7	2
1	2	1	8	1
1	2	1	9	2
1	2	1	4	1
1	2	1		10
Primary				
1	2	2	13	1
1	2	2	18	2
1	2	2		3
Secondary Mild				
1	2			13
Priamary and Secondary Mild				
1	3	1		0
Primary Normal				
1	3	2		0
Secondary Normal				
1	3			0
Primary and *Secondary Normal*				
1	4	1	1	2
1	4	1	2	2
1	4	1	7	z
1	4	1		6
Primary MM				
	4	2	13	2
1	4	2	14	1
1	4	2	15	1
1	4	2	16	2
1	4	2		6
Secondary Mild				
1	4			12
Primary and Secondary Mild				
1				38
1				9.50%
Normal Stuttering				

Case No.	Conditions	Modes	Types	Occurrence
2	1	1	1	2
2	1	1	3	2
2	1	1	4	2
2	1	1	5	2
2	1	1	6	1
2	1	1	7	2
2	1	1	9	2
2	1	1	10	2
2	1	1	12	1
2	1	1		16
Primary Moderate				
2	1	2	13	2
2	1	2	14	2
2	1	2	15	2
2	1	2	17	2
2	1	2	18	2
2	1	2	19	2
2	1	2	20	2
2	1	2		14
Secondary Severe				
2	1			30
Primary and Secondary Moderate				
2	2	1	1	2
2	2	1	2	1
2	2	1	3	1
2	2	1	4	2
2	2	1	6	2
2	2	1	7	2
2	2	1	8	2
2	2	1	11	2
2	2	1	12	2
2	2	1		16
Primary Moderate				
2	2	2	15	2
2	2	2	16	2
2	2	2	17	2
2	2	2	18	1
2	2	2	19	2
2	2	2		9
Secondary Moderati				
2	2			25
Primary and Secondary Moderate				
2	3	1		0
Primary Normal				
2	3	2		0
Secondary Normal				
2	3			0
Primary and Secondary Normal				
2	4	1	1	2
2	4	1	2	2
2	4	1	5	2
2	4	1	6	2
2	4	1	7	2
2	4	1	8	1
2	4	1	9	1

Case No.	Conditions	Modes	Types	Occurrence
2	4	1	10	2
2	4	1	11	1
2		1	12	1
2	4	1		17
Primary Moderate				
2	4	2	13	1
2	4	2	14	2
2	4	2	15	1
2	4	2	16	1
2	4	2	17	1
2	4	2	18	2
2	4	2	19	2
2	4	2	20	2
2	4	2		12
Secondary Moderate				
2	4			29
***Primary** and Secondary Moderate*				
2	5	1	1	2
2	5	1	2	2
2	5	1	3	1
2	5	1	4	2
2	5	1	5	2
2	5	1	6	2
2	5	1	7	2
2	5	1	8	2
2	5	1	9	2
2	5	1		17
***Primary** Moderate*				
2	5	2	13	2
2	5	2	17	2
2	5	2	18	2
2	S	2	19	2
2	5	2	20	2
2	5	2		10
Secondary Moderate				
2	5			27
***Primary and** Secondary Moderate*				
2	6	1	1	2
2	6	1	2	1
2	6	1	3	2
2	6	1	4	2
2	6	1	S	2
2	6	1	6	2
2	6	1	7	2
2	6	1	8	2
2	6	1	9	2
2	6	1	10	2
2	6	1		19
Primary Severe				
2	6	2	13	2
2	6	2	14	1
2	6	2	16	2
2	6	2	17	2
2	6	2	18	2
2	6	2	19	2
2	6	2	20	2
2	6	2		13

Case No	Conditions	Modes	Types	Occurrence
Secondary Severe				
2	6			32
Primary and Secondary Severe				
2	7	1	1	2
2	7	1	3	1
2	7	1	8	2
2	7	1	10	2
2	7	1		7
Primary Mild				
2	7	2	13	2
2	7	2	14	2
2	7	2	15	2
2	7	2	18	2
2	7	2	19	2
2	7	2		10
Secondary Moderate				
2	7			17
Primary and Secondary Mild				
2	3	1	1	2
2	8	1	2	2
2	8	1	3	2
2	8	1	4	2
2	8	1	5	2
2	8	1	6	2
2	8	1	7	2
2	8	1		14
Primary Moderate				
2	8	2	13	2
2	8	2	14	2
2	8	2	15	2
2	8	2	17	2
2	8	2	19	2
2	8	2		10
Secondary Moderate				
2	8			24
Primary and Secondary Moderate				
2	9	1	1	2
2	9	1	2	1
2	9	1	4	2
2	9	1	5	1
2	9	1	6	2
2	9	1	7	2
2	9	1	9	2
2	9	1		12
Primary Moderate				
2	9	2	15	2
2	9	2	17	2
2	9	2	19	2
2	9	2		6
Secondary Mild				
2	9			18
Primary and Secondary Mild				
2	10	1		0
Primary Normal				
2	10	2		0

Case No	Conditions	Modes	Types	Occurrence
Secondary Normal				
2	10			0
Primary and Secondary Normal				
2				202
2				50.50%
Moderate Stuttering				
3	1	1	4	2
3	1	1	5	2
3	1	1	7	2
3	1	1	8	2
3	1	1		8
Primary Mild				
3	1	2	13	2
3	1	2	14	2
3	1	2	15	2
3	1	2	16	2
3	1	2	17	2
3	1	2	18	2
3	1	2	19	2
3	1	2	20	2
3	1	2		16
Secondary Severe				
3	1			24
Primary and Secondary Moderate				
3	2	1		0
Primary Normal				
3	2	2		0
Secondary Normal				
3	2			0
Primary and Secondary Normal				
3	3	1	1	1
3	3	1	3	2
3	3	1	4	2
3	3	1	5	2
3	3	1	8	2
3	3	1	7	2
3	3	1	6	2
3	3	1		13
Primary Moderate				
3	3	2	13	2
3	3	2	14	2
3	3	2	15	2
3	3	2	16	1
3	3	2	17	2
3	3	2	18	2
3	3	2	20	2
3	3	2		13
Secondary Severe				
3	3			26
Primary and Secondary Moderate				
3	4	1	4	2

Case No.	Conditions	Modes	TypeS	Occurrence
3	4	1	5	2
3	4	1	7	2
3	4	1	9	2
3	4	1		g
Primary Mild				
3	4	2	13	2
3	4	2	14	2
3	4	2	15	2
3	4	2	17	2
3	4	2	18	2
3	4	2	19	2
3	4	2	20	2
3	4	2		14
Secondary Severe				
3	4			22
Primary and Secondary Moderate				
3	5	1	2	1
3	5	1	3	2
3	5	1	4	2
3	5	1	6	2
3	S	1	7	2
3	5	1		9
Primary Mild				
3	5	2	16	2
3	5	2	17	1
3	5	2	18	2
3	5	2	20	1
3	5	2		g
Secondary Mild				
3	5			15
Primary and Secondary Mild				
3				87
3				21.75%

DEVELOPMENT AND STANDARDIZATION OF A COMMON SPEECH DISCRIMINATION TEST FOR INDIANS

MAYADEVI

Introduction

Speech audiometry has been an important tool in the diagnostic test battery, as it provides a measure of the listener's response to speech. Discrimination testing clinically aids in the differential diagnosis of conductive, cochlear and retrocochlear pathologies.

A historical perspective of speech tests reveals that many discrimination tests have been developed utilizing different speech materials namely, nonsense syllables, monosyllables (Egan 1948) and synthetic speech sentences (Jerger and Speaks 1968). The Harvard PB lists (Egan 1948), the CIDW—22 lists (Hirsh 1952), and the speech discrimination material standardized on English speaking Indian population (Swarnalatha 1972) are limited to the English speaking population. Campbell's (1949) nonsense syllable list cannot be used with Indians owing to a lack of familiarity. Test materials in Tamil, Telugu and Malayalam (Kapur, Y. P. 1971) have been standardized utilizing disyllabic words as very few monosyllables were available. However, these test cannot be used in all the clinics, because of the language barrier on the part of the tester and the testee.

Further, the synthetic speech identification test developed by Nagaraja (1973) is meant for the literate class among Kannada speaking population. The Hindi PB lists (Abrol 1970) and N. S. De (1973) are standardized for the Hindi speaking population.

Besides these, in India there is a multilingual problem and the existence of cosmopolitan cities has paved way for the mixing up of languages. So any clinic is liable to have cases from a variety of languages. Thus the therapist faces the problem of languages. But, *any* therapist has to deal with cases of other languages.

There is difficulty in producing a test in each language as it affects the tester's efficiency, the time and effort involved in producing tests in all the languages of India is great.

In a situation like this, it is essential to devise a common speech discrimination test using monosyllables of CV (consonent and vowel) combination, that occur in most of the Indian languages. Such 'monosyllables are sufficiently unpredictable for clinical subjects and are perceived relatively independently as individual speech elements' (Carhart 1967). With this, the other essentials like familiarity and control of language environment are satisfied. This common speech discrimination test would even solve the problem of testing the illiterates.

Thus, the present study was an attempt in constructing a new test material for a speech discrimination test, which excludes the drawbacks of the other Indian tests mentioned earlier, and which would help to solve the problems posed by the multilingual situation.

Objectives of the study

The objectives of the present study were as follows:

1. Development of speech discrimination test material common to most of the Indian Languages.
2. Establishment of the testing procedures.
3. Standardization of the test material by:

    (a) establishing validity and reliability of the test,

    (b) finding the performance of normals on this test, and,

    (c) finding the performance of clinical groups on this test.

The hypothesis of the study were:

(1) There would exist no difference in the performance of normal speaking different languages on this common speech discrimination test.

(2) It was hypothesized that the results on this test will also agree with the results of earlier speech discrimination tests, in terms of optimum scores at the most comfort level, performance-intensity function of normals and clinical groups, social adequacy index, and test scores in quiet and noise conditions.

Methodology

Construction of the test material

The Common Speech Discrimination Test material was constructed by selecting the common monosyllables of CV combination (not necessarily as independent monosyllables) as found in Indian languages. This was done by (1) obtaining data from the native speakers and (2) by a comparative study of sounds of different languages available in the literature.

The final list consisted of twenty monosyllables ranging in terms of intelligibility and meaningfulness. Appendix A.

Test procedure

Monosyllables of the speech test material were recorded in a sound treated booth using a carrier phrase 'i:ga, idannu he:II' (Noe Say this) and a time interval of ten seconds was given between each syllable.

Testing procedure Was carried out with the help of the following instruments'.

(1) Arphi audiometer (MIC *IV)* for testing purposes.
(2) A Uher stereo tape recorder Mode! 263 for feeding the recorded signals into the audiometer.
(3) A Monitoring set to enable the tester to monitor the sounds being presented to the subjects.

These instruments were calibrated periodically using Bruel and Kjaer equipment. Zero SRT for Arphi Audiometer was found to be 20 dB SPL. 1000 Hz tone was recorded on a tape and it was fed to the audiometer.

Gain of the audiometer was adjusted until the V.U. meter needle read 'O'. At input of 60 dB HL the output was 80 dB SPL. All the testing was done in a sound treated room which satisfied the prescribed levels for audiometric rooms.

For testing the clinical and normal groups, the following instructions were given:

'Now you are going to hear in your right or left ear some speech sounds like ka, ma, etc. They are preceded by a Kannada phrase 'I :ga idannu helli' you need not repeat the phrase again, but you have to repeat the syllable which you hear in the end'.

The instructions were translated into different languages depending on the subjects. The instructions were modified when the written responses of the subjects were considered.

Here the carrier phrase in Kannada was used for (1) drawing the attention of the patients to listen to the test items, and (2) for monitoring the voice while recording. It was not meant to give any meaning to the patient.

The subjects were selected on the following criteria.

(a) Normals:
  (1) Audiogram configuration of air conduction thresholds within 20 db (I.S.O. 1964).
  (2) Age range: above the age of fifteen years,
  (3) With good communicative ability (sufficient proficiency in mother-tongue).
  (4) With normal otological findings.

Clinical Groups

1. Age range: above the age of 10 years with sufficient proficiency in their mother-tongue.
2. The subjects were tested for:
   (a) E.N.T.
   (b) (l)'PTA (2) BC thresholds.
   (c) Speech reception threshold (for the cases who new Kannada and English).

TABLE 1. Indicates the number of subjects (normals), selected for different experiments of the study

Normals speaking different mother tongue	PTA range	Number of subjects	Sex	
			Male	Female
Kannada	0—15	11	8	3
Telugu	0-15	8	4	4
Malayalam	0—15	9	4	5
Tamil	0—20	11	7	4
Tulu	0—20	3	3	—
Urdu	0—20	6	4	2
Coorgi	0—15	2	—	2
Hindi	0—20	8	8	—
Gujarathi	0—15	2	—	2
Marathi	0-20	6	4	2
Konkani	0—20	6	1	5
Santoni	0—5	1	1	—

TABLE 2. Indicates the number of subjects (clinical group) selected for the different experiments

SI. No.	Type of loss	PTA Range	No. of subjects	M	F
1.	Conductive loss gp.	25—60	29	20	9
2.	Sensorineural loss gp.	20—85	30	26	4
3.	Mixed loss gp.	35—80	23	12	11
4.	High frequency loss gp.	5—20	5	5	—

Methods of testing and level of presentation

The level of presentation was kept constant, i.e., at definite sensation levels above the individual's pure tone average level. The testing was done by the experimenter with normal hearing. The test procedure was first standardized by presenting the test list on thirty normal ears and comparing their verbal and written responses. With clincal population, three responses were elicited for the same sound. As the testing was done in a one-room situation and no talk-back system was used, oral responses were chosen as the chief criteria.

Seventeen experiments were conducted for testing the hypothesis. This included the tests for determining the concurrent, content and predictive validity and test-retest reliability.

Results and Conclusions

The raw data obtained from the several experiments were statistically analyzed to yield the following results:

The level at which normals obtained miximum scores was taken as the reference level for testing other normals speaking different languages. And the performance of normals speaking different languages was compared on Kruskal Wallis test of one way analysis of Variance (Siegel ! 956).

The performance of the clinical groups was compared by using Mann-Whitney 'U' Test (Siegel 1956).

A comparison of the verbal and written responses of the subjects was made by computing the coefficient of Rank correlation (Garret 1971).

With the discrimination scores in quiet and noise situations of normals and SN loss cases, a measure of the 'Discrimination Index' (given as PB Max-PB M in/PB Max, Jerger 1971) was obtained. These values were compared by Wilcoxon Matched Pairs sign Rank Test.

The social adequacy index (H. Davis 1970) for normals and clinical groups Were computed (the average of discrimination scores at 55, 70 and 85 dB SPLs).

The concurrent validity of this test was tested by presenting the English PB list to normals and to clinical groups having a knowledge of English and analysing the scrores on 'Wilcoxon matches sign pair Rank test'.

The test-retest reliability was established by computing 'coefficient of correlation' (Rank correlation method-Garret 1971) between the test retest measures:

The results of the above statistical analysis led to the following conclusions:

1. Normals obtain optimum scores ranging from 90 to 100 per cent in this test at 40 dB SL (ref. PTA).

Note: As PTA is used as the reference level instead of the usual SRT as the reference level, the presentation level in terms of SPL would be 40+PTA (HL)+zero SRT (SPL). In this study zero SRT was 20 dB SPL. If in an audiometer zero SRT is not 20 dB SPL, the presentation level in SPL would be 40+PTA (HL)+zero SRT+(20—zero SRT) correction. correction is (—) if zero SRT is > 20 dB SPL.

2. The performance of normals speaking different Indian languages followed the same pattern.
3. There was no difference in the scores of verbal and written responses of the subjects.

4. Sex difference in terms of performance was found insignificant.
5. There was no difference in the performance of right and left ear on this test.
6. The performance of SN loss cases was different from that of normals, conductive and high frequency loss cases. There was no difference in the performance of mixed loss and SN loss groups.
7. The conductive loss group resembled normals and high frequency loss in their performance.
8. Performance of mixed loss group differed from that of high frequency loss cases.
9. The high frequency loss cases performed like normals.
10. Maximum score was obtained at different levels instead of at 40 dB SL in clinical groups. So it is desirable to determine P.I. function for each case instead of depending on the score at one level.
11. Discrimination Index of normals and clinical groups ranged from 0.05 to 0.55. DI could be considered as a diagnostic indicator in the case of retrocochlear pathologies.
12. The SAL measures for normals differed from that of the clinical groups.
13. The SN loss group yielded low discrimination scores under noise situations and hence this factor should be considered while doing hearing aid evaluation.
14. High correlation scores indicated good test-retest reliability.

Implications of the study

Discrimination testing is an important test battery for differential diagnosis. This test could be used as a common speech discrimination test in all the clinics, owing to the following advantages:

1. Cases with different language background can be tested.
2. The test can be administered by any therapist without knowing the particular language of the case.
3. Responses can be elicited either verbally or in written form.
4. The test could be administered through live voice where recording facilities are not available.

Limitations of the study

1. The test materials did not represent the everyday listening condition of the subjects.
2. This study was limited to the cases who came to the clinic at A.I.I.S.H.
3. Information regarding all languages was not available.

Further research-based on standardizing the test on large population **involving different languages would be** worthwhile.

APPENDIX—A

LIST OF THE MONO-SYLLABLES

Sl. No.		*Hindi*	*Kannada*	*Sl. No.*		*Hindi*	*Kannada*
1.	ma	म	ಮ	11.	na	न	ನ
2.	ta	ट	ಟ	12.	va	व	ವ
3.	Sa	स	ಸ	13.	Na(na)	ण	ಣ
4.	Ka	क	ಕ	14.	ya	य	ಯ
5.	ba	ब	ಬ	15.	la	ल	ಲ
6.	ra	र	ರ	16.	dha	द	ದ
7.	ga	ग	ಗ	17.	La(la)	ळ	ಳ
8.	pa	प	ಪ	18.	ja	ज	ಜ
9.	da	ड	ಡ	19.	sha	श	ಶ
10	tha	त	ತ	20.	cha	च	ಚ

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A STUDY ON CONGENITAL HEARING LOSS IN RELATION TO VENEREAL DISEASE

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Introduction

A review of literature shows that there are only a few studies reported on congenital hearing loss following -venereal diseases (Karmody *et al* 1966; Perlman and Leek 1952 and William 1945). Our present study was to throw some light on this particular aetiological factor precipitating hard of hearing. It was a collaborative work of the department of Audiology and Speech Pathology in the Institute of Otorhinolaryngology and the Institute of Venereology, Madras Medical College, Madras.

The population under study were the inmates of schools for the hard of hearing in Madras, namely; The Little Flower School for the Deaf and Blind, The C.S.I. School for the Deaf, C.S.I. Vocational Training Centre for the Adult Deaf and St. Louis School for the Deaf and Blind. The present study concerned 367 congenital hard of hearing cases.

Methodology

A team of specialists consisting of E.N.T. specialists, venereologists, audiologists and social workers visited the above schools twice a week. For all cases, detailed history was taken with the help of their class teachers as their parents were not available. All of them underwent general medical and otorhinolaryngological examination. A complete examination by the venereologist for any evidence of congenital syphilis was done on all cases and blood samples were collected separately for VDRL analysis. In suspected cases X'rays of the relevant parts were also taken. All the cases were subjected to undergo hearing evaluation. Pure tone audiometry was done by using Arphi clinical Audiometer Mark IV with ISO calibration. The thresholds were established in relatively calm and quiet rooms. The ambient noise was about 50 dBSPL as the rooms were free from noisy surroundings. Speech Audiometry could not be done as the subjects had inadequate speech and language development.

An Analysis of the V.D. cases which attended the Institute of Venereology during the year 1973 was done with relevance to the incidence of hearing loss.

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Results

Out of the 367 cases studied, 242 (65.9 per cent) were males. The age range varied from 5 to 29 years. Table I shows the age and sex distribution of the cases studied.

TABLE I. Age and Sex distribution of hard of hearing cases

Age group	*Male*	*Female*	*Total*
0.9	35 (9.5%)	27 (7.3%)	62 (16.8%)
10.19	194 (52.7%)	68 (18,5%)	262 (71.2%)
20.29	13 (3.7%)	30 (8.3%)	43 (12.0%)
	242 (65.9%)	125 (34.1%	367 (100%)

112 cases (30.7 per cent) gave a family history of hearing loss in either their parents or siblings. There was no significant family history of hearing loss in the remaining 255 (69.3 per cent) cases. (Table II)

TABLE II. Family history of hard of hearing

Age group	*Present*	*Not known*
0.9	25 (6.8%)	37 (10.1%)
10.19	73 (20.1%)	189 (51.2%)
20.29	14 (3.8%)	29 (8.0%)
	112 (30.7%)	255 (69.3%)

Out of the 367 cases only from 6 persons could we obtain a definite histoiy of consanguinous marriage among parents (Table III). In previous studies in South India on children of schools for the Deaf (Kapur, 1968; Rajenderkumar and Kameswaran, 1973) and on other children attending audiology clinics (Rajenderkumar and Kameswaran, 1973), history of consanguinity was reported in a very large percentage. It is possible that the history of consanguinity and even family history of hearing loss may be present in a higher percentage of cases in our study as well, since in the majority, history had to be obtained only from the teachers and not from the parents as the latter were not available.

TABLE III. Number with a history of consanguinity

Age group	*Present*	*Absent*	*Not known*
0.9	5. (1.4%)	5. (1.4%)	52 (14.0%)
10.19	0. (0%)	1. (0.3%)	261 (71.1%)
20.29	1. (0.3%)	1. (0.3%)	41 (11.2%)
	6. (1.7%)	7. (2.0%)	354 (96.3%)

General and venereological examinations did not reveal any evidence of congenital syphilis, primary, secondary or tertiary syphilis or any other venereal diseases.

Otological examinations of these cases revealed that 307 cases had normal ear findings with normal external auditory meatus and intact tympanic membranes. Fifty three cases were having impacted wax in one or both ears. Seven cases were suffering from chronic suppurative otitis media affecting either one or both ears. (Table IV).

TABLE IV. Otological Findings

Age group	*Normal*	*Wax*	*Csom*
0.9	50 (13.7%)	11 (3.0%)	1 (0.3%)
10.19	220 (59.9%)	36 (9.8%)	6 (1.6%)
20.29	37 (10.1%)	6 (1.6%)	0 (0%)
	307 (83.7%)	53 (14.4%)	7 (1.9%)

Pure tone audiometric thresholds have been established for all cases (Table V and IV). It was found that 82 per cent and 82.7 per cent of cases had hearing loss above 90 dB in the right and left ears respectively. 14.3 per cent of the cases showed hearing loss above 80 dB in both ears. In only a small percentage, the hearing thresholds were found to be below 80 dB HTL. None of the cases showed hearing thresholds below 60 dB HTL. In all cases except one,the bone conduction thresholds could not be established even at the maximum intensity levels of the audiometer. The only case in which both air conduction and bone conduction thresholds could be obtained, the air conduction thresholds were 65 dB and 75 dB in the right and left ears respectively and for the bone conduction the threshold was 40 dB in both ears at speech frequencies.

TABLE. V. Right ear pure tone thresholds in db HTL and BHTL

Age group	*60.69*	70.7.9	*80.89*	*90.99*	*100 and above*
0.9	0% (0)	0.3% (1)	1 8% (7)	6.0% (22)	8.7% (32)
10.19	0.5% (2)	1.8% (7)	11.7% (42)	22.0% (81)	3 5.5% (130)
20.29	0.3% (1)	08% (3)	0.8% (3)	2.2% (8)	7.6% (28)
	0.8% (3)	2.9% (11)	14 3% (32)	30.2% (111)	51.8% (!90)

TABLE VI. Left ear pure tone thresholds in db HTL and BHTL

Age group	*60.69*	*70.79*	*80.89*	*90.99*	*100 and above*
0.9	0% (0)	0% (0)	2.5% (9)	6.0% (22)	8.4% (31)
10.19	1.1% (4)	1-1% (4)	10.7% (39)	26.4% (97)	32 1% (118)
20.29	0.3% (1)	0.5% (2)	1-4% (4)	1-1% (4)	3.7% (32)
	1-4% (5)	1.6% (6)	1 4.3% (52)	33.5% (123)	49.2% (181)

The blood samples taken from all the cases were subjected to Venereal Disease Research Laboratory test in the Institute of Venereology, Madras Medical College. The results showed that out of the 367 blood samples, only mse showed a weak reaction at Zero dilution level, All the other blood samples showed non-reactivity to VDRL test—Table VII.

TABLE VII. Analysis of blood VDRL

Age group	*Reactive*	*Non-re act ive*
0.9	0. (0%)	62 (16 8%)
10.19	1. *(0.3%)*	261 (71.1%)
20.29	0- (0%)	43 (11.8%)
	1. (0.3%)	366 (99.7%)

An analysis of the cases attending the Institute of Venereology revealed that during the year 1973, 7284 V.D. cases attended, (Males 5,800; Females 1,484), of which 2,219 (Males 1,629; Females 590) wen- syphilitic cases. Among this there were 47 congenital syphilitic cases (Males 8; Females 39) as shown in Table VIII. Rather oddly females accounted for the larger number of congenital syphilitics cases (about 5:1 ratio), even though in the total number of syphilitic cases males predominated in the ratio of about 3:1. The hearing level of all the congenital syphilitic cases were within normal limits as revealed by puretone audiometry.

TABLE VIII. Incidence of venereal disease for the year 1973 as given by Institute of Venereclogy

	Male	*Female*	*Total*
No. of Total Venereal Diseases Cases	5,800	1,484	7,284
Total No. of Syphilitic Cases	1,629	590	2,219
Congenital Syphilitic Cases	8	39	47

Dicussion

Moore *et al* (1963) stated that there were 1,24,000 cases of syphilis reported in United States in 1962 and also concluded that this figure represented, but 1/5 of the total number. The incidence of syphilis and hearing loss varied in different studies reported having been given as 25 percent and 33 per cent in separate studies by Alexander and Lund as reported by Dalsgaard-Neilson (1938). Karmody and Schuknecht (1966) reported in a study of 'Deafness in Congenital Syphilis', 38 per cent of the cases had hearing loss. The predominance of congenital syphilis in women had been discussed by Perlman and Leek (1952).

In our study the one who showed a weak reaction to Blood VDRL analysis, was a female aged 11 years. Her audiogram showed a flat hearing loss of 100 dB from 500 Hz to 3,000 Hz. and no response for the frequencies above 4,000 Hz. The threshold for 250 Hz was 90 dB in both ears. The audiological finding in this particular case was in correlation to Karmody *et al* (1966) as reported in a study of 143 cases of congenital syphilis. They found that about 38 per cent of their cases showed hearing loss of bilateral, progressive, sensorineural with loudness recruitment and often the hearing levels fluctuated considerably. Williams (1945) stated that in the average syphilitic, specific deafness was rare, and that if deafness was present it was probably due to other causes. On the other hand, in neuro and congenital syphilis the condition occurred fairly frequently. In a study at the Institute of Venereology, it was found that syphilitic keratosis was associated in nearly 10 per cent of cases of congenital syphilis (Sowmini, 1974).

Though a high incidence of congenital syphilis as an aetiological factor for congenital hearing loss was reported by above authors, the present study did not give any evidence of such a high incidence of congenital syphilis in our hard of hearing population.

Though a high incidence of congenital syphilis as an aetiological factor for congenital hearing loss was reported by above authors. The present study did not give any evidence of such a high incidence of congenital syphilis in our hard of hearing population.

In conclussion, congenital syphilis as an aetiological factor causing hearing loss is rather insignificant when compared with other aetiological factors. In our study only in one out of 367 cases (0.3 per cent) of loss and none in 47 cases of congenital syphilis could we find congenital syphilis as a possible cause; even though we often emphasised too much in routine practice the importance of VDRL tests in congenital hard of hearing.

Summary

A total of 367 hard of hearing cases from various schools for the hard of hearing had been studied in relation to congenital venereal diseases. A complete general medical, otorhinolaryngological, and venereological examinations followed by blood VDRL analysis and audiological assessments had been done. Out of 367 cases, 112 cases reported to have definite family history of hearing loss, six gave history of consanguinity and seven cases had CSOM in either one or both ears.

A majority of the cases had hearing loss above 90 dB at speech frequencies in both ears and only in a small percentage the hearing threshold was above 60 dB. Of the 367 blood samples tested, only in one, a female child aged 11 years and whose audiogram showed a flat response of 10 dB in both ears, had a weak reaction at zero dilution for VDRL test. This, very low incidence of congenital syphilis was insignificant as a causative factor of hard of hearing among our children and was in contrast with other studies (Collin S. Karmody *et al*, 1966; Perlman and Leek, 1952; Alexander and Lund as reported in the study of Dalsgaard-Neilson, 1938, and Moore *et al*, 1963) which showed a high incidence of hearing loss due to congenital syphilis.

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SOUND TREATED ROOM AT KASTURBA MEDICAL COLLEGE HOSPITAL, MANIPAL

*S. S. MURTHY, *M. N. VYASA MURTHY, tP. RAMANJANEYULU

One of the major requirements in hearing evaluation is a controlled acoustic test environment. There are different methods of constructing sound treated rooms. In addition to good design, there should be continuous supervision of the construction details. A sound treated room has been constructed at Kasturba Medical College Hospital, Manipal. This paper deals with the particulars of construction of the sound treated room. It is hoped that the particulars furnished here would be useful to those who are interested in the construction of sound treated rooms in their speech and hearing clinics at reasonably low cost.

Noise Level Measurements

Using a SPL meter fBruel and Kjaer type 2203), connected to a microphone (Bruel and Kjaer type 4145 and with an Octave filter (Bruel and Kjaer type 1613) set, the noise levels in the proposed test room location was measured at different positions during peak hours. The results of measurements are given in the Table 1.

TABLE 1. S.P.L. Values measured at K.M.C. Hospital, Manipal

Weighting net work	At 10.30 A.M. (Peak Hr)	At 11.30 A.M. (Peak Hr)
A-Scale	65 dB	62 dB
B-Scale	80 dB	72 dB
C-Scale	92 dB	84 dB
In Octaves		
31.5	90 dB	82 dB
63	84 dB	76 dB
125	74 dB	64 dB
250	70 dB	64 dB
500	62 dB	57 dB
I K	60 dB	54 dB
2 K	62 dB	46 dB
4 K	44 dB	42 dB
8 K	30 dB	36 dB

Note: Frequency in Hz
Intensity in dB. Ref: 0.0002 dynes/cm2

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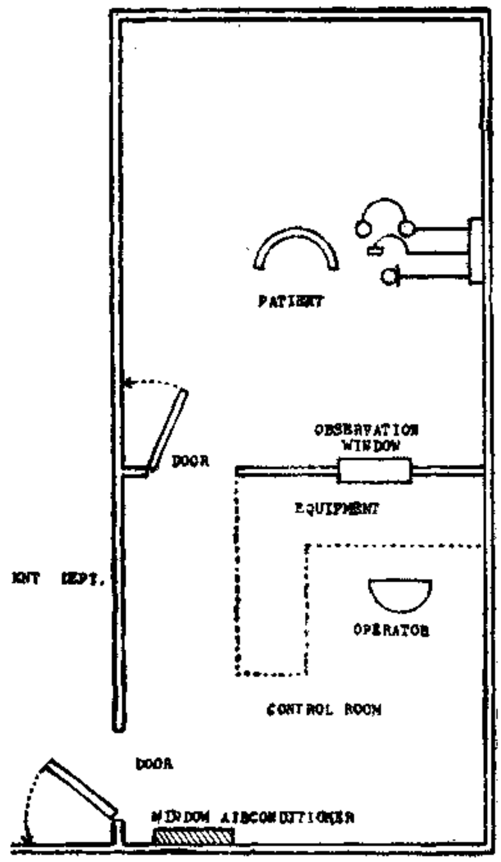
Dimensions of the rooms

The internal dimensions of the rooms were fixed at 9'X 12' for test room and 10'X 9' for the control room (where audiometer is installed) Figure 1 illustrates the dimension of the rooms.



I'lG. 1.

Construction of Walls

Having considered the noise levels, the attenuation characteristics of the bricks (Cook *et al,* 1957) and the required noise levels for testing purposes (Table 2 gives the maximum allowable noise levels proposed in the testing room for audiometers calibrated to ISO 1964) the thickness of the walls was decided. North, South and East side walls were constructed with a width of 131/2 (l1/2" brick wide walls). The west side wall was constructed with a width of 9" (single brick-lengthwise). A 5" air gap was provided between the west side wall and the existing wail. All the walls were constructed, using cement marter and 1j" thick rough cement plaster. While constructing the walls, wooden studs of size 2"x2"x5" with a projection of 2" above the plastering at a distance of 2' for all the inside walls to fix wooden frames were provided. In the case of south side wall, the air gap between the wall and the wooden frame was 5". The stud's dimension for this wall was 2" x 2" X 2". The existing ventillators on the west side wall were covered by bricks.

TABLE 2. Maximum allowable noise levels in a sound treated room for audiometer calibrated to ISO 1964 and ASA 1951 (Hirschorn 1971)

Audiometric frequency	Octave band	Proposed standard for ISO (1964) Sound Pressure level (dB)	ASA (1951) SPL
125	75- 150	31	40
250	150- 300	25	40
500	300- 600	26	40
1000	600- 1200	30	40
2000	1200- 2400	38	47
4000	2400- 4800	51	57
6000	4800- 9600	51	62
8000	9600-19200	56	67

Flooring

The four walls and the floor of the test room were isolated by 4" wide and 12" deep gap. This gap was filled with glass wool and covered by a hard board sheet. Figure 2.

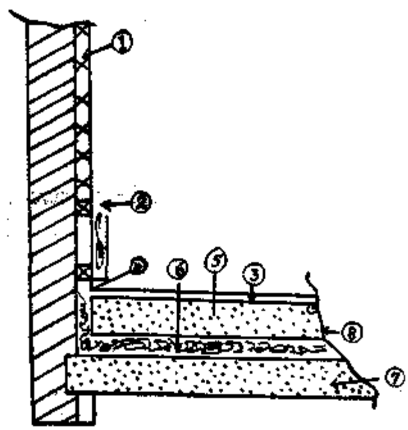


FIG. 2.
1. Wall Treatment
2. Skirting with Minimum Contact
3. Linoleum
4. Air Gap
5. Wood Floor
6. Resilient Material
7. Cement Concrete
8. Water Proof Paper

Observation Window

The observation window consisted of two frames of dimension *21/2'* X2' separated by air gap of 8". It was fixed at a height of 2' above the floor as shown in the Figure 1. The two window frames were fixed with 1/4" thick glass panes. While fixing the glass panes a lining of glass wool and rubber was provided along the edges to avoid leakage of sound. The frames for fixing the window were made with 3" square teakwood bars. The glass pane fixed towards the control room was tilted by 10* on the top side. Figure 3.

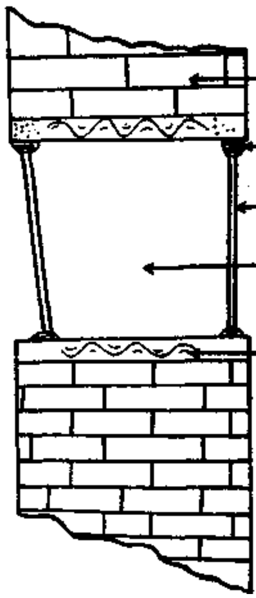


FIG. 3-
1. Brick Wall
2. Rubbed Gasket
3. *i"* Thick Glass
4. Air Space
5 Glass Wool

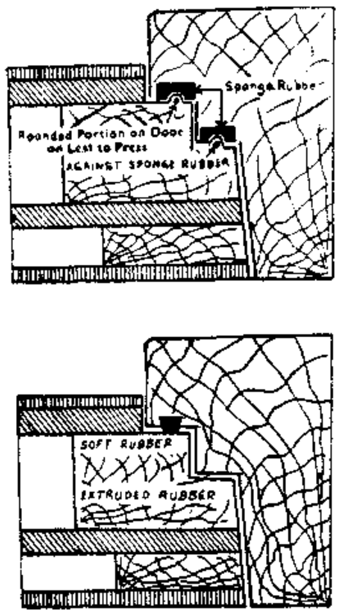


FIG. 4.

Door

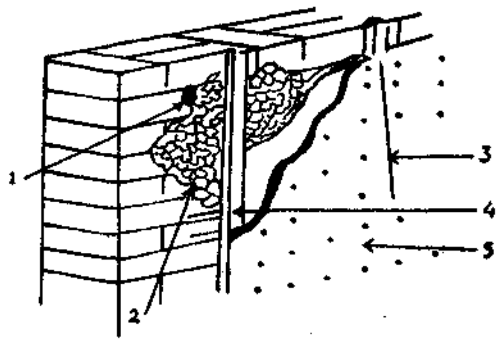
The door was **made of two** shutters and two frames The shutters were designed in such a manner that they opened in opposite directions (Figure 1). The inner dimensions of the teakwood door frame was 61/2'x3'. The teakwood frame of each shutter was 4" thick and it was fixed by two layers of 1/2" thick plywood sheets. The gap between the plywood sheets was filled with glass wool of 3" thickness. The door frames and the shutters were made as shown in Figure 4. The edges of all the door frames were fitted with a rubber lining (i'thick) with the help of an adhesive. The edges of the door frames were provided with 1" thick compressed glass wool and thick drill cloth. The shutters were provided with hydraulic closures. The door frame was installed in such a manner that the shutters were 3" above the existing floor to avoid the obstruction of the carpet. The shutters facing the test room and control room were covered by acoustic tiles.

Internal Acoustic Treatment

All the four walls were covered by 2" thick glass wool and acoustic tiles. To fix the glass wool and acoustic tiles a teakwood frame was provided over the studs fixed on the walls. To support the glass wool, a thin wire was placed over the teakwood frame. A lining was provided .with 3/4" wide,1/4" thick teakwood reapers to the acoustic tiles. The lining was painted with a suitable colour and the acoustic tiles were not painted. Figure 5 illustrates the internal acoustic treatment.

FIG. 5

1. 1" Gap
2. Wire Netting
3. Glass Wool
4. Wooden Battens
5. Perforating Lining Board



Ceiling

A false ceiling was provided 5" below the existing concrete roof. The false ceiling was made of teakwood framework with reapers *21/2'* X *21/2'* fixed at a distance of 2'. Below this frame-work a layer of wire gauze, 2" glass wool and acoustic tiles were provided. A lining was provided to the acoustic tiles as before Figure 6.

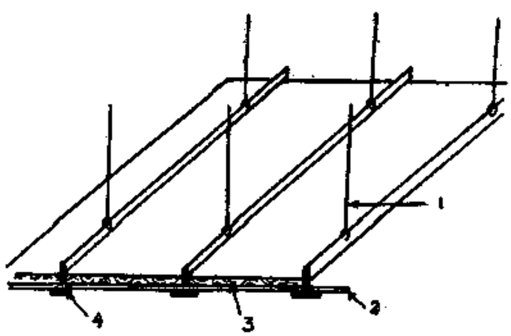


FIG. 6.

1. Chain
2. Lining Board
3. Glass Wool *1"* Thick
4. Bars

Floor

The floor was covered with a layer of *V* thick coir matting and 1" thick carpet.

Light

Indirect lighting was provided above the observation window. Additional power plug was provided as shown In the Figure 7.

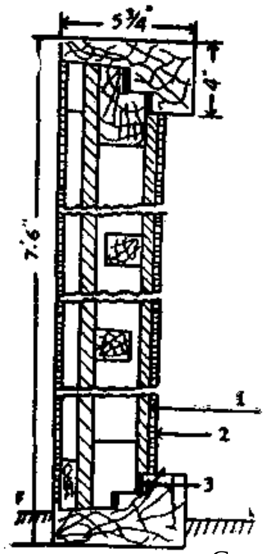


FIG. 7.

1. 1/2" Celotex
2. Glass Wool
3. Sponge Rubber

Connecting Cables

Six shielded microphone cables were provided from the control room to the test room. The cables were fixed before the walls were acoustically treated. The ends of the cables were fixed to suitable jaks which were connected to suitable boxes as shown in the Figuie 7. A polyethylene tube was used to carry the cables across the wall. (Figure 7).

Control Room

All the walls of the control room including the ceiling were covered with acoustic tiles using suitable teak wood frames *(1/2 "*thick, 2" wide) and studs were provided for fixing the frames to the walls. The ceiling frame was 8" below the concrete roof to provide air gap.

Ventilation

A l1/2 tonne window type air-cooler was recommended for sufficient ventilation for both test and control rooms. The cooler was installed just opposite to the door of the sound treated room (Figure 1),

Results

To verify whether the completed room satisfied the proposed standard levels for ISO (1964), wideband noise was generated outside the rooms using Arphi audiometer Model 700 MK II through the loudspeaker (Free field setting). The work levels outside the rooms and inside the testing room were measured using an SPL meter (Bruel and Kjaer type 2203) fixed with a microphone (Bruel and Kjaer type 4145) and Octave filter set (Bruel and Kjaer type 1613). The results are given in Table 3. When the values were compared with the maximum allowable levels proposed for ISO (1964) reference levels, it was found that at all octave bands, the levels in the newly constructed room were well below the prescribed levels. So it is felt that this design was effective and economical.

TABLE 3. SPL values of the new audiometric room at Kasturba Medical College Hospital, Manipai

Scale	Outside the rooms (dB SPL)	Inside the room (dB SPL)
A	85	18
B	87	17
C	90	25

In Octave (centred preferred Freq)	Outside the room	I aside the room	Max. allowable levels proposed for ISO (1964) reference levels (Hirschorn 1971)
125 Hz	84	24	31
2S0 Hz	86	21	25
500 Hz	82	22	26
1000 Hz	85	18	30
2000 Hz	78	17	38
4000 Hz	74	16	51
8000 Hz	74	16	56

Acknowledgement

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HEARING IN FISHES AND REPTILES

S. KAMESWARAN* AND P. V. RAJENDER KUMAR+

Very little work has been done on trie hearing capacity or mechanism of the lower vertebrates in India. Several experimenters such as Kreidl (1895) concluded that fishes were deaf or, at best, could receive some vibrations through cutaneous sense. Only after Bigelow (1904) and others, it was proved conclusively that fishes do perceive sound. In this study an attempt is made to evaluate the hearing capacity of a few fishes and reptiles of South India.

In fishes, in addition to the inner ear, a series of integumentary sense organs, known as lateral line system are present, which perceives displacement of the medium and near field sounds of low frequency range (Harris and Van Bergejik, 1962, Tavolga, 1971). It is thus obvious that the hearing mechanism in lower vertebrates differs vastly from those of man and other mammals, and a comparison of the different hearing mechanisms could be of special interest. While it is known that some of the lower vertebrates have the capacity to hear air conducted sounds, it is said that snakes perceive sounds by bone conduction (Tumarkin, 1968).

Materials and Methods

Three species of telecost fishes namely *Rhinomugil corsula* (Mullet), *Tilapia mossambica* (Tilapia) and *Anabas scandans* (Indian climbing perch), a lizard, *Calotes versicolar* (common garden lizard), md the following snakes: *Ply as mucosus* (yellow and black rat snakes), *Coluber fasciolatus* (Banded Racer), *Boiga ceylonensis* (Ceylon cat snake), *Eryx jhoni* (Sand Boa) and *Dryophis nasutus* (Green whip snake) were used for this study. Of these snakes, Boiga and Dryophis are poisonous snakes (Rajendran, 1968).

An audiometer (BEL) with provision for pure tone and speech audiometry was used for the study along with an activity chamber modified by Kutty *et al.*, (1971) connected to an electronic counter

The experimental animal was left inside the transparent plastic annular activity chamber and the two earphone of the audiometer with ear cushions were snugly fitted to the two top wells of the chamber. This unit was kept inside a wooden box to shut off external light and disturbance. A peep hole covered

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with a one way plastic viewer, was used for observing the animal. The interior of the box was lighted from above. There was provision for measuring the random activity of the animal when it moved round the chamber. This was facilitated by focusing two beams of light (directed from outside of the chamber) on two photocells fixed in the inner hollow of the annular activity chamber. When the animal moved and cut the beam of light the event was counted and a record of the activity per unit time was made.

In the case of fishes, the activity chamber was filled with water leaving an air column at the top of the wells and there was provision to flush the chamber with fresh water continuously by means of a circulatory system. As for *Calotes versicolar* and snakes, the animals were left in the chamber as such and their activity observed. In addition to random locomotary activity of the animal, other behavioural changes were also observed and recorded.

Results and Discussion

Fishes

All the three species of fishes tested responded to pure tones. Different behavioural changes were observed in the three species. In the case of mullet, its random locomotor activity increased when subjected to the sound as could be seen from the data given in Table 1.

TABLE 1. Hearing Response in Rhinomugil Corsula. (Increase of Locomotor activity).

Mean Weight:	36.5 cms.	Water Temp.:	25°C.
Mean Length:	16.5 cms.	Room Temp.:	27°C.

Frequency c/s	10 dB	20 dB	30 dB	40 dB	50 dB and above
125		+	+	+	+
250	—	+	+	+	+
500	—	+	+	+	+
1000	—	+	+	+	+
1500	—	—	+	+	+
2000 and above	—	—	—	—	—

Thus it is seen that Mullet, which is a non-ostariophysid in which Weberian ossicles are absent can perceive frequencies upto a maximum of 1,500 cycles/second only and the hearing threshold was found to be about 20 dB. The lateral line system helps in perceiving only low frequency tones. This finding is in conformity with that of Maliukina (1960).

Anabas scandans and *Tilapia mossambica,* the two other species of fishes did not show any significant change in locomotory activity and hence other behavioural changes like movement of the eye balls were studied in both these species.

The rate of movement of the eye balls was found to be lesser when they were subjected to pure tones of various frequencies. Hearing response in *Anabas scandans* is shown in Table 2.

TABLE 2. Hearing response in anabas scandans. (Decreased eye ball movements).

Mean weight: 26.5 cms. Water Temp.: 2S°C.

Mean length: 10.5 cms. Room Temp.: 27°C.

Frequency c/s	10 dB	20 dB	30 dB	40 dB	50 and above
125		+	+	+	+
250	—	+	+	+	+
500		+	+	+	+
1000	—	+	+	+	+
1500		+	+	+	+
2000			+	+	+
3000			+	+	+
+000				+	+
6000 and above	—	—	- .	—	

From above it is obvious that as regards frequency discrimination *Anabas scandans* can hear tones upto 4,000 Hz., threshold of intensity for the various frequencies being 20 to 30 dB HTL. This is in conformity with the observation that ostariophysids which have a swim bladder connected with the internal ear by means of a chain of ossicles known as Weberian ossicles, perceive high frequency sound (Enger, 1968; Tavolga, 1971). The fish *Anabas scandans* has also an accessory respiratory organ known as iabyrinthiform organ—an air pocket in the head which also aids in auditory function. The sound converted as pressure wave touching the fish is amplified by the swim bladder or any other air pocket in the fish. In spite of this, the non ostariophysids are also able to perceive sound frequencies though at a lower level. Behavioural study in response to pure tone transmission in *Tilapia mossambica* further confirmed that the hearing in non-ostariophysids is limited to the low frequencies as shown in Table 3.

TABLE 3. Hearing responses in tilapia mossambica. (Decreased Eye Ball movements).

Mean Weight: 30 cms. Water Temp.: 25°C.

Mean Length: 12 cms. Room Temp.: 27°C.

Frequency c/s	10 dB	20 dB	30 dB	40 dB	50 dB and above
125		+	+	+	+
250	—	+		+	+
500	—	+	+	+	+
1000	—	+	+	+	+
1500 and above			–	—	—

A study of the 3 species of fishes confirmed the view that ostariophysids have a better hearing range than the non-ostariophysids. But the threshold of hearing was about the same 20 to 30 dB HTL in both ostariophysids and non-ostariophysids. It appears that the ostariophysids possess the lowest auditory thresholds and highest upper frequency limits. This is undoubtedly a function of the Weberian apparatus which couples the auditory signal received by the swim bladder to the inner ear in a manner analogous to the operation of the middle ear ossicles in man. Other air chambers can serve in similar fashion, as, for example, the branchial cavity in the labyrinthine fishes (Schneider, 1941).

It is known that fish could be subjected to conditioned reflexes and most of the earlier observations in sound perception in fishes were made by using conditioning technigues fEngor, 1968). We checked this theory of sound localisation and conditioning reflexes in fishes. In a particular temple in South India (Papanasam temple in Tirunelveli) it is a custom that the priest after offering 'Archanas' to the deity steps out from the temple and moves down to the river. He continuously rings the bell and having got down into the water throws cooked rice which is eagerly devoured by the fishes in large numbers. All these fishes belong to four species of carps (ostariophysids). We conducted experiments in this particular place. After the priest has once fed the fishes, we requested him to remain in the water without ringing the bell. The fishes disappeared, but promptly returned on ringing the bell. This certainly indicates that there is a positive response to the sound of bell and that they are conditioned to that sound as a prelude to feeding. Subsequently, we erected a cloth partition at the bank of the river and sounded a smaller bell but the fishes did not respond. However, when the temple bell was rung again the fishes gathered. From this it could be inferred that the fish (carps) in that river has been conditioned to that temple bell, that is, to its particular frequency.

In this study as sound is produced in air and transmitted through the water mainly as pressure waves there is a probability that the intensity of the sound perceived by the fish is less than the level at which it is produced though the frequency may remain the same (Enger, 1968).

Garden Lizard

Calotes Versicolar, the garden lizard was screened for its hearing capacity, but no locomotor or behavioural changes could be elicited, in spite of repeated attempts at various frequencies and intensity of pure tones. Calotes is known to be an inactive reptile in which locomotor and behavioural changes are manifested to a lesser extent. Earlier studies on activity and metabolism of calotes revealed the same (Kameswaran *et al,* 1973). Its habit could well have rendered this animal not to react to any sound that was not indicative of any immediate danger, i.e., threat. Perhaps more precise methods employing neuro-physiological techniques may yield accurate information on the hearing capacity of this sluggish reptile.

Snakes

None of the snakes responded to pure tones. However, all of them responded to music both instrumental and drum, fed to the activity chamber by means of an audiometer at 50 and 100 dB IITL. The results are shown in Table 4.

TABLE. 4 Hearing response in snakes: Room Temp.: 27°C

Species	Pure Tor.e	MUSIC 50 dB	100 dB
Ptyas mucosus (Yellow)	0		+ + +
Ptyas mucosus (Black)	0		+ + +
Coluber fasciolatus	0	+ + +	+ + +
Boiga ceylonensis	0	+ +	+ + +
Eryx jhoni	0	00	00
Dryophis nasutus	0	00	00

0=No response in any frequency even upto a maximum of 100 dBs.
+ =Mild response. + + = Fair response + + + = Good response.
00=No response.

Ptyas mucosus (Yellow rat snake) when exposed to the music of predominant low frequency tones at 100 dB the visible normal respiratory movements suddenly stopped and was followed by hurried respiration indicating fright. For the same music at 50 dB, the response was only mild. The response was similar in the case of black variety also.

Coluber fasciolatus (Banded racer) when screened responded markedly to music by moving its head from side to side. Its response was good both at 50 and 100 dB HTL.

Boiga ceylonensis (Ceylon cat snake) exhibited continuous movements normally as also when pure tones were fed, but responded well to music by abrupt cessation of movements.

Eryx jhoni (Sand Boa) and *Dryophis nasutus* (green whip snake) the other two snakes also tested in this study, did not show any definite response at all, to either pure tones or the music. Eryx was highly inactive and indifferent and Dryophis though active, did not respond to sound appreciably.

In all these cases, the reaction seemed tO be one of fright.

Previous work on the endolymph and allied fluids of fish and mammalia (Kameswaran, *et ah,* 1972) and the effect of labyrinthine disturbance on metabolism and activity in certain vertebrates (Kameswaran *et al.,* 1973) has shown that the inner ear as such is primitive in fishes and less markedly developed in reptiles. Hence the hearing capacity in these animals, is limited.

Summary

A study on hearing responses was carried out on selected fishes, calotes and a few snakes.

It was found that in fishes the highest frequency range upto 4000 cycles/second was noted in *Anabas scandans*, an ostariophysid. In the other two, non-ostariophysids, *Rhinomugil corsula* and *Tilapia mossambica*, the highest frequency range was found to be 1,500 and 1000 Hz respectively.

There was no significant variation in hearing thresholds between the ostariophysids and non-ostariophysids, which was about 20 to 30 dB.

Calotes versicolar by virtue of its inactive nature was found to be indifferent to the extraneous sounds employed in this study perhaps neuro-physiological techniques will only yield useful information on its hearing.

It is interesting to note that snakes did not respond to pure tones irrespective of the frequency or intensity, whereas they responded only to music which was of predominant low frequency and that the response was chiefly one of fear.

Of the snakes, studied, *Ptyas mucosus, Coluber fasciolatus* and *Boiga ceylonensis* exhibited very good response to sounds, whereas *Eryx jhoni* and *Dryophis nasutus,* showed no definite response.

The results of this study confirm that the fishes and reptiles have a much limited hearing range when compared to man.

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ROLE OF PUBLIC EDUCATION IN POPULARISING THE FIELD OF SPEECH AND HEARING IN INDIA

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Introduction: Need for Public Education

Ignorance of the field of speech and hearing in the country has to a greater extent frustrated the young minds of the voung people of the young profession. Ignorance of the utility of the field is also not a healthy sign for its proper growth and development. If the problems of speech and hearing are not identified and treated early due to lack of awareness among the public, rehabilitation becomes rather difficult and may not be effective. ! t frustrates the desire of the professionals who wish to help and also the needs of such children who need professional help. Not many people know about the speech and hearing problems. As a result many cases do not seek the available help. This escalates the intensity of the problem. Thus public education is essential for the total rehabilitation of the community of communicative handicaps. The Alexander Graham Bell Institute in USA as we know it, is solely and mainly concerned with the public education. Likewise **the John** Tracy Clinic.

Discussion

It is a known fact that the field of speech and hearing is young both in the West and more specially in our country. However this is not a rational excuse to say that it needs some more time and energy for its fulfledged growth and development, as it has come on the scene during the hey days of science and technology. This field ought to have become a living force of the community and be working in every corner of the country because six per cent of country's population i.e., 33.3 millions, suffer from one or the other speech and hearing problems. This figure makes the handicaps a very large minority community here. The governments and other agencies are doing their best to alleviate other minority communities by ameliorating their sufferings. However the same facilities have not been provided for this community of handicaps. If this community is left as it is, it is not only a blot on us but also strain on the country's economy, because, these millions may not be capable of participating productively in the country's development. Thereby a large portion of the manpower becomes a waste. On the Other hand if this community is rehabilitated it becomes a productive tax paying community and thus increases the national income of the country

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and further it may prevent the growth of such handicaps in the generations to come. For this purpose total rehabilitation of the handicaps becomes an absolute necessity and it is possible through public education.

Measures for total rehabilitation aimed through public education:

1. The public must be informed of the preventive measures such as to: avoid consanguine marriages; protect the ears from loud noise; have vocal hygiene, etc.
2. All possible ways and means may be adopted for the early identification to prevent escalation of the problem.
3. The public should be informed how the problem prevails; facilities available to overcome the problems and where such facilities are available for them.
4. The handicapped must be educated for their self-reliance, economically and socially.
5. They must be informed about the available occupational education and also be provided with suitable employment.

As adjuncts to these measures possible research towards better preventive, diagnostic and therapeutic devices may have to be developed and in every district and if possible in every town, centres, like primary health centres, have to be established providing clinical facilities for the communicative handicaps and also occupational education centres in every district or thana. The employers should be informed not to give a step-motherly treatment for these handicaps but to ignore the handicap and exploit the residual abilities of these people.

Role of the All India Institute of Speech and Hearing, Mysore

Soon after its inception, the Institute has taken up public education as its 'first love'. Steps taken to educate the public are:

1. *Pamphlets:* Popular public education pamphlets to begin with have been written in English language and later translated into Kannada (regional language of the state of Karnataka) and Hindi. Major problems of speech and hearing have been covered and some more are being written. In addition wall posters have been printed indicating how to identify certain speech and hearing problems, such as stammering, hearing loss, voice problems, and psychological problems related to speech and hearing.

This literature has been freely distributed to all the visitors to the Institute-medical (specially E.N.T.) personnel, teachers of the various levels of schools; teacher trainee students like the T.C.H. (for the primary and higher primary school teachers) B.Ed., and teachers attending various short termcourses; district publicity information officers of the state of Karnataka; in the Institute's Speech and Hearing Camps and Exhibitions held around the state of Karnataka; to the cases and their parents and to all those who make special requests for this literature; to the public during institution's public functions such as Open Houses, Workshops and Seminars and to the public in the places of screening surveys—such as village screening and school screening.

2. Mass communication: Newspapers—Articles and features on the various aspects of communicative handicaps have been published time and again. Even a visit of an expert or some VIP has been a good excuse to go to the press with the Institute's name. This has been done with the professional selfishness, with a view to create inquisitiveness among the reading public to know about the Institute. Even its admission notifications for the training programme has brought a number of enquiry letters asking about the functions of the Institute.

Radio and T. V: The staff of the Institute have broadcast a number of popular radio talks in English as well as in Kannada explaining the various problems of speech and hearing and the facilities available for these problems at the Institute. On the public demand due to its popularity these talks have been rebroadcast.

The T.V. Centres of Bombay and Delhi of Door Darshan have telecasted a documentary on the activities of the Institute, entitled "Hello Vadiraj—The World of Sound'. This was an official entry of the Government of India in the II Festival of International Short Films for the Youths held at Paris and it got a Certificate of Merit also. The Films Division of India produced this documentary for the Institute. This documentary has been screened all over the country.

3. *Camps and Exhibitions:* The Institute has conducted so far several Speech and Hearing Camps and Exhibitions in different parts of the state of Karnataka. In these camps under Orientation lecture-cum-demonstration programmes to the school teachers, ranging from nursery schools to the higher school level, both the teachers of these schools and the general public covering that particular area have been told about the problems of speech and hearing. They are also appraised how they have to take care of the communicative handicapped children in their respective class rooms and further to guide the parents of such children.

Most of these Camps and Exhibitions have been conducted on the voluntary invitations of the service organisations like the Rotary Clubs and the Lions Internationals. It is heartening to note that the Lions Internationals made the year 1973-74 as the Year of Conservation of Hearing and Sight. The Institute is having a tight schedule of these Camps and Exhibitions during this fiscal year in South India.

A major responsibility of area publicity for the pre and post camps and exhibitions is shouldered by these service organisations. They publicise the programme through distribution of hand bills, displaying big wall posters, banners, screening film slides in all the cinema theatres of that surrounding area, by torn torn, announcements through loudspeakers in a mobile vehicle and fixing responsibility upon the school teachers of the schools in the interior villages to inform the population of that village; displaying posters and requesting the medical people of the area to inform the public visiting them for medical help to send their people who are having speech and hearing problems to the camp for examination.

4. *Screening programmes:* Village screening—The entire population of some nearby villages to the city of Mysore have been screened to identify the speech and hearing problems. People who are identified with the problems have been transported by the Institute's omni bus from those villages for further detailed examination and therapy. They have also been given free boarding and medicine. Continuous follow up has been maintained.

School screening: School going children in the Mysore city are being screened to identify speech and hearing problems. The children having the problems are directed to visit the Institute for further help through their teachers and parents.

Under the teachers guidance programme the teachers of those schools whose children under therapy in the Institute are invited to the Institute and are appraised how to take care of those children in their class rooms.

5. *Public functions:* On occasions like the Alexander Graham Bell Anniversary and Institute's Founding Day, Open Houses are held for the public. Inspired by the 'Red Bag Project' of Dr De Sa of Bombay, Red School Bags are freely distributed to the deaf school going children of the city. As part of the function the children with the Red Bags along with their parents, members of the staff, students of the Institute, invitees and other general public have gone in procession in the main streets of the city. While on procession hand bills were distributed to the public. This has been done to focus the attention of the public towards the problems of the communicative handicapped children, specially the deaf. The expenses of this function was met by a charity film show. Deliberately this was done again to focus the attention of the public towards these problems.

6. *Parent Counselling:* Regular parent counselling sessions are held at the Institute— counselling the parents of the children about the speech and hearing problems. After identifying the neonates in the local maternity hospital the parents are advised to bring those babies to the Institute for further detailed examinations and counselling.

Conclusion

Whatever has been done as explained above, to educate the public is not sufficient due to the vastness of the country, illiteracy, poverty, magnitude of the problem and inadequate facilities at the disposal of the Institute such as professional personnel and funds. However the Institute as a nucleus may intensify most of the activities discussed earlier. To make public education effective and to popularise the field of speech and hearing the following methods may have to be adopted:

1.AT regular intervals feature articles on the speech and hearing problems may be published on the lines of Dr Hiranandani, Dr B. M. Abrol and Mr Ramesh K. Oza, not only in English but also in all the language newspapers, magazines, journals and digests of the country.

2. Likewise popular radio talks and discussions may have to be broadcast from every radio station of the State in the local languages. T. V. may also be used wherever available and short films on these problems be telecasted and screened in the cinema theatres.

3. Service organisations like the Lions International and Rotary Clubs and some other similar organisations may be involved to popularise it through their community service activities.

4. Popularise catchy slogans like, 'Help to hear, to speak', 'Don't say dumb —he can speak if he hears what you speak'.

5. Issue at regular intervals special postal stamps commemorating people like Sir Alexander Graham Bell, Hellen Keller with the co-operation of the postal authorities.

6. Wall posters describing the speech and hearing problems, where facilities are available and what the concerned public has to do, may be displayed in all the railway stations' display boards with the co-operation of the Railway Board. Permission from the concerned Ministry is to be got to display these posters free of cost. Similarly in the bus stations, public libraries and primary health centres. The doctors may be specially requested to refer the cases to the nearest Centres and they may also be appraised to give proper guidance in this matter. The Diretorate of Advertising and Visual Publicity may be requested to render help for publicity through its material and rnachinery..

7. Separate unit may be built up at the Institute, to avoid dislocation of routine training and clinic work there to put up Camps and Exhibitions throughout the country and also to participate in the important exhibitions. Camps and Exhibitions may be put up during the Jatras, Carnivals and on such other occasions where both urban and rural people gather either for religious ceremonies or for commercial transactions. During such occasions plays in the local languages may be staged involving the main characters with one or more communicative disorders and providing relief to the characters on completion of therapy and training. In this care may be taken to remove the myths and superstitions surrounding these disorders. Stress may be made to treat the handicapped as normal and to put up with them as normals. This unit may also publish short stories and plays in the vernacular languages with this background.

8. Display of film slides in the cinema theatres all round the year on concessional rates throughout the country.

9. Immediate steps may be taken by the Institute to establish regional centres of speech and hearing in the country to work as base to provide both clinical facilities and to do research work.

10. Regular short term courses may be conducted for the medical personnel, teachers and social workers throughout the country to propagate the gospel of facilities available for the speech and hearing disorders.

It is reiterated that by these methods, as explained earlier, it is possible to educate the public and to make the field of speech and hearing popular in the country. The other institutions should also come forward to co-ordinate with the Institute to fulfil this task. Public education therefore must be given top priority in the respective institutions for the proper growth and fuller development of the field and to make it popular so that it should become more useful to the community of the communicative handicapped. The prevailing frustration then will vanish in thin air.

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A SAMPLE SURVEY IN SCHOOL CHILDREN REGARDING PREVALENCE OF DEAFNESS AND ITS RELATIONSHIP WITH ACADEMIC PROFICIENCY

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The Object of Study

The object of this study was tofindout the incidence of children having hearing loss in the children studied at random from among the students between age group of 5 to 10 years studying in class I,II. III, IV, V and VI in some of the schools in Calcutta.

The relationship of academic proficiency of these children according to the remarks of the teachers at school and their hearing aquity was also observed.

Equipment: (a) One Arphi Portable transistored audiometer and Amplivox —83 model audiometer.

(b) Routine E.N.T. examination instruments.

Subjects: Two hundred and six (206) children in five schools situated within a range of 3 milies from S.S.K.M. Hospital, Calcutta served as subjects. The children belonged to the age group of S to 10 years and were students in classes 1 to 6.

Method

Head master/mistresses of five different schools in Calcutta were approached and informed about the study. After they agreed to co-operate, the investigator went to the schools and approached the authorities concerned and fixed up date, time and place of examination of the children. The class teachers were given a cyclostyled form of questionnaire with a view to bring out the performance of the children to be examined at school. This form also contained a brief statement as to the purpose of the study and the scope for the class teachers to record the performance of the child in arithmetic, driving, etc., where black board was used

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more and in the subjects where hearing of the child was used more separately. The teachers were also asked to fill in the details about each child viz., the name, age, sex, class and the remarks, marks obtained and examination, etc.

The examination of the children randomly selected from classes I to VI were undertaken in a quiet room in the school preferably on the top floor and usually after school hours. Routine physical examination of the children e.g., measurement of height, weight etc., routine E.N.T. examinations were done using portable headlamp and other routine examination equipments.

The children were then given audiometric tests consisting of 250, 500, 1000, 2000 and 4000 Hz tones through both air and bone conduction. High frequency tones were given first because the rooms were not sound treated and consequently the higher frequencies were perceived better. Children who showed on an average a loss of more than 15 dB in the above frequencies or a significant loss in any one of the speech frequencies in one or both ears were asked to come to the E.N.T. Department of the S.S.K.M. Hospital for more detailed examinations and farther audiometric check up. The school authorities were requested to inform the guardians about this and the children were provided with transport to be brought to the hospital at the appointed time. The co-operation of the school authorities and the guardians were satisfactory.

Results

206 children belonging to age group of 5 to 10 years were studied in five different schools. Of these, 57 (27.6 per cent) children were brought to the E.N.T. Department of S.S.K.M. Hospital for clinical check up and repeat audiometry. Forty five (21.8 per cent) of these children had mild hearing loss and 12 (58 per cent) had moderate hearing loss, 21 (10.1 per cent) had ear problems, 27 (13.1 per cent) had nose and throat affections. There were overlap of the affections in a number of them. General paediatric and psychiatric opinion on some (43) of these children—did not reveal any abnormalities of significance.

Surgical treatment for the ear, nose and throat lesions were offered through the S.S.K.M. Hospital to 19 (9.2 per cent) children with the consent of the guardian but the result of treatment regarding improvement of their proficiency at school could not be judged as follow up reports are not yet obtained.

As for the proficiency of these 206 children on the basis of teachers remarks—72 (34.9 per cent) were rated good, 90 (43.6 per cent) were rated average and 44 (21.3 per cent) were rated poor. Of these, 44 children 18 (8.7 per cent) fell in the category of the children with hearing loss.

Thus among 206 children, 18 out of 44 backward in class were found to have significant hearing loss i.e., 18 (8.7 per cent) showed deafness and backwardness in class among the 206 subjects tested.

Discussion

Audiometric studies are helpful in differentiation but audiograms are not usually easy to obtain on children without sufficient training and are to be done by skillful audiologists. This holds good specially in such screening tests. The deafened group should be followed up both for diagnosis as the sharply sloping audiograms and severe hearing loss is characteristic of deaf children; normal sensitivity or a moderate hearing loss for all frequencies is characteristic of aphasic children. The result could have been analysed for the severely hearing impaired with additional learning problems. Speech test could have preceded the actual survey work.

This study is in fact a gross sample survey of hearing impairment in school going children from different socio-economic background with multi-lingual atmosphere.

The questionnaire was designed to elicit information from parents about family background, the child's birth and development and early experiences related to diagnosis, parent-child interactions and educational guidance.

Nevertheless the information obtained from the study is an important piece of information which might provide the research oriented workers in the field for many other investigations, in a range of topics for exploration.

The purpose then of presenting this paper is to put forward the information gathered through the sample survey conducted so that this may be of use for other workers in this field.

Summary

8.7 per cent of the 206 children who had hearing loss showed backwardness at school. The teachers and the parents were informed about this and were asked to pay special attention to the further progress of the children.

It is felt that further survey with larger number of children and for a greater period of time will reveal more significant information.

LOUDNESS PERCEIVED BY NORAMAL AND ABNORMAL EARS AS MEASUED BY STAPEDIAL REFLEX THRESHOLD

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Stapedial Reflex threshold has gained wide currency in the measurement of loudness experience. (Ewertsenef *al,* 1967; Flottorp, Djupesland and Wither, 1971 : Moller, 1961; Thomsen, 1955) of an acoustic stimulus.

Result of Jerger's (1969) study using acousti c stapedial reflex in sensorineural (S.N.) loss cases shows that the reflex SL decline as a function of increasing hearing loss in patients with loudness recruitment. As S.N. loss increases the SL decreases in regular one to one fashion. The relationship is linear and of unit dope.

Alberti and Kristensen (1970) stated that in the presence of recruitment the intensity level required to stimulate the reflex may be unchanged, or even lowered, while the puretone threshold is markedly elevated.,

Investigations of the acoustic reflex reveal a very consistent finding: hearing impaired patients who manifest recruitment of loudness yield acoustic reflex thresholds at lower sensation levels than do normal hearing subjects who show an absence of loudness recruitment (Ewertsen, *et ah,* 1967; Jerger, 1969; Feldman, 1963; Jepsen, 1963; Lamb, Petersen and Homse, 1968; Metz, 1946, 1952; Thomsen; 1955).

Liden (1970) exposed a few cats to broad band noise at a sound pressure level of 115 dB for 8 hours and measured the reflex thresholds. He concluded that the induced sensorineural hearing loss did not change the intra-aural reflex thresholds.

Petersen and Liden (1972) studied sixty seven normals in the age range of 19-43 years and thirty two S.N. loss cases of varying degree of Cochlear involvement . The only major difference in reflex thresholds between normals and S.N. loss cases was found at 4 KHz where, in general, the greatest degree of hearing loss was noted for the subjects in the sensorineural group.

Beedle and Harford (1973) compared acoustic reflex growth and loudness growth at 500,1000 and 2000 Hz. Results indicated that the acoustic reflex growth is essentially the same for the impaired ears and the good ears of the subjects with a unilateral hearing loss.

Basavaraj (1973) established reflex threshold norms for Indian population. His study also included a few cases with S.N. hearing loss of varying degree of severity. The frequencies 1 KHz, 2KHz, and 4 KHz were common for both population. The normal and S.N. hearing loss ears' stapedial reflex thresholds were respectively as follows: 82,94.42; 80, 86.43; 83,91.25 dBHL. The sensorineural hearing loss group consisted of cases with no tone decay.

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The present paper is an investigation of the observed 'Consistent findings' of several investigators,

Methodology

Experiment I: This part consisted of finding the difference in the acoustic stapedial reflex threshold obtained before and after inducing temporary hearing loss (Cochlear) in normal hearing (-10 to 15 dBHL, I SO 1966) subjects.

Subjects: Ten College students (9M-J-1F) in the age range of 17-25 years were chosen for participation in this study. The subjects selected were only those with bilateral normal hearing (according to ISO 1964 specifications) and whose acoustic stapedial reflex thresholds were less than 95 dBHL at test frequencies, i.e., 1 KHz and 2 KHz. In order to measure the reflex threshold (elevated reflex threshold) after fatiguing the ear, subjects with low reflex thresholds were selected.

Procedure: The following measures were obtained for each subjects:

(a) Pure tone thresholds and acoustic stapedial Reflex thresholds of both ears at test frequencies, i.e., 1 KHz and 2 KHz.

(b) The ear fulfilling the reflex threshold criteria as specified earlier (hereafter known as test ear) was subjected for a continuous 1 KHz tone at 110 dBHL for a period of 30 minutes. Atthe end of 30 minutes, pure tone threshold at 1KHz and 2 KHz were obtained for that ear.

(c) Acoustic stapedial reflex thresholds were once again obtained in the test ear for the test frequencies.

(d) After obtaining the acoustic stapedial reflex thresholds, pure tone AC thresholds were once again measured in the test ear for test frequencies.

The post stimulatory measures were obtained within the first 2 minutes after cessation of the fatiguing stimulus, i.e., 1 KHz tone at 110 dBHL for 30 minutes.

Pure tone thresholds were obtained by using the modified Hughson-Westlake (Jerger and Carhart, 1959) method for all the subjects. Madsen (Model 4251) audiometer with TDH-39 ear phones calibrated to ISO (1964) standards was used for all purposes of this experiment. The calibration was checked using artificial ears (Bruel and Kjaer Model 4152) with condensor microphone (Brucl and Kjaer Model 4144) and A. F. Analyser (Bruel and Kjaer Model 2106). The acoustic reflex measurements were made using Madsen Z070 Electro acoustic Impedance Bridge (calibrated using Bruel and Kjaer equipment). The experiment was conducted in a sound treated room.

The earphone of the Madsen (Model 4251) audiometer was connected to the head band of the Madsen Z070 Electro-Acoustic Impedance Bridge. Thus at a stretch puretone and reflex thresholds were obtained at 1 KHz and 2 KHz for a particular ear. Similar findings were recorded for the other ear. The ear fulfilling less than 95 dBHL reflex criteria was chosen for inducing hearing loss.

The procedure given in the Manual (Manual of Madsen Electro-Acoustic Impedance Bridge Model Z070) published by Madsen Electronics was followed with a slight modification for obtaining the acoustic reflex threshold.

As air tight sealing was not possible, reflex thresholds were measured in the absence of air tight sealing. The difference in reflex threshold was about 5-10 dB in a pilot study conducted with and without air tight sealing.

Difference Method (Garrett, 1971) was used as a test of significance between the mean values of pre and post stimulatory reflex thresholds. Four subjects of the original sample were tested once again to check the test-retest reliability after a period of eight days.

Experiment II: Acoustic stapedial reflex threshold measurement in moderate sensorineural hearing loss ears (40-70 dBHL ISO 1964) with no tone decay.

Subjects: All subjects with moderate sensorineural hearing loss reported (between Sept. 1974 to Feb. 1975) at the AIISH, Mysore were included for this study.

Procedure: The following measures were obtained for each subject.

(a) AC and BC thresholds at audiometric frequencies ranging from 250 Hz to 4000 Hz.

(b) Complete tone decay test measurements (Carhart, 1957).

(c) Acoustic stapedial reflex threshold for frequencies showing moderate sensorineural hearing loss.

Five subjects of the original sample were tested again to check the test-retest reliability.

Results and Discussion

Experiment I: At 1 KHz, the mean pure tone threshold is 7dB. Poststimulatorily, stimulation thresholds had goneup to 53.5 dB, exhibiting a mean threshold shift of 46.5 dBHL. The mean acoustic stapedial reflex threshold (ART) of 87.5 dB is elevated to 101 dB, by a mean shift of 13.5 dB.

At 2 KHz the mean pure tone threshold of 3 dB is raised to 51.5 dB post stimulatorily (mean shift of 48.5 dB). The mean reflex threshold of 86.5 dB is elevated to 97 dB (mean shift of 10.5 dB).

The mean pure tone thresholds obtained, after measuring the elevated reflex thresholds, are 46 dB and 43.5 dB respectively at 1 KHz and 2 KHz. The obtained mean pure tone thresholds show, that for all experimental purposes the subjects had moderate hearing loss (40-70 dB).

There is significant difference between the mean pre and post stimulatory reflex thresholds, at .05 level and .01 level, at 1 KHz and 2 KHz.

Observation of the Temporary Threshold Shift (TTS) and the shift in Acoustic Reflex Threshold (ART) in the present study and in the previous study

(Vyasamurthy, *et al.*, 1975) shows that the shift in acoustic reflex threshold (ART) is about 10-15 dB, irrespective of the amount of TTS. Table 1 gives the relation between TTS and shift in Acoustic Reflex Threshold (ART) for 10 subjects.

TABLE 1. Showing the Amount of TTS and Subsequent shift in Acoustic Reflex Threshold

Number	1 KHz		2 KHz	
	TTS in dB	Shift in ART dB	TTS in dB	Shift in ART dB
1.	55	10	55	5
2.	55	15	45	15
3.	45	10	35	5
4.	50	20	60	10
S.	55	20	50	15
6.	50	15	55	20
7.	25	10	45	15
8.	45	15	45	5
9.	40	10	45	5
10.	45	10	50	10
Mean	46.5	13.5	48.5	10.5

Constant shift in Acoustic Reflex Threshold (ART), irrespective of the amount of TTS, can be well understood if we look into the following examples and the Table 2 and 3.

Examples (fromTable 2):

	ART in dBHL	ART in Sones	Elevated pure tone THS in dBHL	Post Stimulatory ART in dBHL	Post Stimulatory ART in Sones
1.	85	32	60(4)	95	32
2.	85	32	50(2)	95	32

Note:—The number in parentheses are approximate Sone Values.

TABLE 2: Showing the relationship between the Normal Acoustic Reflex Threshold (ART) and the Post Stimulatory ART (i.e., after inducing temporary hearing loss of S. N. type) in terms of perceived loudness among 10 normal hearing subjects at 1 KHz.

No.	ART dBHL	ART in Sones	Elevated Pure tone THS dBHL	Post Stimulatory ART in dBHL	Post Stimulator' ART in Sones'
1	85	32	60(4)	95	32
2	85	32	65 (8)	100	64
3	85	32	50(2)	95	32
4	80	22	55 (4)	100	64
5	85	32	50 (2)	105	64
6	90	47	55(4)	105	64
7	95	69	40(1)	105	64
8	80	22	55 (4)	95	32
9	95	69	50(2)	105	64
10	95	69	55 (4)	105	64

Note:—The number in parentheses equals to the loudness in Sones.

Table 3: showing the relationship between the Normal Acoustic Reflex Threshold (ART) and the Post Stimulatory ART (ie., after including temporary hearing loss of S.N. type) in terms of perceived loudness among 10 Normal hearing subjects at 2KHz.

NO.	ART dBHL	ART in Sones	Elevated Pure tone THS dBHL	Post Stimulatory ART in dBHL	Post Stimulatory ART in Sones
1.	80	22	55(4)	85	16
2.	85	32	50(2)	90	32
3.	90	47	45(2)	95	32
4.	95	69	60(4)	105	64
5.	80	22	50(2)	95	32
6.	85	32	55(4)	105	32
7.	95	69	50(2)	110	128
8.	75	15	50(2)	90	16
9.	95	69	50(2)	100	64
10.	85	32	50(2)	95	32

Note : the number in parentheses equals to the loudness loss in Sones.

The Acoustic reflex threshold (ART) is converted into Sone value using Fletcher's (1953) formula. The following table shows the growth of loudness in sones with increase in intensity, in normal hearing subjects.

dB HL	Loudness in Sones
40	1
49	2
58	4
67	8
76	16
85	32
94	64
103	128

According to this table an ear with 60dB loss incures a loudness loss, approximately of 4 sones. It is explained as follows

$$\text{Loudness in Sones} = 2\left\{\frac{L-40}{9}\right\}$$

$$= 2\left\{\frac{60-40}{9}\right\} = 2^{2.22}$$

2.22log = 2.22x0.301= 0.66822

Antilog of 0.66822 = 4.68 Sones

Thus, the subject loses, approximately, 4 sones, if the loss is 60dB. B for every 9dB increase the above threshold he perceives half the loudness of what

TABLE 4: Comparision of the normal acoustic reflex thresholds (ART; obtained from Basavaraj, 1973) with the ART obtained in typical moderate S.N.hearing loss cases in terms of perceived loudness at 1,2, and 4 KHz.

Freq. in Hz	Mean Normal ART dBHL	Mean Normal ART in Sones	Mean Mod. S. N. hearing loss dBHL	Mean ART in Mod. S. N. loss dBHL	Mean ART in Mod. S.N.los in Sones
1000	82	25	54.81 (4)	96.66	*32*
2000	80	22	5X57 (4)	92.72	*32*
4000	83	27	43.75 *(1)*	91.66	*32*

Note: The number in parentheses equals to the loudness loss in Sones.

normals would perceive. Therefore, the difference between the impaired ear and the normal ear is just about 10 dB. In this particular example (1), it is 10 dB above the normal acoustic reflex threshold.

Such observations have been reported in table 2 and 3. However, the above explanation does not hold good for all subjects, because, some extreme variations are observed in few subjects. This may be because of the inherent limitation of the audiometric dial calibration (in 5 dB steps) or due to the 'Subjective' judgement of the Balance Meter needle movement of the Impedance Bridge (Madsen Z070), to ascertain the reflex.

Test-Retest reliability has been established on four subjects. In one subject, the obtained retest score differed by 10 dB. Otherwise, audiologically acceptable scores are obtained. Reliability was statistically computed by using the 'Rulon Method' as given by Guilford (1965).

Experiment II: Table 4 shows the comparison of the normal acoustic reflex thresholds (Basavaraj, 1973) with the ART obtained in typical moderate sensorineural hearing loss cases in terms of perceived loudness at 1 KHz, 2 KHz and 4 KHz. (At 2 KHz and 4 KHz the HL itself is considered as L Value, i.e., loudness level in phone, as there is negligible difference between 1, 2, and 4 KHz in the equal loudness contours—Stevens and Davis, 1938). The findings show that the loudness (determined by elicitation of reflex) perceived by sensorineural hearing loss ears without tone decay, is diminished by half the normal loudness (equipment to about 10-15 dB loss in intensity).

In other words the difference in hearing level needed for stapedius reflex threshold for SN loss ear is negligible as diminition by half the normal loudness is just 9 dB loss in terms of intensity. (However, the observation extends upto a loss of 15 dB. This could be due to factors explained earlier in Experiment I).

Test-Retest Reliability: has been established on 5 cases. Reliability was statistically computed by using the 'Rulon Method' as given by Guilford (1965).

Conclusions

(1) The normal and the SN loss cases (including induced hearing loss) exhibit stapedius reflex at almost equal perceived loudness.

(2) A seemingly constant shift of 10-15 dB above the normal acoustic reflex threshold is needed in cases with sensorineural hearing loss. This shift is explained on the reasoning that it is to overcome the peripheral threshold level loudness loss. This concept ultimately questions the phenomenon of 'abnormal growth of loudness' in sensorineural hearing loss ears as the abnormality is not with respect to the growth of loudness but only with respect to the hearing level.

The present conclusions warrant further considerations.

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A CASE WITH ABNORMAL TONE DECAY AND RECRUITMENT AS MEASURED BY ABLB (AUTO) TEST—TYPICAL OR ATYPICAL?

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Abstract

A case of abnormal tone decay demonstrating recruitment is reported. If we accept that recruitment is an artifact, the findings of this case are typical of ABLB {auto presentation) test. On the other hand, if vie consider that recruitment is a fact the findings of this case are atypical of ABLB test indicating co-existence of the two lesions viz. cochlear and retrocochlear. If we accept that recruitment is an artifact, ABLB {auto) test is not a useful test in differential diagnosis of cochlear Vs. retrocochlear as recruitment measured by ABLB {auto) test is expected in all SN loss cases irrespective of tone decay provided factors like crossover, diplacusis, pulse rate and error of judgement are controlled.

A lot of concern is expressed by many investigators regarding the audiological tests as many cases of confirmed retrocochlear pathology have been reported to have demonstrated cochlear findings. This concern seems to be unwarranted as cochlear findings in retrocochlear pathology cases seem to be expected findings if we consider that recruitment is an artifact and if the results of SI SI test and Bekesy tracings are influenced by tone decay. Some recommendations have been made.

'When the ABLB recruitment test is performed at a frequency where there is marked tone decay, loudness growth with increasing intensity is less than normal. This result has been termed decruitment (Fowler, 1965, Davis and Goodman, 1966) or reverse recruitment (Dix, Hallpike, 1960, Harbert and Young, 1962b) in contrast to recruitment where loudness growth with increasing intensity is greater than normal'. (Green, 1972).

This paper deals with a case of abnormal tone decay demonstrating recruitment as measured using ABLB (Auto) test. Further, theoretical implications are discussed in the light of the hypothesis that recruitment is an artifact (Jagadish, 1970).

Case Report

A 35 year old educated male reported to the Institute with the complaint of hearing loss in the left ear. He reported that he developed hearing loss in the left ear soon after the attack of meningitis about 5 years ago. He did not have symptoms like tinnitus, vertigo, headache, etc.

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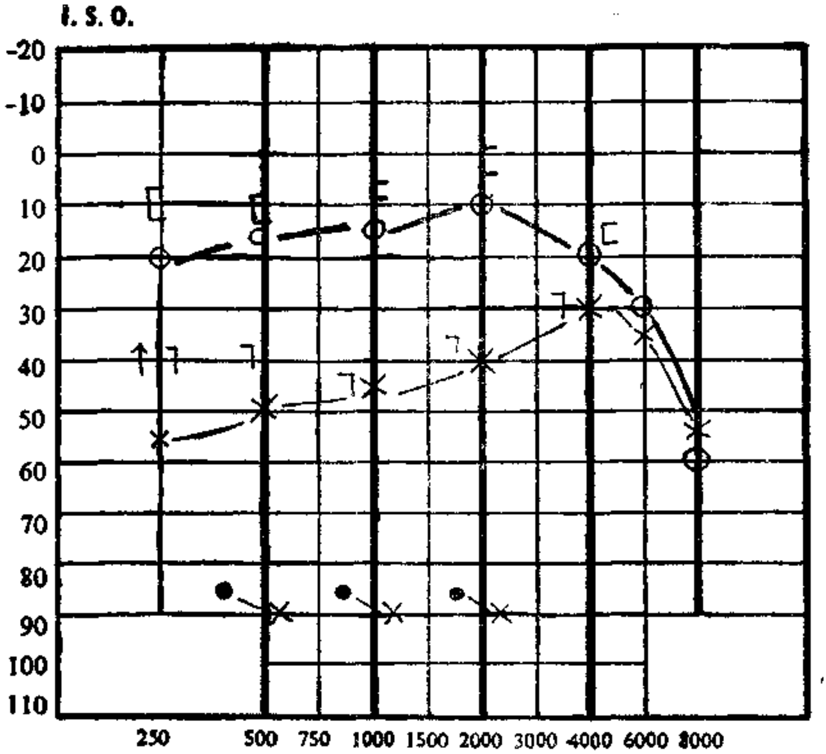
puretone audiometry



Frequency in Hertz

	Right	Left	Aid in Ear Rt	Lt
3 frequency average	13	45		
S. R.T.	20	50		
Discrimn. (P. B. Max.)	90%	25%		

SPECIAL TESTS

	Eight .Ear				Left Ear			
	500	1000	2000	4000	500	1000	2000	4000
SISI-					100%	100%	100%	10.0% ->
ABLB					"	"	"	
STENGER								
TDTdB	5	0	10	35	+60	+60	+70	+75 -->

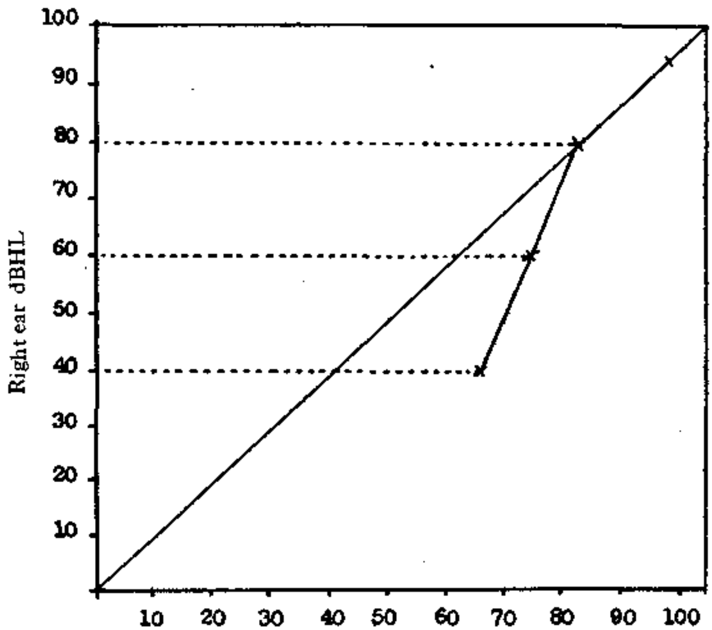
ENT findings were normal except for hearing loss in the left ear. The detailed hearing evaluation is given below. Audiogram was taken using Arphi Model IV audiometer calibrated to ISO (1964) in a sound treated room. Audiometer was previously calibrated using B and K equipment.

Pure-tone audiometry: The audiogram showed Left ear—S.N. loss (moderate) Right ear—high frequency loss.

Speech audiometry showed very poor speech discrimination in the left ear (25 per cent). Right ear had 90 per cent discrimination. Speech discrimination testing was done through live voice testing using English PB list standardized by Swarnalatha (1972) for Indian population. While testing the left ear, masking was used in the right ear.

Complete ABLB test was administered at 1000 Hz using automatic presentation of tones. The rate of pulse was 1/sec.

Freq	1 KHz	(Hearing levels for equal loudness)
Rt.	Lt.	
40 dB	65 dB	
60 dB	75 dB	
80 dB	80 dB	
100 dB	100 dB	



Left ear dBHL

The results showed complete recruitment. Screening ABLB test was administered using automatic presentation (1 pulse/sec). The intensity of the tone was varied in the right ear until the subject reported equal loudness (the tones alternated between the ears). This test was done at 500 Hz, 1000 Hz and 2000 Hz tones. The results showed recruitment at all these frequencies.

500 Hz		1000 Hz		2000 Hz	
Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
85 dB	90 dB	85 dB	90 dB	85 dB	90 dB

Carhart's TDT

(TDT) Tone decay test was administered at all the frequencies (500 Hz to 4 KHz) in both the ears. Marked tone decay was observed at all the frequencies in the left ear. Tone decay was negative in the right ear at all the frequencies except at 4 KHz.

Tone Decay in dB

Freq.	Rt.	Lt. (with appropriate noise in the right ear)	Lt. (without noise in the right ear)
500Hz	5	>60 dB	>60 dB
lOOOHz	0	>60 ,,	>60 „
2000Hz	10	>70 „	>70 „
4000Hz	35	>75 „	>75 „

Tone decay was more than 60 dB at all the frequencies in the left ear even when masking noise was not used in the right ear. The tone decay test was repeated thrice on different days and the results were found to be consistent.

SISI Test was 100 per cent in the left ear at all the frequencies from 500 Hz to 4 KHz. Modified SISI test was administered—the tones were presented at 70 dB HL or higher level for audibility.

The subject detected 1 dB increments but the tone was fading.

Thus false SISI+ve was observed. Appropriate masking noise was used in the right ear.

Impedance Audiometry was done using Madsen impedance bridge (Z0 70). There was no reflex in the left ear even at 120 dB HL (tones were presented to the left ear and probe tip was inserted to the right ear). There was reflex in the right ear (tones to right ear and probe tip to left ear).

	250Hz	500Hz	IK	2K	4K	
Right ear reflex THs	90dB	90dB	85dB	90dB	lOOdB	
Left ear reflex THs	NR	NR	NR	NR	NR	NR=Noreaexatl20dB

Discussion

Test results typical of cochlear and retrocochlear lesions show presence and absence of recruitment respectively when measured using ABLB test (Newby. 1965). As many cases of surgically confirmed retrocochlear pathology cases have been reported to have demonstrated recruitment, Jerger (1961), rightly recommends that the presence or absence of recruitment should not be considered in deciding the site of lesion. He feels that the other tests may be more accurate for detecting the site of lesion than the tests for recruitment. Further, he mentions that from the standpoint of planning for rehabilitation procedure, if not for purposes of medical diagnosis, it is important to ascertain whether or not a patient with a sensorineural loss does have recruitment (as reported by Newby, 1965).

The reported case here exhibits both recruitment and abnormal tone decay. If we accept that recruitment is an artifiact (Jagadish, 1970), the findings of this case are typical of ABLB (Auto presentation) test (Vyasamurthy, 1972). On the other hand, if we consider that recruitment is a fact the findings of this case are atypical of ABLB test. Which one is true? To solve this mystery let me place all the relevant facts we have before us.

Many investigators (Johnson, 1965, Shapiro and Naunton, 1967, Katinsky, S, 1972) have reported the presence of recruitment (as measured by ABLB), high SISI score and II Bekesy tracing in surgically confirmed retrocochlear pathology cases. These investigators have tried to explain the presence of cochlear findings in confirmed retrocochlear pathology cases in terms of predominance of cochlear findings when both the lesions co-exist or as atypical findings.

Dix and Hallpike (1960) suggest that the tumor might interfere with the cochlear blood supply thus creating a secondary cochlear lesion. To support this they have cited examples of two cases who showed absence of recruitment after the removal of the tumor.

Jerger and Waller (1962) suggest tht the audiological signs change with the progression of a lesion. In support of this they report a case whose speech discrimination became poorer and Bekesy tracings changed from I and II and III over a period of time.

Johnson (1965) suggests that the site and size of the tumor influence the audiological findings. However Shapiro and Naunton's (1967) findings are not in agreement with Johnson's observation.

Thus the observation of cochlear findings in some confirmed retrocochlear pathology cases is explained on the basis of the co-existence of the two lesions, progression of the lesion and site and size of the tumor.

It is not clearly known why the cochlear findings should predominate over retrocochlear findings when both the lesions co-exist. In the absence of correct explanation, it would be better to explain the presence of recruitment, high SISI score and II Bekesy tracings in confirmed retrocochlear pathology cases in terms of the influence of tone decay on the three tests' results. When recruitment is measured using ABLB (auto) test, tone decay seems to have no influence and hence recruitment may be expected even with abnormal tone decay when ABLB (auto) is administered indicating that recruitment is typical in cases with abnormal tone decay.

Now it appears that ABLB test is not useful in differentiating cochlear Vs. retrocochlear lesion as recruitment is expected in both the lesions. Jerger has suggested that the presence or absence of recruitment should not be considered to decide the site of lesion and that the information regarding the presence or absence

Sf recruitment obtained by ABLB test would help in recommending amplific--tion in the use of hearing aids to the cases. The latter suggestion goes against ABLB test as recruitment is expected in all the SN loss cases if recruitment is considered as an artifact. Further, if recruitment is a fact it becomes a problem to decide whether the present case has recruitment or not. The reason is that h-has demonstrated recruitment to ABLB (auto) test but not to acoustic reflex threshold test. Which test should be considered to decide whether the case has recruitment or not? The only solution to this question is to accept that recruitment is an artifact and that the presence of recruitment as measured by ABLB (auto) is typical of cases having cochlear and/or retrocochlear lesion.

The above discussion brings forth several questions to be answered.

1. Why is 'recruitment' absent in some VIII nerve lesion cases?
2. Why do some cases of VIII nerve lesion get high SISI score?
3. Why do some cases of VIII nerve lesion get low SISI score?

The absence of recruitment in surgically confirmed retrocochlear pathology cases may be explained on the basis of the method of administration of ABLB test. As manual method of administration is also in practice the cases who have reported to have demonstrated no recruitment might have been tested with ABLB test using manual method (Manual method may allow the tones to fade). Another probable explanation is that the loudness matching is subjective and the results may be influenced by factors like diplacusis, tinnitus, crossover and other unknown factors.

High SISI scores in surgically confirmed retrocochlear pathology cases may be considered as false SISI+ve. Usually false SISI+ve occurs if there is abnormal tone decay. (Owens, 1965, Jerger, 1955, Hughes, 1968). The present case also exhibited 100 per cent SISI score (false SISI+ve) at all the frequencies in the poorer ear when modified SI SI test (Young and Harbert, 1967) was administered. True SISI+ve may also result in retrocochlear pathology cases. This may be explained on the basis of absence of tone decay. It is known that when the energy reaching the cochlea is about 60 dB all the ears respond to 1 dB increments. When modified SISI test is administered to a case with retrocochlear pathology having no tone decay, high SISI score can be expected as the energy reaching the cochlea is not reduced.

Low SISI scores or negative SISI test in surgically confirmed retrocochlear pathology cases may be explained on the basis of marked tone decay (Young and Harbert, 1967). If the tone decay is very rapid 5 second interval between pulses may not be sufficient for recovery (Green, 1972). Hence 1 dB pips are not heard. Another probable explanation is that the author has observed in some SN loss cases neither tone decay nor SISI+ve indicating that SISI test or TDT is not a fool-proof test. Therefore -ve SISI in retrocochlear pathology cases may be considered as a failure of the test.

The above explanations indicate that the subject's performance on SISI test is affected by tone decay.

With the above explanations it may be inferred that the observation of cochlear findings (recruitment, II Bekesy tracings,+ve SISI test and -ve TDT) in surgically confirmed retrocochlear pathology cases is due to the influence of tone decay i.e., the absence of marked tone decay or presence of mild or moderate decay or no tone decay. Now a question arises—if the above statement is true, how is it negative tone decay test results have been observed in confirmed retrocochlear pathology cases? Those who believe that the observation of cochlear findings in confirmed retrocochlear pathology cases is due to the predominance of cochlear findings when both the lesions co-exist might answer the question on the same lines i.e., predominance of cochlear findings. Shall we accept it? I am afraid not. This is because of the fact that it would be difficult to explain the arrest of abnormal tone decay on the basis of the co-existence of both the lesions. How can cochlear lesion arrest tone decay if it exists? In fact, Matkin's (1965) report shows that when both the lesions co-exist the retrocochlear findings predominate indicating that ifthere is abnormal tone decay it will be observed even when both the lesions co-exist. So, it appears that the absence of marked tone decay in surgically confirmed retrocochlear pathology cases may be due to the insensitivity of the test in identifying retrocochlear pathology cases.

To sum up, it may be stated that ABLB test (auto) is not a useful test in differential diagnosis of cochlear Vs. retrocochlear pathology. Neither is it useful in providing information regarding the use of amplification in hearing aids as recruitment may be an artifact. A lot of concern is expressed by many investigators regarding the audiological tests as many cases of surgically confirmed retrocochlear pathology have been reported to have demonstrated cochlear findings. This concern seems to be unwarranted as cochlear findings in retrocochlear pathology cases seem to be expected findings if the recruitment is an artifact and if the SISI test results and Bekesy tracings are influenced by tone decay. As ABLB test is not useful in differential diagnosis of cochlear Vs. retrocochlear and as SISI scores and Bekesy tracings are influenced by tone decay it would be better not to rely on them and thereby wrong diagnosis can be averted. Tests like tone decay, Acoustic reflex threshold measurement, LDT (50 per cent reflex decay time) and speech audiometry incorporating ipsilateral masking seem to be very useful in differential diagnosis of cochlear Vs. retrocochlear lesion. Negative results of these four tests do not rule out retrocochlear pathology. However positive results suggest a high index of suspicion about retrocochlear pathology.

In the light of the above discussion, it appears that it would be very important to have sufficient data on the following:

1. Observation of negative SISI test (modified SISI test) in surgically confirmed retrocochlear pathology cases having no tone decay. With this we can infer that SISI test is not influenced by tone decay.

2. Observation of absence of recruitment (as measured by ABLB auto) in surgically confirmed retrocochlear pathology cases having abnormal tone decay taking full account of the factors like error of judgment, crossover, tinnitus, diplacusis and pulse rate. With this we can infer that recruitment is a fact.
3. Observation of absence of Acoustic reflex in typical moderate or moderately severe SN loss cases having no tone decay or observation of elevated acoustic reflex thresholds in surgically confirmed retrocochlear pathology cases having no tone decay.

The above data would enable us to know whether cochlear findings in retrocochlear pathology cases are due to the influence of tone decay or art due to the co-existence of both the lesions viz. cochlear and retrocochlear. Further, they may throw light on the subject of 'recruitment'.

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VERIFICATION OF THE USEFULNESS OF SHORT INCREMENT SENSITIVITY INDEX (SISI) TEST IN DETERMINING BONE CONDUCTION THRESHOLDS

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Swisher, Stephens and Doehring (1966) suggested that the SISI test might be interpreted as an indirect measure of bone conduction thresholds. Swisher *et al* (1966) also showed that normal and non-adapting sensorineural impaired ears discriminated a signal of 1 dB or less equally well at equivalent SPL. The study by Young and Harbert (1967) showed that at SPL's of 45 and above every normal subject showed a SISI score of 65 per cent or higher for all frequencies. In general, a high SISI score occurs when at least 60 dB SPL reaches the inner ear. Sound pressure level (SPL) reaching the inner ear is the determining factor in the perception of 1 dB increments (Young and Harbert, 1967; Harbert, Young and Weiss, 1969; Martin and Salas, 1970).

If the inner ear receives an audible signal of 60 dB SPL or higher there is essentially no difference in the performance on the SISI test of ears with normal hearing, those with conductive pathology, or those with non-adapting sensorineural hearing loss. If the residual signal is greater than 60dB SPL after the conductive barrier is subtracted, the conductivley impaired ear behaves like a normal ear. In conductive and mixed deafness, the conductive barrier in dB should be added to the 70 dB SPL test signal to obtain a positive score (Young and Harbert, 1967). Higher test frequencies yield higher SISI scores. A study by Martin and Salas (1970) showed that normal ears did not give high scores on the SISI test when tested at the same loudness as pathological ears. Their study shows that high SISI score began to occur in the good ear somewhere between 55 to 65 dB SPL. Katinsky, *et al* (1972) reported that both their clinical experience and recent research have substantiated (Harbert, *et al* 1969) that positive SISI scores rarely are obtained if the test signal presentation is less than 50 to 60dBSPL. Pushpa (1974) found that a majority of normals obtained 100 per cent SISI scores at 65 dB HL.

In 1974, Byers described 'Conductive SISI test,' an indirect procedure to estimate bone conduction threshold for middle ear patients. A series of SISI tests were run beginning at 20 dB SL and increasing in 10 dB steps until a 100 per cent score was obtained. The following equation to predict the bone conduction threshold was suggested:

BC dB=60 dB+Air Conduction (dB)-H.L. dB (100 per cent SISI). The results of 25 conductive SISI tests on a conductive hearing loss group indicated that the equation approximated the bone conduction thresholds. They report that there was no statistical difference between the predicted threshold and

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measured bone conduction threshold for the group. The conductive SISI test has the advantage over the conventional bone conduction measurements in that it overcomes some of the sources of errors of the latter.

To know whether the technique enables us to get a valid bone conduction threshold an attempt is made here to verify the usefulness of the SISI test as a clinical tool in determining the bone conduction thresholds. The purpose of the study was to test the following hypotheses:

(a) All the ears without abnormal tone decay respond to 1 dB increments when the energy reaching the cochlea is around 60 dB.

(b) The bone conduction thresholds obtained by conductive SISI test do not significantly differ from the bone conduction thresholds obtained by conventional bone conduction measurements in conductive hearing loss, mixed hearing loss and in sensorineural hearing loss patients

Methodology

This study comprised the following parts: *(a)* obtaining pure tone air conduction and bone conduction thresholds for all the subjects, *(b)* To find the hearing level at which 100 per cent SISI scores are obtained in normal hearing subjects, (c) Comparison of bone conduction thresholds by conductive SISI method and conventional method in clinical groups (Conductive hearing loss, Mixed hearing loss and Sensorineural hearing loss). The subjects were tested for the frequencies in the order of 1000 Hz, 2000 Hz, 4000 Hz and 500 Hz.

Subjects; Two groups of subjects were chosen. First group consisted of ten normal hearing male subjects who had thresholds of 20 dB (ISO. 1964) or less, bilaterally. A clinical group of 28 m.des and 5 females which included 43 ears with conductive hearing loss of various pathologies such as C.S.O.M., serous otitis media, dry perforation, otosclerosis, ossicular rupture, tympanosclerosis etc., 9 ears with mixed hearing Iossand3 ears with sensorineural hearing loss formed the second group. Depending on the involvement both ears or a single ear was selected for testing. In the clinical group, the subjects age ranged from 15 years to 57 years with a mean age of 29.39 years.

Equipment and test environment: Throughout the study a Beltone 15 CX clinical audiometer was used to get air conduction thresholds and to administer SISI test. Madsen audiometer model to get none conduction thresholds was used. With Beltone 15 CX clinical audiometer TDH 39 earphones mounted in MX-41/AR cushion were used. With Madsen audiometer, Denmark A39 bone conduction vibrator was used. Both the audiometers were calibrated using Bruel and Kjaer instruments. Necessary correction was applied to the obtained audiorretric values wherever needed. The linearity of the attenuator was checked and found to be in order. The SISI unit of Beltone 15 CX audiometer was also calibrated in terms of increment size, the rise and decay time and the signal duration. The calibration was checked at regular intervals. All the testing was done in a sound treated room. Noise levels in the audiometric room were satisfactory.

Test Procedure: For all the subjects pure tone air conduction thresholds, bone conduction thresholds and the hearing level at which 100 per cent SI SI scores were obtained was determined. All the subjects in clinical group had otological examination before testing. In normals, in conductive hearing loss and in mixed hearing loss subjects the SI SI test was given initially at 40 dB above the conductive barrier. In sensorineural loss patients the test was started at 10 dB S.L. Whenever the subjects failed to give response for 1 dB increments, the carrier tone was raised in 5 dB steps. The hearing level at which the subject gave 100 per cent SISI score was determined. The contralateral ear was masked whenever necessary. For all the subjects, ten 1 dB increments were presented as suggested by Yantis and Decker (1964) and Owens (1965). After getting the air conduction thresholds and the hearing level at which 100 per cent SISI was obtained, the bone conduction thresholds were calculated by using the formula;

BC dB=60 dB+AC (DB)-H.L. dB. (100 per cent SISI)

as given by buyers (1974) bone conduction thresholds obtained by conductive SISI test were compared with conventional bone conduction thresholds.

In SISI test administration, first, five practice events of 5 dB, 4 dB, 3 dB, 2 dB, and 1 dB increments were given in order to familiarise the subjects. Then ten 1 dB increments were presented which were superimposed on a sustained tone. Randomly a control event of 5 dB or 0 dB was given depending upon the subjects' response. The hearing level at which the subjects could detect all the ten increments were found out and it was considered as the HL dB (100 per cent SISI).

To check the reliability, tests were repeated on five normal subjects after sufficient time interval to avoid the practice effect.

Results and Discussion

In the first part, to verify the hypothesis,"All the ears without abnormal tone decay respond to 1 dB increments when the energy reaching cochlea is around 60 dB', twenty ears of ten normal hearing subjects were given the SISI test. The hearing level at which 100 per cent SISI score obtained was found out for all the ten subjects. This score was obtained in normal hearing subjects, at a mean value of 65.12 dB HL.

Table 1 gives the mean air conduction thresholds, range of hearing levels for 100 per cent SISI and mean hearing level at which 100 per cent SISI was obtained in normal hearing subjects.

Young and Harbert (1967) reported that in general, a high SISI score occurred when at least 65 dB SPL reaches the inner ear. Intensity level reaching the inner ear is the determining factor in perception of the 1 dB increments. Harbert,

TABLE 1: Indicating mean air conduction thresholds, range of hearing levels and mean hearing levels for 100 per cent SISI

Frequency	Mean air conduction thresholds	The range of hearing levels for 100% SISI	Mean hearing levels for 100% SISI
500 Hz	6.25 dB HL	55-80 dB HL	67.0 dB HL
1000 Hz	6.5 dB HL	55-75 dB HL	66.0 dB HL
2000 Hz	6.75 dB HL	55-75 dB HL	64.0 dB HL
4000 Hz	5.50 dB HL	50-70 dB HL	63.5 dB HL

Young and Weiss (1967) reported that in normals nearly 100 per cent SISI score occurred at 60 dB SPL and also that low SISI scores occurred when the subjects received the signal at 55 dB SPL or below.

A studyby Martin and Salas (1970) also showed that high SISI scores occurred in normal ears somewhere between 55 and '>5 dB SPL. Pushpa (1974) observed that 75 per cent of normal hearing subjects obtained 100 per cent SISI scores at 65 dB HL and the remaining 25 per cent obtained 100 per cent SISI scores within 80 dB HL. The results of this study closely agrees with the above mentioned studies indicating that in normals an average of 65.12 dB HL is required to get a 100 per cent SISI score. Below 55 dB HI, at 500 Hz, 1000 Hz and 2000 Hz and below 50 dB HL at 4000 Hz ,no subject sc red 100 per cent SISI score.

In the second part of the study the null hypothesis, 'the bone conduction thresholds obtained by conductive SISI test do not significantly differ from the bone conduction thresholds obtained by conventional bone conduction measurements in conductive hearing loss, in mixed hearing loss patientsand in sensorineural hearing loss patients' is verified. The obtained results of the clinical group are analysed by dividing them into the following groups: *(a)* Total clinical group (Conductive hearing loss, mixed hearing loss, and sensorineural hearing loss); *(b)* Conductive hearing loss; (c) Mixed hearing loss; *(d)* Sensorineural hearing loss.

Total Clinical Group: For the clinical group inclusive of all the frequencies, 203 bone conduction measurements were made by both conductive SISI method and conventional method. For some ears in the clinical group, bone conduction measurements by conductive SISI method could not be computed for all the four frequencies because of audiometric limits.

In general, bone conduction thresholds ranged from -10 dB HL to 55 dB HL for conductive SISI method and -5 dB HL to 60 dB HL for conventional method. Results showed that there is no significant difference between the means by the conductive SISI test and by the conventional bone conduction test at 0.01 level. The variability within which the individual performed was similar in both the groups. So the null hypothesis for all the frequencies for the total clinical group has been retained.

***Conductive Hearing Loss Group**:* The analysis of the results of this group showed that there is no significant difference between the two mean bone conduction thresholds for the frequencies 500, 1000 and 4000 Hz at 0.01 level. But at 2000 Hz, for this group there is a significant difference between the mean bone conduction thresholds by conductive SISI test and by conventional method at 0.05 level. At 2 KHz, the mean bone conduction threshold by the conductive SISI method was less than the conventional method. As for general purpose 0.05 level is taken into consideration because it covers 95 per cent of the population the difference at this frequency between the two methods can be considered as significant.

The difference between the two methods at 2 KHz may be attributed to Carhart notch which might explain the increased mean value in conventional method. This shows that conductive SISI test is not influenced by the mechanical distortion unlike conventional bone conduction method.

Subjects with conductive hearing loss are similar to those with normal hearing in detecting 1 dB increments when the conductive barrier is overcome, is again supported by this study. At 2 KHz the conductive SISI test yielded better (lower) thresholds than the conventional method.

Mixed hearing loss and Sensor ineural hearing loss groups: In these two clinical groups, the results showed that at all the four frequencies there is no significant difference between the two means.

Only in mixed hearing loss group at all the four frequencies the mean conductive SISI bone conduction thresholds dropped below the conventional bone conduction thresholds. Dirks and Malmquist (1969) stated that cases with mixed hearing loss may be misdiagnosed because the effects of middle ear impairment depress bone conduction thresholds. Probably better conductive SISI bone conduction thresholds in mixed hearing loss cases at all the frequencies may be explained on the basis of the observation made by Dirks and Malmquist (1969).

On ten normal hearing ears, the test to find the hearing level at which 100 per cent SISI scores are obtained was repeated after sufficient time interval. The variation was within ± 5dB for all the ears except for one ear at 2 KHz. Reliability was statistically computed by using the Rulon method and the test-retest reliability was found to be high for all the frequencies.

Conclusions

1. The significant difference in bone conduction thresholds between conventional and conductive SISI methods at 2 KHz for conductive hearing loss group may be attributed to Carhart notch.

2. Conductive hearing loss ears behave like normal ears in detecting one dB increments of SISI test when the conductive barrier is overcome.

3. There is no significant difference between these two methods conventional and conductive SISI at any of the frequencies employed in this study for mixed hearing loss and sensorineural loss group.

4. Conductive SISI scores are reliable.

5. Conductive SISI test has value when bone conduction measurement by conventional method is questionable and when direct measurement of bone conduction is not possible.

Acknowledgement

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MEASUREMENTS OF ACOUSTIC IMPEDANCE IN INDIANS

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Abstract

Impedance measures—tympanometry, acoustic impedance, and acoustic reflex threshold were determined on 136 Indian subjects {191 ears) using electro-acoustic bridge (Madsen ZO 70). The subjects included normal and pathological, varying in age from 6-56 *years. Sex and age differences were observed with regard to static compliance and acoustic impedance. Any conclusion regarding the norms for acoustic impedance cannot be drawn as there is overlapping of pathological and normal ears with regard to acoustic impedance. The normals obtained a wider range of 682-5840 acoustic ohms. Varying of air pressure in the ear canal had significant effect on acoustic reflex threshold.*

The concept of Impedance was introduced in 1914 (Webster 1919). Its application to clinical audiology became evident from the day Metz (1946) published his classic monograph—'The Acoustic Impedance measured on Normal and Pathological ears'. Today, Acoustic Impedance measured at the tympanic membrane is "——not just another audiological test"—it constitutes—a whole new field of investigation with an inherent new methodology". (Zwislocki, 1965).

Currently, acoustic impedance measurements constitutes the only means of direct examination of the middle ear function. They are performed at physiological vibration amplitudes and, therefore, give a direct estimate of the efficiency of the sound transmission. Except in acoustic reflex threshold tests, the sensorineural part of the auditory system is not involved.

The acoustic impedance method is based on a partial reflection of sound. It depends not only on the structure of the tympanic membrane but also on that of the middle ear components and cochlea. Through acoustic measurements on normal and pathological ears and with the help of anatomy and acoustic theory, it is possible to analyze the middle ear function in detail and to correlate the acoustic changes measured at the tympanic membrane to middle ear pathologies. In a way impedance audiometry helps to look beyond the intact tympanic membrane and it tells about the sound transmitting characteristics of the middle ear.

There appear to be numerous studies to establish norms for impedance measurements by using both Zwislocki's bridge and the electro-acoustic bridge. Still there is scarcity of normative data and the available results show discrepancy

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for both the methods. Jerger *et al* (1972) in comparing normative data from six sources, three studies using Zwislocki's bridge and three studies using electro-acoustic bridge found variations.

Normative data are very important for the classification of ears under test into normal or abnormal. The classification of the ears into normal and abnormal depends on which normative data was used for the comparison.

In view of all these it was decided to study the impedance values in Indian population.

Methodology

Subjects: 136 subjects (191 ears) were tested. Table 1, gives the frequency distribution of the subjects.

TABLE 1

Sl. No.	Group	Age range	Mean age	No. of subjects	No. of ears
1.	5-14 yrs (boys)	6-14	8.85	7	13
2.	5-14 yrs (girls)	6-13	8.66	6	11
3.	15-29 yrs (males)	17-29	20.96	30	47
4.	15-39 yrs (females)	16-29	21.32	25	32
5.	30-50 yrs (males)	30-49	38.00	16	30
6.	S.N. loss	12-S6	———	14	20
7.	C.L. other than Otosclerosis			18	28
8.	Otosclerosis			8	13
9.	Mixed loss			11	18
10.	Functional loss			1	1

Apparatus: Madsen ZO 70 electro acoustic impedance bridge was used. To measure the acoustic reflex threshold an audiometer (Madsen) was used along with the impedance bridge.

The procedure used for administering the Impedance Audiometry was same as the procedure giv^n in the manual (Manual of Madsen electroacoustic impedance bridge model ZO 70 published by Madsen Electronics). Regarding tympanometry, due to the non-availability of the X-Y Plotter, the following procedure was designed to obtain the tympanograms: Sensitivity Control was set to position 1. Pump control was rotated until the monometer read 400 mm H_2O. At this pressure the compliance control was adjusted until the balance meter was nulled and the compliance reading on the compliance scale (in equivalent Volume in cc) was recorded. Pump control was rotated until the monometer read 360 mm. H_2O. At this pressure compliance control was adjusted to null the balance with (if required) and the compliance reading with compliance scale was recorded.

This procedure of varying the pressure in steps of 40 mm. H_2O was repeated until the monometer showed +200mm. H_2O. Each time the pressure was varied, the balance meter was nulled by adjusting the compliance controlled the corresponding reading on the compliance scale was recorded.

By using two compliance values i.e., (1) the minimum compliance (C1) recorded and (2) the compliance value (C_2) obtained at +200 mm H_2O pressure, the static compliance (C_s) for the subject was computed: Cs=C2-C1

Results and Discussion

1. Comparison of the two groups (boys and girls) in the age range of 5-14 years shows no significant difference with regard to static compliance indicating no sex difference in younger age groups. This is in agreement with other studies.

2. Comparison of the two adult groups (males and females) in the age range of 15-29 years shows significant difference with regard to static compliance indicating sex difference. The males show higher compliance than the females. This agrees with the reported studies.

3. Comparison of the two male groups on the age range of 15-29 and 30-50 years respectively, shows significant difference in compliance indicating age difference. Compliance declines as a function of age. This conforms with the previous reports.

4. The average compliance and the variance in compliance are more with females than males.

5. There is significant difference in acoustic impedance between girls and boys indicating sex difference in early age groups. The former groups shows higher impedance than the latter. This result is not in agreement with the conclusion number one. It needs further investigations.

6. There is no significant difference with regard to acoustic impedance between males and females for the sameage group (15-29 years). This result also is not in agreement with the conclusion number 2. Further investigations are needed.

7. There is significant difference with regard to acoustic impedance between two male age groups, viz., 15-29 and 30-50 years, indicating age difference in acoustic impedance. The older age group shows higher impedance than the younger group. This is in agreement with the compliance results that it declines with age.

8. Acoustic reflex was observed in 100 per cent cases only at 1 KHz and 2 KHz for all the normal ears.

9. Reflex threshold declines with increase in threshold of hearing in sensorineural loss.

10. Any conclusion regarding the norms for acoustic impedance cannot be drawn as there is overlapping of pathological and normal ears with regard to acoustic impedance. The normals obtained a wide range of 682-5840 acoustic ohms.

11. All conductive and mixed loss cases showed absence of acoustic reflex.

12. Suspected otosclerotic ears (16) obtained impedance score in the range of 1032 to 7552 AC ohms. The mean value is well above the mean for normal ears.

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TWO CASES OF HYSTERICAL APHONIA: A STUDY

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Introduction

The term hysterical aphonia refers to a condition in which the patient looses the voice completely. The onset of the problem is sudden. There will not be any vocal pathology. The etiology will be psychological in nature. It is a conversion of psychological stress into sensory and motor dys-function. Here are the reports of two cases who came to our hospital with the complaint of no voice.

Case report A: Case A (female, age 16 years) reported to the clinic on 29.10.75 with a complaint of no voice. The case history revealed that she developed this problem soon after a family quarrel with her husband a month back.

The E.N.T. examination showed normal laryngeal structures with intact vocal cords, both in its appearance and in its functions. The speech evaluation revealed normal speech apparatus. She could whisper occasionally. The speech pathologist diognosed this patient as a case of hysterical aphonia.

Case report B: Case B (female, age 16 years) reported to the clinic on 30.10.75 with a complaint of total loss of voice. The case history showed that she lost her voice after a quarrel at home eight days back.

The E.N.T. examination indicated normal laryngeal structures with intact vocal cords both in its functions and in its appearance. The speech examination revealed normal speech structures. She could whisper sometimes. The speech pathologist diagnosed this case as having the problem of hysterical aphonia.

Diagnostic evidences: The diagnosis was supported by the following clinical characteristics of hysterical aphonia reported in the literature. (Boone *et al.*, and Travis).

1. No speaking voice. Occasional whisper for social situation.
2. Normal appearance of the vocal cords on laryngoscopic examination.
3. The common etiology will be psychological in nature such as an acute stress, an emotional upset or a conflict.
4. Patient can cough.

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5. The onset is sudden.

6, The incidence of hysterical aphonia is more among females than among males. (7:1 Boone)

Therapeutic Methods

The following therapeutic methods were used for the treatment of these patients.

1. *Counselling method:* In this meth od the patient was made to understand the underlying cause of her problem. She was advised that she can definitely show progress in her voice. She was also advised to come for regular therapy sessions.
2. *Breathing control:* The patient was given few exercises on deep inspiration and on deep expiration so as to facilitate free movements of vocal cords and also make more air available for phonation.
3. *Relaxation exercises:* The patient was instructed that she can get a good voice if she phonates under complete relaxation. A number of relaxation exercises were given to her.
4. *Pushing exercises:* These exercises were given to facilitate vocal cord approximation, which in turn help in good phonation.
5. *Feed back method:* In this method, the patient's voice was fed back through a speech trainer, so as to make the case aware, that she can produce the voice. This acted as a good reinforcement.
6. *Approximation method:* This method was used to adjust the pitch, intensity and duration of phonation to normal range with a model voice, taped.

Therapy: I Session: For case A we used counselling technique for 10 minutes, breathing exercises for 5 minutes and relaxation exercises for 10 minutes. In this session we could reduce her anxiety and tension to some extent.

For case B the same techniques were used for a shorter duration, since she did not show much anxiety she was also asked to phonate 'a' sound. No phonation could be made initially. So pushing exercises were given for 10 minutes. Again an attempt was made to phonate. This time the case succeeded in mild phonation.

II *Session:* For case A counselling was given for 10 minutes. Breathing exercises for 5 minutes, relaxation technique for 5 minutes and pushing exercises for 10 minutes and now the case was instructed to phonate. The case failed to phonate in this session.

For case B along with counselling pushing exercises were given for 5 minutes. Now her phonation was satisfactory. The case showed considerable improvement in the quality of voice with subsequent phonation. The feed back method was used to motivate her. Approximation rr.ethcd was also used to bring normal loudness and pitch in her voice.

III *Session:* Case A was instructed about the improvement of case B. She was also counselled that she can get the same voice provided she follows the instructions properly. Then she was given pushing exercises for 5 minutes. Gradually in her attempt she could bring mild phonation. Now the feed back mechanism was used to motivate her.

For case B this was a last session. Stabilization of her voice was made- She was finally counselled and instructed to follow some relaxation and breathing exercises.

IV Session: Case A was instructed to phonate directly without any exercise. The phonation time was varied. The approximation method was used to change the pitch and intensity of her voice to the normal range. At the end of this session she could produce normal voice.

V Session: Stabilization of her voice was made and instructed to follow some breathing and relaxation exercises at home.

Results and Conclusions

The results are very encouraging for both the cases. Case A showed a normal phonation in 5 sessions of therapy and the case B showed a normal phonaton in the third session itself. Follow up of both the cases will be made after six months.

It is possible to conclude that the results of voice therapy with cases of hysterical aphonia is encouraging. The therapy usually lasts for a few sessions. The counselling of the case is very important to get their co-operation in therapy sessions and also to change their attitude of their problem.

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AUDITORY LOCALIZATION IN HELMET WEARING AND NON-HELMET WEARING CONDITIONS**

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SYNOPSIS

Whether auditory localisation ability will he impaired under helmet wearing condition was the focus of study. Localisation functions were studied under helmet wearing and non-helmet wearing conditions. The results pointed out a definite overall impairment under helmet wearing condition and the worst hit directions were Bottom, Back and Top, No appreciable sex differences were observed.

I. Introduction

The present investigation was carried out in order to study the efficiency in auditory localization for normal subjects under 2 experimental conditions.

1. When the subject did not wear a helmet, and
2. When the subject wore a helmet.

The interest in this study is to compare the efficiencey in auditory localization under the 2 defined experimental conditions. The expectation was that wearing the helmet would impair/or distort auditory localization. With the recently introduced regulations in almost all the states of our country making helmet wearing compulsory for two wheel drivers, the results of such a study may be of some value.

II. Experimental Set Up

The investigation was carried out in the open space of the quadrangle measuring 60 x 60 feet in the All India Institute of Speech and Hearing, Mysore. This physical setting was relatively free from echoes and reverberations. The space in between the subject and the sound source was free from any objects disturbing

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the sound field. The entire field was free from extraneous traffic and other noises as the investigations were held in the holidays and out skirts of the city.

A standard sound perimeter (sound cage) manufactured by M/s Anand Agencies, Poona, along with its accessories was used. The sound cage was placed at the centre of the above site.

The frequency of the test tone was fixed at 500 Hz as it is a very important frequency of all types of horns used in vehicles. A constant sound field of 90 dB was produced at the peripheral rim of the transverse section of the sound cage. The presentations of sounds were snap and did not last for longer than a fraction of a second. The distance from the medial position of the subject's head to the source of sound was kept constant, namely 0.5 meter. For obtaining the sound source a signal of 500 Hz at 2 mv was obtained from the Radart frequency generator and fed to Audio Frequency Amplifier and then to a small speaker fixed in a cabinet with a high quality interruptor switch. The speaker and the amplifier were matched appropriately. A frequency counter was connected to the AF generator to check that the frequency deviation was within limits.

The sound field at the centre of the cage was measured by Bruel and Kjaer SPL meter along with Octave Filter. The Octave filter was employed to measure only the intensity of the test tone and to cut down the influence of external noise. Free field type 1" condenser microphone of B and K was used with the SPL meter. The calibration of the SPL meter with the condenser microphone was checked with piston phone of B and K type. The sound field was fixed at 90 dB, by adjusting the gain of the amplifier, by keeping the loudspeaker on the rim of the transverse plane of the sound cage. The experimental conditions were maintained throughout. The helmet was made of compressed fibre glass and it covered completely the external ears of the subject. It did not have any perforations near the ear zone.

Diagram of the arrangement for the experimental set up is shown in Fig. 1.

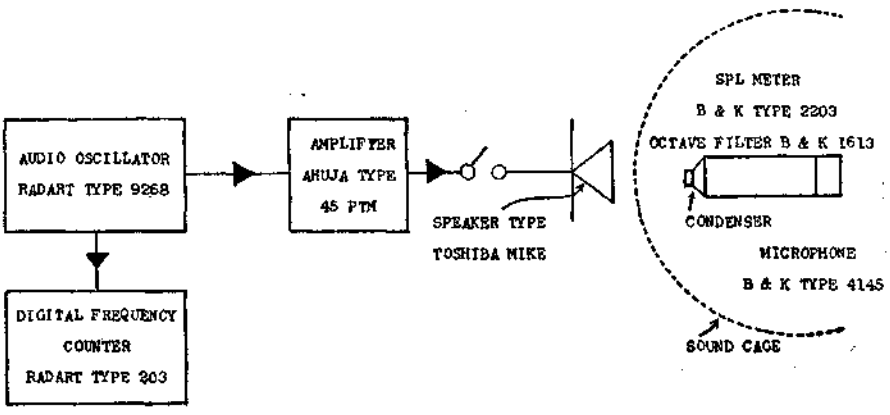

FIG. 1

III. Subjects

In all 30 subjects took the experiment, majority of these were students studying either for B.Sc. orfor M.Sc, in Speech and Hearing and the rest of them were the staff members. There were 16 male and 14 female subjects in the group. The subjects ranged in age from 19 years to 38 years with a mean age of 22.50 years. The mean age of the male group was 24.56 years and the mean age of the female group was 20.14 years. All the subjects had normal hearing,

IV. Methodology

All the 30 subjects were screened for their hearing acuity. The hearing evaluation was carried out in an audiometric room built to ASA specifications. The Madsen make, type OB 70 and TBN 60 clinical audiometers calibrated to ISO specifications were employed for testing. The test conditions were satisfactory. Only two subjects were found to have high frequency loss of about 30 dB average at 4 k, 6k and 8k Hz.

The subject sat on a height adjustable stool at the center of the sound perimeter. The head position was fixed by means of clamps, which did not make room for shifting the head position. The same head position facing the direct front of the sound cage was followed for every subject. Each subject was blindfold under both the experimental conditions. Before experimentation the subject was familiarised about all the ten directions from which sound was presented. He was given the option either to verbally indicate the direction or by means of right hand forefinger to point out the direction from which the sound was heard.

Ten directions were altogether used namely *Front, Back, Left, Right, Front Left, Front Right, Back left, Back Right, Top* and *Bottom.* From each direction sound was presented five times. A schedule was prepared for a random presentation of sounds from all these directions. Altogether there were 150 presentations for helmet wearing and 150 presentations for non-helmet wearing conditions. The direction indicated by the subject was recorded against each trial.

The diagram in Figure 2 illustrates the head position of the subject at the centre of the sound perimeter pointing out the eight directions from which sound was presented. Top and Bottom positions were two additional directions which are not included in the diagram.

The correct number of judgements under each direction for each subject under both the experimental conditions were calculated.

As mentioned earlier, each subject was tested on the audiometers in both the ears at the frequencies 250, 500, 1K, 2K, 4K, 6K and 8K. The maximum, minimum and average values for the entire group at all these frequency levels was worked out. The obtained average values for the group at all the frequency levels are presented in the group audiogram for both the ears. The mean audiogram for the group for both the ears was well within the normal range. The range

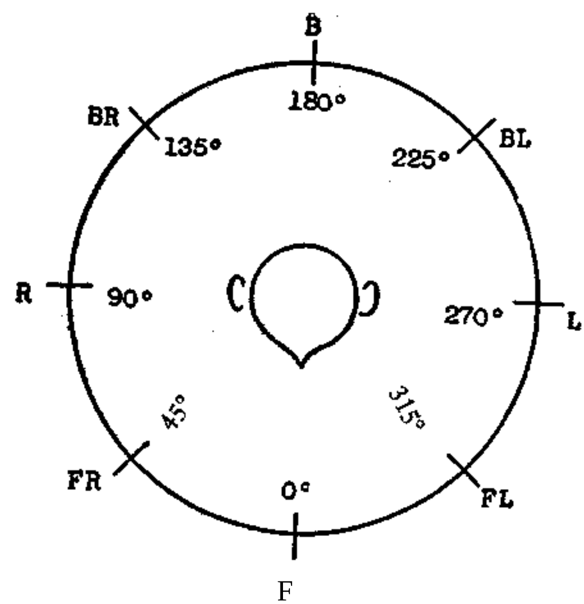

FIG. 2. Fixed head position in sound cage

of scores at any frequency level was as per expectation. Because of high frequency lossin only two cases from 2K-SK, the group audiogram shows a slight dip at those levels. This is seen in Fig. 3.

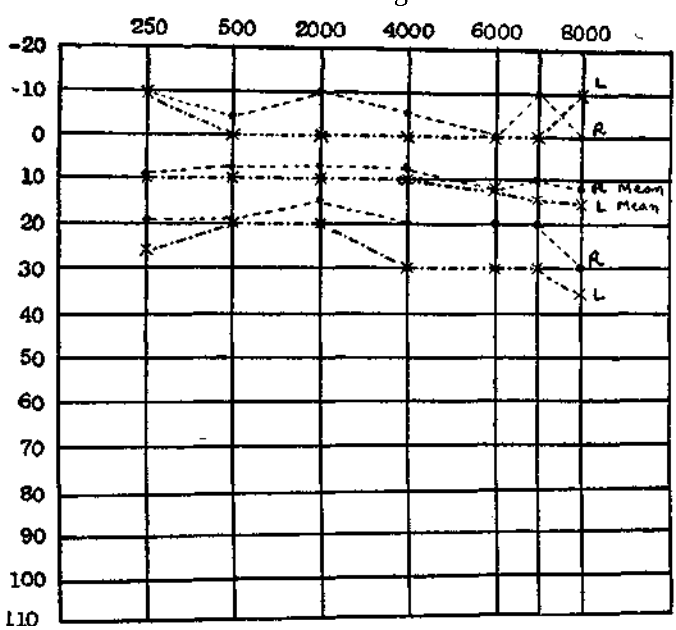

FIG. 3. Audiogram showing minimum, maximum and average thresholds of hearing

V. Results and Discussion

Table 1 presents the obtained results in terms of number of correct localizations and percentage of correct localizations under the 2 Experimental Conditions.

In the table, the results have been presented in the decreasing order of localisation. It can be clearly seen that the directions Right, Left, Front, Right.and Front maintained the top 4 rank positions under both the experimental conditions. Auditory loclizations were better when the subject did not wear the helmet. The average percentage of correct localizations was 64 percent under without helmet wearing and 54 percent under helmet wearing conditions. It is apparent that auditory localization becomes impaired or distorted by about 10 percent when the subject wears helmet.

TABLE 1. Per cent of Correct Localisations

Direction	W. O. H Total No. of presentations	W. O. H No. of correct localisations	W. O. H % of correct localisations	Direction	W. H. Total No. of presentations	W. H. No. of correct localisations	W. H. % of correct localisations
R	150	138	92.00	L	150	135	90.00
L	"	128	85.30	R	"	127	84.60
FR	"	121	80.60	FR	"	100	66.60
F	"	100	66.60	F	"	88	58.60
BR	"	100	66.60	FL	"	81	54.00
FL	"	89	59.30	B	"	68	45.30
B	"	81	54.00	T	"	62	41.30
BL	"	81	54.00	BR	"	62	41.30
T	"	66	44.00	Bot	"	54	36.00
Bot	"	54	36.00	BL	"	38	25.30

Below in Table 2 are provided the obtained results for the four main directions *Right*, *Left*, *Front* and *Back* for both the experimental conditions. Under each major direction, the results obtained from the immediate adjacent directions are also added.

The percentage of correct localization is smallest for sounds coming from the Back direction under both experimental conditions. The difference in percentages between helmet wearing and non-helmet wearing conditions are worth considering for sounds coming from the back direction and right direction A difference in percentage of 21 per cent for the back direction and 16 per cent in the right direction can be observed. The inference is that auditory localization becomes impaired by about 21 per cent for the sounds coming from the back and by

3. The directions Bottom, Back-left, Back-right, Back and Top are relatively more difficult in auditory localization.

4. The sounds coming from the major directions of Right, Left, Front and their immediate adjacent directions are more likely to be localized correctly. The sounds coming from the back directions are the most inaccurately localized. There is a 21 per cent fall in accuracy of auditory localization for sounds coming from back directions under helmet wearing conditions.

5. There is a small difference in auditory localization ability in favour of men under both the experimental conditions, which may not stand for a true sex difference.

6. There is a significant positive correlation in auditory localization between helmet wearing and non-helmet wearing conditions.

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EDITORIAL

There has been a change in editorship of this Journal as there is a change at the helm of affairs at this Institute.

I seem to be an eternal apologiser.

Our 1977 issue of the Journal is coming out late in 1980. I offer my apologies to our writers, sister magazines, subscribers and well-wishers. I do hope we can soon catch up with time.

The articles in the current issue are varied and we would feel gratified if their freshness, even after having been in cold storage for three years, will make up for their belated appearance.

There are several attempts at facing and tackling local problems be they in terms of a Word Discrimination Test for Thailand or studying various aspects of Indian Languages. It is always pleasant to see that people are aware of the problems they face and are doing something about them.

We have included a letter written to us on the eve of a Conference of the Indian Speech and Hearing Association. Robert Milisen is a name we all respect for many reasons.

He taught me at Indiana and he inspires me everyday.

A LETTER

ROBERT MILISEN

It is wonderful to learn of plans to establish speech and hearing associations in your homeland. India is such a massive country with needs in our area that are many times greater than they ever were in the United States not only because of your greater population but because of your many dialects and also because you have a second language, English, which forces bilingualism on many of your people.

Without question, success in unifying and developing your great country depends in large measure on the development of a communication system that will enable each of your citizens to interact with all others through speech and writing. Such a medium is the 'glue' that holds a society together. It is only through this medium that problems can be shared and cooperation obtained in their solution. Your profession can make a great contribution to the establishment of this medium. The area of speech, hearing and language pathology must cope not only with the deviant behavior of a few extreme cases but it must also concern itself with the creation of a linguistic code that will be compatible to the needs of all. This is a slow and tedious process but if it isn't started it will never be finished. Remember Sam Johnson who made a major effort to change the English language and we are still profiting by his efforts hundreds of years later.

Of course the main thrust of your profession is rehabilitation of those people who cannot use, in an appropriate manner, the language which is used by their families and associates. These people who have many problems such as stuttering, hearing defects and language deficiency cannot be brushed aside while you are trying to develop a suitable medium for the whole country. Instead, they must be worked with, while the longer term development is occurring.

As for the care of the handicapped, I have a bit of philosophy to offer. It is so easy to develop a ' cross my palm with silver' philosophy, that is, expecting payment for each clinical service. Such a scheme will result in treatment for only a few of the people, the rich who can pay their own way and the poor who can get government subsidy. Clinicians who work under these guidelines lose the excitement of their clinical work and usually provide inferior services. The reason for the inferiority is that each client has so many needs that cannot be paid for and yet needs which will have powerful effects on the outcome of therapy. Each clinician should be dedicated to providing maximum service to each client, rich, middle class or poor. Lay persons in the environment of the clients should be given help and guidance in managing their own therapy. This can be accomplished best through outpatient diagnosis and counsel. (In the late 30s and early 40s, our clinic helped create such a clinical ideal through a travelling clinic that examined, quite thoroughly, 5000 speech and language defectives, and over

100,000 school children were given hearing tests). As a result of this travelling clinic, the interest in clinical work in the state of Indiana and the development of programs for the handicapped leaped ahead by 20 or 30 years. This work was accomplished by four full-time people whose salaries and expenses were shared by a philanthropic sorority (Psi Iota Xi) arid Indiana University. This was done during the depression and cost only $ 30,000, but of course we had well trained people who were willing to work 12 hours a day and often seven days a week.

This brings up the other part of the philosophy. Clinicians must be people whose interest in the welfare of their clients must take precedence over their personal greed. They must be willing to give services to some clients without fees as well as some services to all clients. The clinician must identify his own financial needs, enough money for food, shelter, clothing, care and education of family and some for pleasure and retirement. All money gathered above that level results from greed. Clinical services should not be sold competitively in the market place. The joy of clinicians serving with a philosophy of ' sharing ' is so great that it shows up in the clinician's work and creates an aura of mutual understanding and respect between clinician and client. Certainly the client never feels that he has been ' ripped off'. Furthermore, clinicians who function this way need never feel hesitant in seeking financial and other assistance for their clients. The clinician is not asking for help for himself but rather for the client and no one can accuse him of acting in a self seeking manner.

Of course, in addition to having a proper attitude, clinicians must be well trained. They must never try to impress their clients with ' fancy ' language.

When they talk, they should do so in a manner that can be understood immediately. Respect will be given them as they succeed in communicating their ideas, not because of superficial methods used to impress.

The creation of programs designed to make people's lives happier is the most exciting of all experiences. You and your countrymen have unlimited opportunity and I wish you the greatest satisfaction in your endeavor.

THE DEVELOPMENT OF A THAI WORD DISCRIMINATION BY PICTURE IDENTIFICATION TEST: PRELIMINARY FINDINGS

GAIL D. CHERMAK AND NUALNIPHA B. PHANIJPHAND*

Abstract

A Thai word discrimination by picture identification test was developed. Phonemic and tonemic contrasts comprised the fine and gross discriminations. Four lists of 25 words each were randomly assembled. Twelve normal hearing native adult Thai speakers served as subjects. The test was administered to each subject both auditorally and auditorally with the closed-set visual cues provided by the pictures. Pearson's product moment correlation coefficients revealed significant correlations between 2 and 3 pairs of lists only when presented in the combined auditory (closed-set)-visual mode and the auditory mode, respectively. Modifications need to be incorporated before this test is clinically reliable. Limitations of the present study in terms of subjects was discussed.

The understanding of speech requires the listener to discriminate and identify the units of a message. Word discrimination testing by picture identification, as well as verbal responding to orally presented materials, is well known in the practice of audiology in the United States of America and other western countries. Test materials and procedures in non-western countries are not as well as developed (Oyer, 1976).

In Thailand, audiology is just beginning to serve the needs of the people. The author will be the third audiologist in this country. One of the needs in terms of materials is a speech discrimination test for the non-verbal, uncooperative, or young patient. It is not feasible to utilize adult speech discrimination tests with children (3-6years) for several reasons:

(1) Considering their probable stage in language development, the test words are unfamiliar and auditory recognition is not possible. (Ross and Lerman, 1971)

(2) Articulatory development in the normal hearing child is often incomplete at this age which may result in unintelligible oral responses.

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(3) Written responses are not feasible due to their age. (Roes and Lerman, 1971)

A picture test similar to the WIPI (Word Intelligibility by Picture Identification), (Ross and Lerman, 1971) has been developed to meet the audiological need in Thailand for a word discrimination test for this population.

Procedures

A Thai word discrimination picture identification test was developed. The Words utilized are: (1) in common use in Thai daily life, (2) within the receptive vocabulary of this age group (3-4 years) and (3) easily communicated through pictures. The pictures were drawn by a Thai art student in Thailand.

Test Development

One hundred and fifty pictures, 6 per page, comprise the test. Each picture represents a monosyllabic word. Four lists of 25 words each were randomly assembled. Fine and gross discriminations per list were on the order of 60 per cent and 40 per cent, respectively. As Thai is a tonemic language[1], words contrasted on tonemic as well as consonant i dimensions. Vowels remained constant among the 6 words per page. Of the 21 Thai vowels[2], all were used except /a:y, o:y, uy, iw, ew, e:w/. Words with hose vowel phonemes primarily carry abstract meanings which are not feasible ior communication through pictures. There are 21 consonant phonemes, and 12 consonant clusters in the Thai language[3]. Initial consonant contrasts account for 52 per cent o£all fine discriminations incorporated in the test. All possible final consonant phonemes were utilized in the picture test. Final consonant contrasts account for 5 per cent of all fine discriminations and 25 percent of all gross discriminations, Tonemic contrasts account for 3 per cent of all fine discriminations. The remaining 15 per cent of gross discriminations was due to initial consonant contrasts.

Test Administration

Twelve, normal hearing native adult speakers of Thai served as subjects (X age=27; range=19 - 37 years). Prior to participation in this study each subject's hearing sensitivity was measured using a Beitone 200C Clinical audiometer. (The calibration of the instrument was checked prior to experimental use, ANSI '69, using a Bruel and Kjaer Sound Level Meter, Type 2203, and its associated Artificial Ear, Type 4152). Hearing sensitivity better than 15dB HL bilaterally at all octave frequencies from 25OHz - 8KHz was considered normal hearing for this study. Pure tone averages for the speech frequencies were calculated for

[1] Appendix A. [2] Appendix B. [8] Appendix C.

each subject's right ear. The PTA was used as a reference for the experimental **task.**

Each of 12 subjects was required to attend to a total of 8 lists[4], 25 words per list, 4 presented via live voice (auditory mode)[5], and 4 presented orally (live voice), utilizing the closed-set visual cues provided by the pictures (auditory-visual, combined presentation). Mode of response was pointing to the correct picture in the latter 4 conditions and writing down the word heard in the auditory conditions. All testing was accomplished in a double walled IAC sound treated booth. All stimuli were presented at 25 dB SL (re:PTA) to the subjects' right ear using a TDH-39 earphone mounted in an MX 41/AR cushion. Simultaneously, speech noise was presented to the subject's right ear at a signal to noise ratio (SNR) of-8 dB. Subjects were instructed to ignore the noise, listen to the word, and point to the appropriate picture or write down the appropriate word (all instructions were presented in Thai). Each stimulus was precedaed by the carrier phase 'point to' /ch'i: pay thî/ or'write down'/k^hǐan k^h am wâ/. The order of experimental conditions was randomly determined prior to subject participation to control for learning and practice effects.

Each correct response received 4 percentage points. Discrimination scores in percentages served as measures. Means, standard deviations, Pearson product moment correlations, and confusion matrices aided in the analysis of the data.

Results

Word discrimination scores in percentages served as measures. Mean discrimination scores and standard deviations for 12 subjects under each of 8 conditions were calculated (see Table 1). Twelve Pearson's Product Moment

TABLE 1

Means in per cent correct and standard deviations for word discrimination in S experimental conditions, N = 12

Combined	Lists	X	S.D.
	1	97.33	3.55
	2	91.67	7.13
		92.33	8.27
	4	90.00	8.27
Auditory	1	87.67	10.85
	2	77.33	19.17
	3	77.00	16.72
	4	79.67	15.58

* The 4 lists in Thai and their English translations are found in Appendix D.

• It was reasoned that these lists might function in a manner similar to the Haskins kindergarten lists. (Haskins, 1949)

Correlation Coefficients were calculated to determine list equivalence (see Tables 2 and 3).

TABLE- 2

Pearson Product Moment Correlation Coefficients for 4 word lists presented in the auditory visual (picture) mode, N = 12

Lists	2	3	4
1	.08	.34	.40
2		.38	.65*
3			.77*

*P < .05

TABLE: 3

Pearson Product Moment Correlation Coefficients for 4 word lists presented auditorally, N = 12

Lists	2	3	4
1	.05	,21	.40
2		,53*	.66*
3			.59*

•P < .05

As can be seen in Table 1, word discrimination was better and variance was greater in the combined (auditory and closed-set visual) mode. A total of 5 correlations were found to be significant at the .05 level of confidence; two of these were among the auditory-visually presented lists and 3 among the auditorally presented lists.

Confusion matrices revealed the following information as seen in Table 4: (1) tonemic errors averaged across lists accoun ted tor 7.7 per cent of errors in the auditory mode and 15.8 per cent of errors n the combined mode; (2) vowel errors averaged across lists accounted for 17.3 ; er cent of errors in the auditory mode and 4.6 per cent of errors in the combined mode; (3) initial consonant errors averaged across lists accounted for 28.7 per cent of errors in the auditory mode and 48.1 per cent of errors in the combined mode; (4) final consonant errors averaged across lists accounted for 46.4 per cent of errors in the auditory mode and 31.6 per cent of errors in the combined mode.

TABLE: 4

Distribution of Tonemic and Phonemic Errors (vowel, initial consonant and final consonant), expressed in number of errors and per cent of errors for each of the four lists in two experimental conditions. Auditory and combined auditory-visual (pictured N = 12

	List 1		List: 2		List 3		List: 4		Mean (X)	
	Aud.	Cbd.	Aud.	Cbd.	Aud	Cbd.	Aud.	Cbd.	Aud.	Cbd.
1. Total Number of Tonemic Errors	4	3	3	0	13	6	8	3	7.0	3.0
2. Total Number of Vowel Errors	12	0	15	0	20	3	13	2	15.0	1.2
3. Total Number of Initial Consonant Errors	19	5	23	11	29	11	29	15	25.0	10.5
4. Total Number of Final Consonant Errors	26	2	48	11	45	6	44	10	40	7.2
5. Total Number of Errors	61	10	89	22	107	26	94	30	87.0	22.0
6. Per cent of Total Errors due to Tonemic Confusion	6.6	30.0	3.4	0.0	12.2	23.1	8.5	10.0	7.7	15.7
7. Per cent of Total Errors due to Vowel Confusion	19.7	0.0	16.9	0.0	18.7	11.5	13.8	6.7	17.3	4.5
8. Per cent of Total Errors due to Initial Consonant Confusion	31.2	50.0	25.8	50.0	27.1	42.3	30.9	50.0	28.7	48.0
9. Per cent of Total Errors due to Final Consonant Confusion	42.6	20.0	53.9	50.0	42.1	23.1	46.8	33.3	46.4	31.6
10. Total Errors in Percentage	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Discussion

The present results indicate that the greatest percentage of errors in the discrimination of monosyllabic words was due to initial consonant confusion and final consonant confusion in the combined and auditory conditions, respectively. Although vowels remained constant among the six words represented by pictures, per page, vowel confusion accounted for 4.5 per cent of the total errors in the combined mode. In the auditory mode, vowel confusion caused considerably more errors (17.3 per cent). Tonemic contrasts accounted for 3 per cent of the fine discriminations in the test; however, tonemic confusion was relatively great, 15.7 per cent and 7.7 per cent in the combined and auditory modes, respectively. Whereas, initial consonant contrasts accounted for 67 per cent of the discriminations (52 per cent of all fine discriminations and 15 pet cent of all gross discrimination), errors due to initial consonant confusion was 48 per cent in the combined and 28.7 per cent in the auditory mode. Final consonant contrasts accounted for 30 per cent of all discriminations (25 per cent of gross discriminations and 5 per cent of all fine discrimination); errors due to final consonant confusion was 46.0 per cent in the auditory mode and 31.6 per cent in the combined mode. It is apparent that tonemic confusion and final consonant confusion provided proportionately more trouble for the subject.

Correlation coefficients indicate that in its present form the Thai word discrimination by picture identification test is not useful clinically. Although the significant correlation between lists 2 and 4, 2 and 3, and 3 and 4 were fair to good (in terms of magnitude), these were the only correlations found to be significant. The lack of significant correlations may be due in part to the small sample (N=12), the small number of test items (N=25), and the small variance, especially in the combined mode of presentation.

The test in its present form may produce different correlations if administered to the intended population. Children between the ages of 3-6 possess less well developed language and auditory perceptual skills than the adults used in the present study (Maccoby, 1967). Some researchers contend that children display different modes of linguistic processing (Brown and Bellugi, 1964; Klima and Bellugi, 1966). Therefore, it is imperative that young Thai children serve as subjects for this test instrument. The second author will conduct such a study upon returning to Thailand.

It was observed that several pictures were confusing for the subjetcs and therefore should be re-drawn for future use These pictures include: (1) the hole; (2) the roll of cloth material; (3) the dam; (4) the crooked line; (5) the representation of the adjective deep.

Summary and Conclusions

A Thai word discrimination by picture identification test was developed. Inter-form equivalence was poor as assessed by Pearson's Product Moment Correlation Coefficients. Confusion matrices revealed a disproportionate amount of confusion caused by tonemic and final consonant contrasts in the combined (auditory-visual) and auditory modes of presentation. Prior to the clinical utilization of this test modifications must be made to establish inter-form reliability and more proportionate dispersion of errors. In addition, the utilization of Thai children as subjects may provide different results.

APPENDIX A

Thai Tonemes

The five Thai Tonemes are high, mid, low, rising and falling, represented by the following symbols marked on top of the vowel phonemes:

1. The "mid" tone, no symbol representation.
2. The "high" tone, represented by / '/ .
3. The " low " tone, represented by / * /.
4. The "rising" tone, represented by /v/
5. The " falling " tone, represented by /A/.

APPENDIX B

Thai Vowels

Classified by Shape of Lips, and Height and Place of the Tongue

	Unrounded Front		Central		Rounded Back	
High	/i /	/i:/	/w /	/w: /	Inl	lu:l
Mid	/e /	/e:/	/ə/	/ə:/	lot	lo:l
Low	/se/ l	/əe:/	/a /	/a: /	/o/	lo:l

*/:/ indicates vowel length, which is significant in Thai.

The three Thai diphthongs are / ia, wa, ua /. The Thai semi-vowels include / w / and / y /.

APPENDIX C

Thai Consonants

Classified according to Manner and Place of Articulation

Manner of Articulation / Place of Articulation	Bi-labial	Labio-dental	Apico-alveolar	Alveo-palatal	Dorso-velar	Glottal
1. Stop:						
(a) Voiced	Ibl	—	/d/	—	—	/ /
(b) Voiceless Aspirated	/ph/	—	/th/	/ch/	/kh/	—
(c) Voiceless Unaspirated	/p/	—	/t/	/c/	/k/	—
2. Fricative, voiceless	—	/f/	/s/	—	—	/h/
3.. Nasal:	/m/	—	/n/	—	/ /	—
4. Lateral:	—	—	/l/	—	—	—
S. Flap:	—	—	—	/r/	—	—
6. Semi-vowel:	/w/	—	—	/y/	— -	—

• The /h/ that accompanies the voiceless stops / p,t,c,k / is the aspiration ;h/. There are ten consonant clusters functioning with / r,l /. They are / pr—, ph r—, pl—, ph 1—, tr—, th r—, kr—, kh r—, kl—, kh 1— /. The consonant clusters with / w / are / kw—and kh w— /. These, clusters never occur finally. There are only nine final consonant phonemes: /—p, —t, V —k —n, —m, —n, —3, —w, —y/.

APPENDIX D

1.. Thai Word Discrimination Picture Identification Test

Item	List 1	List 2	List 3	List 4
1	/ŋu:/	/hǔ:/	/pu:/	/mǔ:/
2	/ŋa:/	/bà:/	/mǎ:/	/hâ:/
3	/ca:n/	/bâ:n/	/kʰwǎ:n/	/rá:n/
4	/kʰwa:y/	/wâ:y/	/ya:y/	/dâ:y/
5	/pèt/	/dèk/	/hèt/	/bèt/
6	/rɯa/	/sɯ̌a/	/sɯ̀a/	/ŋɯ̀a/
7	/pʰɯ̂an/	/rɯan/	/dɯ̀at/	/cʰɯ̂ak/
8	/pʰát/	/wát/	/hàk/	/kàt/
9	/tʰà:t/	/hà:p/	/kwà:t/	/krà:p/
10	/tʰɔ́:ŋ/	/klɔ:ŋ/	/sɔ̌:ŋ/	/kʰlɔ:ŋ/
11	/caw/	/tàw/	/kʰâ:w/	/wâ:w/
12	/cʰɔ́:n/	/mɔ̌:n/	/nɔ̌:n/	/nɔ:n/
13	/ŋɔ́ʔ/	/kɔ́k/	/pɔ̀:k/	/kɔ̀ʔ/
14	/kʰǐaw/	/kʰǐan/	/kʰîaw/	/kʰǐaŋ/
15	/mót/	/rót/	/kʰrók/	/hòk/
16	/klûay/	/kʰùat/	/nùat/	/kruay/
17	/kày/	/kʰày/	/lày/	/fay/
18	/hɔ̌y/	/kɔ̂y/	/rɔ́y/	/sɔ̂y/
19	/tóʔ/	/hǒ:n/	/ló:n/	/kʰô:n/
20	/hì:p/	/mî:t/	/klì:p/	/kʰrî:p/
21	/rôm/	/lóm/	/kʰon/	/pʰǒm/
22	/wæ̌:n/	/kʰæ̌:n/	/wæ̀ŋ/	/wæ̂n/
23	/pɯ:n/	/tɯ̀k/	/mɯ̀k/	/pʰɯ̂ŋ/
24	/cæ:w/	/kæ̂:w/	/hæ̂w/	/tʰæ̌w/
25	/tʰû:p/	/lû:k/	/plù:k/	/cùk/

APPENDIX D

2. English Translation of Thai Word List

Item	List 1		List 2
1.	Snake		Ear
2.	Tusk (animal's)		Shoulder
3.	Dish		Home
4.	Buffalo		A manner of respect
5.	Duck		Child (general)
6.	Boat		Tiger
7.	Friend		House
8.	Fan		Buddhist temple
9.	Tray		A basket carrier
10.	Stomach		Drum
11.	Stove		Tortoise
12.	Spoon		Pillow
13.	A kind of fruit		Water tap
14.	Green		Write
15.	Ant		Vehicle
16.	Banana		Bottle
17.	Chicken		Egg
18.	Shell	fish	Little finger
19.	Table		Howl
20.	Box		Knife
21.	Umbrella		Fall
22.	Ring		Arm
23.	Gun		Building
24.	Paddle		Glass
25.	Incense stick		Child (of parents')

APPENDIX D

3. English Translation of Thai Word List

Item	List 3	List 4
1.	Crab	Pig
2.	Dog	Five
3.	Axe	Store
4.	Grandmother	Thread
5.	Mushroom	Fish hook
6.	Mat	Sweat
7.	Boil	String
8.	Break (v)	Bite
9.	Sweep	A manner of great respect
10.	Two	Canal
11.	Rice	Kite
12.	Worm	Sleep (v)
13.	Peel	Island
14.	Fang	Cutter
15.	Grinding pot	Spill
16.	Mustache	Cone
17.	Shoulder	Fire
18.	Hundred	Neklace
19.	Bald	Falling trees (action)
20.	Petal	Fin
21.	Person	Hair (on head only)
22.	Part of something broken off	Eye glasses
23.	Ink	Bee
24.	Water chestnut	Row
25.	Plant (v)	Top knot

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DEVELOPMENT OF A SYNTHETIC SPEECH IDENTIFICATION TEST IN KANNADA LANGUAGE

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Abstract

An attempt has been made to develop ' A Synthetic Speech Identification Test In Kannada Language', to serve the urgent clinical needs on the basis of 'A new approach to speech audiometry'. Synthetic speech sentences of first and second order were construsted. They were recorded with a competing speech signal. It was presented to sixty normal ears and forty-three pathological ears. Their data were analyzed by using non-parametric statistics.

Speech audiometry is a basic tool of audiological evaluation. Pure tone audiometry alone does not provide any information about a person's ability to hear above the threshold and hence should be supplemented by speech audiometry. Speech audiometry helps to measure threshold, supra-threshold intelligibility, progress in lip-reading, auditory training, success in otological surgery and to aid in the diagnosis of peripheral and central auditory disorders.

A variety of materials such as consonants, words (mono and disyllabic), nonsense syllables, sentences and continuous discourses have been used as materials for speech audiometry. In using these materials many of the limitations of each of these materials have been noticed.

Monosyllabic words are sufficiently unpredictable for clinical subjects and are perceived relatively independently as individual speech elements. So intelligent guess work on the part of subjects is minimized. Egan *et al* (1948) developed a series of tests at Psycho-Acoustic Laboratory, Harvard University and were known as PAL Tests No. 9, 14 and 12. Later Hirsh *et al* modified these tests at the Central Institute for the Deaf and were available for clinical use as W-l, W-2 and W-22 Tests of CID. Northwestern University Tests No. 4 and 6 were developed later using phonetically balanced and monosyllabic words. Later multiple choice tests, rhyme tests and modified rhyme test were developed. The Kansas University developed the K-U Speech Discrimination Test. These emphasized the auditory phonemic factors and minimized the linguistic factors. Later it was felt that, the use of single words especially single syllable words imposes severe limitation such as vocabulary, relative range of difficulty, meaningfulness which acts as variables and imposes a limitation on the parameters of

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speech and its changing pattern over time. So the National Research Council on Hearing and Bio-acoustics found the monosyllables as not a proper representative of everyday speech and suggested the use of sentences as material for speech audiometry. Sentences are considered to be more valid indicators of speech.

Bel Telephone Laboratories constructed interrogative sentences which are to be answered by the listener. These lists were found to be useless for the clinician as it involves not only hearing but also the ability to answer the questions on the part of the listener. Simple sentences were constructed by Hudgins *et al.* at Harvard University (PAL Test 12). Later set of sentences were constructed at CID to represent everyday American speech. The disadvantages in using sentences as speech material is that fairlv long lists are required as the same sentences cannot be repeated as it becomes easier for a listener to recognize a sentence just by a key word. Sentences are highly redundant and cannot be used as valid materials for testing as it gives room for guess work. But these tests have high face validity 'as samples of everyday speech.

To overcome the above disadvantages James Jerger *et al.* deviced 'A new approach to audiometry' in .which *(a)* the message set is closed *(b)* scoring is unambiguous *(c)* each test word is multiword rather than single word. This technique has been extensively made use of in the present study.

In India Abrol (1971) Kapur (1971), Swarnalatha (1972), De (1973) and many more have constructed materials for speech audiometry in different languages. . So far no test in Kannada has been developed. The problem in developing a test using PB words or Spondees in Kannada is the availability of a very few monosyllabic or disyllabic with equal stress. No word in Kannada ends with a consonant. So English PBs and Spondees have been used with English knowing Kannada people and. words digits and conversation have been used with those who know Kannada only. The present study was the first to be undertaken to overcome this difficulty.

Methodology: The ."After only' research design is made use of in the study* It .was conducted in three stages. They are (1) construction of the material; (2) the development of the test procedure and (3) collection of data.

Construction of material: Synthetic sentences are the sentences which are artificial as they are not real and/or synthetic as they follow a specificable rules of syntax. Synthetic sentences of first and second order were constructed.

First order sentences:' Words from the list of most commonly used words of the language (computed by the research project SRS Ind 38-68 AIISH using 20,000 words of the'language—report 1970-71) were selected at random and put together in the same order of selection to form a seven word sentence. Twenty such sentences were constructed

Second order sentences": One word from the above cited list is taken at random and given to an individual 'A' to construct a sentence using the given word in the initial position. This word served as the first word of the second order sentence. The word that immediately followed the given word was taken from the sentence constructed by the individual 'A', and given to another individual 'B' to construct a sentence using this word in the initial position. This word served as the second word of the second order sentence. The word that immediately followed the given word in the sentence constructed by the individual 'B' was taken as the third word of the second order sentence. This third word was used to elicit the fourth word of the second order sentence from yet another individual. The fourth word was used to elicit the fifth and so on till the seven words are reached in the aforementioned way. In this way 20 sentences Were constructed by using different individuals for each of the word and each of the sentence. The people did not know as to why the word was used or the purpose of it. (Thus a curse word has also occurred in one of the sentences). The length of each sentence was controlled by taking seven words only in a sentence. The probability of each sentence to occur in any order is controlled by random selection.

These sentences were tested for homogeneity in reading and identification. For this purpose five subjects with normals otologic and audiologic findings and who could read and speak Kannada were selected. The time taken by them to read the sentences and to identify them after hearing through the head set and from a given list are noted down. Those sentences of first order and of second order which require equal reading time and equal identification time are grouped together to form sets of 10 sentences each in both the orders.

Competing Speech: A continuous speech signal was selected from a Kannada novel which was considered by most of the readers as interesting to be used along with synthetic sentences for making the task as realistic and as difficult as possible.

The sentences of the first order (Appendix: Chart I) were randomly scrambled into three lists of 10 sentences each to form the set one. In the same way 10 sentences of the second order (Appendix: Chart II) were scrambled into three random lists of 10 sentences each to form set two. Set one and set two sentences were recorded on channel one of a magnetic tape. A time gap of 10 seconds between sentences, 15 seconds between lists and 20 seconds between sets two was provided. The competing speech was recorded on the channel two of the same tape. It preceded and exceeded the synthetic speech sentences by 30 meter readings. This was tape-1. One list of first order sentences and another list of second order sentences were at randomly selected from tape-1 and recorded on tape-2 with a time gap of 10 seconds between sentences and 15 seconds between sets on the first track of the tape-2. On the track 2 of the tape-2 competing speech was recorded. It exceeded and preceded the synthetic sentences by 30 meter readings.

Development of Test procedure: The test was conducted in an audiometric room which met the ISO standards for audiometric rooms.

APPENDIX : Chart—I

Synthetic Speech Sentences of First **Order**

1. ಒಂದು ಅವರು ಮನಸ್ಸು ಅವನು ಇದು ಈಗ ಸ್ವಲ್ಪ
2. ಒಂದು ತಲೆ ನೋಡು ಹೋಗು ದಿನ ನನಗೆ ಒಳಗೆ
3. ಎಷ್ಟು ತಪ್ಪು ಈ ಊಟ ಅವನು ನಿನ್ನ ಮೇಲೆ
4. ಬೇಕು ಕಂಡು ತಪ್ಪು ಪಡು ಹೊರಗೆ ಈ ನಿನ್ನ
5. ಮದುವೆ ಸಿಕ್ಕು ಒಳಗೆ ಕೈ ದಿನ ವಿಷಯ ಒರುವ
6. ಸಿಕ್ಕು ಎಂಬ ಹಿಂದೆ ಎಂದ ಅವರು ತನ್ನ ಹೀಗೆ
7. ಇವರು ತಲೆ ಆ ಪಡು ಕುಳಿತು ಶ್ರೀ ಕಾಣು
8. ಬೇಕು ಮೇಲೆ ಮೊದಲು ತೆಗೆದು ನಿನ್ನ ಶ್ರೀ ಬಗ್ಗೆ
9. ಕುಳಿತು ತೆಗೆದು ಅವರು ಯಾಕೆ ಅವರು ಒಳಗೆ ಇನ್ನು
10. ಕಾರ್ಯ ಕಂಡು ಈ ಹೇಗೆ ಬರುವ ಹೇಳು ಇದು.

Chart—II

Synthetic Speech Sentences of Second Order

1. ಸಣ್ಣ ಮಹಾದೇವ ಈ ಹುಡುಗರು ಎಲ್ಲ ಇನ್ನುವುದಕ್ಕೆ ಮಾಡುವುದಕ್ಕೆ
2. ಯುವಕನಲ್ಲಿ ಬಿಸಿ ಬಿಸಿ ಕಾಫಿ ಮಡಿ ಮಾಡುವುದಕ್ಕೆ ಕೆಲಸ
3. ಪೆದ್ದ ನಾಗರಾಜ ಸತ್ತುಹೋದ ಅಯ್ಯೋ ನನ್ನಪ್ಪ ಬಹಳ ಚೆನ್ನಾಗಿದೆ ತುಂಬಾ
4. ಲೋಟ ಬಹಳ ಗಾಳಿ ತಂಪಾಗಿ ಇಲ್ಲ ತಲೆ ಇಲ್ಲ ತಲೆಯಿಲ್ಲದವಳಿಗೆ
5. ಸಮಾಜ ಬಹುಬೇಗ ಬನ್ನೀ ಬನ್ನೀ ಒಳಕ್ಕೆ ನನ್ನ ಮಕ್ಕಳು
6. ನಡೆದುಕೊಂಡು ಹೋಗು ಬೇವಾಸಿ ಬಿದ್ದಿತ್ತಿದ್ದೆ ಏಕೋ ಇಷ್ಟೇ ತಲೇಸಾ
7. ಕೂದಲು ತುಂಬಾ ಚೆನ್ನಾಗಿ ಕೆಲಸ ಇಲ್ಲ ಇಲ್ಲವೇ ಇಲ್ಲ ನನ್ನ
8. ರಾಗ ಹಾಡುತ್ತೀಯೆ ಅಂತ ಮತ್ತೆ ಎಲ್ಲಿಗೆ ಬೇಕಾದರೂ ಕಾಸು
9. ಬಂಗಾರ ನನಗೆ ಬಂಗಾರದ ಮನುಷ್ಯ ನಾನು ಹುಟ್ಟಿದ್ದೇ ತಡವಾಗಿ ಏಕೆ
10. ಬೀಗ ಎಲ್ಲಿಗೆ ಹೋಗಿದ್ದೆ ಅವನು ಬರುತ್ತಾನೆ ಬೇಡ ಬೆಂಗಳೂರು.

Instruments: Uher variocard 26- stereo tape recorder with Scennheiser type MD 722 LM microphone was used to record and reproduce the signal.

Audiometer: The signal was fed through an Arphi model 700 MK audicr meter with TDH 39 headsets. Sine there was no provision to feed the second tape signal through the audiometer it was suitably modified to inject the second signal in place of noise on the second channel of the audiometer. The two outputs from the tape recorder were fed to the auidiometer such that the synthetic speech appeared on channel one and the competing speech on channel two. The audiometer was kept either in hangen right or left with a function selector switch in speech/ masking position all through the testing. A pre-amplifier EA 724 Stereo developed at the electro acoustic laboratory All India Institute of Speech and Hearing was used in between tap. recorder and audiometer to boost the signal to the required extent.

To know which sentence was presented at any instance of time during testing a monitoring set comprising of an amplifier (Arphi TH 25) and headset (513/4-PP-531) was provided to the experimenter. The output of the monitor never exceeded 30 db at any moment of time during testing to avoid interference with the test signal.

To make the patient response a motor act thus avoiding ambiguity in scoring he was provided with 10 push button switches in front of him numbered from 1 to 10, correspondingly numbered 10 bulbs were arranged in front of the tester.

Subjects: The criteria for selection of subjects were *(a)* audiogram configuration *(b)* proficiency in speech and reading Kannada *(c)* above the age of 12 years *(d)* SRT not exceeding 65 dbs. They were tested for (1) pure-tone audiogram (2) SRT (3) special test as needed and (4) for ear-discharge and wax. In cases of wax and discharge they were tested only after the ear became clean and dry. The following table shows the distribution of the subjects studied:

			(in years)		(in dbs)	
Subjects		No.	Age range	Mean age	SRT range	Mean SRT
Normals	M	40	16-30	21	5-15	11.2
	F	20	18-23	21.5	10-15	11.5
Conductive	M	10	19-43	31	18-98	63.0
	F	2	21	21	23-42	32.5
Mixed	M	5	20-56	38	13-40	26.5
	F	2	30	30	53-60	56.5
S.N. Group	M	15	18-72	45	17-65	41
	F	4	33-37	35	52-65	53.5
High Freq. Loss	M	4	25-31	28	13-20	16.5
	F	1	19	19	13-18	15.5

Instructions: There are 10 sentences written and numbered from one to ten on this chart. Please read them carefully. Now you are going to hear a continuous speech in one of your ears. Along with it and amidst it, these sentences will come one at a time. You should hear it carefully, identify the sentence which you hear from the given list and press the push switch corresponding to the number of the sentence that you have heard, for a while. If you miss any of the sentences please let me know. Now please be ready.

Procedure: Experiments 1 and 2 to find the presentation level of the signal and message competition ratio (ratio of the synthetic speech signal to competing speech) for maximum performance on this test, five individuals with normal otologic and audiologic findings were presented with tape-1. The intensity level was varied in five db steps from the level of SRT each random list till maximum performance score was obtained. Then the message competition ratio was varied holding the presentation level constant from the level of zero db to forty five db above that of the synthetic sentences, noting down the responses at each of the level. The data was analyzed.

Data collection: First, tape-1 was presented to sixty normal ears at 40 db SL and O db MCR. Their responses were noted down and analyzed (Experiment No. 3). Next to rule out the effect of fatigue and to save time, tape-2 signal was presented to the above sixty normal ears and their data were recorded and analyzed (Experiment No. 4). In the same way the responses of 43 clinical ears were recorded and analysed at 40 db SL and O db MCR (Experiment No. 5). To find the performance intensity function of the clinical ears 10 randomly selected clinic 1 ears were subjected to testing on tape -1. Starting from the level of SRT the intensity was varied in 5 db steps till 45 dbs are reached. At every intensity level different random lists were used to rule out the practice effects. The responses were recorded and analyzed (Experiment No. 6). To find the reliability of the test, 20 randomly selected normal ears were subjected to re-testing on tape-2 at 40 db SL and 0 db MCR. Their responses were recorded and reliability was computed. (Experiment No. 7). To find the validity of those subjects who know both Kannada and English were tested on English PB test in addition to the Kannada SSI test. Scores of both the tests were compared each other and validity was computed (Experiment No. 8).

Results: It is found from the Experiments 1 and 2 that the performance on SSI test increases as the level of presentation is incresed till 45 db SPL and remains constant thereafter at the level of O db MCR. From the level of 15 to 25 db the performance was O for all the MCR levels. As the MCR was varied in 5 db steps from O to 45 db the performance dropped down and maximum performance was seen. The following table shows the results of the Experiment No. 3, 4, 5 and 6.

Type of Hearing loss	Number of ears	PB range (in per cent)	SSI range (in per cent)	PB and SSI difference
Normals	60	92-100	90-100	Not significant
Conduct! ves	14	95-100	80-100	-do-
S.N. Group	20	40- 70	30- 80	-do-
Mixed Group	7	73- 90	80-100	-do-
High freq. loss	7	75-100	90-100	-do-

It is found from the results of the Experiment No. 3 and 4 that the normal ears obtained maximum performance scores on SSI test. Out of the 60 ears tested 11 ears got 90 per cent scores and the remaining obtained 100 per cent scores. It is also observed that the SSI score was greater than or equal to the PB scored in most of the cases. To find the statistical significance of difference between the performances on SSI and PB tests with any group and to find the statistical difference on the performance of SSI test by different groups non-parametric statistics i.e. wilcoxon-Matched-Pair Signed-ranks test and Mann-Whitney U test was applied respectively.

There was significant difference in the performance of normals on SSI test and PB tests.

From the results of Experiment 5 it is found that the sensorineural loss cases obtain lowest performance score on SSI test, mixed loss cases obtain higher scores than the sensorineural loss cases and conductive loss obtain same score as the normals. From the analysis of the data it is found that the clinical group show significant difference in performance from one another and from normals except for conductive loss cases where in the performance was same as that of normals.

From the results of Experiment 6 it is found that the performance increases as the intensity is increased. The graphic representation of the results of Experiment 6 was compared with the graphic representation of the PB scores. It is found that the area under SSI graph is greater than the area under PB graph.

The test retest relaibility was found to be high as the obtained values were 0.56,0.76,1 and 1.

The test was found to be valid as there was no difference between PB and SSI scores on Wilcoxon matched pair sign rank test.

Conclusions: It is concluded that:

1. The performance on SSI test varies directly as the level of presentation and inversely as the level of MCR.

2. Normals obtain maximum score on SSI test at 40 db SL and O db MCR.

3. There exists no significant difference between normals and conductive loss cases in performance on the SSI test.

4. The clinical groups show significant difference between normals and one another in performance on the SSI test.

5. SSI test can be validly used with Kannada knowing people.

Limitations: Limited to Kannada population only. It cannot be used with children and those who do not know reading.

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A RATIONALIZED ROMAN SPELLING SYSTEM FOR THE INDIAN LANGUAGES WITHOUT DIACRITICAL MARKS FOR USE IN CERTAIN APPLIED AREAS

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Abstract

In this paper a Roman Spelling System for Indian Languages has been outlined, for use in special areas of application.

A Speech Therapist, for example, who has to keep a written record of the speech of a patient, before, during and after therapy, at present finds it difficult to do so: firstly, because the use of the International Phonetic Alphabet, with its extra symbols and diacritical marks, requires too much patience and practice as a phonetician or linguist. Secondly, the therapist may be able to handle only one or two, Indian Language scripts, but may have to deal with patients speaking different languages.

His familiarity with the 26 letters of the Roman alphabet, and the way they are combined in the proposed system to write his own language, makes it possible for him to note down words spoken in any other Indian language.

Introduction

It has been found that Indian languages have often to be represented in the Roman Script with or without diacritical marks in the following areas:

(1) In scholarly linguistic articles in which Indian language material is required to be cited.

(a) The discussion sometimes involves problems of phonetics. In such a case, for any language, Indian or Foreign, the International Phonetic Alphabet, or any modified version of it using diacritical marks, is unavoidable.

(b) More often, however, details of phonetics ace not essential. Etymology, morphology, syntax, semantics and lexical matter are the questions discussed. In such studies phonetic symbols and diacritical marks are not essential. In fact printing with diacritical marks is difficult, cumbersome and costly. Here, a spelling system would be more advantageous.

(2) In indexing Indian language books in a library. In this case also, the use of diacritical marks is cumbersome, when the titles have to be typed on

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an ordinary, standard, office typewriter designed for typing English. A spelling system would be most useful for this purpose.

(3) In language analysis using a computer, especially, it is the Roman script alone that is accepted by the majority of the computers available anywhere in the country. Diacritical marks cannot be used for feeding material through punched cards to the computer. However, an alpha-numerical system or a spelling system could be used. The alpha-numerical system, which employs a mixture of letters and numerals, cannot be easily read by a non-specialist, although the machine can process it. A spelling system would be more useful both for the human reader as well as the computer. The man to machine and machine to man communication would be more natural (to man) in a readable spelling system.

(4) In the field of case-taking by a speech therapist, who will have to deal with patients speaking different Indian languages, the therapist would find it most convenient to use a common script for taking down the speech of his patients. Here too, cumbersome diacritics would be inconvenient for the therapist. A spelling system would be ideal.

It has therefore been found essential to device a Rationalized Roman Spelling System for the Indian languages at least for the four purposes mentioned above, if not for general use.

In our own work on the speech patterns of bilinguals or of aphasics, studied with the help of the computer, several such spelling systems were tried. But most of them were defective in one respect or another. Finally we have now arrived at a system that is uniformly applicable to a majority of the Indian languages with which we are acquainted. (It is a fair guess that the system is applicable to all other Indian languages t?lso, as there is an overall uniformity in the sound systems of the two major families of Indian languages, namely, the Indo-Aryan and the Dravidian).

The spelling system proposed here follows certain uniform phonetic principles.

1. *Phonetic Principles*

(1) Long vowels and geminate consonants are represented by writing the symbol for the short vowel or non-geminate consonant twice.

Examples:

Short Vowels	*Long Vowels*
a	aa
i	ii
u	uu
r	rr
1	II
e	ee
o	oo

Note: r, 1, rr, 11 are vowels when preceded *and* followed by other consonants or pause. The vowels e and o are short in the Dravidian languages, ee and oo being long. In the Indo-Aryan languages e and o are longer than the Dravidian short vowels, but shorter than the Dravidian long vowels ee knd oo.

Non-geminate consonants	*Geminate consonants*
k	**kk**
g	gg
c	cc
j	jj
t	tt
d	dd
n	nn
P	PP
b	bb
m	mm
1	11
v	w
r	rr

Note: 1,11, r and rr are consonants when preceded or followed by a vowel.

(2) Retroflex consonants, to be distinguished from their dental or alveolar counterparts, are represented by the symbol for the corresponding dental (or alveolar) sound followed by the letter x. (The letter x is thus used only as a sign of retroflection and has no sound value of its own).

Examples:

Dental or Alveolar Consonant	*Retroflex Consonant*
t	tx
d	dx
n	nx
s	sx
1	lx
r (trill)	rx (flap)

(3) Aspiration of stop or flap consonants is indicated by placing the letter h after the symbol or symbols for the corresponding stop or flap consonants.

Examples:

Stop Consonant	*Aspirated Stop. Consonant*
k	kh
g	gh
c	ch
j	jh
tx	txh
dx	dxh
t	th
d	dh
P	P^h
b	bh
rx (flap)	rxh (flap)

(4) In the case of non-stop and non-flap consonants the letter h is placed after a dental consonant to denote the corresponding alveolar variety.

Examples:

Non-stop and non-flap

Dental Consonant	*Alveolar Consonant*
s	sh
n	nh
r	rh

Note: The alveolar and dental nasals and trills are to be found only in Tamil and Malayalam. If nh is written as n and rh is written as r, it would still be intelligible, for in the pronunciation of many speakers there is no difference between them.

(5) Certain sounds, which in many Indian languages (and especially Sanskrit) are interpreted as consonants when preceded or followed by a vowel, but as vowels elsewhere, are represented by one and the same letter.

Examples:

Letter	*Vowel, when neither preceded nor followed by a vowel, as in the word*	*Consonant, when preceded or followed by a vowel, as in the word*
r	rsxi	maharsxi
	krsxi	varsxaa
	krtam	kartum
1	klptam	kalpitam
	ltx	latx

(all in Sanskrit).

(6) The long or geminate varieties of such sounds are also represented by doubling the letters.

Examples:

Letters	*Vowel* (when no vowel on either side)	*Consonant* (when there is a vowel at least on one side)
11	—	vallabh (Hindi) mohallaa (Urdu)
rr	kartrrn (Skt.)	gurram (Telugu)

(7) The letter w is used, *after a consonant,* to represent the neutral vowel, if this neutral vowel is phonemic in a language, as it is, in Malayalam. (Phoneticians usually represent it by the letter *3).*

Examples from Malayalam:

vanna '(The one) who came'
vannu 'I (you, he, she, it, they, we) came'
vannw 'Having Come'

(8) The letter w is used, *after a vowel,* to denote nasalization of the vowel. (In print W resembles an inverted M, a nasal consonant). It is also used to represent the anuswara in Devanagari script.

Examples:

पंकजम् (Skt.) pawkajam
कुंजरः (Skt.) kuwjarah
मैं (H.) maiw
हूँ (H.) huuw

(9) The letter h, after a vowel and before a stop consonant, or when it is final, stands for the *tiisarga.*

Examples:

ऋषिः raxih (Skt.)
रामः raamah (Skt.)
दुःखम् dubkham (Skt.)

(The second h after a stop consonant denotes aspiration).

(10) The letter h, when preceded by a vowel but not followed by a stop consonant or pause, or when it occurs in word initial position, stands for the consonant 5.

Note: Aspiration of a stop consonant, visarga and the independent consonant h, have the same phonetic quality and they occur in mutually exclusive positions. Thus they could be represented by one letter h.

Examples for the consonant h:

हरिः	Harih (Skt,) (The second h is a visarga).
हम	Ham (H.)
रहना	rahnaa (H.)

(11) If in any language, there is no distinction between a dental and alveolar variety or between a dental/alveolar and a retroflex variety, the letters h and x used for such a distinction may be dropped.

Symbol	*Pronunciation*	*Example*	*Remarks*
r	alveolar	rahnaa(H.) raamah (Skt,)	non-Tamil, non-Malayaalam. Do
sh	sh (alveolar)	shawkar (I.-A.)	Bengali, with no distinction between s and sh (has same pronunciation sh for both).*
s	sh (alveolar)	sawghatxifa samaye (Beng.)	

* But sh is not written as s since the etymological connections between Bengali and Sanskrit is retained in the spelling.

(12) The k-group (kavarga) and the c-group (cavarga) nasals are respectively denoted by ng and nj.

Examples:

vaangmay (Maratxhi)
Nanjtatpurusxah (Skt.)

(13) If the nasals referred to above in (12) are respectively followed by the sounds g and j, one more letter g or j is to be used.

Examples:

कुञ्ज	kunjj (H.)
अङ्ग	angg (H.)
अङ्क	angk (H.)

Note: The above words could be alternatively written as कुंज kuwj, अंग awg and अंक awk, respectively,

(14) T*he* combination lzh denotes a variety of sound found in Tamil and Malayalam, that could be described as: 'A voiced alveolar (or retroflex) weak groove spirant, strongly lateralized'. The lateral nature is represented by 1 and the voiced spirant nature is denoted by the zh combination. (We note that the voiceless alveolar spirant is sh). The total combination Izh denotes one sound that has all these phonetic characteristics.

Examples:

vaalzhaip palzham (T.)
vaalzhap palzham (M.).

(15) The combinations cs and jz represent the affricates (non-palatal variety), as opposed to the alveo-palatal affricates c and j, are found in Marathi, Telugu, etc., before the vowels a, o and u.

Examples:

चांगला csaawglaa (Mar.)
जवळ jzavalx (Mar.)

Note: चहा in Marathi is pronounced cahaa (and not csahaa).

(16) The retroflex flaps rx, rxh, the voiced denti-alveolar spirant z, the voiceless labio-dental fricative f and the post-velar stop q are sounds peculiar to Hindi and Urdu.

Examples';.

larxkaa parxh rahaa hai (H. and U.)
zaruur (U.)
zabardast (U.)
sabaq(U.)
qilaa(U.)

(17) The vowel a at the end of a syllable is ordinarily not pronounced in some languages like Hindi, Marathi, etc. When this is the case the letter a is omitted from the Roman spelling (although in the Devanagari version the vowel is shown, but rules of pronunciation indicate when it is to be omitted).

However in a language like Hindi, the vowel a, which was present at an earlier historical time, but now omitted in modem speech and prose form, is partially restored by the neutral vowel w in poetry. Hindi poetry, if written in the Roman script will have to take into account this fact and write the neutral vowel w in the appropriate places.

Examples.:

Prose	*Poetry*
hamko	hamwko
usko	uswko
unko	unwko
parbat	parwbatw
darpanx	darwpanxw
aakaashse	aakaashw se
bol rii katxputlii	bolwriikatxwputwlii
merii me	rii

(18) In Tamil and Malayalam, the letter combinations nh, rh denote a single sound of the alveolar variety contrasting with the dental varieties n and r.

In other languages like Sanskrit, Hindi, etc., nh and rh would denote respectively two sounds n+h and r+h.

If a Hindi word like anhonii or a Sanskrit word like arhataa are taken into Tamil or Malayalam, they could be respectively written anhhoonii and arhhatai (or anhhooni and arhhata) if absorbed into the language.

If they are not absorbed into the language, and are treated only as unabsorbed Hindi or Sanskrit words, as is the case with anhonii, they could be spelt as in the original language and at the first occurrence of the word in any discussion the pronunciation could be indicated in brackets, such as.

anhonii (anh-hoo-nii)

With regard to naturalised Tamil words, the sounds and letters representing them namely n and nh are to be kept distinct. Thus, one has to write:

Annakaram (T.), where nn--+n+n
and annhai (T.), where nnh—-+nh+nh.

The Tamil script maintains this distinction between n and nh. However, many dialects fail to bring out the difference in pronunciation. On the other hand, in spoken Malayalam the difference in pronunciation is maintained as in:

panni
and pannhiirw

although the Malayalam script represents the two sounds by one letter.

2. *Spelling Convention for Doubled Consonants that are represented by more than one Letter*

(1) The letters h, x, g and j are written after the preceding letter is doubled, to represent a doubled consonant,

Examples:

Single Consonant	*Geminate Consonant*
ng	ring
nj	nnj
tx	ttx
dx	ddx
nx	nnx
lx	llx
rh	rrh (pronounced: trrh)
nh	nnh

(2) The homorganic nasal followed by a consonant of its own group is formed as follows:

Combination	*Symbol*
ng+k	ngk
ng+g	ngg
nj+c	njc
nj+j	njj
nx-f-tx	ntx
nx+dx	ndx
nh+rh	nrh*

* In this combination rh is a triu in Tamil but a flap in Malayalam.

(3) The non-aspirated stop followed by the aspirated stop is written as follows:

Combination	*Symbol*
k+kh	kkh
g+gh	ggh
c+ch	cch
j+jh	jjh
tx+txh	ttxh
dx+dxh	ddxh
t+th	tth
d+dh	ddh
p+ph	pph
b+bh	bbh

(4) Note the differences in the following combinations:

jnj——+ j +nj
njj —+ nj+j
nnj —+ nj+nj

(5) Note that:

The vowels e and o are short in the Dravidian languages (ee and oo being long). In the Indo-Aryan languages e and o are generally longer than in the Dravidian languages.

3. *The Proposed Common List of Vowels and Consonants in the Roman Script for Indian Languages.:*

Letters	Sanskrit	Hindi	Malayalam	Tamil	Kannada	Telugu	Remarks
A	अ	अ	അ	அ	ಅ	అ	
AA	आ	आ	ആ	ஆ	ಆ	ఆ	
I	इ	इ	ഇ	இ	ಇ	ఇ	
II	ई	ई	ഈ	ஈ	ಈ	ఈ	
U	उ	उ	ഉ	உ	ಉ	ఉ	
UU	ऊ	ऊ	ഊ	ஊ	ಊ	ఊ	
W	-	-	്	-	-	-	
R	ऋ	ऋ	ഋ	-	ಋ	ఋ	
RR	ॠ	-	ൠ	-	ೠ	ౠ	
L	ऌ	-	ഌ	-	-	ఌ	
LL	ॡ	-	ൡ	-	-	ౡ	
E	ए	ए	എ	எ	ಎ	ఎ	
EE	-	-	ഏ	ஏ	ಏ	ఏ	
AI	ऐ	ऐ	ഐ	ஐ	ಐ	ఐ	
O	ओ	ओ	ഒ	ஒ	ಒ	ఒ	
OO	-	-	ഓ	ஓ	ಓ	ఓ	
AU	औ	औ	ഔ	ஔ	ಔ	ఔ	
AW	अं	अं	അം	அம்	ಅಂ	అం	
AH	अः	अः	അഃ	அஃ	ಅಃ	అః	
K	क	क	ക	க	ಕ	క	
KH	ख	ख	ഖ	-	ಖ	ఖ	
G	ग	ग	ഗ	-	ಗ	గ	
GH	घ	घ	ഘ	-	ಘ	ఘ	
NG	ङ	ङ	ങ	ங	ಙ	ఙ	
C	च	च	ച	ச	ಚ	చ	
CH	छ	छ	ഛ	-	ಛ	ఛ	
J	ज	ज	ജ	ஜ	ಜ	జ	
JH	झ	झ	ഝ	-	ಝ	ఝ	
NJ	ञ	ञ	ഞ	ஞ	ಞ	ఞ	

Letters	Sanskrit	Hindi	Malayalam	Tamil	Kannada	Telugu
TX	ट	ट	ട	ட	ಟ	ట
TXH	ठ	ठ	ഠ	-	ಠ	ఠ
DX	ड	ड	ഡ	-	ಡ	డ
DXH	ढ	ढ	ഢ	-	ಢ	ఢ
NX	ण	ण	ണ	ண	ಣ	ణ
T	त	त	ത	த	ತ	త
TH	थ	थ	ഥ	-	ಥ	థ
D	द	द	ദ	-	ದ	ద
DH	ध	ध	ധ	-	ಧ	ధ
N	न	न	ന	ந	ನ	న
P	प	प	പ	ப	ಪ	ప
PH	फ	फ	ഫ	-	ಫ	ఫ
B	ब	ब	ബ	-	ಬ	బ
BH	भ	भ	ഭ	-	ಭ	భ
M	म	म	മ	ம	ಮ	మ
Y	य	य	യ	ய	ಯ	య
R	र	र	ര	ர	ರ	ర
L	ल	ल	ല	ல	ಲ	ల
V	व	व	വ	வ	ವ	వ
LZH	-	-	ഴ	ழ	-	-
LX	ळ	-	ള	ள	ಳ	ళ
RH	-	-	റ	ற	-	ఱ
NH	-	-	ന	ன	-	-
SH	श	श	ശ	-	ಶ	శ
SX	ष	ष	ഷ	ஷ	ಷ	ష
S	स	स	സ	ஸ	ಸ	స
H	ह	ह	ഹ	ஹ	ಹ	హ
KSX	क्ष	क्ष	ക്ഷ	க்ஷ	ಕ್ಷ	క్ష
JNJ	ज्ञ	ज्ञ	ജ്ഞ	-	ಜ್ಞ	జ్ఞ

4. *Samples of Texts in Individual Indian Languages and Notes;*

(1) *Sanskrit (Sazoskrtam)*

The visarga and the consonant letter ह् are mutually exclusive in their occurrence. Hence one symbol h suffices for both. Aspiration too could be treated as the addition of ह् to the preceding stop consonant. (It could be proved theoretically that the visarga:, the consonant ह् and the aspiration are one and **the** same entity, represented in different ways in different positions, by those **who** devised the Devanagari script.)

In: Raamah Hareh bhraataa

1 2 3 4

1 **and** 3 **are** visarga, 2 is the consonant ह् ;and 4 is aspiration.

Sample Sanskrit Text in the Roman Spelling System

DASHA MUUDXHAAH

Ekadaa dasha muudxhaah deshaatxanaaya prasthitaah. Kincid duuram gataanaaw tesxaaw upasthitaa kaacid agaadhaa nadii. Baahubhyaam tarantas te katham api nadiiw tiirtvaa paaraw gataah.

Aasiit tesxaam madhye "kashcana vrddhah. Sa 'kim sarve tiiram anupra-**aptaah?'** iti jijnjaasamaanah taan ekaikasho ganxayaamaasa. Paraw navaiva parinxamitaas tena. Tatah sa aakroshat, 'Aho! Vayaw dasha prasthitaah. Idaaniim navaiva smah. Nuunam asmaakam eko nadyaam nimagnah. Gave-sxayata tam' iti. Tatas tesxaam ekaiko'pi ganxanaaw cakaara. Paraw navaiva drshyante. Tatas tesxaaw vyaakuliibhuutaanaaw mahaan kolaahalah samajani.

Tatraiva naatiduure kasyacid rsxeh aashramo avartata. Tatra vasan rsxih tesxaaw vicesxtxitam avalokya uccair jahaasa. Tasya haasashabdaw shrutvaa muudxhaas tarasaa tam upasrtya haasakaaranxam aprcchan.

Rsxir aaha, 'Aho! Anaatmajnjaa yuuyam. Yusxmaakam ekaiko'pi naat-maanam aganxayat. Tenaayaw vyaamohah sanjjaatah' iti.

Tad aakarnxya te muudxhaah salajjam adhomukhaah prayayuh.

(2) *Hindi (Hindii)*

Words of Sanskrit origin in Hindi speech and prose version generally **drop the** syllable-(or word-) final a, as shown below!

Sanskrit	*Hindi*
Sthitaprajnjah	sthitprajnj
Kamalahaasah	Kamalhaas

But these vowels are restored, at least as a neutral vowel w (phonetically represented as a in IPA notation) in poetry.

Even words from non-Sanskrit sources ending in a consonant, like *dil, bilkul,* etc., add this neutral vowel after each syllable in poetry according to metric requirements:

Dil mew dard	—+	Dilw mew darwdw
bilkul	—+	bilwkulw
ham ko	—+	hamw ko
darpanx(Skt.)	—+	darwpanxw

Sample Text in Romanized Hindi

(a) Subrahmanxya Bhaaratii saadhaaranx jantaa ke kavii haiw. Aap kii krtiyow mew saadhaaranx jan-bhaasxaa kaavya-bhaasxaa ke ruup mew bartii gaii hai. Tab tak saadhaaranx jan-bhaasxaa ucca saahitya ke yogya bhaasxaa nahiiw maanii jaatii thii. Aap ne mazduurow ke dvaaraa gaaye jaane vaale lok giitow ke sawgiit (tarz) kaa adhyayan kiyaa thaa. Aap kii salaah hai ki kavi log saadhaaranx jantaa ke aashray par nirbhar rahaa karew.

(b) Ek baar Raajaa Dusxyant shikaar khelne van gaye. Vahaaw ve ek hiran kaa piichaa karte hue Kanxva Rsxi ke aashram mew pahuwce. Harinx ko chorxkar unhowne aashram mew pravesh kiyaa. Kanxva Rsxi kii putrii Shakuntalaa ne vahaaw Raajaa kaa svaagat-satkaar kiyaa. Pratham darshan mew hii Shakuntalaa ke anupam saundarya se aakrsxtxa hokar Raajaa Dusxyant us par anurakt ho gaye. Raajaa Dusxyant ne Shakuntalaa ke sammukh usse gandharv-vivaah kar lene kaa prastaav kiyaa. Shakuntalaa ne prastaav maan liyaa aur apnii icchaa se Raajaa se vivaah kiyaa.

(3) *Malayalam {Malayaalxam)*

The main peculiarities of malayalam are the letters and combinations:

w — the neutral vowel
ng — velar nasal, nng—doubled velar nasal
nj — alveo-palatal nasal, nnj—doubled
jnj —+ j+nj
nx — retroflex nasal, nnx—doubled
r — (inter-) dental trill
rh — alveolar trill
nrh —+-nh-+rh-alveolarnasal + flap
n — dental nasal
nh — alveolar nasal
1 — alveolar lateral (interdental of denti-alveolar)
lx — retroflex lateral
lzh — alveolar (or retroflex) groove spirant, voiced, strongly lateralised.

The different varieties of nasals are phonemic and occur singly and geminated, with and without the consonant of their varga after them. A typical sample with nasals is: n Njanngalx anngaatxiyil cennw mannjalx vaanngi.

Sample Text in Romanized Malayaalam

MALAYAALXA SAAHITYAM

Malayaalxa saahityattinrhe valxarccayil samskrtam valxare valiya svaadhiinam celuttiyittxundxw. Malayaalxa kavikalx aadya kaalattw samskrta vrttanngalxaanxw avarutxe krtikalxil upayoogicc irunnatw. Bhaasxayum samskrta padanngalx nirhannjataay irunnu. Aadya kaala kavikalxil vecc eerrhavum pragatbhanum, anukaalika malayaalxa aksxaramaalayutxe pitaavum aaya Elzhut-tacchane (16-aam shataabdam) sambandhicc eedxattoolxam itutikaccum vaas-tavam aanxw.

18-aam shataabdattil, Kunjcan Nambiyaar, saahitya bhaasxaye saadhaaranxa jiivitattile bhaasxayumaayi atxuppikkuvaan shramiccu. Paksxe ii puroogama-naatmaka pravanxata kalzhinnja ampatoo arhupatoo samvatsaranngalxil maatram aanxw, vikhyaatar aaya kavikalx, Vallxattoolx Naaraayanxa Meenoon, Ullxuur Parameeshvara Ayyar, Kumaran Aashaan, G. Shangkara Kurhuppw enn ivaru-txeyum, Shivashangkara Pillxa, S. K. Poorrhakkaattxw ennivar tutxanngiya aaahityakkaaranmaarutxeyum racanakalxil pratyaksxam aayit tutxanngiyatw.

Malayaalxa bhaasxayile aadyatte vyaakaranxam prasiddhiikariccatw 14-aam shataabdattil aanxw: itw 'Liilaatilakam' enna peeril samskrta bhaasxayil aayirunnu.

(4) *Tamil (Tamilzh)*

The main peculiarity of Tamil is that the voiced and voiceless varieties of Stop consonants are not phonemically contrastive. They are therefore written by one symbol in the native script.

In the Roman version too, the voiceless consonant symbol may be used for the voiced consonant also. Pronunciation would then be according to rules, taking into account the position of the consonant in a word.

Word initially and when geminated they are voiceless stops, intervocalically and post-nasally they are voiced stops. There are no aspirated stops in Tamil.

Thus a name like Gandhi could be written in standard Tamil as Kaanti (aal pronounced: Kaandi). In Roman script, however, names could be writ-ten in accordance with the native language, as Gaandhii (or in the anglicised form: Gandhi).

Sample Text in Romanized Tamil

PATTU MUUTXARKALX

Pattu muutxarkalx oru uurai vittxu atxutta uurai nookkip purhappattxa-arkalx. Valzhiyil avarkalx oru aalzhamaanha aarrhai vant' atxaintanhar.

Elloorum eppatxiyoo niinti akkarai vantu ceerntu vittxanhar.

Avarkalxil oruvaraanha kilzhavar oruvar, 'elloorum vantu vittxoomaa' enrhu terintu kolxvatarhkaaka oworuvar aaka ennxat totxangkinaar. Aanhaal ennha aaccariyam! Onhpatu peer taanh iruntanhar. Utxanhe marrhavar ello-orum oworuvar aaka ellooraiyum ennxip paarttanhar.

Appatxiyum onhpate peer iruppataik kantxu, 'Ayyo! Nammil oruvar aarrhil muulzhki irhantu vittxaaree!' enrhu pulampal aayinhar.

Aruke maratt' atxiyil viirrhirunta turhavi oruvar ivar kalxutxaiya muttxa-alxttanhattaip paarttup 'pokk' enrhu cirittu vittxaar.

Itaikkeetta muutxarkalx, 'Ennha, turhaviyaaree, engkalxil oruvar irhantu vittxaar. Avar yaar enrhu teriyaamal naangkalx pulampukirhoom. Taangkalxoo, cirikkirhiirkalxee! Atu eenh?' enrhu keettxanhaf.

'Niingkalx elloorum tannhunxarv' arrhavarkalx. Ungkalxil oruvarum irhakkavillai paarungkalx' -enrhu colli, avarkalx anhaivaraiyum varicaiyaaka nirhutti vaittu turhaviyaar ennxik kaanxpittaar. Cariyaakap pattu peer irun-tanhar.

'Aahaa, turhaviyaaree! Taangkalx oru periya mahaanh! Irhantu kaanxa-amal poonaavarai, kantxu pitxittu, uyirppittu vittxiiree! Ummai naangkalx vanxangkukirhoom', enrhu colli, 'dadxaaP enrhu elloorum avar kaalil vilzhun-tanhar.

Turhavi miintxum cirittaar. Pirhaku connhaar, 'Ungkalxil yaarum irhak-kavillai. Niingkalx tannhunxarv' arrhavarkalx enrhu connheenhallavaa? Niing-kalx oworuvarum tannhai vittxu vittxu marrhavar ellooraiyum ennxinhiirkalx, awalxavu taanh', enrhaar.

Itaik keettxa muutxarkalx, vetxkit talai kunhintu aw itxattai vittxu akanr-hanhar.

* * * *

In the above Tamil passage it is seen that the voiced consonants g, j, dx, d, and b have been rarely used. This is because we have followed the Tamil phonemic system and have used one symbol k, c, tx, t or p for the two allophones k, c, tx, t or p and g, j , dx, d or b.

However, a speech therapist may be interested in gathering more phonetic rather than phonemic information.

He may find that for the phonemic version *connhaanh,* for example, different dialect speakers bring out different phonetic versions, such as: sonnaaw, shonnaaw, connhaanh, etc,

* * * *

(5) *Kannada{Kannadxa)*

Almost all sounds of Sanskrit and in addition the Dravidian features of short and long vowels are to be met with here.

Owing to the feature of short versus long vowels, however, a Sanskrit name like *Snehalataa* would take the form *Sneehalata* in Kannadxa. The final a is written short for grammatical reasons, but is pronounced long.

Sample Text in Romanized Kannada

HANNERADXU JANA BUDDHIVANTARU

Obba guruvige hanneradxu janaru shisxyar iddaru. Avarige buddhi iralilla. Aadaruu, avaru taavu bahu buddhivantar endu tilxidu kondx iddaru. Janaruu avarannu buddhivantar endu haasya madxutt iddaru. Avaru ondu dina holxege miinu hidxiyalu hoodaru. Adaare, miin eenuu sigal ilia.

'Naavu tumbaa kasxtxa pattxevu. Aadare, iidina ond aadaruu miinu sigal ilia,' endanu obbanu.

'Hoogali, bidxu. Miinu hidxiyalu banda naavu ii holxey alii mullugi saayade manege hindirugidare saaku,' endanu mattobba.

'Sari, naavu hanneradxu janaru iruvevoo, illavoo, noodxoonxa,' endu heelxi ellarannuu enxisidanu modalaneyavanu. Kuudxale, 'ayyayyoo, naavu hannondu mandi maatra ill iddeeve! Innobban elli? end avanu hedari keelxidanu,

Ellaruu enxisi noodxidaru. Tannannu bittxu enxisidarinda ellariguu hannondu janaree iruvudaagi kandxitu.

'Namma guruvige heege mukha toorisoonxa? Niirinalli biddavana henxavannu hudxukuvaa', endanu inn obbanu.

Hiigendu, aa hanneradxu janaruu alxuttaa holxeyakadxege horatxaru.

Astxaralli, allige obba kudure savaaranu bandanu. 'Buddhivantare, eetakke niivu hiige alxutt iruviri? Een aayitu?' endu avenu keelxidanu.

Visxayavannu tilxidu kondxa meele aa kudure savaaranu, 'Niivu hannondee jana iruviri. Hanneradxaneyavanannu hudxuki kottxare nanage niiv eenu kodxuviri?' endu keelxidanu.

'Nammall iruva hanxavann ellanimage kodxutteeve', endaru ellaruu.

'Haagaadare sari. Saalaagi nilliri. Hanneradxaneyavanannu hudxuki kodxuteene. Kuudxale hanxavannu kottxubidxiri', endanu.

Enxisi, enxisi koneyadaagi, 'Ivanee hanneradxaneyavanu. Ivanannu ellaruu bigiyaagi hidxidu kollxiri. Hanxavannu kodxiri. Naanu barutteene,' endanu kudure savaaranu.

Hanxavannu kottxu bittxu, hanneradxu jana buddhivantaru obbarann obbaru tabbi hidxidu kondxu gurugalxa balxige hoodaru.

Gurugalxige tamma kateyannu heelxidaru. Gurugalxu kateyannu keelxi nakkubittxaru.

(6) *Telugu (Telugu)*

Same as Kannada. But it has the two types of affricates, c vs. cs and j vs. jz.

A name like Raaju is pronounced as Raajzu and could be written that way.

Sample Text in Romanized Telugu

Neen aavuuru enduku vellxaanoo, naak ippudxu jnjaapakam leedu. Kaani vellxadxam, cinnappatxe sneehitudxu kanapattxam, tana intxiki nannu tiisuku vellxatxam jarigindi.

Kalavaka kalusukoovatxam valla, cinnappatxi visxayaalu talucsukoni nav-vukontxaavunna samayawloo atadx occaadxu. Raavatxam raavatxam elaa vac-caadxani?

Munduvaakili nemmadigaa tericcaadxu. Kudxikaalu gadxapaloo pettxi atxuu itxuu dongacsuupu csuushaadxu. Csawkaloop unna muutxani padilaw-gaa rendxoo ceet too pattxukoni, tala ooragaa pettxi adxuguloo adxugu veesu-kuntxu, naa sneehituni daggaraku vocci csawkaloo muutxa andistuu, 'Idigoo nooy, dxabbu' annaadxu.

(7) *Marathi (Maraatxhii)*

Like Telugu, this language too exhibits the difference between c and cs as well as between j and jz, as in:

चहा	cahaa
चांगला	csaawglaa
जवळ	jzavalx

In the Marathi (Devanagari) script the anuswara is used;

(1) to indicate nasality:

संपला	sawplaa

(2) to differentiate between two grammatically different words that are pronounced alike: ते te, तें te.

(3) to indicate that a certain word is an adverb:

येथे yethe

सकाळीं sakaalxii

(4) to indicate that the final letter representing a consonant + अ retains that अ in pronunciation:

त्याचं tyaacsa, as against

त्याच tyaacs

(5) to indicate, in the case of चे and चें that

चे is ce and

चें is cse,

and so on.

In the Roman version all anuswaras which indicate nasality alone would be represented by w. Others would not. In the last two cases cited, w is not necessary, for the unpronounced final अ is omitted in Roman and the pronounced final अ is written as a. The anuswara in Roman, w, is not required in the case of चे and चें, as their pronunciations are indicated by ce and cse respectively.

(This convention is all right so long as we deal with the pronunciations in speech or in reading aloud a written text. If our aim is to get back the original written Devanagari version of the Roman version by a computer, then the Roman spelling should everywhere use w to represent anusvaara. But this is not considered in this paper).

Accordingly our Roman version of a Marathi passage would go as below:

Sample Text in Romanized Marathi

Tyaa divshii dupaarii redxiovar kaahiitarii csaawglaa kaaryakram hotaa mhanxuun tyaa don vaajzeparyant jzaagyaacs hotyaa - mag jzhop laagenaa mhanxuun adxiicscyaa sumaaraas baaher aalyaa va saahajikacs tyaawnii Saduu kotxhe aahe te paahile. Gharaat kotxhe naahiiw he paahuun tyaawnii tyaacyaa nehmiicyaa khelxnxyaacyaa jzaagekadxe paahile - tethehii tyaawnaa to dislaa naahiiw. Ekdondaa tyaawnii haak maarlii panx tyaacse uttar aale naahiiw mhanxuun khaatrii karanxyaa saatxhii tyaa baagetuun kopryaakadxe nighaalyaa. Tyaawnii paayaat kaahii ghaatle navhte mhanxuun kiikaay tyaawcyaa paavlaawcsaa aavaajz ajibaat hot navhtaa. Aand tyaa agdii jzavalx yeuun pohoceparyant tyaawcii Saduulaa csaahuul hii laaglii nasaavii. Kaaranx to tyaacyaa udyogaat agdie guwg jzaalaa hotaa. Ksxanxbhar tyaacii badxbadx tarii kaay csaallii aahe ti aikaave yaa hetuune tyaa agdii halxuu ekaa jzhaadxaa maage yeuun ubhyaa **raahilyaa.**

5. Use of the Roman Spelling for Case-Taking in Indian Languages

In addition to noting down other details of a Case, the speech therapist has to note down the language material concerning a patient's speech.

In this, he often has to deal with patients who speak languages different from his own.

The therapist may be acquainted with the IPA Phonetic Alphabet or even with the different Indian language scripts. However, he may not be able to **use** them effectively and correctly in noting down language material from his patients.

If he is acquainted with a common script that is uniform for all Indian languages and if he could write his own language in such a script which uses only the known letters of the Roman alphabet and nothing more, then his work is greatly facilitated.

The author suggests the use of this Roman Spelling System by therapist in taking notes of their cases and report the advantages or disadvantages they find in doing so.

THERAPY THROUGH LIMITED LANGUAGE*

N. RATHNA+

The field of Speech and Hearing is growing up in India and it is becoming increasingly clean that the discipline has to grow its roots into this soil. It has to take its nourishment from the soil in which it is rooted and it has to adapt itself to meet the needs peculiar to this country. It is common knowledge that India provides many unique challenges and thus demands approaches which are not fully imported from other climates. We can ill afford to limit ourselves attempting research for international consumption ignoring the real challenges of our own nation. Tropicalisation and import substitution is the order of the day and this must hold true in professional activities.

Among such challenges demanding new ways of attack is the challenge of Languages or multiplicity of languages and the problems it creates for Speech and Hearing specialists working any where in this country. At All India Institute of Speech and Hearing, Mysore, we have been selecting our students from all over the country so that our profession will have in its ranks people who speak a variety of languages. We have been exposing our students to at least one new language with a hope that this will facilitate later language learning. We have been trying to have student therapists practice therapy in languages they are not well versed in. We have also tried interview and counselling therapy using interpreters. Speech and Hearing camps in Andhra, Kerala, Karnataka, and Tamil Nadu have helped us in our attempts to meet this challenge. They have also brought up the challenge of cases and escorts with whom we share no language. We have been forced to handle cases from other languages and thus we have been forced to devise ways of handling the not so rare situation of cases with no shared languages *with* the therapist. The reasons for this are many. The problems of job situations is such that no student can be certain of getting a job in the area of his choice. We have run into Kannada and Telugu students working in the Punjab, Malayalam students working in Lucknow with Hindi and Kannada students in Kerala with Malayalam. There is also considerable mobility of our experts and of lay people such that we have no idea of what language the next case or the list would speak and we can never be sure that we can handle that language.

The present paper is an attempt at helping therapists who have to deal with cases with whom they do not share a language. When we look at our client oriented *activities* we can broadly divide them into three functions, diagnosis,

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Counselling, and continued therapy. It had earlier been indicated that diagnosis and counselling could be done through interpreters. This can be done quite effectively as our experiences in our clinic and camps have shown. However, the utility of interpreters is generally limited to diagnosis and counselling. Some types of therapy can also be done through an escort or directly with the case through interpreters because these can be done intensively and over a short stretch of time. We could use a colleague or a friend as the interpreter. However, it is unrealistic to expect the help of an interpreter for continued therapy over long periods of time, in some cases over many months, unless the escort can act as interpreter. How do we initiate therapy and continue therapy stimulating speech, evaluating it and modifying it when we cannot communicate with the case/the escort. We cannot turn the cases away nor can we wait till we learn the strange tongue. We have to manage to initiate therapy and keep it going for some time till we can learn the language. We must also remember that not all languages are easy to learn and not all people are good at learning languages. It is as an attempt to meet this situation that the following approach is recommended.

Inspired by the phrase books used by the tourists and the multi language medical diagnostic questionnaire developed in Europe, it is now proposed that a limited set of sentences can be effectively used to initiate and give therapy in any language. Our successful experience with many deaf cases is also one strong point of confidence.

It was felt that fifty sentences would be a fair limit because it is large enough to permit versatile handling of various therapy activities and small enough to permit frequent referrals to the phrase book. These sentences were arrived at from our analysis of our activities and experiences in camps and of therapy oriented activities of students, colleagues and self. It can be seen that there are only fifty sentences included now because these were considered adequate. The sentences have been revised by many colleagues and students who have all given valuable suggestions and made useful changes. The list has so far been tried out on recording with a voice case, articulation therapy with a hard of hearing child and in camps.

It is now proposed to try out this list on a variety of cases and through various languages. Then a phrase book for Indian Languages will be brought out.

With the help of this list it is believed that a therapist with no knowledge of the cases' language can initiate therapy. He can elicit speech samples from the escort, elicit the same from the case, compare the models and suggest modifications. The list of sentences also includes greetings and common instructions for popular therapy activities. The list can be used for articulation therapy, voice therapy, stuttering therapy, and some levels of language therapy. Vocabulary construction will *be/with* the help of the escort. Thus the limited language proposed lief e can help a great many therapy activities especially if we follow strictly systematic functional analysis approaches.

This list will be limited in its utility with informal play therapy situations and in dealing with borderline cases such as those with misarticulations only in running speech. Comparing models in running speech to identify deviations is a difficult task especially when you do not know the language This list will not be useful in technique of therapy which demand continuous counselling and in psychotherapy oriented approaches.

However, it is believed that these sentences will prove effective. This is one of the ways of meeting the challenge of the languages. Greater validation efforts will add to testing the efficacy of the lists. The list of sentences is presented here to elicit more suggestions and to enthuse further attempts at solving the language problems of our country.

The country's unique demands have to be met by unique solutions and we are all team mates in such activity.

1. Hello
2. Come
3. Sit down
4. Say this
5. Try again
6. Louder
7. Good
8. Better
9. Yes
10. No
11. Open your mouth
12. Do this/or do like this
13. Lift your tongue
14. You try it
15. Higher
16. Lower
17. Take a deep breath
18. Now slowly breath out
19. Prolong your speech (every sound)
20. Wait
21. What do you say for this?
22. What is he/she/it doing?

23. Read this
24. Come tomorrow
25. Bye Bye
26. Do you hear it?
27. Change it
28. Show it
29. Take it
30. Give it to me
31. Write it
32. Colour it
33. Where is it?
34. How much? How many?
35. Not like that
36. Practice this at home
37. Hear this
38. See this/Feel this
39. How are you
40. What is your name?
41. Where do you stay?
42.. Clear your throat
43. How do you like it?
44. Belch
45. Softer
46. Slower
47. Feel Relaxed
48. That's right!
49. What/How did you try at home? (and How long)
50. Why? Which?

A CASE OF HYSTERICAL DEAFNESS AND ITS MANAGEMENT

R.S. GREVAL* and BHAGAT SINGH

Psychogenic deafness (Fowler, 1959), or nonorganic ('functional') hearing loss (Chaikhn and Ventry, 1963), or pseudohypoacusis (Goldstein, 1966) can be broadly divided into hysterical, or conversion, deafness and malingering. The former is marked by the fact that the patient believes that he or she has a genuine hearing loss, or that the moderate loss of hearing he or she has is a really serious one (functional 'overlay' on organic deafness). The hysterical patient is not trying to 'fool' anyone and is perfectly willing to cooperate in a test situation.

The malingerer, on the other hand, knows the true state of his or her hearing and deliberately tries to deceive the examiner. His or her attitude during a hearing test may range from one of suspicion to that of outright belligerence. Nevertheless, he or she has to cooperate in the test situation in order to maintain the role of a hearing-handicapped individual (Newby, 1965; Sonenshein, 1970).

Gleason (1958), in a study of 278 military personnel with nonorganic hearing loss, found that a deaf patient who is inconsistent on audiological testing is likely to be deviant psychologically but may not necessarily be psychiatrically ill. Fifty five per cent of the subjects studied were judged to be emotionally immature and thirty per cent neurotic.

Cohen *et al.* (1963), from a study on two groups of servicemen for nonorganic hearing loss, concluded that individuals who present inconsistent responses in hearing tests may be influenced by psychodynamic factors.

Beagley and Knight (1968) stated that hysterical deafness is rare but does occur and can be diagnosed if careful attention is paid to the diagnostic criteria. They summarised twenty one cases of nonorganic hearing loss and specified one case as fulfilling all the criteria of a psychiatric background.

Recently the problem of psychogenic or functional deafness has been surveyed by Bregulla (1970), Denmark (1971), Hansen (1972), Jahn (1972), Velmans (1973), Vernon (1973) and Pankratz *et al.* (1975).

The following case is discussed because of its interesting presentation and management.

CASE REPORT

M. S., male, aged 40, (C. R. No. 433 and I. C. No. 27106) reported to the

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ENT Outdoors of the Dayanand Hospital, Lxidhiana, Punjab on 8.1.75 with the complaint of profound bilateral deafness since 23 days.

History of the Present Illness: The patient had sustained a mongoose bite on his left foot on 29.11.74. Following the bite the patient had pain in and bleeding from the wound. The next day he attended the Civil Hospital, Ropar. There he was advised to take anti-rabic treatment. When the patient had been given twelve injections he felt his head was heavy and developed irritation in his ears. Three days later he became completely deaf. Going into more details during the history-taking the authors came to know that the patient used to meet some other person who had been bitten by a dog and had also been taking anti-rabic treatment from the same hospital. After the patient had taken six injections he noticed that his companion was missing. When he enquired about him the doctors told him that the other person had been referred to Chandigarh as he had developed rabies. After another six days the patient came to know that the person had died there. The patient was then very much alarmed as he felt that he might not end up in the same way. He narrated this incident to everybody at home and wept. After this he developed complete loss of hearing in both ears.

Past History: There was no history of diabetes, tuberculosis, hypertension or any CNS disturbance, nor of any psychiatric problem in the past.

Family History: The patient had his father and mother alive and had six children, three sons and three daughters. He lived in a joint family. There was no history of family disharmony.

Personal History: He was a farmer. He was not addicted to alcohol, tobacco or opium.

General Physical Examination: The patient was moderately built and moderately nourished. He had no anaemia, cyanosis or lymphadenopathy. His pupils were normal and reacted to light. His B. P. was 120/80 mm. Hg., and his pulse was 70/minute and regular with normal volume and tension. Heart and Lungs: NAD. Higher functions were normal except that the patient was unable to hear at all.

Psychological Examination: The patient gave a blank look and was irresponsive to any noise or command.

E.N.T. Examination: This revealed no physical abnormality of the external ear or eardrum on either side. Both drums were normal in appearance and were mobile. Nose and throat were normal.

Hearing and Caloric Tests: No response to any of the classical hearing tests was elicited. There was no bone conduction response when the butt of the tuning fork was applied on his mastoid cortex or vertex. Tuning fork of 256 Hz produced response of 'bone vibration sense' (skin sensation) only in both ears, whereas there was no auditory response to tuning forks of higher frequencies. Vestibular reactions were normal to hot and cold water caloric stimulation.

Audiological Examination: The first test was done on 8.1.75. In all, three tests were done, all of them with an Arphi Audiometer, Model 700 MK IV. The audiometer had been periodically calibrated objectively. The testing was conducted in an adequately sound-proof room.

The first test elicited no response to either AC or BC even at 115 dB and 65 dB respectively. When however a wide-band masking burst of 100 dB was introduced, first in his right ear and then in his left, eye blinking and localization responses were noticed. There was no response to speech even at the highest level available on the audiometer.

Because the patient responded to masking noise at 100 dB a re-test was done after one hour when he was explained that the machine (the audiometer) would clear the blocks in his ears and help him to improve his hearing. In his right ear the hearing loss again ranged from 70 to 90 dB, the loss for speech being 45 dB. In his left ear the hearing loss ranged from 75 to 100 dB and the loss for speech was 60 dB. Once again his responses were inconsistent.

A third test was carried out on 9.1.75. In this test the average loss through speech frequencies was 50 dB in each ear. However SRT's were 25 dB and 15 dB in his right and left ears respectively. During the same test the following remarkable observations were made:

1. The patient could hear pure tones both in the right ear and left ear through earphones even at 45 dB and 50 dB respectively but could not hear them through the bone conductor even at 60 dB (when the earphones had been removed). But with the earphones replaced along with the bone vibrator the patient could hear pure tones through the bone vibrator even at 15 dB in both ears.

2. The patient could hear conversation with the earphones on even after the audiometer had been switched off but could not respond to conversation when the earphones had been removed.

Because of these intra- and inter-test variables and a large detected discrepancy through the speech frequencies functional hearing loss was suspected.

Summary of Course of Treatment

Session I

10-1-75

The patient was taken to a sound-treated room and earphones of the audiometer were placed over both his ears. A wide-band masking noise of 100 dB intensity was introduced in his right ear for two minutes and then for an equal period in his left ear. There upon the patient described that he felt some 'water bubbles' were in both his ears which were blocking them, thereby preventing him from hearing any sound, but that after the treatment with this (masking) sound some of the 'bubbles' seemed to have been removed. On this the audiologist signalled to him in the affirmative.

After an interval of about five minutes the above procedure was repeated but with the employment of 70 dB intensity wide-band masking noise. The patient told the audiologist that he could hear this sound and his ears were being cleared of the 'water bubbles'. The treatment session was terminated at this point.

Session II

11-1-75

The attendant of the patient reported the next day that the patient had been trying to listen to the radio that morning. The patient also reported that he could hear the radio when turned on to its full volume.

The patient was again given the wide-band masking noise treatment for two minutes to each ear, but at 50 dB level intensity, and then after an interval of 6ve minutes at 40 dB intensity. After this speech was introduced at 50 dB level intensity alternately in each ear. The patient responded well and was overjoyed at this. The patient was assured that he would be all right after the next session.

Session III

13-1-75

The patient looked cheerful and happily told the authors that his hearing Was normal. He could hear the conversation in the house where he had been staying and there were no 'water bubbles' left in his ears. The authors told the patient that his hearing seemed to be normal and wanted to confirm this with the machine (audiometer). The patient's audiogram and **SRT** were taken and found to be within normal limits.

Follow up (1) after one month.

Audiogram and SRT showed clinically normal hearing.

Follow up (2) after five months.

Audiogram and SRT showed clinically normal hearing.

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ACQUISITION OF ARTICULATORY SKILLS IN KANNADA SPEAKING CHILDREN OF 3-7 YEARS§

N. P. NATARAJA,* ANIL K. BHARDWAJI AND M. S. MALINI

Articulatory patterns of speech develop as one aspect of physiological system, encompassing total growth and development of an individual in union with maturation and learning. Articulation depends upon a continuous process of development from a simple and homogenous medium to complex, modified differential level of growth. Articulatory acquisition or the learning of a system of sounds require the ability to produce different phonetic features such as voicing, aasality, etc., of the phonemes. These phonetic features are present in babbling stage itself. When one says that a child has learnt a sound, it not only means that the child has learnt the distinctive features necessary, but also that it is accepted by the child's linguistic community.

It is generally believed that the development of articulation of sounds is gradual and this development is found to follow a specific pattern in all the children. This specific pattern of development may be attributed to the neuromuscular development. Poole (1934) and Templin (1957) have given the general patterns of acquisition of phonemes in pre-school and primary school children. Their findings reveal that:

1. In the earlier years the order of most to least accurate production of sounds is that of diphthongs, vowels, consonant blends, 2. The accuracy of production of different consonants would be in the following order: nasals, plosives, fricatives combinations and semi-vowels, 3. Voiceless counterparts are articulated more accurately than the voiced, 4. By 8 years development of articulations is complete.

Jakobson (1941) opines that there is a universality in the acquisition of articulations. According to him the first sound to be acquired is /a:/ followed by (+anterior) and (+plosive) consonant, usually a bilabial. The first consonantal opposition made is that of oral nasal labials and dentals. These two oppositions are found to form the minimal system of the languages of the world.

The consonantal oppositions are followed by the contrasting of vowels first is that between a narrow and a wide vowel (e.g. :/i/and /a/). Following this is the splitting of the narrow vowel into a palatal and velar or a more central

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degree of opening (i.e., between/a/ and /i/ remitting in the vowel /e/). The result of these two contrasts leaves the child with three vowels which is found to constitute the minimal vocalic system of languages in the world. Fricatives are found to be acquired after the acquisition of all the stops in all the languages of the world. The acquisitien of back consonants takes place after the acquisition of the front ones i.e., labials and dentals. Thus back orals and nasals are acquired after the acquisition of front orals and nasals. The back fricatives are acquired after the front fricatives. An affricate is found to be acquired after the fricatives of the same series. Till then, the child uses the corresponding stops or fricatives in place of the affricate (e.g.: t/ or ,/s/ for /tj/).

A differentiation of rounded vowels according to degree of aperture can arise in the child's language only after the same differentiation of unrounded vowels is completed or acquired. Therefore the differentiation of/u/ and /o/ occurs only after the differentiation of /i/ and /e/ Oppositions which occur rarely in the child's language are found to be the last to be acquired. Children are found to use the liquid /I/ alone for a long time and then comes the differentiation between /l/ and /r/.

According to Poole, (1934) by three and a half years the consonants /b/, /p/, /m/, /w/ and /h/ are well developed. By four and a half years the child articulates /d/, /t/, /g/, /k/, /l/ and /y/ also. By 5-1/2 years the sound /f/ is added up. Around 6i years of age he acquires a few more sounds viz., /v/, /J/, and /t/. By 7i years the development of articulation comes to an end after the acquisition of /s/,/z/,and/r/.

Even though the above studies have shown that there is a specific pattern of development followed by the children, it is found that some children deviate from them. Some of them may not follow the same sequence and some others may follow the sequence but not within the age limit. This is because articulation is dependent on many complex and multi-dimensional factors. They are:

1. Intelligence
2. Socio-economic group
3. Effect of siblings and birth order
4. Speech stimulation
5. Lexical and grammatical measures
6. Sex
7. Organic factors, auditory acuity, poor speech sound discrimination, abilities and auditory memory span
8. Kinesthetic senses

Aims of the present study

The present study intended to find out:

1. If there is a specific pattern of development in the acquisition of speech sounds in Kannada.

2. If yes, is there a difference in this pattern and that of the schedules given for the development of articulation in English.

3. If there is a sex difference in the acquisition of articulation.

4. If there is any influence of socio-economic group on the acquisition of articulation.

Hypotheses:

1. There is a specific pattern of development of articulation skills in Kannada.

2. There is a sex difference in the acquisition of speech sounds, and

3. S3cio-economic group or status plays no role in the acquisition of articulation.

Implications

1. To compare the findings of the articulation tests given to a child with the schedule which would aid in diagnosis.

2. To find out whether schedules of articulation development for English speaking children i« applicable to the Kannada speaking children also or not.

Limitations

1. Only a limited number of children were tested.

2. Socio-economic groups of the subjects were determined only on the basis of school reports.

Methodology

The following criteria were used in the selection of subjects:

1. Their age should be between 3-7 years.
2. Their mother-tongue should be Kannada.
3. They should have normal hearing. For this purpose the children were screened at 20 dBHL, at the frequencies 500-4000 Hz., using a Beltone 12-D audiometer calibrated to ISO (1964) standards in a room with minimum noise conditions.

The subjects were students of a school in Mysore city.

The children thus selected were divided into three socio-economic groups based on the annual income and education of the parents. They were divided into 4 age groups of 1 year interval. The number of subjects in each age group was as follows:

Materials used for testing

The Kannada diagnostic articulation test by Babu, R. M. *et at*, (1972) was administered to all the Ss. Part I of the test includes items to test vowels, diphthongs and consonants. Sounds tested in part f I are the same as that in part I but the words used were different. Part III was used for blends. All the consonants except /n/ and /l/ were tested in initial and medial positions since Kannada has got no consonants in final positions. The consonants */n/* and /l/ were tested for the medial positions alone since these sounds do not occur in the initial position. Only one sound was tested using one picture.

The Ss. were instructed as follows:

'I will show you some pictures, You will have to name them. Whenever you feel some difficulty let me know of it'.

If the intended response was not obtained the Ss was asked to repeat after the tester. All the Ss. were tested in a room with minimum distractions and the responses were recorded using a Philips N-2218/Automatic recorder.

Analysis of the data

The recorded data was presented to 3 trained listeners (students of B.Sc. in Speech and Hearing). Some time later the same data was presented to the same listeners to check the reliability and the responses were found to be the same. Each observer was also allowed to listen to the same part of the data until he clearly heard the response of the Ss.

Results

The vowels /a/, /a:/, /i/, /i:/, /u/, /u:/, e/, /e:/, ,/o/ and /o:/ were acquired by both the males and females of 3-4 years. The consonants /k/, /g/, /t/, /tj/, */d/, /t/, /d/, /n/*. /P/. /b/, /m/ /j/ /y/ /s/ and /h/ were acquired by both the male and female Ss. in both the initial and in the medial positions by the same age. /n/ and /l/ were acquired by both the groups, Male Ss. articulated the sound /dz/ in the initial as well as in the medial positions, while the females could articulate this in only the initial position. Female Ss.

of this group had acquired the consonant /r/ in both the positions but the males had not. The females had acquired both the diphthongs bested, i.e., /ai/ and /au/ whereas males substituted the sound /au/ by /o/. The acquisition of the blends had just begun. The female Ss. articulated the blend /sk/ while the acquisition of blends had not yet begun in any of the male Ss.

In the 4-5 years group, it was noted that the boys had acquired all the vowels and diphthongs including /au/. They had acquired only one blend viz., /bl/. Female Ss. of this group had acquired the consonant /ʃ/in both the positions when the male Ss. continued with the error.

In the 5-6 years group, male Ss. were found to have acquired /r/ and /ʃ/. Girls were found to articulate triple consonant blends correctly by 6 years.

Only 60 per cent of the male Ss. of 7 years had acquired the articulation of triple consonant blends.

Conclusions

The findings are in agreement with the first hypothesis that there is a definite pattern in the acquisition of articulation in Kannada.

The findings are also in favour of the second hypothesis i.e., there is a sex difference in the acquisition of articulatory skills. Female Ss. are found to be faster in the acquisition of the speech sounds than the males.

Socio-economic status seems to affect the acquisition of articulation.

Summary

36 school children in the age range of 3-7 years were tested using 'Kannada Diagnostic Articulation Test' by Babu R.M. *et ah,* (1972). The data was analysed separately for the 4 age groups viz., 3-4, 4-5, 5-6,6-7 years for the two sexes and also for the socio-economic groups.

Findings reveal that there is a definite pattern in the development of articulation in Kannada. The Kannada speaking children were found to be ahead of the English speaking children in the acquisition of articulation.

Girls are found to be faster than the boys in the articulatory acquisition.

Children of higher socio-economic groups are found to be quicker than that of the lower and middle socio-economic groups in the acquisition of articulation.

Acknowledgement

The authors are thankful to the students of Second B.Sc, and the subjects who took the test and to all others who helped them in conducting the study.

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A PHONEMIC CHECK LIST FOR KANNADA ARTICULATION TESTS

KUMAR, P. J.,* RATHNA, N.† AND MANOHAR, P. D.

Tests of Articulation in Kannada language was developed in 1972 (Ram Mohan Babu, Rathna and Bettageri, 1972). The tests consists of two parts:

1. Screening Test and
2. Diagnostic Test

Screening test consists of 54 picture cards designed to elicit a given sound as a single or one blend, each in one position.

Diagnostic test consists of 112 picture cards to elicit a given sound.

The test examines all the consonants in Kannada in all medial and initial positions in which they occur naturally in Kannada language. All the vowels are examined only in initial position and as they are influenced by the consonants preceding them in medial and final positions.

Both tests include a reading passage to give a representative sample of the actual speech of the subject.

Phonemic Check List

The purpose of the phonemic check list is to record the responses of the subjects administered with the articulation test.

A check list is given in Appendix I. The check list consists of two axis. The vertical axis contains the set of phonemes which are expected to be produced by the subject on stimuli presented by the therapist. The horizontal axis contains the phonemes which are produced.

Following symbols have been used for different types of articulatory errors:

X for distortion

/ for substitution

+ for correct production

O for omission

—— for inconsistent production.

Following colours have been used for initial and medial productions:

Red—For initial production

Blue—For medial production

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APPENDIX I

SOUNDS PRODUCED (columns) / SOUNDS EXPECTED TO BE PRODUCED (rows)

	k	g	tʃ	dʒ	ṭ	ḍ	ṇ	t̪	d̪	ŋ	p	b	m	y	r	l̲	v	S	s	h	ḷ
k																					
g																					
tʃ																					
dʒ																					
ṭ																					
ḍ																					
n																					
t̪																					
d̪																					
ŋ																					
p																					
b																					
m																					
y																					
r																					
l̲																					
v																					
S																					
s																					
h																					
ḷ																					

Distortion ×

Substitution /

Produced correctly +

Omission O

Inconsistent —

Red: Initial position

Blue: Medial position

Case Name:

Case No:

Age: Sex:

Date:

APPENDIX II

Distortion X

Substitution /

Prcduced correctly +

Omission O

Inconsistent —

Red: Initial position

Blue: Medial position

Case Name: Mr. X

Case No:

Age: 20 years, Sex: Male

SOUNDS PRODUCED (columns) / **SOUNDS EXPECTED TO BE PRODUCED** (rows)

	k	g	tʃ	dʒ	ʈ	ɖ	ɳ	t̪	d̪	n̪	p	b	m	y	r	l̪	v	S	s	h	ɭ
k	+																				
g		+																			
tʃ								/													
dʒ									/												
ʈ								/													
ɖ									/												
ɳ										/											
t̪								+													
d̪									+												
n̪										+											
p											+										
b												+									
m													+								
y														+							
r															O						
l̪																+					
v																	+				
S																			/		
s																			+		
h																				+	
ɭ																	/				

The check list can be used purely for the unaspirate consonant phonemic production in Kannada.

A check list of responses of an hypothetical misarticulation subject is given in Appendix II. The responses given are for medial production. For example, if t is distorted, it can be denoted by symbol x in the block, whirl) is corresponding to t both horizontally and vertically.

Advantages of the checklist are:

1. Reduction in the ambiguity of recording the responses, thus allowing very little confusion in reading the responses.

2. Wastage of paper can be reduced to a large extent.

Summary to Appendix II

/k/	Produced correctly
/g/	Produced correctly
ts	Substituted by *t̲*
dʒ	Substituted by *d̲*
t	Substituted by t̲
d	Substituted by *d̲*
n	Substituted by *n̲*
t̲, d̲ &n	Correctly produced
p,b&m	Correctly produced
y	Correctly produced
r	Omitted
l&V	Correctly produced
	Substituted by *s.*
s&h	Correctly produced
1	Substituted by/

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Ram Mohan Babu, P., Rathna, N. and Bettageri, R. 'Tests of Articulation in Kannada", JAIISH, III, pp. 7-19,1972.

RATE OF SPEECH IN DIFFERENT INDIAN LANGUAGES*

N. RATHNAt AND ANIL K. BHARDWAJ+

Rate of speaking is traditionally described as the number of words spoken per minute during a complete speech performance (Kelly and Steev, 1949). This would include all pauses intentional and unintentional and the meaningful words spoken in unit elapsed time. Recent investigation has indicated a relationship between syllable duration and speaker intelligibility. Even laymen seem to link up unintelligibility with rate of speech though it is often mentioned in the converse relationship. They seem to infer a faster rate of speech is unintelligible. Any tourist in foreign countries must have had the complaint that the tourist speaks very fast while he himself felt that the natives were very fast. Actually they were both saying that they do not understand each other. It has often been claimed that Indian languages, the South Indian language in particular are very fast.

In addition to affecting intelligibility, rate of speech is a characteristic that does not receive as much attention as it deserves from speech. However, recent reviews have expressed that change of rate of speech seems to be the common factor in many different approaches to stuttering therapy. Prolongation has been found by us to be an economical time saving for the case and escort and effective, treatment for stuttering. We have found that keeping the passages constant and varying the amount of prolongation would be a useful measure of the rate of speech in general and of the rate of prolongation most suited to the individual cases. Though rates of speech are important, studies on the rate of speech have been rare.

It is in this circumstance that we are attempting to develop rate of speech measurement.

Methodology

Five languages, Hindi, Punjabi, Kannada, Tamil and Marathi were taken up for the study. Three native speakers for each language were taken as subjects.

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* This paper was presented at the X Annual Conference of Indian Speech and Hearing Association held at Mysore, January 1978.

Subjects were asked to read a chapter from a book for five minutes. We let the subject choice arts or science topic depending upon his taste and experience. The reading material was collected from Central Institute of Indian Languages. The level of difficulty was presumably same in all languages as per reports from that institute.

Each subject was asked to read and it was recorded for 5 minutes, using a Philips N-2218 automatic recorder. Then they were asked to speak for 5 minutes which was also recorded. This spontaneous speech was regarding a subject of their own interest.

However, randomly chosen time intervals of 1 minute were taken for analysis to help achieve average scores of rate of speech. This recorded data was analysed by a qualified Speech Pathologist. Out of 5 minutes duration of reading passage and spontaneous speech, randomly chosen speech samples of one minute were taken and analysed for words per minute and syllables per minute.

Implications

Information is now collected for normal speakers. This rate could be beneficially utilized in therapy techniques for stuttering and cluttering, where change of rate of speech seems to play an important role. Standardized passages which could be used for testing and quantifying rate of speech can. be developed. These rate of speech measurements could he well utilized for making comparative statements regarding individual differences and variations in speech.

Results

We have found the following:

Marat hi

Subjects	Passage Words	Reading Syllables	Spontaneous Word*	Speech Syllable
I	145	387	120	310
II	126	333	113	322
III	121	345	137	403
TOTAL	392	1065	370	1035
Mean	130.66	355.00	156.66	345.00

Conclusion and Summary

The rate of speech has been indicated. However, it has to be remembered that rate of speech does vary according to state of mind or of the environment.

Hindi

Subjects	Passage Words	Reading Syllables	Spontaneous Words	Speech Syllables
I	162	389	123	261
II	193	443	190	269
III	239	489	148	296
TOTAL	594	1321	461	826
Mean	198	437	153.66	275.33

Punjabi

Subjects	Passage Words	Reading Syllables	Spontaneous Words	Speech Syllables
I	174	351	128	271
II	159	327	148	282
III	1S6	326	171	400
TOTAL	489	1004	447	953
Mean	163	334.66	149	317.66

Kannada

Subjects	Passage Word*	Reading Syllables	Spontaneous Words	Speech Syllables
I	95	450	99	397
II	111	464	135	475
III	73	375	100	396
TOTAL	279	1289	334	1268
Mean	93	429.67	111.33	442.66

Tamil

Subjects	Passage Words	Reading Syllables	Spontaneous Words	Speech SyUables
I	136	501	109	447
II	123	518	119	470
III	123	492	121	428
ToTAt	382	1511	349	1345
Mean	127.33	503.70	116.33	448

Five languages Hindi, Kannada, Tamil, Marathi and Punjabi were taken for study and 3 native speakers for each language were taken and their speech for 5 minutes was recorded and randomly, 1 minute was taken for analysis.

This was done to establish language habit measurements. Modifications from the speaking pattern could be guided by rate of speech. We now plan to set up standard 1 minute passages in an attempt to quantify several stages of prolongation.

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TRANSIENT HEARING LOSS FOLLOWING ADMINISTRATION OF FUROSEMIDE — A STUDY CONDUCTED ON GUINEA PIGS

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M. KANNAPPA REDDY,* MUTHULAKSHMI BHARATHY* AND
S. KAMESWARAN*

Introduction

Furosemide is a new and potent diuretic which has become very popular with physicians in the management of oedema, especially in patients with severe cardiac decompensation (e.g. Pulmonary oedema due to its substantial antihypertensive effectiveness). This study was undertaken following reports of sensorineural hearing loss in the human beings with poor kidney function, the very patient treated with these diuretics and experimental induction of deafness in guinea pigs following administrations of either Furosemide or Ethacrynic acid — another new diuretic very closely related to Furosemide in its pharmacological properties.

Chemistry

Furosemide is a monosulfamoyl anthranilic acid derivative which has greater diuretic efficacy than chlorothiazide.

The carboxyl group is a common feature amongst two diuretics — Furosemide and Ethacrynic acid, both of which have been credited with similar mechanism of action and a similar effect on hearing — namely inducing a sensorineural disturbance in hearing.

Recent Trends in the Field

Impairment of hearing, transient and - permanent has been reported by several groups of workers (V. K. G. Pillay *et al.*, (1969) Becker and Schneider (1966) and one histopathological study of the temporal bone following ethacrynic acid therapy has also been published but all these studies lack precision and present a complex picture. In most cases the hearing loss could have been contributed by one or more of several factors like electrolyte imbalance, hepatic coma, other oto-toxic drugs, etc.

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More recently Cedric A. Quick, Arndt, J. Duvall and others (1970) have done substantial work in this field. They inject Ethacrynic acid intra-venously into guinea pigs and reported loss *of* hearing in animals receiving high doses within 4-6 minutes and in most animals the hearing did not return within the time of sacrifice which was by 5-6 hours. Electron microscopic study of the cochlea revealed morphological changes confined to the striavascularis and outer hair cells. There was atrophy of the intermediate cells and less damage to the marginal cells. The basal cells, spiral ligament and spiral prominences were ultrastructurally normal. With administration of horseradish peroxidase, the pathway of this foreign protein could be traced into the intercellular spaces between the marginal and intermediate cells, after egress from the vessel, to be picked up by the intermediate cells which are the primary target of damage by ethacrynic acid. Bearing these recent advancements in mind, the oto-toxicity of the diuretic, furosemide was investigated in guinea pigs.

Methodology

The jugular veins in guinea pig was exposed with a small incision and furoaemide was injected intravenously into the animal in doses varying from 10 mg--220 mg/kg body weight. Hearing was tested by frequent assessment of preyer's reflex and the animal was also tested for any gross vestibular damage.

The animals were divided into the following groups: Group A—-treated with 50 mg/kg body weight... 20 animals. Group B —40 animals — treated with furosemide dose ranging from 10-22(1 mg/kg weight to study the dose-response relationship. Group C — 15 animals treated with 25 mg/kg of furosemide from 7 days to study the effect on hearing of chronically treated guinea pigs, and any possibility of cumulative -toxicity.

Results

In group A of the animals treated with 5 0 mg/kg weight, all the animals became clinically deaf, as indicated by the absence- of preyer's reflex from within 5 minutes to 10 minutes and regained their hearing from within 30 minutes to 1 hour with the majority of the animals recovering in 45 minutes.

In group B an attempt to find a dose response relationship showed that was no strict dose-response relationship and there was a lot of difference in individual response pattern obviously due to individual variations.

It was again observed in group B that most animals, with the exception of animals with very high doses (180-220) regained hearing within 30-75 minutes and even animals treated with very high doses 180-220 mg/kg regained their hearing within 2-3 hours. Thus any possibility of permanent damage to hearing

Was completely eliminated. Hearing loss was observed from 60 mg/kg onwards and this hearing loss was only transient even with doses 200 times the normal human dose. While regaining the hearing, it was observed that hearing returned in stages. In doses below 60 mg/kg no deafness could be clinically found.

In group C — animals with chronic treatment of Furosemide in dose of 25 mg/kg for 1 week — it was observed that there was no cumulative toxicity leading to hearing loss either transient or permanent.

Discussion

The above results leave no doubt that the loss of hearing after administration of Furosemide is purely of a transient nature. While it is not clear what exactly is responsible for this transient deafness direct toxicity to the VIII nerve in the nature of Streptomycin toxicity is ruled out because of the very short duration of deafness and absence of vestibular signs. Whether the toxicity is due to an action on the cochlea similar to its renal action is an interesting probability worth investigating into. Further, any tissue damage being the cause of deafness may also be savely ruled out in view of the transient nature of the ototoxicity. Again chronic treatment of guinea pigs with sub-toxic doses of the drug does not result in any deafness either transient or permanent, thereby eliminating the possibility of cumulative toxicity.

Results are also awaited of a study of the Electron Microscopic patterns in the cochlea during the time of this transient loss of hearing.

Summary

Furosemide has been reported to cause sensori-neural hearing loss in guinea pigs as well as humans. In this study conducted on guinea pigs the following important features were observed.

1. Furosemide causes hearing loss in guinea pigs above doses of 50 mg/kg.

2. The hearing lossistransient and unlike the reported toxicity of ethacrynic acid rarely persists for any duration longer than li hour.

3. In most of the animals the hearing returned within 30-60 minutes and it was observed that hearing returned gradually in stages.

4. Attempts to establish a dose — response relationship revealed a great degree of individual variation in response to standard dose. However the loss of hearing was definitely of a longer duration at higher doses of the drug.

5. Chronic treatment of animals with a smaller dose failed to produce any cumulative ototoxicity.

6. In our experiments there was no evidence of any vestibular damage of any nature.

7. While recovering, the animals seemed to recover hearing in stages.

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LANGUAGE FOR THE SCHOOL GOING DEAF CHILDREN •

K. MOHAMED FAZLULLA+

In many states of the country the students have to study three languages in their school curriculum. The languages became a great barrier for the deaf children who try to be integrated in the schools for the normals. The problem gains in perspective when we remember that *Language* is the biggest problem for the deaf child.

We at the Institute of Speech and Hearing in Mysore are interested in helping the deaf children stay at home, attending normal schools and growing up like their hearing peers. We find that this is the best approach in terms of professsional philosophy and we also find it the most practical solution for the problem of an astronomically large number of deaf children in this country (N. Rathna *et al,* 1976). Handicapped children attending normal schools is an education for both the handicapped and the non-handicapped.

A deaf child in a normal school who is acquiring with difficulty one normal language and who is learning to speak, read and write *cannot easily take the burden of more than one language.* When learning one language well is itself a problem, the deaf children have to learn three languages in many school systems around the country which is rather cruel and frustrating.

Language is primarily a tool for communication, information gathering and dissemination. Keeping this definition in our view, we have been concerned with the implications of the ' Three Language Formula' with reference to the deaf children.

The existing school curriculum is forcing a polylingual situation on all school-going children by making them learn three languages which in many cases becomes four if the mother tongue is different from the regional language. Because our language of education is so different from the language of use, even in rural areas, we may consider that the children learn four languages including a different version of their mother tongue. This does cause difficulties to many normal children and in some children the interference of one language on another seems to contribute to inefficiency in all languages (N. Rathna *et al.,* 1976).

Weinreich, as quoted by Rathna and George Samuel, puts forward the view that any individual who speaks two or more languages will experience inter-

*** This paper was presented in the IX Annual Conference of ISHA.**

t Mr. K. Mohamed Fazlulla, Publicity and Information Officer, AIISH, Mysore.

ference due to the contact between them. Thus multilingualism affects language proficiency. The studies made by McCarthy, D. Smith, M. E. and Seidle have all revealed reduced language proficiency of multilinguals in comparison to monolinguals.

In the light of these studies, we may consider that the existing school curriculum of the study of the three languages as an unreasonable burden on the normal children and therefore more so on the deaf children. It is this that makes us advocate a single language education to the deaf at our Institute.

From the present school curriculum it is apparent that more time is spent on teaching languages than on any other teaching. Unfortunately the children spend less time on each language and less time on the other subjects, such as, science, mathematics, social studies, etc., than a monolingual school will. Other things being equal time available for teaching and learning should be directly proportional to proficiencies achieved. To this extent, at least, three language teaching is a definite load because it takes time away from other subjects which are more useful in today's pragmatic world. That makes it imperative that the best use of time should be made to provide more information, more education and more facility with other tools for today's world and we must infact provide more proficiency in one language, the regional language which for a great majority is also the mother tongue.

Monolingualism should be adopted to provide one strong language and a stronger education which would help us in the effective integration of deaf children with the normals. And this is one of our major concerns in respect of rehabilitation in India The UNESCO and the World Congress of the Deaf have unanimously recommended a single language for the education of the deaf children.

At the Institutewe have received quite a number of representations from the parents of the school-going deaf children to provide exemption to the deaf children from the study of two languages. They represented that these children find it extremely difficult to learn all the three languages. Moreover their performance has been very low in the languages when compared to other subjects. So these children who get good marks in other subjects are held back only because they do not pass all language test.

On our request in this regard the Government of Karnataka and the Government of Tamil Nadu have allowed the deaf children studying in the normal schools, to study only one language upto matriculation. Thus in the State of Karnataka, a deaf person can now pursue education all the way to a doctoral degree with only one language. This can be done either in English or Kannada the regional language.

The Governments of Kerala and the Maharashtra are considering our proposal fox exemption and response from other states are awaited. However, if a concerted effort is made by the professional bodies to approach the Union Government to give a national policy on this problem the deaf children throughout the country would get a big relief from the language burden and integration would be easier and more meaningful.

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A SURVEY OF THE HEARING IMPAIRED CHILDREN REGARDING SCHOLASTIC ACHIEVEMENTS IN NORMAL SCHOOLS.*

SUBRAMANIAM ASOK KUJMARt

Introduction

The education of the aurally handicapped has been among the earliest of the Special Educational problems to receive organized attention. Still systematic research is needed in the field and this has been frequently mentioned by the pioneers in this field. Also approaches in the education of the aurally handicapped change from day to day.

According to Bentzen (1962), every handicapped child must be treated as a normal child and it is good for the normal society to realise and accept that a part of it is handicapped. He also emphasises the need for placing the hearing handicapped children with the teachers who are trained to teach normal children in a normal situation. The same thing is repeatedly emphasized in India also by N. Rathna (1970, 1972, 1975), J. Bharathraj (1975), S. Nikam (1975) and others. The situation in India, to-day is such that one should willingly experiment with this approach. If we find that this method can be applied in India, it would be of great help (N. Rathna, 1970).

Aim of the Study-

To verify this, children are being recommended now in normal schools and a number of hearing impaired children are attending the normal schools in various parts of Mysore city.

The present study was designed to study the problems of these hearing impaired students, their parents and their teachers, regarding their scholastic achievements in normal schools.

The study was designed to answer the following questions:

1. Do the students who wear the hearing aid for a longer duration in a day achieve better scholastic achievements than those using the hearing aid for a shorter duration in a day?
2. Do the students, receiving parental help in doing their school home works, achieve better scholastic achievements?
3. Is attending Speech Therapy a must for good scholastic achievement for these students?

*** This is an abstract of the dissertation submitted in 1975.**

+ Mr S. Asok Kumar, M.Sc, Audiologist, Institute of Oto-Rhino-Laryngology, Madras Medical College, Madras-600 003.

4. Is bilingualism or multilingualism a factor in better scholastic achievements of these students?
5. Does regular consultation with the professionals like Speech Pathologist, Audiologist, etc., improve the scholastic achievement in these students?
6. What are the other problems faced by the parents and teachers of these students regarding their scholastic achievements?
7. Is it advisable to recommend the hearing impaired students in normal schools?
8. Is the scholastic achievement of the hearing impaired students in normal schools same as other normal students?

Definitions of Some Terms Used

1. *Hearing Impaired children:* are those who are born impaired or who have suffered the loss early in infancy before the speech and language patterns are acquired (Streng, 1958).

2. *Normal schools:* are those where there are no special education classes and the teachers have received no special training for teaching the handicapped (S. Nikam, 1975).

Methodology

Selection of subjects

For the selection of subjects for this study, the following criteria have been considered:

1. Severe sensory neural loss, both congenital and acquired before the development of speech and language.
2. Average intelligence or above (I.Q. of 90 and above is considered to be average.)
3. Complete hearing evaluation and a suitable hearing aid recommendation by a professional.
4. Admission to a normal school in Mysore City.
5. They should be free from any other handicap.

It was found that only thirty students satisfied all the above criteria and so they were selected as subjects. These thirty subjects comprised of fifteen males, of age range from 3 years to 13 years (Mean age, 8.26 years) and fifteen females of age range from 6 years to 20 years (Mean age, 12.47 years).

Selection of schools

It was found that the thirty subjects selected were enrolled in seventeen schools in the City. These seventeen schools included:

Nursery schools	3
Primary schools	11
High schools	3

Out of these schools, it was found that there were eleven Kannada medium schools, five English medium schools and one Urdu medium school. It was also found that all the seventeen schools were co-educational.

Formation of questionnaires

Separate questionnaires were framed for the parents and class teachers of the subjects. The questionnaires for the parents consisted of fifty one questions and that for the teachers consisted of forty-four questions. The questionnaires thus prepared were administerd individually to both teachers and parents in their leisure time with previous appointment.

Results and Discussion

From the analysis of data collected from both parents and teachers, the problems were studied under the following categories:

1. General information.
2. Knowledge about hearing loss and hearing aids.
3. Communication.
4. Speech stimulation and home training.
5. Problems in teaching.
6. Consultation with professionals.
7. Problems of Bilingualism and Multilingualism.
8. Scholastic achievements.
9. Problems in games and sports.
10. Social problems.
11. Opinion of teachers regarding normal school admission.
12. Parental ambitions.

Results were analysed and discussed. The following were the findings of this study:

1. It was found that twenty-four subjects were using the hearing aids through out the day and the remaining six were not. Twenty-four subjects who were using the hearing aid throughout the day, were found to be good in scholastic achievements. And the remaining were found to be poor in scholastic achievement.

2. Parental help in doing these students school home work, was found to be associated with the better scholastic achievement.

3. It was found that the subjects, who were regular in attending speech therapy, were better in scholastic achievements than these who were not attending regularly.

4. Students with bilingualism or multilingualism background were found to be lagging behind in scholastic achievements when compared with students with monolingualism background.

5. Regular consultation with professionals like Speech Pathologist, Audiologist, Otolaryngologist,etc., was fcund to be an important variable in the Scholastic achievement.

6. The following problems were found to be faced by the parents and teachers:

(a) A majority of teachers did not have sufficient information about hearing impairment.
(b) They did not know even the basic facts about the hearing aids.
(c) Few parents were unaware of the facts about the care of hearing aids, periodic change of batteries, regular cleanirg of ear mould, etc.
(d) Few parents and teachers were using signs to communicate with these students.
(e) Parents of one subject were unaware of the importance of the insistence of speech to these students.

7. According to Teachers' reports, these students were ccmparable to any other normal students in scholastic achievements and so the results of this study strongly supported the admission of hearing impaired children in normal schools.

8. This study supported the view that these students were ccmparable within the scholastic achievements and thus the last question was answered.

Conclusion

The results of this study proved the success of integration of the hearing impaired children in normal schools. Also the results of this study will enable the speech and hearing specialists to confidently recommend the enrolment of hearing impaired children in normal schools as against the conventional placement in deaf schools.

Acknowledgment

The author gratefully remembers the valuable guidance and constant stimulation of his guide, Mr P. D. Manohar, M.Sc, Lecturer in Speech Pathology, All **India** Institute of Speech and Hearing, Mysore, without which this study would not have been possible.

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EFFECT OF MASKING AND FATIGUE ON ACOUSTIC REFLEX THRESHOLD (ART)*

M. N. VYASAMURTHY+ AND H. S. SATYAN+

Introduction

Masking and fatigue are two different processes (Ward 1963). Masking represents the change of threshold for one auditory stimulus concurrently with the presentation of a second stimulus. For example, a subject has a threshold of lOdB at 4 KHz, in the presence of a broad-band noise at 80dB SPL his threshold of hearing at 4 KHz may increase to 50dB HL. Here, the difference in the thresholds at 4 KHz (40 dB) is referred to as the threshold shift brought about by the masking noise. The threshold in the presence of the noise is referred to as masked threshold. Masking is regarded as a ' line-busy' phenomenon and as such there is a great deal of neural activity.

Auditory fatigue represents the change of threshold following exposure to auditory stimulus. In contrast to masking, auditory fatigue is a ' *line-dead'* phenomenon as the neural elements either are *temporarily incapable of being fired or at least at* refractory period (Ward 1963). Here the neural activity is much less unlike in masking.

Despite the difference between the two, they have a common factor viz., bringing a change in the ability to detect a particular auditory signal.

Having known that masking and fatigue are two different processes and that both of them produce threshold shifts, seme studies (Tonndorf *et ah,* 1955, Sherrick 1959, Small and Minifie 1961 b; Harris 1947-48, Brandt 1963)have been reported regarding their effects on differential thresholds for intensity and differential thresholds for frequency. Masking and fatigue have been observed to have different effects on the above parameters. For example, if a 1000 Hz tone at 60 dB SL (re: normal threshold) has a differential threshold of 2 dB with enough noise to shift the normal threshold by 40 dB, the differential threshold will be increased. However, if the level of the tone is raised in the presence of noise so that it is 60 dB SL (re: masked threshold) the differential threshold will still be 2dB (Small, 1963). According to Elliott *et ah,* (as reported by Small, 1963) if the same threshold shift is brought about by fatigue, the DL for intensity at 60 dB SL (re: to TH after fatigue) will not be 2 dB, but something significantly less.

The present investigation ' Effect of masking and fatigue on acoustic reflex threshold ' was conducted to establish whether there was any significant difference in their effects on ART in normals.

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Method

Subjects: Five normal hearing subjects in the age range of 17 to 23 years were selected for the study. All the subjects had normal hearing (20 dB ISO 1964) for frequencies from 250 Hz to 4 KHz.

Apparatus: Pure tone audiogram was taken for all the subjects using Arphi Model IV audiometer (ISO 1964). The audiometer was calibrated using B and K equipment.

Impedance measurements were done using an Electro-acoustic impedance bridge (Madsen model Z070). It was calibrated using B and K equipment.

Procedure

Testing was done in a sound treated room which satisfied the maximum allowable noise levels prescribed.

Experiment No. 1: *Effect of masking on acoustic reflex thresholds:*

1. Pure tone audiogram was taken for both the ears for frequencies from 250 Hz to 4 KHz.
2. Acoustic reflex thresholds of right ear were measured for the frequencies 2 KHz and 4 KHz.
3. Masking noise (wide band) was presented to the right ear at 84 dB SPL and masked thresholds for 2 KHz and 4 KHz were determined.
4. Acoustic reflex thresholds of right ear were measured in the presence of ipsilateral masking (84dB SPL) for frequencies 2 KHz and 4 KHz.

Experiment No. 2: *Effect of fatigue on acoustic reflex thresholds*

1. Wide band noise at 124 dB SPL was presented to the right ear for thirty minutes continuously,
2. At the end of thirty minutes' exposure time, the noise was cut off. The thresholds for frequencies 2 KHz and 4 KHz were determined soon after the termination of the noise. TTS for the frequencies 2 KHz and 4 KHz was computed.
3. After a recovery time of one minute the acoustic reflex thresholds were determined i.e., finding the minimum intensity of the tones (2 KH_a and 4 KHz) required for the right ear to elicit the reflex,

Experiment No. 3. *Reliability check*

To check the reliability of the results obtained in Experiment No. 1 and Experiment No. 2, the experiments were repeated to the three subjects and the results were statistically analysed.

Results

Table 1 gives the acoustic reflex thresholds at 2 KHz and 4 KHz for all the five subjects under the two conditions. (1) with ipsilateral masking and (2) after the ear was fatigued. Retest values are also indicated.

Table 2 gives the masked thresholds and TTS in all five subjects. Retest scores are also included.

In Table 3 Mean and Standard deviation values and interpretation are presented for the air conduction threshold shifts produced at 2 KHz and 4 KHz by ipsilateral masking noise and also for TTS produced at 2 KHz and 4 KHz by fatiguing stimulus.

The analysis of the data shows that there is no significant difference between test and retest scores in either of the two frequencies with respect to either shifts produced by ipsilateral masking or TTS produced by fatigue.

Table 4 shows that there is significant difference between the Mean ART (Acoustic Reflex Threshold) with noise and the Mean ART after fatigue at both the frequencies. Statistical analysis was done to see whether there was any significant difference in the results between the frequencies tested. The results showed that there was no significant difference in the results obtained at 2 KHz nd 4 KHz. The effects of masking and fatigue on ART are illustrated in Figure 1.

TABLE I

	Test Scores				Retest Scores			
	ART with noise		ART after fatigue		ART with noise		ART after fatigue	
	2K	4K	2K	4K	2K	4K	2K	4K
A	95 (95)	95 (95)	115 (95)	120 (95)	—	—	—	—
B	90 (90)	100 (100)	110 (90)	115 (100)	85 (85)	85 (85)	95 (85)	105 (85)
C	95 (95)	105 (105)	105 (95)	120 (105)	—	—	—	—
D	95 (95)	95 (95)	105 (95)	105 (95)	100 (100)	90 (90)	120 (100)	115 (90)
E	90 (90)	100 (100)	100 (90)	110 (100)	90 (90)	100 (100)	100 (90)	110 (100)

Numbers in the parenthesis indicate acoustic reflex thresholds measured in the absence of ipailateral masking noise and before the ear was fatigued.

TABLE 2

Subjects	Test Scores: Shift in THS produced by Ipsilateral masking 2K	4K	Test Scores: T.T.S. after fatigue 2K	4K	Retest Scores: Shift in THS produced by ipsilateral masking 2K	4K	Retest Scores: T.T.S. after fatigue 2K	4K
A	35	40	40	40	—	—	—	—
B	40	35	45	35	20	40	25	60
C	40	35	30	30	—	—	—	—
D	25	30	15	35	25	30	20	35
E	35	55	25	65	50	35	50	60

TABLE 3

	Mean	S.D.	N	t	Interpretation
1. Shifts in THS produced by ipsilateral masking at 2 KHz					
Test	35.00	6 . 1 :	5}	. 4 4	*
Re-test	31.66	16.07	3}	0.44	t
2. Shifts in THS produced by ipsilateral masking at 4KHz					
Test	39.00	9 . 6 1	5}	. 6 6	*
Re-test	35.00	5.00	3}	0.66	t
3. TTS produced by fatiguing stimulus at 2 KHz					
Test	31.00	1 1 . 9	5}	. 6 6	*
Re-test	31.66	16.07	3}	0.66	t
4. TTS produced by fatiguing stimulus at 4 KHz					
Test	41.00	1 3 . 8 ¦	5}	. 9 8	*
Re-test	5100	5.05	3}	0.98	+

• No significant difference at .05 level
t No significant difference at .01 level

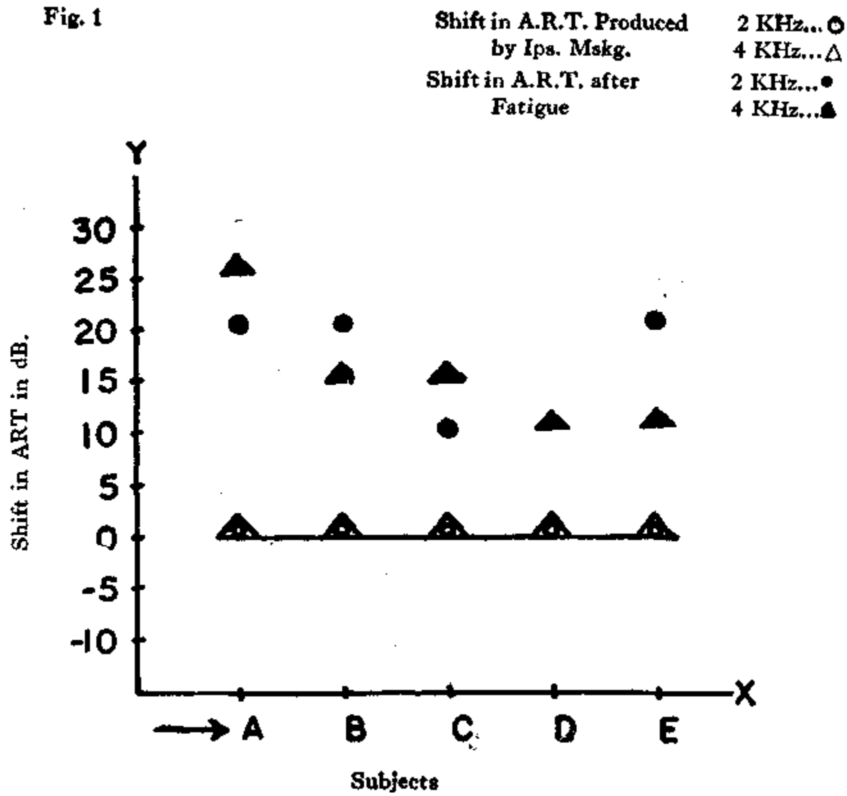
TABLE 4

	Mean	S.D.	N	t	Interpretation
1. ART with noise at 2 KHz	93.00	2 . 7 ̂	5}	7 . 2 0 7.20	*
2. ART after fatigue at 2 KHz	109.00	4.18	5}		t
3. ART with noise at 4 KHz	99.00	4 . 1 ̂	5}	1 . 3 6	*
4. ART after fatigue at 4 KHz	114.00	6.52	5}	4.36	t

• Significant difference at .05 level
f Significant difference at .01 level

j

Fig. 1



Discussion

The results show that there is no significant difference in the acoustic reflex threshold measured in the presence of ipsilateral masking and in the absence of ipsilateral masking noise. This indicated that masking had no effect on acoustic reflex threshold. On the other hand, the results on the effects of fatigue on ART showed that there was significant difference in the acoustic reflex thresholds measured before and after fatigue. The shift in ART is not in proportion to the threshold shifts produced by the fatiguing stimulus. The mean shifts in ART are 16 dB and 15 dB at 2 KHz and 4 KHz respectively whereas the mean shifs in thresholds are 31 dB and 41 dB at 2 KHz and 4 KHz respectively. In subject ' E', TTS at 4 KHz is 60 dB whereas the shift in ART is just 10 dB at 4 KHz. The above finding indicates that the shift in ART may not be related to the shift in the absolute thresholds brought about by fatigue in the cochlea. So it appears that the shift in ART after the ear is fatigued may be due to the fatigue of the tympanic muscles.

To verify whether the shift in ART after the ear is fatigued is due to the fatigue of the tympanic muscles alone, acoustic reflex thresholds of non-fatigued ear (left ear) measured before and after the fatigue of the right ear were compared. The rationale for this experiment was based on the fact that monaural stimulation results in bilateral reflex. Consequently, the tympanic muscles of the ear contralateral to the fatigued ear should also undergo fatigue even though the fatiguing stimulus is not presented to that ear. It was found that there was no difference in acoustic reflex thresholds of the non-fatigued left ear before and after the right ear was fatigued. However the failure to observe any shift in ART in the non-fatigued ear may be due to the delay in the measurement of the reflex of the non-fatigued ear. To measure the reflex of the non-fatigued ear the probe tip had to be inserted to the fatigued ear and tone had to be presented to the non-fatigued ear. Removing the earphone kept on the fatigued ear and inserting the probe tip to the same ear takes some time. Probably this delay may be responsible for the absence of any shift in ART in the non-fatigued ear. It is known that a momentary rest is enough for the middle ear muscles to regain their contractile strength. The above problem can be overcome if the impedance bridge having provision for ipsilateral reflex is used.

An alternative method to verify whether the shift in ART in the fatigued ear is due to the fatigue of the tympanic muscles alone or not is to study the recovery . pattern of ART and absolute threshold in the fatigued ear. If the shift in ART in the fatigued ear is due to the fatigue of the tympanic muscles alone, there should be complete recovery of ART within a short time. It was observed that the shift in ART was maintained for more than 30 minutes. However, the study of recovery pattern of TTS and ART after the ear is fatigued was not studied in detail. This has to be dealt with separately.

Conclusion

Masking and fatigue influence ART differently. The former has no significant effect on ART whereas the latter increases ART. The shift in ART of the fatigued ear is not in proportion to the TTS produced in the fatigued ear. The mean shifts in ART are 16 dB and 15 dB at 2 KHz and 4 KHz respectively. The mean shifts in thresholds are 31 dB and 41dB at 2 KHz and 4 KHz respectively.

The findings: (1) No change in the shift of ART of the fatigued ear during 20-30' of recovery time and (2) no change in the ART of the non-fatigued ear when measured before and after fatigue indicate that the shift in ART of fatigued ear may not be due to the fatigue of the tympanic muscles alone even though the shift is not in proportion to the TTS.

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VERIFICATION OF SIMMONS AND DIXON'S SUMMATION LOUDNESS DECREMENT PRINCIPLE

RANGASAYEE, R.*

Loudness information is coded by the cochlea and the auditory nerve. This coding is explained on the basis of two operational mechanisms. The first is essentially a *Place Principle,* wherein the nerve fibers excited by outer hair cells require a less intense stimulus than do the. fibers excited by the inner hair cells (Harris, 1953). Traditionally, defects in the coding mechanism have been associated with Fowlers recruitment phenomenon (Simmons and Dixon, 1966). When the more sensitive outer hair cells (or related structures) are damped, auditory threshold is elevated. However, when the undamaged inner hair cells are excited as a function of intensity raise, the resulting loudness sensation eventually equals that of the undamaged ear.

The second mechanism for loudness depends upon a *Summation Principle,* the total number of nerve fibers excited (Harris, 1953, Wever, 1949). More intense sounds excite a larger area of the cochlea and ultimately more nerve fibers. An important feature of this code is its distribution within the cochlea: *(a)* as intensity increases, most of the additional energy is distributed toward the basal end; *(b)* low frequencies spread further than high frequencies. The audiological consequences of these features have been studied in normal and are clinically recognised in masking phenomenon.

To study the consequences of summation loudness defects, Simmons and Dixon (1966) chose two typical unilateral high frequency sensorineural hearing loss cases with following audiometric configurations.

Case 1: Unilateral right ear high frequency sensorineural loss of sudden onset.
A'C Thresholds

	Frequency (in Hz)						
	250	500	1000	1500	2000	4000	8000
Left ear	10	5	5	10	20	5	5 dB HL
Right ear	10	10	10	10	60	95	NR dB HL

Case 2: Right ear Meniere's Syndrome
A/C Thresholds

	Frequency (in Hz)					
	250	500	1000	2000	4000	8000
Left ear	15	10	15	10	10	30 dB HL
Right ear	30	25	15	25	55	60 dB HL

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In case 1, when ABLB was administered at 1000 or 1500 Hz where the threshold was normal, an abnormally slow loudness growth occurred in the damaged ear. In case 2, abnormally slow growth of loudness occurred when the test Frequency (1000 Hz) was normal and below the region of the hearing loss.

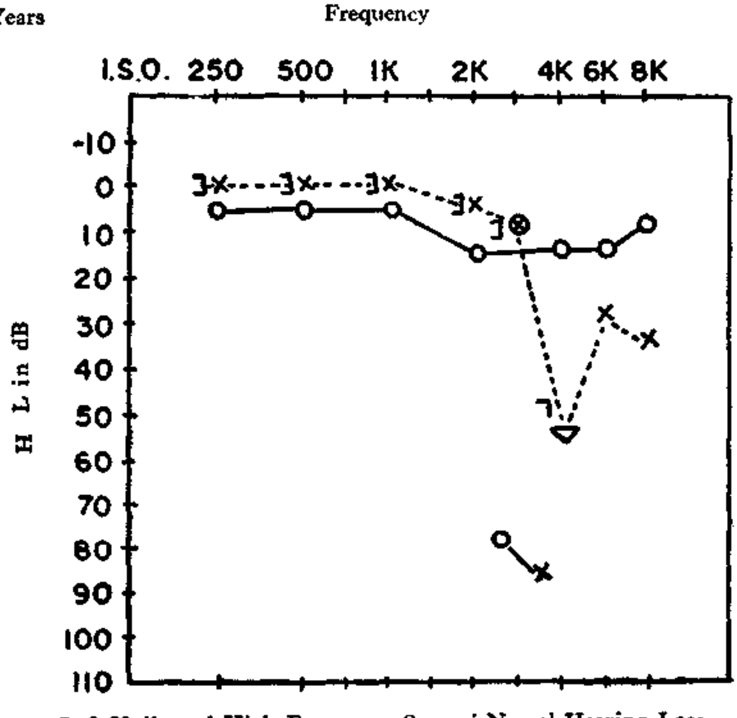
Simmons and Dixon (1966) stated that case 2 is important because it demonstrates that summation loudness defects are not tied up inexplicably to 8th nerve defects (in pure cochlear portion of the nerve), but can also be observed in classically recruiting ears.

These two cases were selected because both had cochlear losses and because they had the necessary threshold contours for demonstrating the frequency-dependent nature of the summation loudness.

Simmons and Dixon (1966) illustrated that the frequency dependence of summation loudness results from the shape and spread of the cochlear travelling wave. Near threshold, the travelling wave excites neuroepithelial tissue over a small area with low frequencies centred more apically than high frequencies. All frequencies excite about the same number of nerve fibers. As stimulus intensity increases, more and more energy is distributed toward the basal end (Schuknecht, 1960). Thus the additional fibers stimulated as intensity increases will always be those which innervates hair cells whose most sensitive (threshold) frequencies are higher than the frequency of the stimulating tone. If the basal

AUDIOGRAM

Case: 1
Age: 17 Years

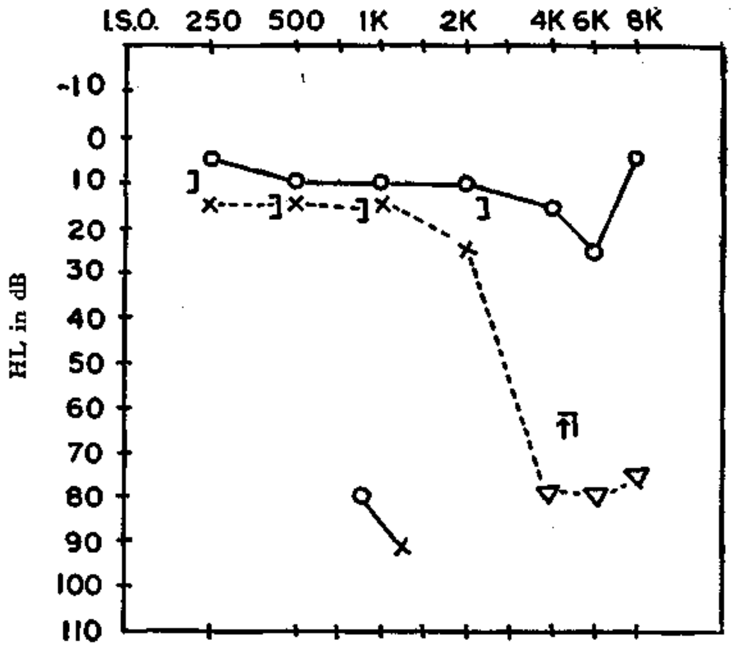


Left Unilateral High Frequency Sensori Neural Hearing Loss

AUDIOGRAM

Case No. 2
Age 18 Years

Frequency

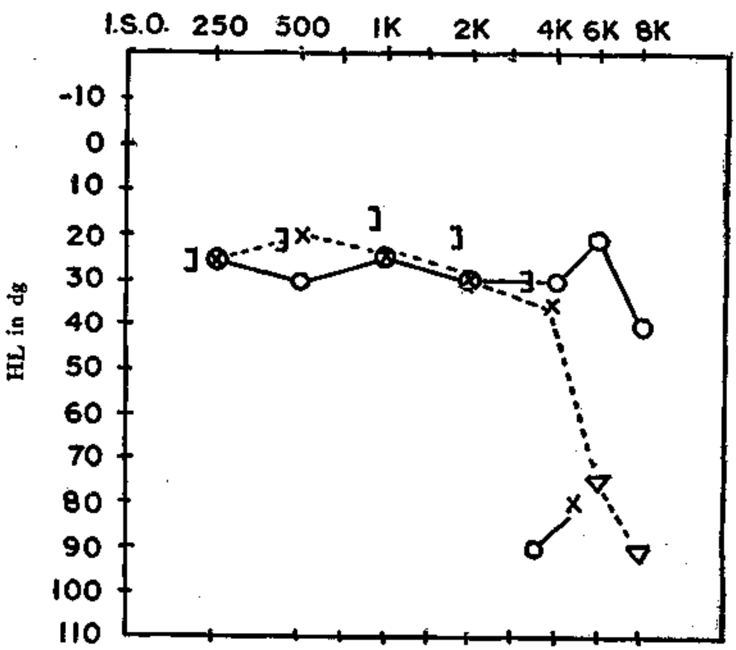


Left Unilateral High Frequency Sensori Neural Hearing Loss

AUDIOGRAM

Case No. 3
Age 42 Years

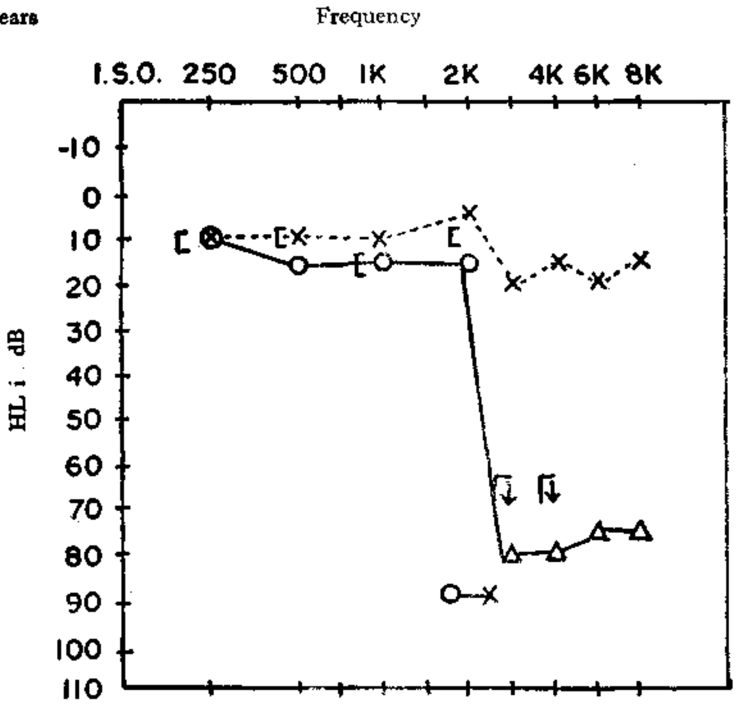
Frequency



Left Unilateral High Frequency Sensori Neural Hearing Loss

Case No. 4
Age 33 Years

AUDIOGRAM



Right Unilateral High Frequency Sensori Neural Hearing Loss

cochlear tissue (or nerve fibers) responsible for higher frequency is damaged or destroyed, the number of nerve fibers excited will increase at a slower rate than the normal ear (e.g. case 1). Compared to the normal ear, the relative number of discharging fibers decreases as the wave spreads into the damaged region of the cochlea.

According to Simmons and Dixon's (1966) findings in case 1, the growth of loudness does not stop entirely beyond the beginning point of damage (in the vicinity of 1500 Hz in the example). Instead, loudness grows more slowly. A higher intensity is required to gain equal status with the opposite ear. Loudness by the Place Principle (outer, inner hair cells, etc) still functions in non-damaged areas.

In case 2, Place Principle sensitive cells within the damaged region may also have been functioning at high intensities, thus causing loss of loudness decrement (Simmons and Dixon, 1966). A summation loudness decrement can occur in several places, just as long as increasing stimulus intensity leads to spreading of excitation from relatively normal into more damaged regions (Simmons and Dixon, 1966).

Methodology

Administering screening ABLB (Tillman, 1969) test for cases with unilateral high frequency sensorineural hearing loss. Thus by finding out the hearing level at which a pure tone in the normal ear sounds equally loud to the reference tone of 90 to 100 dB HL presented to the affected ear. This test was administered at the highest bilateral normal hearing frequency. The interaural intensity difference at the point of balance was determined.

Subjects: Four adult males with unilateral high frequency sensorineural hearing loss served as subjects for this experiment.

Procedure: The following measures were obtained for each subject.

1. Pure tone thresholds of both ears at all audiometric frequencies from 250 Hz to 8000 Hz.
2. Screening ABLB test (Tillman, 1969).

Modified Hughson and Westlake (Jerger and Carhart, 1959) procedure wa8 used for obtaining pure tone thresholds. Screening ABLB as reported in literature was administered. The procedure was as follows:

Instructions to the subjects: ' You are going to hear pure tones in your ears alternately. The tone will be at constant intensity in the poorer ear and the intensity of the tone in the better ear will vary. Hold your right hand (if right ear is poorer) at constant level and vary the height of the left hand (if left ear is normal). If the loudness of the tones in the two ears is equal, hold the two hands at equal level. If the loudness in the left ear (normal) is more, hold the left hand at a higher level than the right hand. If the loudness in the left ear (normal) is less, hold the left hand at a lower level than the right hand.

After giving the instructions, the subjects were asked to repeat the instructions to make sure whether they understood the instructions.

Procedure: The frequency adjacent to the impaired frequency of the affected ear, having normal hearing was chosen for loudness balancing. At about 100 dB HL the tone was presented to the poorer ear. The same tone was presented alternately to the two ears for brief intervals (autopresentation). The intensity of the tone in the better ear was varied until the subject reported equal loudness. The hearing levels at which the subjects reported equal loudness was noted. The experiment was repeated thrice to check the reliability of the loudness judgements.

The interaural intensity difference at threshold and interaural intensity difference at the point of balance were computed. For example,

Interaural intensity difference at threshold=X dB

Interaural intensity difference at the point of balance =Y dB

Y-X>10 dB was considered as an indicator of decruitment.

Equipments used and Calibration

Madsen (Model 4251) audiometer with TDH-39 ear phones calibrated to ISO (1964) standards was used for obtaining thresholds. Beltone 15CX Model equipped with TDH 39 earphones was used for screening ABLB test. The audiometric output was measured using Artificial ear (Bruel and Kjaer Type 4152) with Condensor microphone (Brueland Kjaer Type 4144) and AF Analyse (Bruel and Kjaer Type 2106). Beltone 15 CX Audiometer's output was measured for ABLB setting for each channel. The experiment was conducted in a sound treated room.

Results and Discussion

An attempt is made to verify Simmons and Dixon's (1966) ' Summation Loudness Decrement' principle to explain the phenomenon of decruitment in four unilateral high frequency sensori neural hearing loss cases (see audiograms).

Table I shows the SPL values required to perceive the pure tone equally loudly in both the ears, when screening ABLB was administered at the normal frequency in 4 subjects with unilateral high frequency sensorineural hearing loss. Interaural intensity difference at threshold and at the point of balance are compared and no summation loudness decrement (Decruitment) is observed.

TABLE I

Subjects	Test Frequency in Hz	SPL value in the pathological ear at the point of balance	SPL value in the normal ear at the point balance	Interaural intensity difference at threshold <P-N)*	Interaural intensity difference at the point of balance (P-N)*	(Y-X)	Inter-pretation
1	3000	86 dB	80 dB	0 dB	6 dB	6 dB	Not greater than 10. So no Decruit-ment
2	1000	91.5dB	80 dB	5 dB	11.5 dB	6.5dB	-do -
3	4000	80 dB	90 dB	5 dB	—10 dB	—15 dB	-do-
4	2000	90 dB	90 dB	10 dB	0 dB	—10 dB	-do-

•(P-N)=in (Pathological ear—Normal ear).

The column (Y-X) in Table I gives the difference between the interaural intensity difference at the point of balance and interaural intensity difference at the threshold. Decruitment is said to be present if (Y-X) value exceeds 10 dB. But even the maximum obtained (Y-X) value is 6.5 dB.

The absence of loudneas decruitment in these four typical unilateral high frequency sensorineural hearing loss cases questions the Simmons and Dixon's Summation Loudness Decrement Principle. The present observation refutes the above authors findings. This contradictory observation warrants further experimentation.

Acknowledgements

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BIOCHEMICAL CHANGES IN THE INNER EAR FLUIDS AS THE DIAGNOSTIC INDICATOR IN CERTAIN HEARING DISORDERS

SUBRAMANIAM ASOK KUMAR*

1. The fluid system of the inner ear was formerly thought to consist of the endolymph (otic fluid) and the perilymph (periotic fluid). Recent observations have not only doubted the site of the fluid formation and absorption but have added the possibility of one more fluid system called Cortilymph. (Engstrom, 1960).

2. Perilymph and endolymph have been considered inaccessible in the past because of the anatomical location of the human labyrinth and the possibility of inflicting trauma with the destruction of cochlear and vestibular functions. Modern surgical procedures and micro chemical analysis of the inner ear fluids however, have provided a variable data recently. Whereas, perilymph has been shown to have a composition much like that other extra cellular fluids, the endolymph has a remarkably high potassium content and a low sodium content similar to that of intra-cellular fluids. (Smith, *et al.,* 1954),

3. Kaieda (1930) and Ledoux (1941) and his associate did experiments on the inner ear fluids of the animals like cat and dog and observed small but reliable differences in the osmotic pressure of these liquids and compared with that of cerebro-spinal fluid and blood plasma.

4. Smith *et al.,* (1954) showed that endolymph potassium concentration was thirty times that of periiymph and spinal fluid whereas sodium concentration of perilymph was ten times higher than that of endolymph. The concentration of the chloride ion was about ten per cent lower in endolymph than in perilymph. But no difference was found in the concentration in any of the above mentioned three ions between perilymph and spinal fluid. If the tunnel of corti is supposed to be filled with endolymph, then it would be seen that the high potassium content would seriously interfere in the conduction of sound in the nerve fibres that cross the tunnel. Hence it is aparent that the fluid in the tunnel of corti is unlikely to be endolymph and it is named as cortilymph.

5. Biochemistry and biochemical methods of investigations have produced marked illumination in many problems in regard to hearing and hearing loss. Rauch and Kostlin (1958) have defined the constituents of normal human inner ear fluids. In the following table, a comparison of biochemical composition of inner ear fluids with C.S.F. and blood serum is given:

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Substance or measure	Blood serum	C.S.F.	Perilymph	Endolymph
Sodium mEq/Litre	141	141	135-150	13-16
Potassium mEq/Litre	5	2.5	7-8	140-160
Chlorine mEq/Litre	101	126	135	120-130
Magnesium mg/100 ml	2	2	2	—
Protein, total	7,000	10-25	70-100	20-30
Corbon dioxide mEq/Litre	27	18	10	20
.Phosphor Anorg mg/100 ml	2	1	1-3	0.8-1.3
PH	7.3S	7.35	7-2	7.5

Walter and Raymond (1950) observed the difference in the protein contents of the two fluid system. Rauch and Kosltin (1958) have observed higher protein values in the both endolymph and perilymph.

6. The similarity between the chemical composition of the perilymph and th« CSF and the existence of the aqueduct of the cochlea which joins subarachnoid and perilymphatic spaces suggest that perilymph is indeed cerebrospinal fluid.

7. There are some reports like that of Shea (1963) which suggest the excessive amount of CSF escaping from the oval window when the stapes is removed this again confirms the origin of perilymph.

8. The difference in the protein contents of the two fluid system as observed by Walter and Roymond (1950) also proves the concept of identity of perilymph and CSF. Thus it is concluded that the perilymph is probably derived from at least two sources:

(1) From CSF which supplies some of the crystalloids like Sodium+ which are able to diffuse through the membranous barrier. A similar diffusion of crystalloids may take place from the endolymph into the perilymph through Reissner's membrane.

(2) Experimental results suggest the perilymph in the intact ear is also produced within the labyrinth, probably as a direct blood filterate from the vessels of the spiral ligament. Axelsson's (1968) observations suggest that perilymph is formed in the scala vestibuli and gets absorbed in scala tympani.

9. Endolymph is thought previously to be secreted by stria vascularis or by the adjacent tissues of the outer sulcus. Dholman (1964) suggested that endolymph is produced by certain specialised cell regions in the walls of the membranous labyrinth. These areas are called planum semilunatum and perimacular regions. Planum semilunatum is a half moon shaped area located in the lateral wall of the ampulla. He has also proved that there are two types of cells in these regions and they are dark cells and light cells. Dark cells are engaged in absorptional activities and they absorb fluid and certain ions, dispose

of some of this material to the capillaries and return fluid and possibly other ion to the endolymph through the light cells.

10. The special composition of endolymph with its high potassium and low sodium content indicates that this fluid is produced by an active secretory energy consuming process and the region of the stria vascularis is well adopted to this purpose. Whether the ducts of the outer sulcus are also concerned with the absorption or with the pressure regulation in the scala media remains uncertain still.

11. The classical route of resorption is the endolymphatic duct and sac-Evidence is also available that the circulation of the endolymph may be radial rather than longitudinal, i.e., each section of the chochlea may be self-sustaining and remains, more or less independent of areas more apically or basally situated (Lawrence and Arbor, 1965).

12. Naphtalin and Harrison (1958) suggested that endolymph is derived from perilymph across Reissner's membrane and reabsorbed by the stria vascularis. It remains still uncertain whether the perilymph or the stria vascularis is the origin of the endolymph and whether the circulation is radial (across the scale of media) or longitudinal.

13. Cortilymph has received attention only recently. It is believed that the tunnel is completely closed in every direction and that the Cortilymph is an intraepithelial accumulation of intracellular fluid. It has also been suggested that it formed from the cerebrospinal fluid passing along the fibres of the auditory nerve through the canal of the bony spiral lamina. (Ballenger, 1969)

14. These fluids serve not only the purpose of conveying the proper nutrition to certain structures and maintaining the metabolism but they also serve a more subtle purpose of aiding the energy transformation processes. Another function of the intracranial extension of both the otic and periotic space is the maintenance of equilibrium between perilymphatic and endolymphatic fluid pressure. Normal vestibular and cochlear functions depend upon the stability of these fluids equilibrium. (Lawrence and Arbor, 1965). In 1961, Wullstein and Rauch initiated the study of inner ear fluids in abnormal ears by analysing fluid obtained from patients with various hearing disorders.

15. In 1970, Warrent L. Griffin Jr. and Herbert Silverstein have discussed the biochemical changes of the inner ear fluids obtained from patients with otosclerosis, Meniere's disease and acoustic tumours.

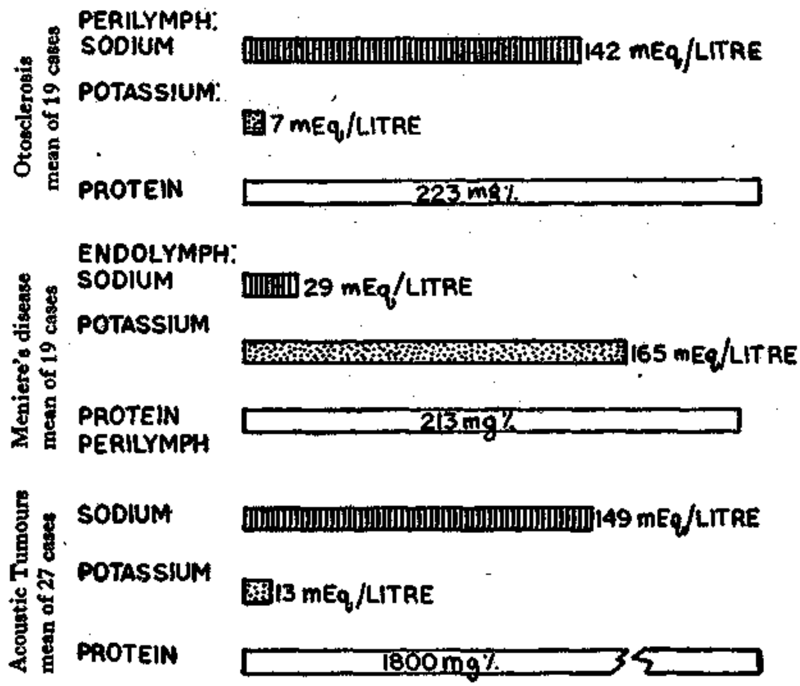
16. In otosclerosis, the fluid was obtained during stepedectomy procedure — a small amount of fluid being removed from oval window following extraction of the stapes foot plate. On analysis, the higher sodium and lower potassium volumes were found. The mean sodium value was 142 mEq/Litre and the mean potassium value was 7 mEq/Litre. The mean protein value was found to be 223 mg per cent.

17. In Meniere's disease, the fluid was obtained by the footplate puncture technique just prior to the performance of labyrinthectomy. On analysis, it was found that there was a higher potassium (mean value = 165 mEq/litre), a

lower sodium (mean value —29 mEq/litre) and a normal protein (mean value=215 mg per cent). These findings suggest that endolymph was obtained from a fluid space normally containing perilymph. The explanation for this is the presence of endolymphatic hydrops with the saccule dylated to such an extent that it had become contiguous with the under surface of the stapes foot plate. The pipet, when inserted through the stapes foot plate, collected endolymph rather than perilymph. This procedure then becomes a biochemical method for confirming the results of endolymphatic hydrops. In the same cases, again when perilymph analysis was done by taking the fluid by penetrating the round window membrane with a pipet, it was found that the sodium was high, potassium was low and protein was high.

18. In acoustic tumour cases, the fluid was obtained from the horizontal semi circular canal during the translabyrinthine approach to this tumours. It was found on analysis that in these cases a higher sodium (mean value = 149 mEq/ litre, a lower potassium (mean value = 13 mEq/liter and a markedly elevated protein (mean value = 1800 mg per cent). In cases, the protein values ranged frorn 1030 to 3580 mg per cent. It was also found that in no case of proven acoustic tumour has a perilymph protein value of less than 1030 mg per cent.

The values of Sodium, Potassium and Proteins in Otosclerosis Meniere's disease and Acoustic tumour



19. The sodium, potassium and protein values found in otosclerosis, Meniere's disease and acoustic tumour are summarised in bar graph form.

20. The biochemical changes in these conditions are distinct and it becomes readily evident that these differences might be employed as a differential diagnostic aid in addition to cochlear and vestibular investigations in hearing disorders.

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AGE, EUSTACHIAN TUBE FUNCTION AND INCIDENCE OF CONDUCTIVE HEARING LOSS

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The anatomy and physiology of the pharyngo-tympanic tube (Eustachian tube) was given out by Eustachius. In his literature on the pharyngo-tympanic tube, he emphasized the importance of this tube in the middle ear functioning. Today the importance of this tube in the middle ear ventilation and also in the process of hearing has been accepted. It is the general opinion of the present day clinicians that malfunctioning of the eustachian tube may result in:

1. Acute or Chronic Otitis Media
2. Secretory Otitis Media.

Holborow (1970) indicates important anatomical and functional differences of the eustachian tube in children and adults. He further reports that the anatomical differences in the shape and position of the tube lead to a less efficient mechanism in infancy and early childhood. Hence, he emphasizes the concept of a critical age for the incidence of aural disease which is chiefly caused by eustachian tubal malfunction. According to Holborow (1970) this critical period of tubal inefficiency is relatively short and extends from birth to about seven years of age. Therefore, the purpose of the present investigation is to test hypotheses: i.e.,

(1) The incidence of Conductive hearing loss and Sensorineural hearing loss do not differ from each other in the 3-9 years age group.
(2) The incidence of Conductive hearing loss and mixed hearing loss do not differ from each other in the 3-9 years age group.
(3) The incidence of Sensorineural hearing loss and mixed hearing loss do not differ from each other in the 9-15 years age group.
(4) The incidence of Conductive hearing loss and Sensorineural hearing **loss** do not differ from each other in the 9-15 years age group.
(5) The incidence of Conductive hearing loss and mixed hearing loss do not differ from each other in the 9-15 years age group.

Methodology

Subjects: The sample of the present investigation consisted of two groups, A and B. The two groups were formed by taking age as the criterion. The group A consisted of thirty (30) subjects and the ages of the subjects were between three (3) to nine (9) years. The mean age of this group was five (5) years. Similarly, even the group B consisted of thirty (30) subjects but the subjects

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were aged between nine (9) and fifteen (15) years. The mean age of this group was fourteen (14) years. Both the groups had approximately equal number of males and females. All the subjects tested were patients who came to the Otorhinolaryngology department with the complaint of difficulty in hearing.

Procedure

A case history was taken prior to all the examinations. The case history consisted of information on the family history, developmental history and medical history. Later, all the subjects were examined for otorhinolaryngological problems. Findings were recorded on a sheet. In this examination the conventional tuning fork tests like Rinne's, Weber's tests were administered and the results were recorded.

Later, all the subjects were given a detailed audiological examination. Usually the audiological examination started with the administration of pure-tone air and bone conduction tests. Wide band masking noise was used appropriately (Studebaker, 1967) whenever indicated. Depending on the extent of the air-bone gap, the hearing loss was classified either as Conductive, Sensori-neural or Mixed. However, Speech audiometric data could not be obtained due to lack of necessary equipment during the time of the study. Under conditions where it was essential, Short Increment Sensitivity Index Test (SISI Test), Tone Decay Test (TDT) and Alternate Binaural Loudness Balance Test (ABLB) were administered. With the help of audiological examination and the ENT examination, diagnosis was made.

The audiologic evaluations were made by one of the authors, employing the same test methods with all the cases irrespective of age and sex.

Results and Discussion

The sample, tested in the present investigation consisted of two groups A and B and each group consisted of thirty (30) subjects. Majority of the subjects tested were school going children. However, no attempt was made in the present investigation to pontrol the socio-economic status of the subjects. This may be a significant variable which has to be controlled.

Reliability of the scores was established through test-retest procedure. From the original sample of sixty (60) subjects, ten (10) subjects from each group were selected at random. However, only the audiological evaluation was repeated on these selected subjects. The Product Moment Correlations were determined to establish the reliability. The correlation coefficients obtained between the scores of the two testings were 0.71 and 0.63 for the groups A and B ,respectively. The obtained correlation coefficients were significant at .05 level of confidence.

Table 1, gives the pure-tone audiometric average in both the groups. Table 2, gives the incidence of conductive hearing loss, Sensori-neural hearing loss and mixed hearing loss in both the groups. Table 3, gives the incidence of the three types of hearing losses of both the groups in percentage.

The chi Square test was used to test all the six (6) Null Hypotheses. The obtained table value and chi square values are given in the table 4.

TABLE 1

Pure-tone average scores in both the groups

Group	Age Group Year	Mean age Year	Mean PTA Rt	Mean PTA Lt
A	3- 9	5	54 dB	50 dB
B	9-15	14	63 dB	55 dB

TABLE 2

Incidence of Conductive hearing loss, Sensori-Neural hearing loss and Mixed hearing loss in both the groups

Group	No. of conductive loss	No. of Sensori-neural loss	No. of mixed loss
A	18	3	9
B	16	7	13

TABLE 3

Incidence of Conductive hearing loss, Sensori-Neural hearing lost and Mixed hearing loss expressed in percentage

Groups	Percentage of conductive loss	Percentage of sensori-Neural loss	Percentage of mixed loss
A	60	10	30
B	33.33	23.31	43.33

TABLE 4

X' Values and the respective table values

Hypothesis	X' Value	Table value at 0.01 level	Table value at 0.05 level	*df*
1	10.70	6.635	3.841	1
2	3.00	6.635	3.841	1
3	3.00	6.635	3.841	
4	0.54	6.635	3.841	
5	0.38	6.635	3.841	
6	1.80	6.635	3.841	

The first null hypothesis, i.e., the incidence of conductive hearing loss and sensori-neural hearing loss do not differ in the 3-9 years age group, was rejected in favour of the alternative hypothesis. The alternative hypothesis which was confirmed was that the incidence of conductive hearing loss is significantly greater than the incidence of sensori-neural hearing loss in the 3-9 years age group. However, there was not statistically significant difference in the incidence of sensori-neural and mixed hearing losses and also between the conductive hearing loss and the mixed hearing loss in the 3-9 years age group. From these results obtained in the present investigation it may be said that the incidence of middle ear involvement is significantly greater than the involvement of inner ear alone in children aged between three (3) to nine (9) years.

This finding of the present investigation is in accordance with the speculations of Holborow (1970), who emphasized that it is the conductive hearing loss which is predominent than the other types of hearing losses in the children aged between 0-7 years. This greater of conductive hearing loss at this age has been attributed to eustachian tube malfunctioning. It is cited that there will be clear differences between the adult and the child in the anatomy of eustachian tube. The ostium of the tube is more exposed as it lies lower in the shallower naso-pharyngeal vault, but more important are differences in the cartilage and muscle. In adults the tubal cartilage lies at right angles to the plane of the base of the skull. But in children it lies more in the plane. Further there is a very considerable change in the amount of glandular tissue around the tube. This decreases with the age. Hence in infancy and in early childhood the mechanism of the tubal opening is less efficient. It may be because of this inefficiency there will be eustachian tube malfunctioning in infancy and in early childhood. And, this in turn may be the chief operating cause for the greater incidence of the conductive hearing loss than the other types of hearing losses in the 3-9 years age group.

The second consideration of the present investigation was to test the similar null hypotheses in the Group B. Here again the chi-square test was used to test the-statistical significance of the difference in the incidence of conductive hearing loss, sensori-neural hearing loss and mixed hearing loss in the 9-15 years age group. The obtained X2 values are given in the Table 4.

In the Group B, all the three null hypotheses (4th, 5th and 6th) were confirmed at both the levels of confidence (0.01 and 0.05). This indicated that there is no difference in the incidence of conductive hearing loss, sensori-neural hearing loss and mixed hearing loss in the 9-15 years age group.

Similar to the first finding even this finding of the present investigation is in accordance with the speculations of Holborow (1970). Holborow (1970) said that the period of tubal inefficiency is relatively short and extends from birth to about 7 years of age. Then, probably almost equal incidence of all the three types of hearing losses in the Group B indicates that the incidence of tubal inefficiency decreases significantly after 9 years. On the other hand, greater incidence of conductive hearing loss in the Group A indicates that probably the incidence of tubal inefficiency is greater between the third and the ninth year.

With the findings of the present study in hand it may be tentatively concluded that as emphasized by Holborow (1970), there appears to be a definite relation between age, eustachian tube function and the incidence of conductive hearing loss. It is highly probable that in infancy and in early childhood period there is eustachian tube malfunctioning and consequent to this there is greater incidence of conductive hearing loss. Further, the incidence of conductive hearing loss decreases after 9 years because of decrease in the incidence of eustachian tube malfunctioning.

Summary

Thirty subjects in the age group 3-9 years and thirty subjects in the age group 9-15 years were put on an audiological examination. Results indicated that the incidence of conductive hearing loss was high in the former group and in the later group there was no difference in the incidences of conductive hearing loss sensori-neural hearing loss and mixed hearing loss. It is concluded that because of the malfunctioning of the eustachian tube during early childhood the incidence of conductive hearing loss is high.

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DEVELOPMENT OF ADVANCED AUDIOLOGICAL EQUIPMENT IN INDIA FOR THE IDENTIFICATION AND DIAGNOSIS OF THE DIFFICULT-TO-TEST CASES

P. RAMA MOHAN BABU*

Considerable progress has been made in audiological testing methods in the past few years with the commencement of production of diagnostic audiometers in the public and private sectors in India. Though these audiometers are satisfactory for cases with simple auditory problems, their scope is rather limited with the difficult-to-test population. These audiometers require a voluntary participation of the patient and as such the responses are subjective in nature. There is a dire necessity for the development of low-cost indigenous equipment with which objective evaluations of hearing can be done. An attempt is made in this paper to explore the possibilities of development of such equipment. A few details of the work carried out in this direction at the B.M, Institute of Mental Health, Ahmedabad are also mentioned.

Basically the audiometric procedures can be divided into three categories.

Category I (a)

Routine pure-tone and speech audiometty in which the case is conditioned to give either verbal or motor responses.

Audiometers which are manual, semi-automatic, or automatic fit into this category. However, in using these audiometers, the responses given by the testee are subjective in nature.

Category I (b)

Under this category use of the available clinical audiometers with a few additional equipment which make the testee's responses relatively more objective can be mentioned. These include the Reaction Time Audiometer, Signal Detection Audiometer etc.

Category II

Under this, audiometers which depend on eliciting reflexes can be mentioned These include the Psycho Galvanic Skin Response (PGSR) Audiometer, Psycho Voltaic Skin Response (PVSR) Audiometer, Evoked Response Audiometer (ERA), Averaged Evoked Response Audiometer (AERA), the Impedance Audiometer, etc.

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Category III

Under this category are included instruments which measure reactions of the auditory analyzer itself viz., Direct Measurement of Cochlear Microphonics, etc.

In the present study, difficult-to-test cases include *(a)* infants, *(b)* the deaf and the multiply handicapped individuals, *(c)* individuals claiming compensation as a result of accident or injury in which they lost part of or total hearing, *(d)* hysterical cases who feign hearing loss to gain some benefit other than monetory, *(e)* the mentally retarded cases, (/) cases with emotional problems (excessive anxiety, fear, depression etc.) and those with loss of reality problems (psychotice etc.).

These cases present problems in testing because their voluntary participation in the test situation is required and they are not in a position to do so. The responses are dependent in many respects upon the readiness or refusal of the examined person to respond. They may also lack motivation or the necessary insight into their problems and as such the routine pure-tone and speech tests in the category of I (a) are not feasible with them. Other methods have to be considered.

At present only few centres like the All India Institute of Medical Sciences, New Delhi, B.Y.L. Nair Hospital, Bombay, Post-graduate Medical Research Centre, Chandigarh and, All India Institute of Speech and Hearing, Mysore, are having relatively sophisticated equipment with which auditory function can be tested to a reasonable extent objectively.

There is no doubt that considerable research work has been done and is still being done at our public enterprises viz., Bharat Electronics, National Physical Laboratories, Indian Telephone Industries etc., as well as private enterprises viz., Arphi Inc., Singh Trading Co., etc., in the development of audiometers, hearing aids, auditory trainers etc. However, with a direct participation of the audiology and speech pathology centres mentioned above, in the design, development, modifications and standardization of the new equipment Audiology and Speech Pathology are bound to progress very rapidly.

Also, every year new speech and audiology clinics are being opened in various parts of the country. Most of these are equipped with minimum audiological testing equipment like an audiometer. It must be a familiar experience for everyone working in these centres to come across difficult-to-test cases. Though the research centres mentioned above are in a comfortable position to deal with these problems even the rest of the clinics could be helped to overcome this handicap if equipment is designed in India with the guidance of the few well established research centres. This will result in considerable reduction of the gap in theory and practice existing between the Western countries and India and also considerable saving in our foreign exchange.

Equipment

Category I

If the three categories of audiometers mentioned earlier audiometers in I (a) are manufactured in India excepting for the automatic and semi-automatic ones. In the I (b) category are included Reaction Time Audiometer and Signal Detection Audiometer.

Reaction Time Audiometer

One of the chief difficulties in interpreting audiograms of difficult to test subjects is to evaluate how well they are motivated to respond. It would seem desirable to assess motivation in the audiometric testing situation independently of the procedures designed to test hearing itself. Reaction time i.e., the time elapsing between presentation of stimulus and the subject's response can be used to evaluate motivation since rapid responses occur only in motivated individuals.

Non-verbal children can be expected to respond to visual stimuli like normal children of the same age unless lack of motivation or severe ' CNS ' damage is present. A child who responds rapidly and consistently to supra threshold visual stimuli and not at all to auditory stimuli is probably not perceiving the sound. If a child responds fast to light and slowly to sound, it is possible that he is motivated but that the sound is near his threshold since reaction time is known to increase markedly when stimulus intensity approaches threshold. Similarly this audiometer could be used to diagnose functional hearing loss cases and other difficult-to-test cases also.

Signal Detection Audiometer

In conventional audiometry the subject's decision as to the presence or absence of the sound is not controlled. By applying the theory of signal detection to the conventional audiometry and plotting the ' Receiver Operating Curves' (ROC) thresholds can be obtained precisely

Category II

Orientation Reflex Audiometry:

Psychogalvanic and psychovoltaic skin response audiometers are dependent on the principles of (1) Fere as developed by Bordley and Hardy (1947) and (2) Manfredi (1952) respectively. By means of these audiometers responses to the acoustic stimulus can be reliably and objectively recorded without having to resort to the patient's answers.

The Veterans Administration (of U.S.A.) has specified that in examination of every case in which a compensable disability would result from accepting the patient's voluntary thresholds a GSR test must be performed at least at one frequency in each ear. If this procedure reveals a functional hearing loss, the

GSR testing should be performed for all the speech frequencies in each ear And it is also valuable in early diagnosis of hearing loss in children. These are only a few of the uses in which PGSR could be used.

Evoked Response and Averaged Evoked Response Audiometers

These two would require the use of an EEG and a computer in addition to the audiometer and as such they are very expensive and not viable at this stage.

Category HI

Direct measurement of cochlear microphonics would involve the development of refined techniques of introducing the electrodes into the auditory analyzer and equipment for measuring the small potentials generated.

At the B. M. Institute of Mental Health, Ahmedabad we have a speech and audiological clinic, a post graduate training programme in speech and hearing and a clinically oriented research programme. Under this research programme Reaction Time Audiometer, Signal Detection Audiometer as well as psychogalvanic and psychovoltaic Skin Response audiometers are planned and they are in various stages of design, development and fabrication. For lack of time the technical details are not presented here but we certainly welcome other centres to share our efforts in this regard.

A direct participation of the few speech and hearing centres with research facilities will help in hastening the process of development of our field as a whole. Through the central services of Indian Speech and Hearing Association these low cost equipment designs etc., and the technical know-how can be provided to the other speech and hearing centres. Also when the research centers have standardised the procedures the details can be passed on to the public and private enterprises for production depending on the feasibility.

Summary

Need for the development of advanced audiological equipment indigenously at low cost for assessing the difficult-to-test cases has been pointed out. A direct participation of the Audiological Centres where research facilities are already available in such development was stressed. After standardization of these designs and the methods of assessment, through the coordination of ISHA and public and private enterprises these expertise and technical know-how can be made avilable to the other speech and audiological clinics.

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EFFECT OF VIBRATOR APPLICATION FORCE ON BONE CONDUCTION OUT-PUT AT DIFFERENT FREQUENCIES

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Introduction

Although the air-conduction pathway generally is considered to be the principal mode of sound transmission, the movements of a vibrating body may also be transmitted to the inner ear through direct contact with the skull' . (Dirks, 1974)

Bekesy was the first investigator to demonstrate clearly that the mode of excitation of the cochlear receptors was the same for air conduction and bone conduction signals. By adjusting the amplitude and phase of air conducted signal he was able to cancel bone conduction signal at 400 Hz. Lowy (1942) also produced air-bone cancellation of the cochlear microphonics within the frequency range from 250 to 3,000 Hz in guinea pigs and cats.

The subject of bone-conduction has been of primary interest to otologists and audiologists because of the diagnostic usefulness of the measurements.

Review of Literature

Generally Bone-conduction threshold is expected to be better when the vibrator application force is increased. But, the studies do not agree with this principle.

B ekesy (1939) and Konig (1955) found that the change in B.C. threshold is maximum when the vibrator application force is less than 750 gms and a very small change was found when the static force was 1000 and 1500 gms. Depending on these findings Konig suggested that the coupling force should be approximately 1000 gms to have a minimum variability of B.C. threshold.

Harris *et al.* (1953) investigated the effects of increased application force from 100 to 500 gms, at the test frequencies of 250, 1000 and 8000 Hz. The greatest change in threshold was found at 250 Hz. According to them, the application force should be standardised somewhere between 200 gms to 400 gms.

The results of the two aforesaid studies do not agree with each other.

Goodhill and Holcomb (1955), Nilo (1968) Watson (1938) and Whittle (1965) have made other contributions concerning the role of force in measuring bone conduction.

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The problem of change in bone conduction sensitivity with respect to vibrator application force is further complicated by the studies which dealt with the Mechanical Impedance of the head. Dadson (1954) observed changes in mechanical impedance by varying the force of application. Corliss and Koidan (1955) however, reported similar impedance values at coupling forces from 500 to 1000 gms. Whether or not the differences are due to the smaller number of subjects used in the latter experiments has been unresolved.

According to the international standards for bone-conduction thresholds, the B.C. vibrator application force should be approximately 550 gms for a bone vibrator with a plain circular face of 1.75 cm^2. Commercially available head bands exert a static force of approximately 300 gms to 400 gms when the vibrator is placed on the mastoid process of adult subjects (Dirks, 1965, Studebaker, 1962). The size of the head and the elasticity of the head band primarily determine the application force on a particular head.

Some other variables which bring a change in B.C. thresholds are:

(1) Air pressure variation in external auditory canal.
(2) Loading of Tympanic membrane.
(3) Alteration or removal of structures of the middle ear.
(4) Occlusion effect.
(5) Size of the B.C. vibrator.
(6) Vibrator placement.
(7) Individual differences in the mass of the head, and
(8) Ambient Noise level.

The review of the literature shows that there is no agreement between the various investigations regarding the changes in B.C. response due to the application of various forces.

The purpose of the present study was to find out experimentally the change in B.C. output for various static loading from 100 gms to 1000 gms in 100 gm steps.

Methodology

Equipment used:

B and K Artificial Mastoid Type 4930—
Madsen OB70 Clinical audiometer (calibrated to ISO (1964) standard)
B.C. vibrator No: X 114 Denmark.
Frequency analyser (B and K 2107)
Different weights 100 gms to 1000 gms.

Particular attention was paid to long term stability regarding mechanical impedance and transducer characteristics.

The artificial mastoid consists of an inertial mass of 3.5 kg with a curved top plate of stainless steel, upon which are mounted the impedance determining elements, built-up of laminated butyl silicon rubber pads.

A light weight spring with nearly massless rubber bands holds the B.C. vibrator under test against the rubber surface of the mastoid with a static force which can be adjusted to any value between 2 and 8 N.

The static load adjustment of artificial mastoid was removed. The B.C. vibrator of the audiometer was kept on the artificial mastoid. Different masses were kept on the light weight loading arm which was kept on the B.C. vibrator. The output from the artificial mastoid was fed to the frequency analyzer which was set to the reference before the instrument was used. The output was measured at 40 dB HL of the audiometer at different frequencies for each mass. When the frequency analyzer was adjusted to reference, the voltage reading could be read on dB scale (i.e., 94dB=50mv, 100dB=100 mv indicating the reference value of **1 μ v.)**

$$dB = 20 \log_{10} \left(\frac{x \ \mu v}{1 \ \mu v} \right)$$

Discussion

Table 1 shows the B.C. output at different frequences and at different values of static load.

At 2 KHz the output values of static load increases as the application force increases. But it is evident from the table that for static forces 500, 600 and 700 gms, the output for all the tested frequencies remained almost same. **This** supports the ISO recommendation. (ISO recommendation; static force of 550 gms for B.C. vibrator output measurements).

RESULTS

Masses in grams

Frequen-cies in Hz	100	200	300	400	500	600	700	800	900	1000
250	56	55	55	54	54	54	53.5	53.5	53.5	53.5
500	54	53	53	52	53	53	52.5	52.5	52.5	53
1 K	50	50	47	46	46.5	46.5	47	47	47.5	48
2 K	51	51	51	52	52	52	53	53	53.5	54
3 K	48	42	40	40	40	40	41	40	41	42
4 K	50	40	35	35	35	34	32	32	32.5	33

TASLE I: Shows the output in dB for various masses at each frequency-dB Ref. one micro volt (1 /J V).

From Fig. I it is observed that the change is more in higher frequencies viz., 3K and 4 KHz particularly at lower static forces (for 100 and 200 gms).

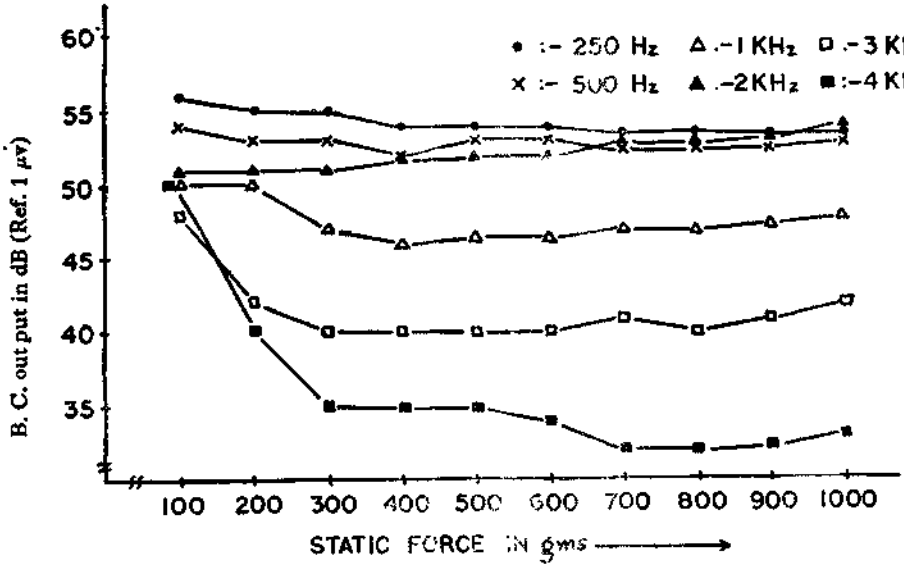

Fig. I

Table II shows the comparison of the results obtained in the present study with the results of the previous studies

TABLE II

Bekesy (1939) & Konig (1955)	Harris *el al* (1953)	Present Study (1978)
1. Largest changes at forces below 750 gms	1. Great change for 250 Hz due to various force app.ication	1. Little change for 250 Hz from 100 to 1000 gms
		Great changes for 3K and 4 KHz at lower static forces (100, 200, 300 gmb) Ref: Fig. I
t. Recommendation:		
100 gms force	200 to 400 gms	400 to 1000 gms

Summary

A review of literature regarding the effect of vibrator application force on bone-conduction output shows a lack of agreement between the various investigations. The present study was undertaken to find out the change in B.C. out-

put for various force values from 100 gms to 1000 gms in 100 gms steps. The B.C. vibrator from an audiometer was kept on the B and K. artificial mastoid (4930). The output from the artificial mastoid was fed to an A.F. analyzer for the purpose of measurements.

The result indicates a little change in B.C. output at 250 Hz for the static forces ranging from 100 gms to 1000 gms and the change was more at the fre-fueneies 3 KHz and 4 KHz for the lower static forces. However the change in B.C. output was very little for a static force of 400 gms to 1000 gms for all the test frequencies. This study supports the **ISO** recommendation of static force for B.C. output measurements.

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SOCIO-ECONOMIC PROBLEMS OF THE COMMUNICATIVELY HANDICAPPED IN INDIA

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Introduction

When the country's forty per cent of population is living below the poverty line; seventy per cent living in villages and when illiteracy is not lower than poverty, rehabilitation of the communicatively handicapped who form six per cent of the country's population becomes an extremely difficult task.

Inadequate speech and hearing centres in the country and the long duration of therapy needed, has made the problem still serious.

Wearing hearing aids is a social taboo. Only a limited number of people afford to have it. Thus a majority of the people who need it are living without it. It frustrates both the audiologists and the cases.

Poverty, social taboos and illiteracy have hindered the larger sector of population to overcome the speech and hearing disorders making the handicapped a burden on the society and an invariably unproductive element in the national economy. Proper public education campaign is lacking.

Discussion

The main social problem of the communicative handicapped is ' Social Integration'. Lack of proper public education among the normals has aggravated this situation.

To a large extent the handicapped are deprived of the normal school education. Thereby they cannot actively participate in the day to day activities. Moreover, they become subjects for teasing and taunting by the normal children. They are forced to get isolated and withdrawn from the normal activities. There are no proper outlets to recognise their potentials. They will go ' unheard, unsung, and unhonoured.'

The attitude of the parents to their own handicapped children is deplorable. They attribute the handicap to the bad deeds of the child's previous Janma—*(pehley janam ka pap hat).* They take it as their fate. Further, the handicapped become the subjects of accusation and cause for all the bad things which would happen at home. The ignorance of the parents regarding the causative factor of the handicap creates an ' unhealthy' environment for them.

The adults find it extremely difficult to get jobs even though they are capable of discharging the given work efficiently and even when their handicap is no hurdle

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for efficiency, such as, stammering, cleft palate, etc. These disorders may be overcome. In such cases there is no reason why they should not be given equal opportunity for employment.

For instance, a young and brilliant boy appeared and qualified himself for all the requirements for pilot's training. Finally, when he appeared for a personal interview, he was not selected just because he had stammering. This boy is now undergoing therapy at the Institute (AIISH, Mysore) rather a bit disappointed on losing his bright career. There are many such cases.

In the case of females, the situation is still more distressing as most of the males are not willing to marry girls because of the handicap. This causes frustration both to the parents and the person having the disorder.

Miss Z, a pretty young girl of an economically sound family acquired sensorineural hearing loss during her seventeenth year; wears a hearing aid and is doing her final B.Com., degree course by correspondence. For past three years her parents are trying their best to arrange her marriage giving handsome dowry to the prospective suitable groom. But they have not been able to do so as yet. There are many such girls in our country.

Master Babloo is a communicative handicapped child of eight years of an urban nuclear family. The parents are employed; the elder children are engaged in their scholastic activities. Babloo is alone with his uneducated maid servant who has little time to take care of him. Babloo is deprived of filial love and affection when it is most needed. There are many such Babloos in our urban areas.

Mr A, a handsome youth of 25 years had determined not to marry just because of his feminine voice. But, a week's therapy at the Institute (AIISH, Mysore) for his ' feminine voice,' entirely changed his philosophy of life. Now he is a married man; happily leading his married life with two children. But how many such puberphonic youths have found solution in the country?

Our present society has inherited the cultural heritage which is the product of an agrarian society. Agrarian society has been found to be a static one. To preserve the social values and the landed property among their own members consanguineous marriages became a social order. Further when the society was divided into professional groups and then into different castes, the principle of consanguineous marriages became further rigid and this dogma is still the ' legal tender ' in many castes and sub-castes. This system is shared by every section of Indian society. However, this much ' valued principle' has become a major factor in producing a large "number of speech and hearing disordered people in the country. A study carried out by Mehboob Shahnawaz (1974) at the All India Institute of Speech and Hearing, Mysore has established this fact.

thus discouragement of consanguineous marriages goes a long way in our preventive attempts.

ECONOMIC ASPECT

As stated earlier, forty percent of our country's population is living below poverty line. In such a situation any attempt at rehabilitation gets frustrated.

To augment this phenomenon new scientific devices and techniques should be evolved and adopted to reduce the high cost and time needed for examination, treatment and counselling. For this purpose we can fully exploit all the channels of mass media more specially the radio and the television. A preliminary study done at the Institute by Satyendra Kumar (1974) to detect hearing loss by administering a test through radio, is laudable. By a single broadcast it is possible to screen thousands of people at a stretch to determine hearing loss. We need many such devices and techniques.

Public education in the rural areas is of utmost necessity as seventy per cent of the country's population live there. We have found that the school teachers and the medical people exert great influence over them. They are their 'friends, guides and philosophers.' If these people are educated it is easy to educate the rural folk. To meet this need regular orientation programmes appraising them about these problems should be given to medical men, school teachers, grama sevaks, and social workers. This helps in early identification and rehabilitation.

The improper treatment of the handicapped in terms of education, social status, training and employment has made them a liability on the Indian society. Due to this fact they have become unproductive members of the society. On the contrary the general belief is that these people are more conscious of the work, mistakes committed are few and the output in terms of quality and quantity is always better. Therefore any investment made will not become a waste. They will be the tax-payers and also productive members of the society. Thereby they will-pay off more than the investment involved in rehabilitating them and they will never be a burden.

It is therefore the primary responsibility of the so called normals to remove the hurdles. Because a society is only as strong as its weakest individual, therefore we cannot afford to ignore the needs of the handicapped.

Conclusion

These factors compel us to draw a conclusion that there is an imminent need, for social integration between the normals and the 'handicapped.' However, the following suggestions are made for their betterment and to have a changed outlook:

1. The selling price of hearing aids must be minimised, if possible by government subsidy. For employees the employers should reimburse the cost of the hearing aid.

2. New techniques suiting to the Indian conditions must be evolved and adopted to reduce the duration of the therapy period.

3. More number of speech and hearing centres should be opened up preferably in every district headquarter- of the country.

4. Correspondence therapy for the deaf children in all the regional languages should be started on the lines of John Tracy Clinic.

5. A campaign must be made *against consanguineous marriages,*

6. Establish more number of vocational training centres.

7. Above all public education should be intensified appraising the public in general and the medical men, school teachers in particular for the early identification of the problem which will help the people to seek the expertise as quickly as possible and to ' integrate socially' the handicapped.

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