PERFORMANCE ON AN AUDITORY TASK BY NON-NATIVE SPEAKERS OF ENGLISH ON SELECTED BI-SYLLABLE WORDS

Register No. 6

RANGAMANI G.N.

A Dissertation submitted in part fulfilment for the Degree of Master of Science (Speech & Hearing)

University of Mysore

Mysore

1984

Dedicated to

Anna., Amma

&

to the memories of

Thata (C. Basappa Naik)

C E R T I F I C A T E

This is to certify that the Dissertation entitled: " Performance on an auditory task by non-native speakers of English on selected bi-syllable words" is the bonafide work in part-fulfilment for the Degree of M.Sc., II year (Speech & Hearing) of the student with Register Number 6

Date: 17.5.84

Director
All India Institute of Speech & Hearing
Mysore.

C E R T I F I C A T E

This la to certify that this independent Dissertation entitled " Performance on an Auditory task by non-native speakers of English on selected bi-syllable words" has been prepared under my supervision end guidance.

Dr.(Miss) Shailaja Nikam
(Guide)

Professor & Head
of the
Department of Audiology
All India Institute of Speech & Hearing
Mysore

Date:

D E C L A R A T I O N

This independent dissertation is the result of my own study under-taken under the guidance of Dr.(Miss) Shailaja Nikam, Professor and Head, Department of Audiology, A.I.I.S.H., Mysore and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore: Register No. 6

Date :

ACKNOWLEDGEMENTS

I am grateful to Dr. (Miss) Shailaja Nikam, professor and Head, Department of Audiology, A.I.I.S.H., Mysore for her excellent counsel and guidance to me in the preparation of this Dissertation.

I am thankful to:

Dr. Ratna, Director, A.I.I.S.H., Mysore, for having provided me with an opportunity to successfully complete this dissertation.

Mr. S.S.Murthy and Miss Choodamani, Department of Electronics, A.I.I.S.H., Mysore for their help.

Mrs. Shakuntala Sharma, C.I.I.L., Mysore for her advice regarding statistical procedures.

Mr. Jagadish, M.S., Final B.Sc, A.I.I.S.H, Mysore for having read the word lists.

Miss Malini, M.S., A.I.I.S.H., Mysore for her invaluable assistance and suggestions.

All the subjects who kindly cooperated to undergo the testing.

My friends Uma, Lakshmi, Usha and Latha for their help and support.

All my near and dear ones who have helped me in their own ways.

Mr. M.R.Subbannna for the neat typescript of the Dissertation.

* * * * * *

CONTENTS

...

CHAPTER - 1

INTRODUCTION

In routine audiological evaluation, one makes use of a number of stimuli such as pure tones, noise and speech signals. Although pure tone audiometry is basic to any consideration of clinical audiology, some of its inherent disadvantages give way for speech audiometry to gain an upper hand. While pure tones are easy to calibrate, standardise, and their test-retest reliability is high, they are relatively uncommon and abstract. Pure tone audiometry fails to determine the individual's ability to handle speech communication (Harris, 1965). Pure tones being simple, are not of much help in the assessment of higher auditory cortical functions (Penfield and Evans, 1956; Goldstein, Goodman and King, 1956; Hodgson, 1967). Thus despite the fact that pure tone audiometry helps in the determination of the subject's auditory receptive abilities, one has to be cautious in the interpretation of the results because of some of the obvious inherent disadvantages of pure tone audiometry discussed above.

The inherent drawbacks of the use of pure tones, have therefore led to the wider use of speech stimuli. Speech stimuli are meaningful and they simulate the patient's everyday auditory experiences. Thus, speech-audiometry has a greater weightage than pure tone audiometry in audiological evaluation.

In speech audiometry, different measures may be obtained. The most important ones that are usually sought are 'speech reception threshold' and 'speech discrimination score'.

Other measures such as the threshold of detectability and tolerance or discomfort levels may also be determined. 'Speech reception threshold' and 'speech discrimination score' have been used in the diagnosis of conductive hearing loss and sensori-neural hearing loss. One of the reliable indicators of pseudo-hypacusis is a speech reception threshold that is better than that predicted by pure tone average (Carhart, 1952).

Speech stimuli have also been used in the differential diagnosis of cochlear and retrocochlear lesions. Various forms of speech stimuli have been used in the evaluation of central auditory disorders. Example: Filtered speech tests (Bocca, Calearo and Casslnarl 1954), synthetic sentences (Jerger and Jerger, 1974; Speaks, 1975; Jerger and Jerger, 1975), staggered spondaic words(Katz, 1962, 1968), time compressed and time expan-ded speech (Bocca et ml, 1954, 1955; Calearo and Lazzaroni, 1957; Sticht and Gray, 1960; Bocca and Calearo, 1963). Speech stimuli such as spondees, mono-syllables, synthetic sentences have been used in the hearing-eld evaluation to judge the amount of gain needed by the patient, in the relative benefits of ampli-fication over the unaided performance (Carhart, 1946a, 1946b; Jefferes, 1960; Zerlin, 1962; House, et al, 1965; Kopra and Blosser, 1968; Walden and Kasten, 1969; Schultz and Schubert, 1969; Hood, 1970; Pode and Kasten, 1971; Jerger and Hayes, 1976). Speech reception threshold and speech discrimination score mea-sures have also been used to predict the outcome of otologic sur-gery (Kasden and Robinson, 1969; Robinson and Kasden, 1970), and to assess the value of therapeutic procedures such as speech-reading and auditory-training (Hirsh, 1947). Thus, speech stimuli are indispensible in routine audio logical evaluation and speech-audiometry forms and important tool in diagnosis, differential diagnosis and prognosis.

Need for the study:

Speech reception threshold tests are already available in some Indian languages viz. Hindi (Abrol, 1971), Kannada (Rajashekara, 1976; Hemalatha, 1981), Gujarathi (Mallikarjuna, 1984). The currently available speech reception threshold tests in English are modified and standardized on English sneaking Indians (Swarnalatha, 1972).

However, the above tests have certain limitations; they are as follows:

1. The utility of the tests developed in Indian languages are restricted to the speakers or listeners of the respective Indian languages.

2. The utility of the English speech reception threshold test that has been modified and standardized on Indian population is restricted only to literate Indians knowing English.

3. Further, in some of the Indian languages, the availablility of bi-syllabic words similar to those in English are limited. Although meaningful monosyllabic units are available, they are very few in number and their availability to construct a list appears to be limited. Thereby the bi-syllabic units become essential in speech discrimination testing.

India is a country of many States and languages. Speech tests are available in only a few of the Indian languages, Thus, this factor becomes a, major setback duriong audiological testing,

Most of the rural population are illiterates and the majority of the speech reception threshold tests available in Indian languages are standardized on literate population. Hence the utility of these tests is restricted to the literate population.

Thus a test that can be used to test people, from different language groups and where literacy is not the prime factor would be more useful in Indian set up. Accordingly, an attempt is made in the present study to construct and standardize a speech reception threshold test consisting of simple bi-syllabic English words, with the view that it can be used with people from different language background and who have also had no formal education in English. Such a test would be similar to the presently available tests in English and allow for comparison of the results across two or more centers, whenever necessary.

The present study is aimed at answering the following questions;

1. At which level is the speech reception threshold obtained? And does the percent of correct responses of the bi-syllabic words vary with variation in the presentation levels?
2. Are there significant differences between the different forms of the list?
3. Is there significant difference in the performance of the subjects of the different language groups?
4. Is there two-way / three-way interaction among the above variables?

-oOo-

Chapter - 2

REVIEW OF LITERATURE

Speech stimuli are indispensible in routine audio logical evaluation. Speech tests are used to supplement the pure tone testing. Although pure tone audiometry gives an idea about the functioning of the auditory systems, it does not throw much light upon the difficulties the patient experiences in communication. A quantitative and qualitative assessment of the hearing loss for speech as it relates to the ability to communicate may be more meaningful to the examiner and patient. Thus speech audiometry is aknowledged to be one of the fundamental tests of hearing impairment.

In speech audiometry various measures may be obtained, viz. speech-reception threshold, threshold of detectability, threshold of tolerance or discomfort levels and speech discrimination score. Of the various measures that are sought, speech reception threshold (SRT) is a basic measure upon which the supra-threshold speech tests are based.

Speech reception threshold " is a measure of the intensity of speech which enables a subject to correctly repeat 50% of the speech materials that are presented to him" (O'Neill and Oyer, 1966).

Various kinds of speech stimuli have been used to determine the speech reception threshold, eg.: Sentences, connected discourse and spondees.

<u>Sentences:</u>

The first speech tests were spoken or whispered messages at measures distances between the talker and the listener. These tests provided a gross estimate of the listener's ability to hear speech and they failed to quantify the hearing impairment for speech. In an attempt to quantify the hearing for speech, more controlled and reliable measures were initiated.

The first widely used recorded auditory test for measuring hearing loss for speech was developed at Bell-telephone laboratories in 1926. This test known as Western electric 4 A (later 4 C) was a recording of spoken digits (Fletcher and Steinberg, 1929;. These phonograph records were the standard recorded materials and were used in the group testing of school children (Hirsh, 1952).

Fletcher and Steinberg, (1929) used sentences in their early work. These lists consisted of interrogative sentences that were to be answered instead of repeating the stimulus that was presented. This test had certain limitations. The subject not only had to listen to the words of the sentence, but he also had to provide answers to some fairly difficult questions, eg: "why is silk preferred to cotton for umbrellas?" etc.. Another disadvantage was that the subject was expected to have some knowledge of New York City and its environs.

Simpler lists of sentences were constructed at the Psycho-acoustic Laboratory by Hudgins et al, (1947). The test so constructed was termed as auditory test No. 12. The questic

..7

1. Cited in Hirsh, 1947.

2. " " Hirsh, 1952.

were relatively more simple than those developed by Bell Telephone laboratories (Fletcher and Steinberg, 1929) and could be answered by a single word. This feature made the auditory test No.12 useful when a written test for use in group testing was required. When a single subject was tested he was allowed to repeat a sentence he heard.

The disadvantage of sentence tests is that lone lists are required because the same sentence cannot be used twice with one listener, as his capacity of memorize makes it easier for him to recognize a sentence again, even from a single key word. But these tests have high face validity as samples of English speech.

Hughson and Thompson (1942, cited in O'Neill and Oyer, 1966) found a good degree of correlation between the SRT for sentences (prepared by the Bell Telephone laboratories) and the pure tone average (average of pure tone thresholds at 512, 1024 and 2048Hz multiplied by 0.8)

Connected discourse:

Continuous discourse was considered to be an even more valid representation of speech. Although difficult to quantify with respect to the response of the observer, the most valid sample of English speech is a paragraph or several paragraphs of continuous discourse (Hirsh, 1952). The available material is uniformly monotonous and uninteresting, so much so, a speaker can repeat the material with remarkably little variability in intensity.

Falconer and Davis (1947) employed a sample of connected discourse to which the subject listened and adjusted the level of the recorded speech to a point where he could just understand what was being said. The test was compared experimentally with auditory test No. 9 and the threshold determinations were found to be nearly identical. The test was reported to have the following advantages (Falconer, 1948).

1. Speed (about 2 mins.)
2. Interest for the listener and lack of mental fatigue.
3. High face validity (It uses a sample of actual radio broadcast)
4. Satisfactory reliability.
5. Negligible learning effects.

The main disadvantage of the test was the subjective nature of the end point. Some subjects could give an erratic threshold (Falconer, 1948).

Spondees:

Recorded materials were developed at Harvard in the psycho-acoustic laboratory. It included the auditory test No. 9 and the auditory test No. 14. The latter consisted of spondees which were recorded at a constant level, while the former consisted of the same spondees as in auditory test No.14, but were recorded at attenuated levels. Hudgins et al, (1947) selected the spondaic words so that they were 1) familiar to the listeners, 2) dissimilar in phonetic construction 3) a normal sampling of English speech sounds, and 4) homogeneously audible.

These two recorded tests permitted a quick and reliable measure of the threshold of intelligibility and its related clinical measure, the hearing loss for speech.

Several deficiencies of the Harvard tests were reported. "Specifically it has been reported informally, that certain of the records of auditory test No.9 yield slightly different thresholds from other of these records" (Hirsh et a1, 1952, p.321). Secondly the vocabulary was too large for many clinical patients.

To overcome these limitations of the Harvard tests, Hirsh et al, (1952) modified the Harvard lists, at the Central Institute for the deaf. Their aim was to restrict the vocabulary level to suit a general clinical population. Speech reception tests W-l and w-2 were developed as the CID recorded versions of auditory tests No.14 and No.9 respectively, familiarity of the original 84 words was determined. 36 words that were rated as most familiar were selected from the original list and recorded into six different forms. Words that were too easy were reduced by 2dB and the more difficult words were increased by 2dB. The threshold for normal ears in the initial testing with the revised form was in the vicinity of 14.2 dB (re: 0.0002 microbar). C.I.D test No.2 used the same words but employed a 33 dB attenuation range with every 3 words being attenuated by 3 dB. The threshold for this test was 17.7 dB (re:0.0002 microbar).

Lower thresholds were obtained with C.I.D tests when compared with that of the Harvard tests. Thresholds for the original spondees were in the order of 22 dB (re: 0.0002 microbar). While an average speech reception threshold of 14 to 15 dB (re: 0.0002)microbar was obtained for the W-1 lists. Average speech reception threshold for W-2 test was 18 dB(re: 0.0002 microbar) as compered to 14 or 15 dB for the W-1 list. Also free-field presentation of the spondee materials through a loud speaker resulted in a SRT that was some 3 dB lower than when the materials were presented through earphone (monaural presentation).

Apart from spondaic words, various other speech materials have been used to obtain SRT. Mac Parian (1940, cited in O'Neill and Oyer, 1966) was one of the first investigators to use mono-syllabic words in the development of a test of speech threshold. The test consisted of the first 500 monosyllabic words from the Thorndike lists and the first 50 monosyllabic words from the Gates list. The words were recorded on discs and were presented from an inaudible level to audible level. At the time when the subject was able to detect only one out of every five of the words, the record was sneeded up. Then a comparison was made of the changes that occured in test scores from the first testing. Another modification of the test involved recording of 50 words, divided into 5 different time groups. The interval between words decreased from 10 secs, to 2 secs. This provided a test of the subject's 'hearing skill'.

Other threshold measures: There are other measures of speech threshold, viz. speech detection threshold (SDT) and threshold of perceptible speech. However, these measures do not yield the same value aS SRT. Speech detection threshold was found to be 16.47 dBSPL, speech reception threshold was 25.47dBSPL and threshold of perceptible speech was 28.47 dB SPL (Chaiklin, 1959).

Eg an (1948)[1] reported a magnitude of the difference between SRT and SDT not to exceed 12 dB and threshold of perceptibility for running speech was 8 dB above SDT. Put this difference was reported to change with such factors as the shape of the pure tone audiogram, instructions, etc..

Estimates of the different threshold measures reported by Chalklin correlates well with that of Hirsh's estimates(Chaiklin, 1959).

Chaiklin (1959) found the normal threshold for spondaic words to lie somewhere between l8-25dB (re: 0.0002 dynes/cm^2) which was consistent with the 22 dB (re: 0.0002 dynes/cm^2) normal threshold specified for speech eudiometers by the American Association (1953)

The standard for intelligible sneech is reported to be 19dB above 0.0002 microbar (ANSI, 1970). This standard reference threshold SPL applies to the use of Vestern electric type 705-A. earphones in the National Bureau of standards 9-A. coupler (ANSI, 1970). If the Telephonics TDH-39 earphone is used, the reference threshold sound pressure level should be 20 dB above 0.0002 microbar (ANSI, 1970).

Although speech thresholds have been obtained for various speech materials such as monosyllables, sentences and connected discourse. These materials are used less frequently than spondees (Harris, 1965). Spondaic words are specified as the standard test material (ASHA, 1979) for the determination of SRT.

1: Cited in Chaiklin, 1959

SRT and Pure tone average:

Severel studies have indicated the interdependence of pure to average and speech receiption threshold (Fletcher, 1929, 1950; Carhart, 1946, 1971; Davis, 1948;[1] [2] Glorig et al, 1954; Lightfoot et al, 1956;[3] Corso, 1957;[4] Corso and Cohen, 1958;[5] Jerger et al, 1959; Chaiklin and Ventry, 1964; Chaiklin, Dixon and Font, 1967;[6] Gjaevenes, 1969, 1974; Porter, 1971).

This interdependence is sound to vary depending on 1) the kind of speech thresholds being investigated, 2) the method of testing, 3) Familiarization, and 4) sophistication of the subject and other variables (Jerger et al, 1959).

Fletcher (1929, 1950) found that the average of the two frequencies with lowest value of the three frequencies, i.e. 500Hz l000Hz and 2000 Hz could be used to predict the speech reception threshold.

Gjaevenes (1969, 1974) used regression equation to predict the SRT. He found a linear relationship between SRT and pure tone HL. He proposed the following formula for predicting the SRT from pure tone HLs. Accordingly

$$SRT = 0.8 + 0.34 - HL(.5)+ 0.12.HL(1)+0.34.HL,(2)+ 0.15.HL\ (3\ Kc/s).$$

His method is more accurate than the simple averaging method of the three frequencies viz. 500Hz, 1000Hz and 2000 Hz. He also found that cochlear hearing loss cases yield somewhat lower SRTs than conductive hearing loss cases. As the number of frequencies taken into consideration increased from 1 to 9, the standard error of estimate of predicted SRT decreased from 8.2 to 5.7 . However, there was negligible effect from using more than 3 frequencies (Gjaevenes, 1974).

1,2,3,4,5,6 : Cited in Jerger et. al. 1959

Carhart (1971) proposed the following formula to predict the speech reception threshold from pure tone average, when the audiometric contour is not taken into account and when the testing equipment is calibrated to ANSI reference levels.

SRT = -2 dB+ 0.5T + 0.5T

Spondee 500Hz 1000Hz

The 2dB is a minor correction constant (rounded to the nearest 2-dB step.

The interdependence of SRT and PTA for higher frequencies is poorer than other frequencies. The group with notches beyond 2048 Hz could not be differentiated on any important point from the group with flat losses (Carhart, 1946). It was also found that acuity between 512 Hz and 1024 Hz is more clearly related to speech reception for equated words than is acuity between 1024 and 2048 Hz.

Carhart and Porter (1971) established the effects of audiometric configuration on the relationships between thresholds for spondees and for octave frequencies from 250 to 4000 Hz. It was observed that 1000 Hz was found to be a good predictor of SRT. Adding a second frequency improved the accuracy of prediction slightly. This second frequency varied with audiometric configuration. The relative weightings of the two frequencies also varied as did the correction constant that was required. Adding a third frequency did not produce any practical improvement in predictability for SRT.

Thus, it was indicated that the audiometric pattern influences the threshold for spondees.

The relationship between the pure tone average and SRT has been determined. Itis found to vary depending on the following factors:

1. The kind of speech threshold investigated.
2. The speech test materials used, and
3. The method of testing (Jerger et ml, 1959).

Davis (1948) reported the average of the thresholds for 500, 1000 and 2000 Hz as 9 dB(SPL);at the game time he gave thresholds for various sneech stimuli which ranged from 22 dB for spondees, through 26 dB for sentence material and digits, to 33 dB for PB words as spoken by Rush Hughes.

Lightfoot et al, (1956) observed a 16.5 dB difference between the threshold intensities for 1000 Hz and for spondee words exhibited by 31 otologically normal subjects.

Glorig et al's (1954) survey revealed a difference of 15 dB SPL between the median threshold values for 1000 Hz pure tone and for spondee words for all errs in the 'selected normal words, for all ears in the 'selected normal group'. Similar observation was made by Corso (1957) although he employed a different criterion for selection of subjects. He reported a difference of 14 dB SPL between the thresholds for pure tones and for SRT obtained using CID auditory test W-2.

Macrae and Bridgen (1973) found that everyday speech reception by listener's with hearing impairment was very largely determined by their degree of threshold impairment, Their study supported hypothesis that impairment of threshold acuity rather than impairment of maximum speech discrimination limits speech reception in everyday situations. In noisy situations, the perceptible energy in speech at frequencies above 2000HZ contributed significantly to its intelligibility. It was concluded that threshold impairment at these frequencies has an adverse effect on speech reception in at least some everyday circumstances.

For all practical purposes the average pure tone result for 500, 1000 and 2000 Hz has been the most popular method for predicting a relationship between pure tones and speech thresholds (Hopkinson, 1978).

The high positive correlation between pure tone average and SRT led some authorities to state that the actual determination of SRT is unnecessary (Silverman and Hirsh, 1955). However, any discrepancy between pure tone average and SRT is an important one in determining the accuracy of both pure tone average and the SRT (Martin, 1958). Hence testing SRT ig crucial.

Bone conduction - Speech reception threshold. (BC-SRT)

Bone conduction speech reception threshold is determined by routing the signal through the bone conduction vibrator. Py comparing the 3RT obtained by air conduction and bone conduction, presence of a conductive component can be detected (Srinivasan, 1974). This is especially useful in children where bone conduction (BC) cannot be measured using pure tones. A high correlation between the average bone conduction threshold at 500Hz, l000Hz and 2000Hz, and bone conduction SRT has been obtained (Goetzinger and Proud, 1955 [2]; Kerrell, Wolfe and Mc Lemore, 1973)[3].

..16

1: Cited in Berger, 1978
2,3: Cited in Martin, 1981

Hahlbrock (1962) reported that in profound SN loss cases bone conduction stimulus elicits tactile stimulation. By drawing up the articulation curves tactile and auditory stimulus response can be differentiated.

Although the above studies do point out the utility of BC SRT testing, further research is warranted before they are employed in routine diagnostic/rehabilitative activities.

Merits of Speech Reception Threshold Testing:

SRT is = basic measure upon which other supra-threshold speech tests are based. SRT testing is used as a screening device in testing programmes in schools and industries. Most of the available speech tests take less time than pure tone tests and thus they lend themselves to quite general use in schools (Hirsh, 1947). Similarly in industries, there might not be a specially employed person to test the hearing. In such instances recorded lists may be used for screening purposes (Hirsh, 1947). People suspected of having hearing loss may be referred for a detailed audiometric evaluation.

The items of auditory tests No. 9 and 12 are useful as checks in auditory training programmes (Hirsh, 1947).

Using speech tests, it has been possible to evaluate the social adequacy for hearing (Davis, 1948).

Since hearing primarily serves the purpose of communication speech is more reliable and valid stimuli to be used than pure tones which are abstract stimuli.

Thus, by measuring a patient's ability to use his hearing ways a that are closer to every-day auditory experience, speech audiometry not only validates the findings of pure tone audionetry, but also have diagnostic end prognostic applications (Hirsh et al, 1952).

Factors influencing the sneech reception threshold:

Several factors influence SRT. They are as follows:

1. Tester Variable: Certain qualities or the tester's voice are of direct influence. Other variables such as tne sex, pronounciation, regional accent, training, capacity to build rapport ana bins all bear a direct influence on SRT.

French and Steinberg (1947) used male and female speakers in their speech tests and noticed differences in the listener's scores. They reported that men's voices are about one octave lower in pitch than women's ana the latter tend to be somewhat richer in high frequency sounds. This led to another hypothesis that there existed a difference between the manner in which hypacusic ears hear ana understand the voices of men and women.

Palmer (1955) made investigations of this problem and reported that the difference in the talker's voice did not bear any influence on the intelligibility scores of hard of hearing individuals. It was concluded that tne acoustic differences or the speaker's (male/female) voice do not contripute significantly to the test score, and if inter-speaker dirrerences exist other aspects especially the erticulatory characteristics of different speakers must be considered (Falmer, 1955).

2. Subject variables:

Factors such as attention span, motivation, vocabulary, physical and mental state of the individual can affect the SRT.

Group differences in auditory acuity was introduced by the use or vocabulary level as a selection criterion (Farrimond, 1962). It was also found that listening techniques affected auditory performance at low signal levels. More intelligent listeners were maximally efficient at the commencement of the auditory test and therefore tney improved little with further practice. Less intelligent subjects speared to have a high threshold initially. Central factors related to ability to predict or anticipate the sentence items of the test on the basis or part of the total information available in the sentence influenced the individual's hearing ability for speech (sentences), Farrimond (1962).

3. Variable related to Test Procedure:

These include

a. Familiarization

b. Live vs recorded voice presentation

c. Descending vs ascending method

d. Homogeneous intelligibility.

a. Familiarization: Familiarization improves tne SRT. Tillman ana Jerger (1959) demonstrated that tne short term practice in the task of responding to spondees at threshold intensities exerted no influence on the spondee threshold SPL in normal hearing subjects. However, these subjects wnen given prior knowledge of the test vocabulary yielded spondeed tnresnold at SPLs which were 4 to 5 dB lower than those yielded by subjects not given such knowledge.

The spondee thresholds established after familiarization were not only lower in the mean SPL values, but also were less variable upon repeated testing (Jerger et al, 1959; Tillman and Jerger, 1959). Thus familiarization with test spondees was considered to be an important step during establishing the spondee thresholds.

In order to eliminate the need for familiarization, a list of spondees selected from tne CID W-1 list, was constructed by Conn, Dancer and Ventry (1975). The list so constructed produced spondee thresholds equivalent to those optained with familiarization. This result further substantiates the important influence of familiarity on SRT.

b. Live vs recorded voice presentation:

O'Neill and Oyer (1966) found not much of a difference between live voice and recorded SRTs. Creston et al, (1966) found that both recorded and live voice presentation were reliable methods, but live voice presentation allowed for more flexibility.

Recorded stimuli have the obvious advantages such as preservation of fidelity and ease of handling. Recorded speech material reduces intra and inter-test variability, They provide for grepter standardization and results from centre to centre can be easily compared. The recorded tests include the calibration tone to properly set the sensitivity gain (Harris, 1965; O'Neill and Oyer, 1966; New by, 1972).

In any event live voice testing is the least desirable method because it introduces an unnecessary source (the speaker) of intra and inter-test variability (Chaiklin and Ventry, 1964).

However, the use of recorded material also has certain disadvantages. The clinician may have to stop the recording to permit the client to respond to the test word before the next one is presented- Disc and tape recordings will show wear after a period of use, introducing distortion of the signal and noise into the test systems Therefore it is necessary to be alert to these problems.

While recorded presentation is the preferred choice, clinical situations may arise which favour the use of a monitored live voice presentation. Live voice allows for flexibility in the presentation of test words (Carhart, 1948). But live voice presentation poses certain problems. It is difficult to monitor the test words to a consistent intensify level and it may not be possible to present each spondee in the same manner to every client. However, depending on various factors, a monitored live voice father then recorded presentation, as well as improvisation of materials may be necessary.

c. <u>Descending vs. ascending method:</u>

Martin and Pennington (1971) reported that bracketing was the most widely used method to establish the SRT. The second largely used method was descending steps. Ascending steps was used by a few audiologists.

Chaiklin, Font and Dixon (1967) established a high positive correlation between ascending 5 dB spondeed thresholds and the pure tone results, The ascending method had the advantage of having simplified sampling beginning and end points, and could be used to examine functional hearing loss. however, the authors also pointed out that the descending procedure may be more useful among young children and those persons who do not understand the instructions well.

However, there are no clinically significant differences in SRT obtained using ascending and descending techniques (Hopkinson, 1978).

5 dB vs 2 dB steps:

There is much variability in the classical procedure used to establish the 50% criterion for SRT.

Chaiklin, Front and Dixon (1967) used ascending 5 dB steps and found a high positive correlation between ascending 5 dB spondee thresholds and pure tone results.

Chaiklin and Ventry (1964) compared the 2 dB and 5 dB measurement methods. It was found that the 5 dB measurement method resulted in spondee thresholds that (a) agreed well with 2 dB method thresholds (b) had high correlation with pure tone thresholds and (c) had high reliability. Since the 5 dB measurement method was accurate and faster, a change-over to 5 dB measurement technique was recommended.

Fore recent literature show a tendency toward standardization of the SRT procedure (Tillman and Olsen, 1973; Wilson, Morgan and Dirks, 1973; Martin & Stauffer, 1973).

d. Homogeneous intelligibility:

Homogeneous intelligibility is an important factor in the determination of SRT. As the intensity of speech is increased from a a very low value to a very high level, the articulation score or the percentage of items that a listener will repeat, will increase (Hirsh, 1952). A graph obtained by plotting these values is called on "articulation function".

The spondee's gain function is steeper then that of the PB word lists. Its average slope between 20 and 80% is about 10% (Hirsh, 1952). The steepness of the gain function can be changed by manipulating the homogeneity of a list with respect to intelligibility.

Ideally, a SRT list should be homogeneously intelligible. Homogeneity can be achieved either by selecting only those words that tend to reach the listener's threshold at the same intensity level or by recording individual words in such a way that they all tend to be heard at the same level of reproduction. Hudgins et al, 1947).

Bowling and Elpern (1961) found a range of 10dB in intelligibility among the 36 words of the CID auditory test W-1. They suggest the use of only 22 words that were found to vary by only 3.5 dB. In a similar study Curry & Cox (1966)[2] found that the spondees in the CID auditory test W-l varied in intelligibility by a range of 8 dB. They concluded that the general efficiency would be enhanced by using only 27 of the words that fell within the range of - 2 dB.

Peattie et al (1975) found a range of 7.9 dB in the relative intelligibility of the spondees of the CID auditory test W-1. They recommended the exclusive use of 18 words that had a mean range of 1.5 dB. ...23

1,2 : Cited in Beattie, et al 1975

Thus homogeneuity is important to obtain precision in estimating the level at which 50% of the items are identified, end to use as few items as possible to obtain the SRT (Hudgins et al, 1947).

Procedure for determining SRT:

The SRT method proposed by Tillman and Olsen (1973) involved basically four steps: 1) Familiarization with test materials, 2) Determination of initial test intensity 3) Determination of threshold, 4) Derivation of threshold. Threshold is determined by subtracting the number of correct responses from the initial intensity, ie., the intensity at which step 3 is begun. To this difference a correctionfactor of one is added. The intensity derived is the SRT.

Wilson, Morgan and Dirks (1973) suggested a modification of the Tillman-Olsen (1973) procedure. These techniques incorporate 2 and 5 dB intensity decrements with two and five words being presented at the respective intervals. The modified formula represents a refinement of the Spearman-Karber method.

Accordingly $T_{50\%} = i \; \frac{1}{2}(d) - \frac{d(-r)}{n}$

where

T_{50} = Threshold

i = initial test intensity

d = the dB decrements

r = Correct responses (total)

n = Number words/decrement

Tillman and Olsen's method (1973), along with many previously recommended methods, involves prior estimates of hearing sensitivity, usually determined by the PTA. However, in certain situations it may be necessary to determine the SRT without prior knowledge of pure tone average, eg. hearing aid evaluations, testing small children, elimination of bias in training student clinicians, and testing patients with non-organic hearing loss (Martin and Stauffer, 1975). Martin and Stauffer (1975) devised a modification of the Tillman-Olsen method which can be used without a prior estimate of the degree of the loss.

The 2 methods, i.e., Tillman-Olsen's method and the modified method (Martin & Stauffer, 1975) were compared and no differences were demonstrated with respect to the measured SRTs, and the time required for the 2 methods to complete the tests was equal (Martin and Stauffer, 1975).

Speech reception threshold tests developed in India:

Several speech reception threshold tests were developed in some of the Indian languages.

Abrol (1971) developed speech reception threshold test in Hindi. However this study had several limitations, i.e.,

1) practice effect was not taken care of,
2) speech reception threshold level was not mentioned
3) articulation curves were not established.

Swarnalatha (1972) modified the presently available English tests and standardized it on an English speaking Indian population It appears that no attempt was made to assess the extent of the subjects' knowledge of English.

She found that both adults (16 to 25 years) and Children (7 to 15 years) obtained SRT of 9dB (re. PTA 10 dD). The standardized speechlists were found to be equal in difficulty, valid and reliable.

However, the tests' utility is restricted in that, it can be used only with Indians having a knowledge of English.

Rajashekara (1976) developed n picture SRT test for adults and children in Kannada. The articulation function for this word list extended over 30 dB. Hence the words were not considered equally homogeneous.. Further, pictures were not used in the standardization of the SRT teat, based on the grounds that all children tested were normals. Thus the standardized SRT test was more of a word list than the picture SRT test.

Hemalatha (1981) developed a SRT test in Kannada for children. Picturizable poly-syllable words were the stimuli, The children tested were in the age range of 3-5 years and the mean SRT was found to be 11 dB HL.

However, the above study has certain limitations. Although it was intended to test children with Kannada as their mother tongue, all subjects did not have Kannada as their mother tongue(Hemalatha, 1981). Thus the resulting score could be influenced by the subject selection criteria. Further the above test makes use of polly-syliabic words to determine the intelligibility of speech. But at a given intensity, the more syllabus there are per word, the more intelligible is the word, and higher is the articulation score for a list of such words (Hirsh, 1952). However using polysyllabic words in Kannada to determine SRT is unavoidable because the bi-syllabic words available are not similar to the spondaic words in English Moreover, the availability of meaningful monosyllabic units are very few and thus it becomes necessary to use the bi-syllabic in speech discrimination testing.

Since the above test was standardized only on school children its validity with other groups of children has to be established.

The above review points out to the usefulness of SRT testing and the tests available to establish the SRT. Inspite of the number of SRT tests developed in India, gome of their drawbacks limits their utility in routine diagnostic activities. Thus a test which can be used with different language and literacy groups needs to be developed.

*****

..27

Chapter - 3

METHODOLOGY

The purpose of the present study was to determine the auditor; performance of non-native speakers of English, on selected bi-syllabic words.

The study was designed to be conducted in 3 phases. They were as follows:

Phase I : Determination of the familiarity of bi-syllabic English words that are frequently used in Indian languages.

Phase II: Construction of a list of bi-syllabic words that were rated as 'most familiar' in Phase-I.

Phase III: standardization of the above list and to answer the following questions.

1. Does the percent of correct responses of the bi-syllabic words very with the variation in presentation levels? And at which level is the speech reception threshold obtained.
2. Are there any significant differences between the different forms of the list?
3. Is there any significant difference in the performance of the subjects of different language groups?
3. Is there twoway / three way interaction among the above variables?

Phase I:

Sixty persons from four different language background, viz. Kannada, Tamil, Bengali and Urdu, served as subjects for the Study. The language groups were selected randomly depending upon the availability of number of subjects in each language group. Fifteen people from each language group were selected. All the subjects met the following criteria:

a) An educational background of Pre-University course P.U.C.) or less (minimum level of TV standard) with the medium of instruction being non-English,

b) No history of hearing loss, any ear infections, headache, head injury or ototoxicity.

Test Materials:

A list (List - I, Appendix -I) of bi-syllabic English words that are commonly used in Indian languages was constructed, recorded and made use of in the present experiment. The words were drawn from the C.I.D. snondalc word lists (Hirsh et al, 1952), leading magazines and newspapers.

Recording Procedure:

The list of words was recorded on a casette tape using a Philips Casette deck (F 6112/00) and an ampex microphone. The recording was done in a sound treated audiological testing room, where the noise level was so low as to not to interfere with the recording.

The words were read out by a male speaker who is a non-native speaker of English. The bi-syllabic words were spoken with equal sress. The level of the words were maintained constant with the Vu-meter needle peaking at '0'. A gap of 10 secs, was allowed between every successive bi-syllabic words.

Test Procedure:

The tape was played on a portable National Panasonic Casette recorder (Rq 512DS). The distance of approximately 3 ft. between the speaker and the subject was kept constant throughout the testing period.

The subjects were asked to listen to the tape, and rate the familiarity of the bi-syllabic words on a 3-point scale, i.e

- Most familiar
- familiar
- not familiar.

Phase II:

Item analysis of the words rated for their familiarity in Phase I was carried out. A list of words rated as 'most familiar' by more than 75% of the subjects was constructed and designated as list-II. The list of words so constructed served as the stimulus material for the Phase—III of the experiment.

Phase-III:

Subjects:

72 people from four different language background (18 people from each language group Viz. Kannada and Tamil of the Dravidian family and, Urdu and Bengali from the Indo-Aryan family) served as the subjects, only those subjects who met the following criteria were selected.

a. Age range of 16 to 28 years.

b. Educational background of Pre-University Course or less (min. of IV Standard) with the medium of instruction being non-English.

c. Normal hearing (Ref. ANSI.1969) bilaterally for air-conducted pure tones at octave frequencies ranging from 250Hz to 8000HZ, also including 6000 Hz.

d. No history of any ear infections, heed ache, heady-injury or ototoxicity.

Test Materials:

The list of words (List-II) arrived at the end of Phase-II was randomized and four different forms (in different order) were constructed. These forms were designated as Form II-A, Form II-D, Form II-C and Form II-D (Appendix-II). All the four forms were recorded and made use of in the present phase of the experiment.

Recording Procedure:

The four forms of the list of English bi-syllabic words (list-II) viz. Forms II-A., -B, -C, -D were recorded on a Cnaette tape using a Casette deck (Philips F.6112/00) and a microphone (ampex).

The recording was done in a sound treated room where the noise level was within the permissible limits (ANSI, 1969) (Appendix- V). The words were re-d out -y the same m*le spe*ke^ (93 in phase-I) who is a non-native speaker of English. The bi-syllabic words were pronounced with equal stress. The level of the bi-syllcbic words was maintained constant with the Vu-rneter needle peeking at '0'. A gap of 10 sec. was allowed between every successive bi-syllabic words to enable the subjects to write down their responses.

The recorded Casette was played on a Casette deck (Philips, F 6112/00). The output of the deck was given to a graphic level recorder (B & K 2305) and the average level of different levels of a11 the bi-syllabic words were -et ermined. A l000Hz tone corresponding to the average peak level was recorded in the beginning of every form of the list.

Instrumentation:

A 2-channel audiometer (Madsen OB-70) and a Casette deck (Philips F 6112/00) were used for the collection of data. The recorded form's of words were played on the tape recorder and the output was fed into the tape input of the audiometer. The output of the audiometer was given to the earphones (TDH--39) housed in supra-aural ear cushions (MX 4l/AR). An objective, calibration of the audiometer (Appendix -III) was carried out before the commencement of the experiment and again at regular intervals. The frequency characteristics of the earphones used in the present study is shown in Appendix-IV.

Test Environment:

The experiment was carried out in a two room situation with sound treatment. The noise level in the rooms was measured using a sound level meter (B & K 2209) and a condensor microphone (B & K 4144) with ½"-l" adapter (B & K DB 0962) to check that the noise levels were within the permissible levels (Appendix-V).

Test Procedure:

Initially, the subjects threshold of hearing for air-conducted pure tones at octave frequencies ranging from 250 Hz. to 8000 Hz, also including 6000 Hz was established using the modified Hughson-Westlake procedure.

Subsequently the subjects' responses to the four forms of list-II was determined. Only the better ear was tested. However, an Attempt was made to represent the ears equally.

Instructions:

The subjects were instructed in their respective mother tongue. The following instructions were translated into all the four languages:

"You will now hear a few words.

The words will be as following:

'Bus stop', 'ice-cream', 'Post Card, etc..

You should carefully listen to the word and write down whet you hear. In case you cannot identify what the word is, try to guess. Is it clear?"

To standardize the list of words the forms of the word lists were presented at six different levels with reference to the pure tone average of 500Hz, l000Hz and 2000Hz. The levels were -2 dB, 0 dB, + 2 dB, +4 dB, + 6 dB and +8 dB (ref: PTA). The forms and the order of the levels of presentation were randomly distributed. Each subject listened to all the four forms of the list at any of the four levels. Subjects were asked to write down their responses on a sheet of paper provided to them. The gain of the tape recorded was so adjusted so as to peak the 1000 Hz tone at Vu -0 on the audiometer.

The scoring was done manually, Each correct response was given a score of 2.5%. The total number of correct responses were determined. The results were analyzed using appropriate statistical procedures.

*****

Chapter - 4

RESULTS

The data was analyzed to obtain the central tendency and variability measures. Mean and median scores were calculated for all the forms at different levels separately. Standard deviation was computed to establishthe dispersion of the scores. The values of the measures stated above are as depicted in Table I and Table II.

Effect of level:

From Table I it may be observed, that, in general the percent of correct responses of the bi-syllabic words in the Kannada group, increases with the increase in sensation level. Variability in the scores decreased with the increase in sensation level in case of Form-A. Forms-E and Form-D also showed a reduction in variability with the increase in sensation level, with the exception of one level, viz. +8 dB sensation level (ref. PTA.). Form-C failed to show a consistent reduction in variability with the increase in sensation level.

Table II shows the performance of the Tamil group. The percent of correct responses of the bi-syllable words in forms -A and -B, increases with the increase in sensation level. However forms-C and -D do not show a consistent increase in the percent of correct responses with the increase in sensation level. The variability of the scores decrease with increase in sensation levels in forms -A. and -B. The reduction of variability with increase in sensation level was also observed in c-se of Porm-C, with the exception o* one level, viz. 8 dB sensation level (Ref.PTA). ^orm-D felled to show r consistent reduction In variability with increase In sensation level.

Articulation function.

Articulation functions for the four forms of the list for Kmnnada and Tperil groups are shown in Fig. 1 and Trig. 2 respectively. From the Articulation functions of both the groups it may be not"d that the percentage of correct responses of the bl-syllablc words increased with increase in sensation level. However, the increase in percentage of correct responses were not consistent. None of the forms o^ the list show a plateau in their function indicating that the scores may improve at higher sensation levels.

The slopes o" the articulation function for the Kannada group ore 9.75^/dB (Form-A), -2.77#/dB(Fbrm-E), 8.75^/dB (Form-C), and 4.59%/dB (Form-D) between 0 to 2 dB sensation levels (Ref. PTA). The slopes of the articulation function for the ^amll group between. 0 anrl 2dP sensation level (rAf.PTA) are 4.17^/dB (FOrm-A), 2.92ydB(F^rm-B), 6.25</dB(Form-C), and 7.]f/dB(Form-D). The mean slope o^ the articulation function for the Kann«da group is 5.1#/dB an'i that for the -L'arll group It is 5.2#/dB.

In addition to the measures of central tendency ^nd variability, two analysis of variance (^NOVA) (Gullford and Fletcher, 1979) w-^s also computed.

Table-I

(Kannnda group) - showing the mean, median and standar deviation of the percentage of correct bi-syllabic words at six SLs.

levels in dB	Form-A Mn	Form-A Mdn	Form-A SD	Form-B Mn	Form-B Mdn	Form-B SD	Form-C Mn	Form-C Mdn	Form-C SD	Form-D Mn	Form-D Mdn	Form-D SD
-2	55	52.5	15.41	64.17	57.5	13.12	54.17	52.5	14.33	62.5	67.5	7.07
0	64.17	67.5	16.49	66.67	65	8.25	55.83	62.5	11.24	57.5	55	7.35
2	81-67	85	4.71	64.17	60	13.59	73.33	75	6.24	66.67	65	18.41
4	61.67	57.5	7.73	75.83	70	15.85	63.33	62.5	1.18	86.67	87.5	5.14
6	76.67	77.5	7.17	68.33	67.5	5.14	85.83	90	7.72	81.67	80	4.25
8	87.5	87.5	2.04	84.17	85	9.2	80	85	8.89	76.67	85	15.45

TABLE - II

Tamil - showing the mean, median and standard deviation of the percentage of correct bi-syllabic words at six SLs

Levels in dB	Form-A.			Form-B			Form-C			Form-D		
	Mn	Mdn	SD	Mn	Mdn	SD	Mn	Mdn	SD	Mn	Mdn	SD
-2	79.17	77.5	5.20	62.5	65	9.01	59.17	60	9.20	58.33	65	20.95
0	69.17	67.5	10.10	79.17	77.5	5.20	65.83	77.5	18.29	63.33	67.5	5.89
2	77.5	85.	15.21	85	82.5	7.36	78.33	77.5	5.14	77.5	75	9.35
4	75.83	80	9.46	79.17	77.5	4.25	64.17	65	3.12	83.33	82.5	1.18
6	83.33	77.5	12.3	77.5	75	5.40	89.17	90	3.12	82.5	82.6	2.04
8	89.17	90	3.82	87.5	87.5	0	88.33	87.5	5.14	88.33	90	6.24

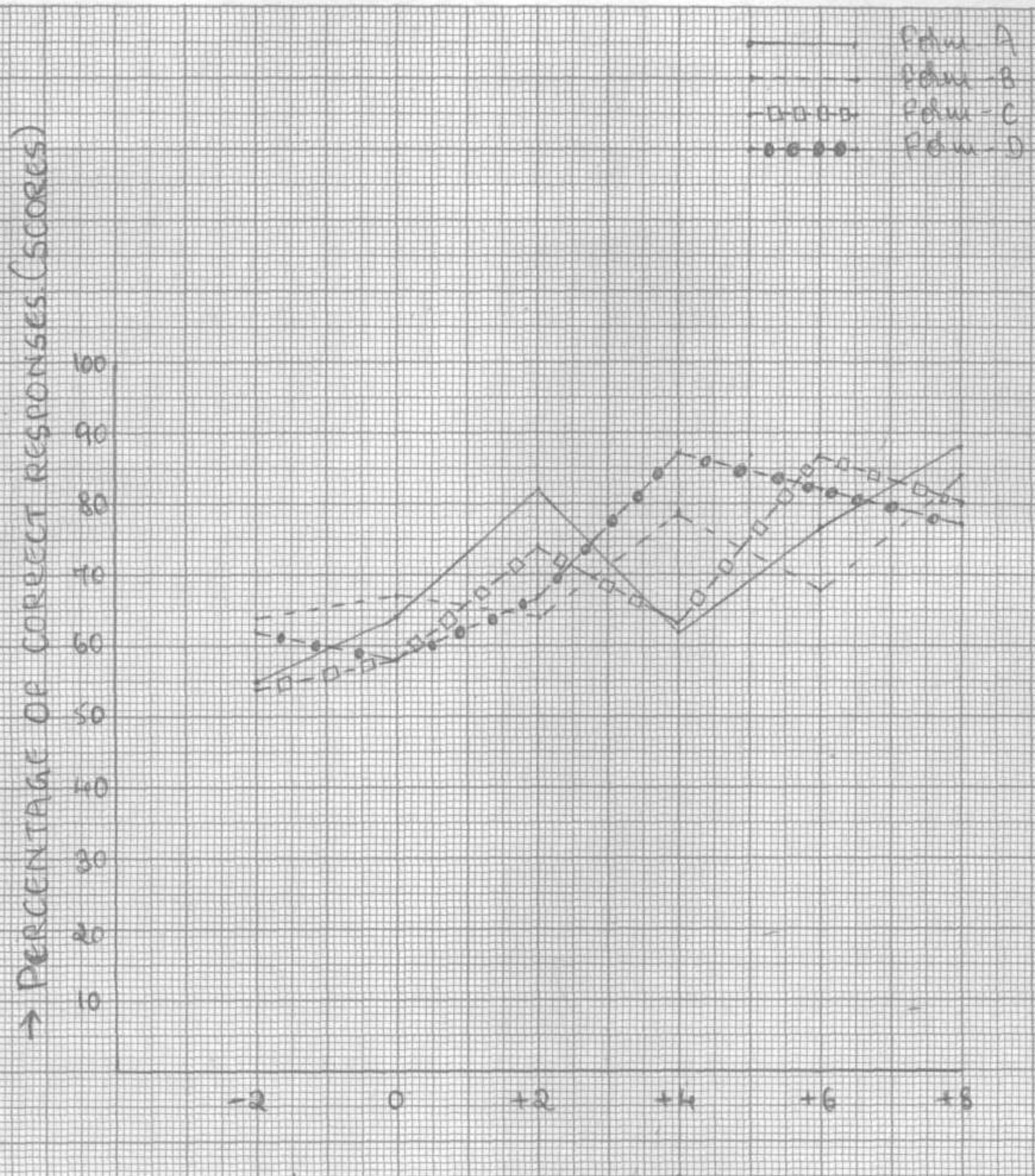


FIGURE 1 showing the mean articulation scores of the subjects at different levels (ref PTA). (KANNADA GROUP)

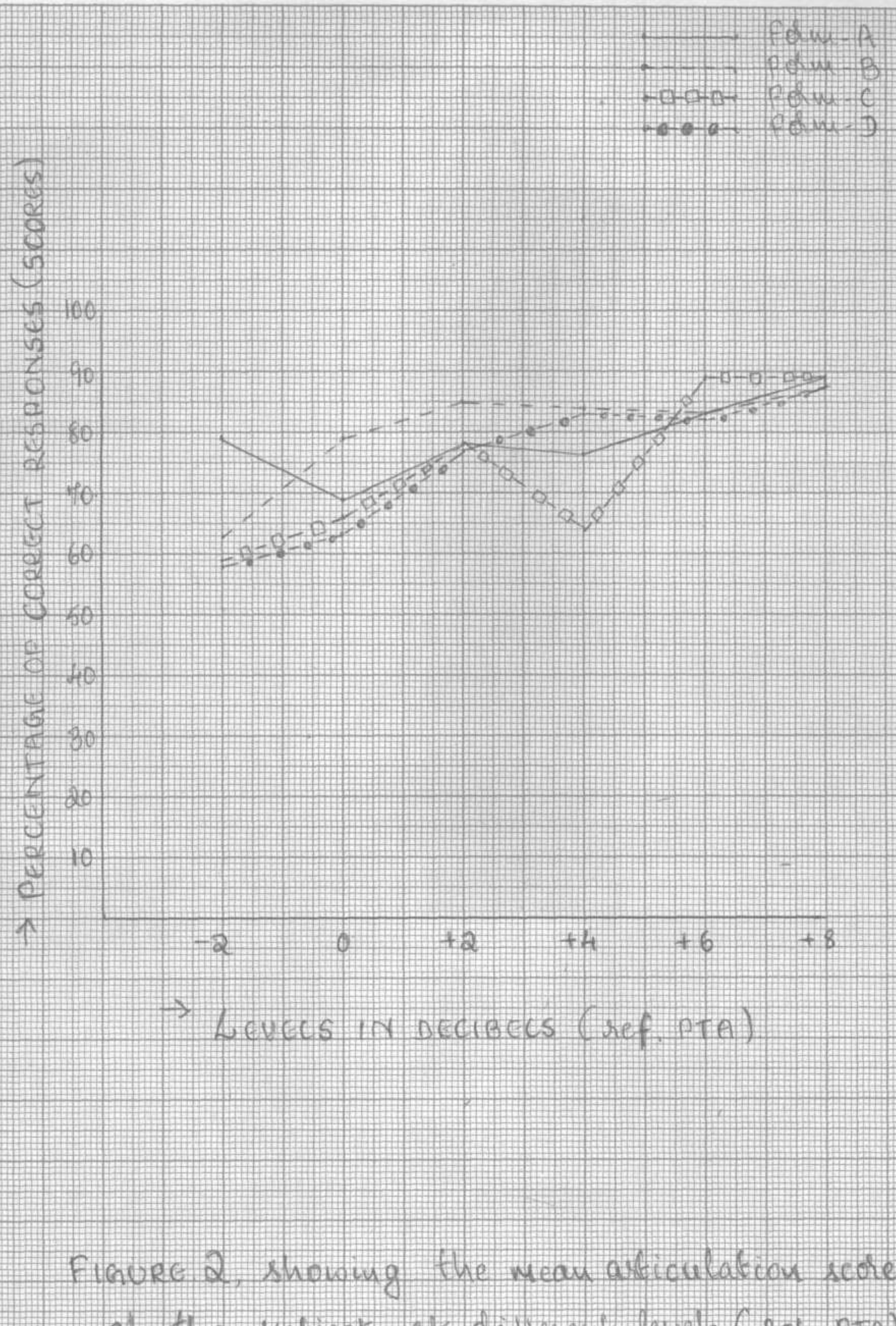


FIGURE 2, showing the mean articulation scores of the subjects at different levels (ref. PTA) (TAMIL GROUP)

TABLE - III

Results of the two-way analysis of variances for the main efects of lists, levels, and their interaction for the Kannada group

Sources of varience	Sum of squares	Degree of freedom	Mean sum of squares	F ratio
Levels	5012.93	5	1002.59	6.003 *
Forms	98.87	3	32.96	0.19
Interaction	2877.72	15	191.85	1.14
Error	8016.65	48	167.01	
Total		71		

* Significance at 0.01 level of confidence

TABLE - IV

Results of the two-way annlysis of variances for the Main effects of lists, levels and their interaction 1or the Tamil group

Sources of Variance	Sum of sauares	Degree of freedm	Mean sums of squares	F-ratio
Levels	4584.12	5	916.82	8.73 *
Forms	298.87	3	99.62	.95
Interaction	1893.31	15	126.22	1.20
Error	5041.67	48	105.03	
Totpl		71		

* Significant at (3.01 level of confidence

TABLE - V

Results of the two way analysis of variance for the main effects of levels languages and their interaction

Sources of variance	Sum of squares	Degree of freedom	Mean sum of squares	F-ratio
Levels	9495.66	5	1899.13	13.75 *
Language	1375.17	1	1375.17	9.96 *
Interaction	101.38	5	20.28	0.15
Error	18227.1	132	138.08	
Total		143		

* Significant at 0.01 level of confidence

Results of the two way analysis of variance:

The results indicated no significant differences among:

1. the different forms of the list at 0.05 level and
2. the interaction between the forms of the list at 0.05 level (see Table-Ill and Table-IV).

Effect of native language

The results demonstrated significant differences among the native language groups at 0.01 level, (see Table-V). However, the interaction between the native languages and sensation levels was not significant at 0.05 level.

The results Obtained are discussed in the next Chapter.

*****

Chapter - 5

DISCUSSION

The results obtained in the present study may be discussed under the following headings, viz. effect of sensation level, differences among the different forms of the list and the effect of native language among the performances of the different language groups.

Effect of Sensation Level:

The mean slopes of the articulation function for the Kannada group (5.1%/dB) and the Tamil group (5.2%/dB) as reported earlier, are not as steep as that obtained using CID W-l test (Hirsh et a1, 1952). They obtained a slope of 8%/dB.

The differences between the above two studies could be attributed to the methodological differences - the sensation levels used in the standardization of the list in the present study is different from that of Hirsh et al's (1952) study. The slope in the present study was calculated between 0 dB SL and +2 dB SL (ref. PTA), whereas Hirsh et a1 (1952) calculated the slope over a range of 8 dB, the limits which have not been specified.

While the present test made use of simple and most familiar bi-syllabic words, where, most of the words were not strictly spondaic, i.e., the two syllables in some words did not have equal stress, but Hirst et al (1952) made an attempt to ensure that the syllables in a word had equal stress.

However, the findings of the present study is in agreement

...

with of Hudgins et al (1947, cited by Hirsh, 1952) who establishe articulations functions for selected (bi-syllables with equal stress) and unselected bi-syllables (bi-syllabes which had no equal stress). They reported a slope of 10%/dB for the articulation function of selected spondees and a slope of 5%/dB for the articulation function of unselected bi-syllables. Unselected bi-syllables are not homogeneous withrespect to intelligibility and they result in a more gradual slope than that obtained using selected spondees (Fudging et al, 1947). Thus this factor could " have resulted in the gradual slope that is obtained in the present study.

The difference between the study by Hirgh et al's(1952) and the present study could also be attributed to the difference in the response modality/that was employed. The subjects in the present study were asked to give written responses. This could have resulted in the less than 100% score. Also many of the subjects had only primary education and many of them reported to be out of touch with writing. They also reported that they could have performed better if they were asked to respond orally, as they could hear the words but could not write them correctly, within the time alotted for writing their responses.

SRT Level:

The mean SRT level in the present study will be probably Attained at -3dB SL (ref.PTA). Since the mean score of the correct responses was 55% at thelowest sensation level i.e., -8 dB SL. Considering the slope of 5%/dB, the above SRT threshold was extrapolated. Hence the mean SRT for the Tamil group would be 8 dB and for the Kannada group 7 dB, with the mean pure tone average being 10.94 dB and 10.4 dB respectively. The SRT, when calculated in dB SPL, results in 27.5 dB SPL and 26.5 dB SPL for the Tamil and Kannada groups respectively. These levels are considerably higher than the SRT level(14 or 15 dB ref. 20 uPa and 18 dB ref. 20 μPa with CID W- and CTD W-2 respectively) reported by Hirsh et al (1952). This difference could be once again attributed to the methodological differences discussed above. However, a more plausible reason could be that Hirst et al (1952) tested native speakers of English while in the present study non-native speakers of English who had no formal education in English served as subjects. The evidences that the native speakers obtain higher scores on a discrimination task, than the non-native speakers (Nikam, Beasley and Rintelmann, 1976; Malini, 1981; Sinha, 1981; Sood, 1981) provide further support to the findings of the cresent study.

Differences among the_different forms of the list:

The two way analysis of variance (Table III and Table IV) indicated no significant differences among the different forms of the list even at 0.05 level. Thus the fores may be used inters changeably in the determination of the speech reception threshold.

Effects of native language:

The results of the two way analysis of variances (Table V) depleted significant differences between the two language groups tested. However, this could be due to the fact that the Tamil

...

subjects had a higher educational standard when compared to the group of subjects with Kannada as their native language. Further the probability of perception of a given sound in a given environment is related to the language back ground of the listener (Sapon and Carroll, 1957, Singh, 1966 and Singh and Black, 1966). Thus the differences between the two language groups could also be attributed to the above factor.

Clinical implications:

The results of the present study suggest that the test can be used with subjects who have no formal education in English. Further the test can also be used with various linguistic groups. However, norms should be specifically obtained for the particular language group before it is clinically applied

*****

Chapter - 6

SUMMARY AND CONCLUSIONS

In the present study and Attempt was made to construct a speech reception threshold test, utilising English bi-syllabic words.

The study consisted of constructing a list of words which were rated as most familiar by more then 75% of the subjects from four different linguistic groups, viz., Kannada, Tamil, Urdu and Bengali. The final list of words was randomized and four different forms of the list was constructed. These forms were standardized on two different groups of normal hearing subjects who had their native languages as Kannada and Tamil respectively.

Based on the results of the above study, the following conclusions seem warranted;

1. The mean speech reception threshold is obtained at -3 dB (ref. PTA). The percentage of correct responses of the bi-syllabic words increase with increase in sensation levels.

2. There are no significant differences between the different forms of the list, suggesting that the forms could be used interchangeably in clinical application.

3. A significant difference was noticed between the performances of the two language groups tested.

Thus the present study can be used with subjects who have no formal education in English. Further, the test can also be used with different linguistic groups. However, norms should be specifically obtained for the particular language group before it is clinically applied.

Suggestions for further research

1. Forms may be established for different language groups. A comparison can be made of performances of the subjects in to these groups.
2. The performances of literate and illiterate groups of subjects may be compared.
3. The validity of the test on hearing impaired patients needs to be evaluated.
4. The performance of subjects may be evaluated using oral responses.
5. An assessment of the performance of subjects at higher and lower sensation levels than that used in the present study may be made.

*****

BIBLIOGRAPHY

Abrol, B.M., Establishment of a pilot rehabilitation unit in Audiology and Speetch pathology in India, Final report, New Delhi; A.I.I.M.H., 1971

ASHA guidelines for determining the threshold level for speech. ASHA., 21 (1979). 353-356

Seattle, R.C., Svihovec, D.V., and Edgerton, B.J. Relative intelligibility of the CID spondees as presented via monitored live voice. J.Speech Hear. Dis. 40, 84-91. 1975.

Berger, K.W., Speech audiometry in D.E. Rose (Ed.), Audiological assessment. II edition, Chapter 7, pp.227-260, N.J.: Prentice-Hall, Inc., 1978.

Bocca, E. and Calcaro, C., Central hearing processes, in J.Jerger (Ed.), Modern developments in Audiology, Chapter 9, New York: Academic Press, 1963

Bode, D.L. and Fasten, R.N., Hearing aid distortion and consonant identification, J.Speech Hear. Res. 14, 323-331, 1971.

Carhart, R., Tests for selection of hearing aids: Laryngoscope, 56, 780-794, 1946a.

Carhart, R., Volume control adjustment in hearing aid selection. Laryngoscope, 56, 510-526, 1946b.

Carhart, R., Speech reception in relation to pattern of pure tone loss. J. Speech Hear. Dis., 11, 97-108, 1946c.

Carhart, R., Observations on relations between thresholds for pure tones and for speech. J.Speech Hear. Dis. 36, 476-483, 1971

Carhart, R., and Porter, L.S. Audiometric configuration and prediction of threshold for spondees, J.Speech Hear. Res., 14 486-495, 1971.

Chaiklin, J.B., The relation among three selected auditory speech thresholds., J.Speech Hearing Res., 2, 237-243, 1959.

Chaiklin, J.B. and Ventry, I.M. Spondee threshold measurement: A comparison of 2 and 5 dB methods., J.Speech Hear. Dis. 29, 47-59, 1964.

Chaiklin, J.B., Font J. & Dixon, R.F., Spondee thresholds measured in ascending 5-dB steps., J.Speech Hear. Res. 10, 141-145, 1967.

Conn, M., Dancer, J. and Ventry, I.M. A spondee list for determining speech reception thresholds without prior familiarization, J.Speech Hear. Dis. 40, 388-396, 1975.

Doyne, M.D. and Steer, M.D., studies in speech reception testing. J.Speech Hear. Dis., 16. 132-138. 1951.

Falconer, G.A., The reliability and validity of monitored connected discourse as a test of threshold intelligibility: J.Speech Hear. Dis., 13, 369-371, 1948.

Farrimond, T., Factors influencing auditory perception of pure tones and speech. J.Breech Hear. Res., 5. 194-204. 1962.

Gjaevenes, K., Estimating SRT from pure tone hearing loss, J.Aud. Res. 9, 139-144, 1969

Gjaevenes, K., Estimating SRT for Norwegian PP monosyllables from the pure tone audiogram in conductive deafness. J.Aud.Res. 14. 61-64, 1974.

Ferris, J.D., Speech Audiometry in Glorig, A. (Ed.), Audiometry: Principles and Practices, Ch.7, pp.151-169. Baltimore: Williams and Wilkins Co., 1965.

Hemalrtha, R., SRT for children in Kannada - Unpublished independent project, University of Mysore, 1981.

Hirsh, I.J., Clinical application of two Harvard auditory tests. J.Speech Hear. Dis., 12. 151-158. 1947.

Hirsh, I.J., The measurement of Hearing, New York: Mc Grow Hill Book Co., 1952.

Hirsh, et al. Development of materials for speech audiometry. J.Speech. Hear. Dis. 17. 321-337. 1952.

House, A.S., et al, Articulation testing methods: Consonantal differentiation with a closed response set. J.Acoust. Soc. Am., 37, 158-166, 1965.

Jefferes, J., Quality judgement in hearing aid selection. J.Speech Hear. Dis. 25. 259-266. 1960.

Jerger, J.F., Carhart, R.; Tillman, T.W.; Peterson, J.L. Some relations between normal hearing for cure tones and for speech. J.Speech Hear. Res. 2, 126-140. 1959.

Jerger, J., and Hayes, D., Hearing aid evaluation. Arch.Otolaryngol., 102, 214-205, 1976.

Jerger, J. and Jerger, S., Auditory findings in brainstem disorders. Arch. Otolaryngol., 99. 34?-349. 1074.

Jerger J. and Jerger, S., Clinical Validity of central auditory tests. Scand. Audiol., 4, 147-163, 1075.

Kasden, S.D. and Robinson, M. Bone conduction speech discrimination in different pathologies. J.Aud. Res. 9, 268-270, 1961

Katz, J., The use of staggered spondaic words for assessing the integrity of the central auditory nervous system., J.Aud.Res. 2, 327-337, 1962.

Katz, J., The SSW test - an interim report. J.Speech Hear. Dis. 33, 132-146, 1968

Katz, J., Clinical use of Central auditory tests in J.Katz (Ed.) Handbook of Clinical Audiology, II Edition, Ch.20, 233-243. . Baltimore: Williams & Wilkins Co., 1978.

Kopra, L.L. and Blosser, D., Effects of method of measurement on most comfortable loudness level for speech. J.Speech Hear. Res. 11, 497-508, 1968

Kreul, E.J. et al, A proposed clinical test of speech discrimination. J.Speech Hear. Res., 11, 536-552, 1968.

Macrae, J.H. and Bridgen, D.N. Auditory threshold impairment and every day speech reception. Audiol. 12, 272-290, 1973.

Malini, M.S., Standardization of NU Auditory test No.6. on an English speaking Indian Population; Unpublished Master's Dissertation, University of Mysore, 1981

Mallikarjuna, The spondee words in the Gujarati Language - Presented at the XVI Annual ISHA Conference at Madras, 1984. 198

Martin, F.N. Introduction to Audiology Ed.2, New Jersy,Prentice Hal

Martin, F.N. and Pennington, C.D. Current trends in audiometric practices, ASHA, 13, 671-678, 1971.

Martin, F.N. and Stauffer, M.L. A modification of the Tillman-Olsen method for obtaining the SRT, J. Speech Hear. Dis. 40, 25-28, 1975.

Newby, H.A., Audiology, Ed.3. New York: Appleton- Century Crofts, 1972.

Nikam, S., Beasley, D.S. and Rintelmann, W.F., Perception of time-compressed CNC monosyllables by non-native speaker/listeners of English., J.Amer. Aud. Soc. 2, 45-48, 1976.

O'Neill, J.J. and Oyer, H.J. Applied Audiometry, New York; Dodd, Mead and Company, Inc., 1966.

Rajasekhara, K. The development and standardization of a picture SRT test for adults and children in Kannada - Unpublished Master's Dissertation, University of Mysore, 1976.

Robinson, M. and Kasden, S.D. Bone conduction speech Audiometry: A calibrated method to predict post-stapedectomy discrimination scores. Ann. Otol. Rhinol. Laryngol. 79, 818-824, 1970.

Ross, M., Hearing aid evaluation in J.Katz (Ed.), Handbook of Clinic audiology, Ed.2, Ch.43, 524-542, Baltimore: Williams and Wilkins Co., 1978

Sapon, S.M. and Carroll, J.B. Discriminative perception of speech sounds as a function of native language. Genl. Ling. 3, 62-72, 1957.

Schultz, M.C. and Schubert, E.D. A multiple choice discrimination test (MCDT). Laryngoscope, 79, 382-399, 1969

Singh, 3. Cross-Language study of perceptual confusion of plosives in two conditions of distortion. J.Acoust. Soc. Amer. 40, 635-658 (1966.

Singh, S. and Black, J.W. Study of 26 intervocalic consonants as spoken and recognized by four language groups. J.Acoust.Soc. Amer. 39, 372-387, 1966.

Sinha, A.K. An effect of Linguistic experience and auditory word discrimination by native and non-native speakers of Hindi. Unpublished Master's Dissertation, University of Mysore, 1981

Sood, S.K. Perception of Time compressed CNC monosyllables by non-native speakers of English, Unpublished Master's Dissertation, University of Mysore, 1981.

Srinivasan, K.P., Bone conduction. Speech reception threshold. Scan. Aud. 3, 145-148, 1974.

Sticht, T.G. and Gray, B.B. The intelligibility of time-compressed words as a function of age and hearing loss. J.Speech Hear.Res. 12, 443-448, 1969.

Swarnalatha, K.C. The Development and standardization of speech test material in English for Indians- Unpublished Master's Dissertation, University of Mysore, 1972.

Tillman, T.W. & Jerger, J.F. , Some factors affecting the spondee threshold in normal hearing subjects, J.Speech Hear.Res.2, 141-146, 1959.

Tillmsn, T.W. & Olsen, W.O., Speech Audiometry,in Jerger, J.(Ed.) Modern Developments in Audiology. Ed.2, Ch.2, Few York: Academic Press, 1973.

Willeford, J.A., Sentence tests of central auditory dysfunction, in J.Katz,(Ed), Handbook of Clinical Audiology, Ed. 2, Ch. 22, 252-261. Baltimore:Williams & Wilkins Co.1978.

Zerlin, S., A new approach to hearing-aid selection. J.Speech Hear. Res., 5, 379-376, 1962.

*****

A P P E N D I_X-I

1. Railroad
2. Ice cream
3. Bus stop
4. Whitewash
5. Football
6. Toothbrush
7. Platform
8. School bus
9. Soap box
10. Booth paste
11. Bed sheet
12. Footpath
13. Tubelight
14. Tar road
15. Lifebouy
16. Workshop
17. Railway
18. Chair car
19. Playground
20. Blackboard
21. Hairpin
22. Beetroot
23. Home work
24. Sick leave
25. Car shed
26. Bathroom
27. Bookshelf
28. Headlight
29. Tea stall
30. Footing
31. Handloom
32. Staircase
33. Roommate
34. Gas stove
35. Lamp shade
36. Chalkpiece
37. Suitcase
38. Matchbox
39. Fruit juice
40. Key chain

41. Necklace
42. Ear ring
43. Road train
44. Pop com
45. House rent
46. Lunch break
47. Hosepipe
48. Footstep
49. Wrist watch
50. Store room
51. Cold drink
52. Toll gate
53. Rice mill
54. Postcard
55. Grandson
56. First show
57. Post box
58. Housefull
59. Birthday
60. Noon show
61. Postman
62. Bus route
63. Right turn
64. Door lock
65. Main road
66. Thank you
67. Wheelchair
68. Headache
69. Watchman
70. Bread piece
71. Light bill
72. Road block
73. Milk van
74. Car race
75. Light switch
76. right shift
77. Line bus
78. Notebook
79. Steel plate
80. Doorbell
81. Full stop

APPENDIX - II

FORM 'A'

1. Football
2. Blackboard
3. Lifebouy
4. Birthday
5. Home work
6. Necklace
7. Suitcase
8. Right turn
9. Post box
10. Store room
11. Postcard
12. Tubelight
13. Postman
14. Door lock
15. Railway
16. Book shelf
17. Platform
18. Soap box
19. Hairpin
20. Bed sheet
21. Watchman
22. Notebook
23. Chalkpiece
24. Bread piece
25. Ice cream
26. Gas stove
27. Bus route
28. Doorbell
29. Toothpaste
30. Noon show
31. Main road
32. Match box
33. Light switch
34. Bathroom
35. Light bill
36. Thank you
37. Cold drink
38. Playground
39. First show
40. Fruit juice

A P P E N D I X - II

FORM 'B'

1. Bus route
2. Light bill
3. Bathroom
4. Match box
5. Hairpin
6. Tubelight
7. Cold drink
8. Notebook
9. Birthday
10. Postman
11. Toothpaste
12. Bookshelf
13. Soap box
14. Watchman
15. Gas stove
16. First show
17. Main road
18. Bread piece
19. Necklace
20. Bed sheet
21. Playground
22. Boor lock
23. Post card
24. chalk piece
25. Thank you
26. Post boy
27. Fruit juice
28. Light switch
29. Railway
30. Platform
31. Home work
32. Suit case
33. Noon show
34. Black board
35. Right turn
36. Store room
37. Football
38. Lifebouy
39. Ice cream
40. Doorbell

A P P E N D I X - II

FORM 'C'

1. Thank you
2. Bathroom
3. Cold drink
4. Playground
5. Light switch
6. Store room
7. Black board
8. Chalkplece
9. Post box
10. Hairpin
11. Match box
12. Door lock
13. Main road
14. Lifebouy
15. Bookshelf
16. Birthday
17. Postcard
18. Necklace
19. Soap box
20. Railway
21. Bread piece
22. Right turn
23. Gas stove
24. Toothpaste
25. Noon show
26. Tubellght
27. First show
28. Bug route
29. Post man
30. Watchman
31. Bed sheet
32. Platform
33. Fruit juice
34. Notebook
35. Suit case
36. Light bill
37. Ice cream
38. Football
39. Door bell
40. Home work

A P P E N D IX - I I

FORM 'D'

1. Necklace
2. Football
3. Hairpin
4. Post man
5. Doorbell
6. Note book
7. Bread piece
8. Gas stove
9. Chalk piece
10. Lifebouy
11. Light bill
12. Light switch
13. Bed sheet
14. Fruit juice
15. Main road
16. Cold drink
17. Soap box
18. Playground
19. Right turn
20. Hatch box
21. Store room
22. Watchman
23. Post card
24. Black board
25. Door lock
26. Home work
27. Thank you
28. Platform
29. Suit case
30. Bookshelf
31. Noon show
32. First show
33. Bath room
34. Birthday
35. Tubelight
36. Ice crenm
37. Bus route
38. Railway
39. Toothpaste
40. Post box

APPENDIX - III

I Pure tone Calibration:

Calibration was checked for both intensity and the frequency pure tones generated by the audiometer (Madsen OB 70 clinical audiometer).

1.1 Intensity calibration:

All intensity measurements were done when the audiometer output was set at 70 dB HL. The acoustic output of the audiometer was given through earphones (TDH-39 with MX-4l/AR ear cushions) to a. B & K condensor microphone type 4144, which was fit into a a B & K artificial ear type 4152. The microphone was connected into a B & K pre-amplifier type 2616. The signal was then fed into a B & K audio-frequency (AF) analyzer type 2107. Whenever the difference between the observed SPL value and the expected value (AFSI standards, 1969) was more than 2.5 dB, internal calibration was done by adjusting the presets in the audiometer. Thus the output levels of the audiometer was well within 2.5 dB with reference to the standards.

1.2 Frequency calibration: The frequency of the pure tones were checked using a Rodart 203 timer/counter. For this the electrical output of the audiometer was given. The frequency reading on the dial and the difference between the two never exceeded 3% of the dial reading.

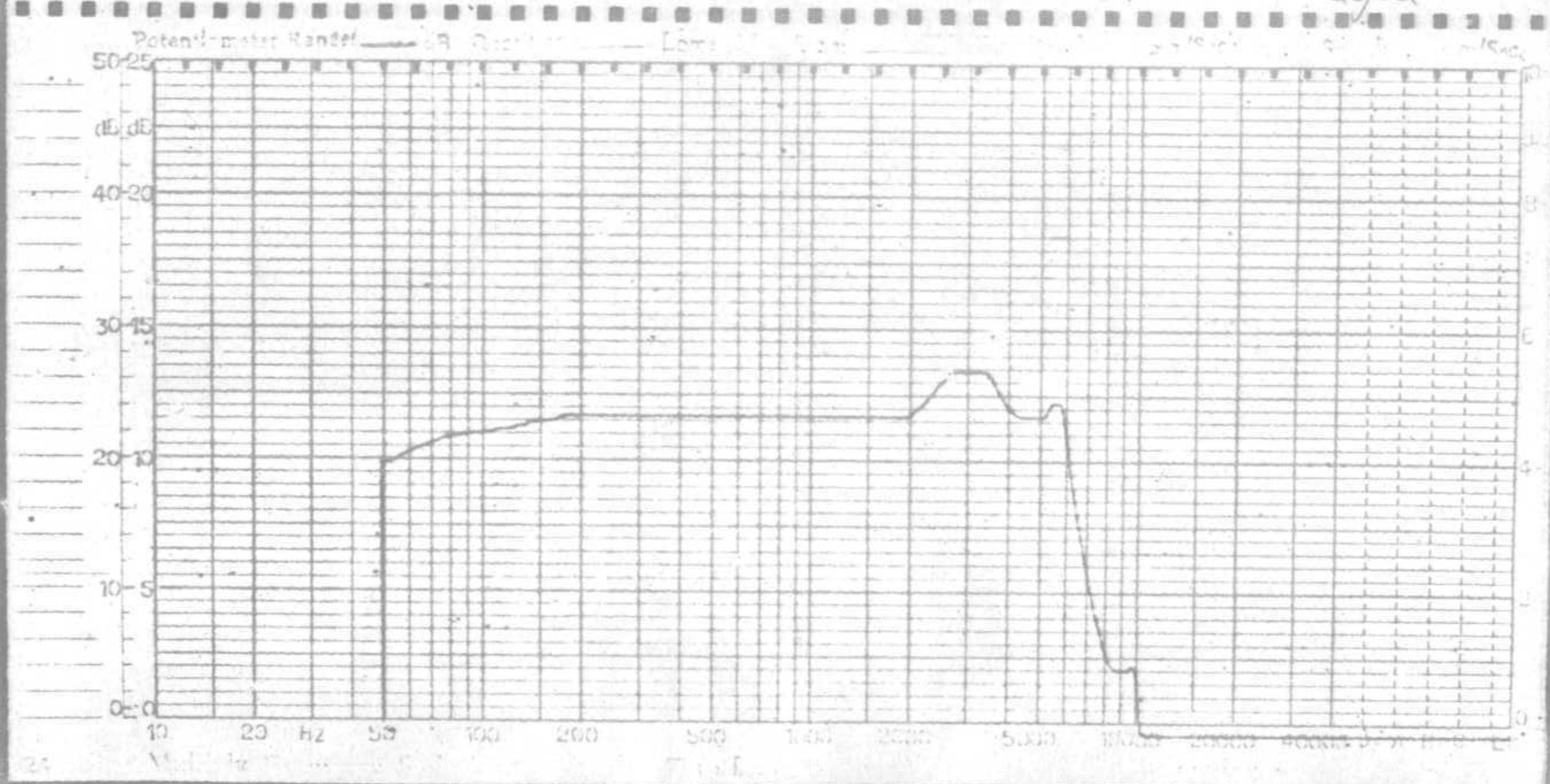
...

2. Earphone frequency response characteristics:

Earphone frequency response characteristics were checked by using a B & K Beat frequency oscillator (B.F.O) model 1022 and a B & K level recorder model 2305. The frequency of the pure tones generated by the B.F.O was checked previously with a Rodart 203 timer/counter and was found to be satisfactory. The electrical output of the B.F.O. was given to the earphones (TDH-39 with MX-41/AR ear cushions) that were to be used in the study. The earphone output was collected by a B & K condensor microphone type 4144 connected to a B & K pre-amplifier type 2616. This was given to a B & K level recorder 2305. The frequency response of the earphones was thus graphically recorded on a recording paper QF 1124. The frequency response characteristics of the earphones used in the study are depicted in Appendix-IV.

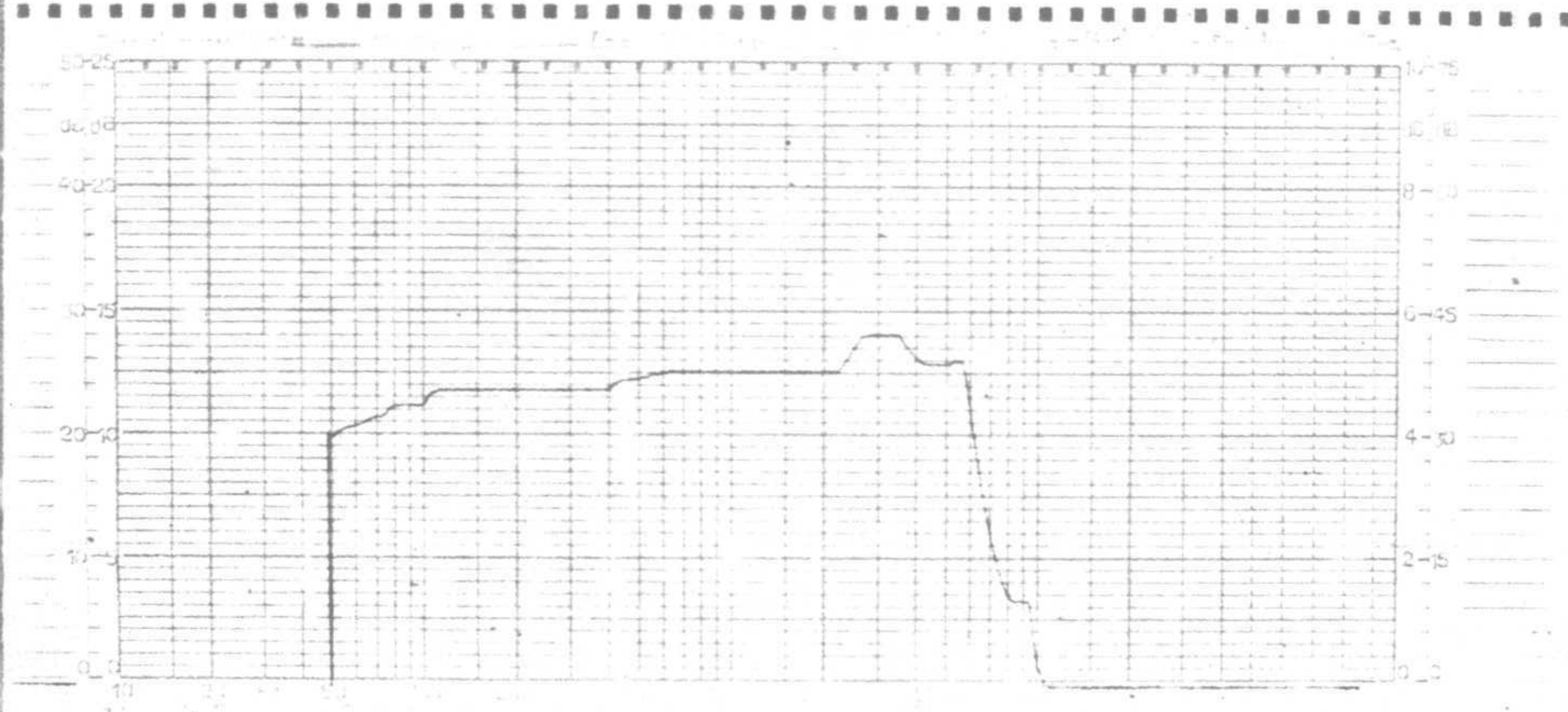
....

APPENDIX IV



Frequency Response Characteristics of Earphone 1 [right]

APPENDIX IV



Frequency Response Characteristics of Earphone 2 [left]

APPENDIX- V

Noise levels in the test room

125 Hz	- 29 dB (A)
250 Hz	- 20 dB (A)
500 Hz	- 11 dB (A)
1000 Hz	- 13.5 dB (A)
2000 Hz	- 12.5 dB (A)
4000 Hz	- 14.5 dB (A)
8000 Hz	- 8 dB (A)

...