Development and Standardization of A Lip Reading Test In Hindi Language To Detect Psuedo Hypacusis

REG- NO-10

A DISSERTATION SUBMITTED IN PART FULFILMENT
FOR THE DEGREE OF MASTER OF SCIENCE
(SPEECH AND HEAR[NG)
UNIVERSITY OF MYSORE 1982

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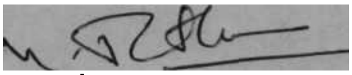
To,

My Parents.

<u>C E R T I F I C A T E</u>

This is to certify that the dissertation entitled "Development and Standardization of a lip reading test in Hindi language to dtect psuedo hypacusis," is a bonafide work in part fulfilment for the degree of Master of Science (Speech and Hearing), of the student with Register No. 10.



Director,
All India Institute of
Speech & Hearing, Mysore

C E R T I F I C A T E

This is to certify that the dissertation entitled "Development and Standardization of a lip reading test in Hindi language to detect psuedo hypacusis" has been done under my super vision and guidance.

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Lecturer in Audiology,
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D E C L A R A T I O N

This dissertation is the result of my own work done under the guidance of Mr. M.N.Vyasamurthy, Lecturer in audiology, All India Institute of Speech & Hearing Mysore, and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore, Reg.No.10

Dated:

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C O N T E N T S

CHAPTER - 1

Introduction

Many patients seen in audiology clinics manifest symptoms of non-organic hearing loss. They may be malingering, exaggerating a hearing loss, have a psychogenic disorder or there may be other reasons for test results to be inaccurate. The responsibility of the audiologist is to determine the true organic thresholds of hearing, even if this must be done with less than the full co-operation of the patient (Martin 1981).

The subject of functional or non-organic hearing loss has received considerable attention for many years from the physician and (more recently) the audiologist. Chaiklin and Ventry (1965) have listed more than 400 possible causes of functional deafness (Kinstler 1971).

In its most simplest terms 'non-organic hearing loss', means "an exaggerated elevation of auditory thresholds." Martin (1981) has defined the term as "an apparent loss of hearing sensitivity without organic pathology, to explain the extent of the loss or, with insufficient pathology to explain the loss or the extent of the loss."

Not all audiologists and other specialists concerned with hearing, use the term non-organic hearing loss, (Martin 1981). Chaiklin and Ventry (1963) and many others greatly stress the use of the term 'functional hearing loss, as it is more meaningful and operational. But Martin (1981) comments that, while the term functional may be used to express any kind of non-organic disorder, the word psuedo hypacusis relates specifically to hearing loss. So there still remains a great controversy on which term needs to be used.

Although functional hearing loss or functional overlay has long been a recognized clinical entity, only recently, have, reasonably accurate methods been_developed to measure organic thresholds in subjects who are unable or unwilling to respond accurately in the test situation (Kinstler 1971).

As functionality itself becomes more readily identifiable, the problems posed by functional loss - diagnosis, evaluation establishment of organic thresholds, attitude toward the patient, possibility of resolution of functional component or treatment of the patient are of increasing concern to the clinical audiologist, to the otologist and to those involved in rehabilitation of the deafened (Kinstler 1971).

But the increasing research in this field has been able to provide us with knowledge which would be of great help while dealing with functional hearing loss patients. The source of patient referral, history of hearing loss, symptoms and behaviour, both during and outside of hearing tests are factors to be considered before making a diagnosis of non-organic hearing loss. Patients whose hearing loss appears to be exaggerated may manifest these symptoms because they are incapable of more reliable behaviour, because of will-ful fabrication or exaggeration of a hearing disorder or because of some psychological disorder. Observation of the patient and special tests for non-organic hearing loss Often lead the audiologist to the proper resolution of the problem (Martin, 1981).

The primary purpose of special tests for psuedo-hypacusis is to provide information about the patients hearing, even in cases where cooperation is lacking. Tests for non-organic hearing loss may be performed, With puretones or with speech Some tests may be carried out with the usual diagnostic audio-meter, and other tests require special equipment. Unfortu-nately, many of the tests are merely qualitative, that is, they produce evidence of non-organicity but do not reveal the threshold of hearing. Other tests are quantitative, revealing information about the actual thresholds of the patient, (Martin, 1981).

The different tests have been developed to aid in diagnosis of functional hearing loss are Stenger test which has puretone and speech categories, the Doerfler-Stewart test, the Lombard test, delayed feedback tests which again has the puretones, and speech categories, Bekesy audiometry, swinging story test, electro-physiologic tests under which come the acoustic reflex tests, electro-dermal audiometry, evoked response audiometry and respiration audiometry.

Identification of non-organic hearing loss may be made by use of a standardized test for lip reading ability (Utley 1940), often with excellent results. Falconer (1966) also found that patients with functional hearing loss, often emphasized the point that they get along well in ordinary situation, inspite of their hearing loss, because they read lips. He inferred that, they were not solely depending on lip reading but were making atleast some use of hearing. He felt that these patients would usually submit to a 'lip reading test.'

Based on the above, Falconer (1966) developed a 'lip reading test' which contains auditory as well as visual stimuli and consists of monosyllabic homophenous words which are nearly impossible to perceive by lipreading alone. The patient how ever does not know this and responds in his usual way to sound and vision. Because, most of the correct responses are a result of audition, the patient inadvertently reveals some degree of functional hearing loss.

To determine the usefulness of 'Falconer's lipreading test; in the establishment of organic hearing levels, Goldman (1971) administered the test to normal, organic and functional hearing loss groups. He concluded that the test can help to determine the organic hearing levels definitely, with its predicted SRT relating closely to standard pure tone and speech measures and that it is remarkable in exposing the functional problem without obviously indicating to the subject that he has been caught.

Subba Rao (1981) worked on the lines of Falconer (1966) and developed a lipreading test in kannada language. He also, concluded that the test helped in predicting SRT which, very closely corresponded to the true SRT in normal and also in sensori neural hearing loss patients. He recommended that similar tests, be constructed in other Indian languages.

Need for the Studv:-

Hindi is our National Language. Majority of the Indians speak the Hindi language and most of the Hindi speaking people may be mono-linguals. Thus, there is a great need for developing a lipreading test in Hindi language, to identify psuedo hypacusis.

Plan of the Study:-

The study was planned to develop the test materials in Hindi language, and, then to standardize the test materials on normal and hearing loss population.

CHAPTER - 2

Functional Hearing Loss - Review

2.1 Introduction:-

The lack of cooperation in some of the patients seen in Audiology may be due to the fact that 1) he does not understand the test procedure 2) is poorly motivated 3) is physically or emotionally incapable of appropriate responses 4) wishes to conceal a handicap 5) is deliberately feigning or exaggerating a hearing loss for personal gain or exemption or 6) fails to respond accurately due to unconceous motivation (Chaiklin & Ventry, 1963).

Among these, are a group of those patients who may profess to have a total loss of hearing or show an amount of hearing loss which appears greater than can be explained on the basis of pathology in the auditory system. Remarkably, however, the patient may respond adequately in ordinary conversation with or without a hearing aid (Falconer '66), Frederick '78).

Many terms have been used to describe the existence of such a hearing loss, they are functional hearing loss (Jerger '67, Alberti, '70), non-organic hearing loss (Barr '52), Dixon & Newby, '70), psychogenic hearing loss (Doerfler, '54, Martin, '46) psychic deafness (Froeschels, '44), Auditory malingering, (Fournier '58, Gullman, '38, Kodman et al '59), pseudo-neural hypacusis (Brockman '60), hysterical deafness (Rosenberg, '40), psuedo deafness(Heferman, et al. '55). These variety of terms have made diagnosis difficult, as well as communication (Ventry & Chaiklin, '62).

Ventry & Chaiklin ('62) are of the view that the most appropriate term is 'functional hearing loss' as it is a generic term that labels a group of things or events that have one or more common attributes. The term has been defined as 'Functional hearing loss means that the patients hearing problem has been investigated as thoroughly as possible with the best available instruments and method and that, no organic factor was found to account for his symptoms'(Landes & Bolles, '50). It may also mean that the medical findings were insufficient to account for the magnitude of patient's symptoms. This conception allows the possibility that further examination may reveal an organic condition to account for all or a part of the patient's problem.

Davis & Silverman ('60) believe that very often organic and psychogenic problems are involved in the degree of hearing loss in uncertain proportions. Therefore, it is important to recognize that the word 'functional' is not an antonym of 'organic' or a synonym of 'psychogenic', but as a diagnosis it means that an organic etiology if any is unknown. But Goldstein('66) stresses that functional hearing loss has no organic basis, rather it has psychogenic origin.

Functional hearing loss, traditionally includes both the intentional pretense of not hearing and the unconcious failure to hear, because of some psychic disturbance(Goldstein '66) Beagley ('73) has tried to intuitively sub-divide this group into the above two sub-divisions. i.e., (1) Those with concious stimulation, which includes, feigning, malingering or simulation. (2) those with sub-concious stimulation, this group has also been called as the hepterical or psychogenic group.

No audiologic test differentiates between these two groups. The literature differentiates, stating that a person who is feigning, is usually inconsistent in his responses, during various hearing tests and the results of the varying hearing tests are not compatible with each other or with patients obvious ability to hear, when he is not in the test situation. In a psychogenically impaired patient, it is assumed that he will not be consistent in his failure to respond during hearing tests to sounds weaker than a given level and that his test results will be compatible with his ordinary reactions or lack of reactions to speech, and other sounds in his daily life(Goldstein '66). Some authors use the term 'psychogenic deafness' to indicate those patients with concious exaggeration of hearing loss(Johnson et al '56, Klotz et al '60, Kodman et al '59) and the term 'true psychogenic deafness' for those with unconcious motivation (Bailey and Martin '61).

Malingering is often confused with functional hearing loss, although it is not its synonym. 'Malingering' is a specific term referring to concious exaggeration or fabrication of symptoms for primary or secondary gain (Chaiklin & Ventry '63). It is best viewed as a symptom rather than a diagnosis (Flicker, '58, Williams, '66). At present, the only way it can be identified is when a person admits he is malingering.

Prior to World War II, the topic of functional hearing loss wasn't given much importance, the reasons being (a) failure to recognize the problem, (b) limited number of standardized hearing tests, (c) inadequate audiometric equipment and (d) possibly a lower incidence of functional hearing loss.

After the war the percentage of cases with this problem increased, drastically, and was estimated by Johnson ('56) as being 11% to 45%. Today, functional hearing loss is not just limited to those in army, industrial set up, otologic and audiologic setting, in fact it can occur whenever hearing is measured (Chaiklin & Ventry '63). A large number of tests have been described as an aid to diagnose functional hearing loss, ranging from sophisticated tuning fork examination to complex psycho-acoustic and psychological examination (Alberts '70). Some of these will be discussed in detail later on.

2.2. **Incidence of Functional Hearing Loss in Adults**:-

Chaiklin & Ventry ('63) sate that the incidence of the problem, got from different studies is variant, as it depends on (1) the patients evaluated in each setting, (2) the criteria of functionality varies, (3) order of testing(Menzel '60) (4) some clinics administer the special tests for functional hearing loss only when it is suspected (Young & Gibbons '62), whereas other clinics administer it more or less as a routine, thus incidence is higher in the latter conditions, (5) It results from differences in the degree of which subjective evaluations are used in the identification process. In some clinics, the examiner's subjective endence is considered as important, while in others objective endence is necessary.

Although systematic large scale approach to the problem is needed, some authors have reported the incidence. Feldman ('69) stated that 3% of the general population may fall into this category. Nilo & Saunders('76) found that 1% of general population had the same, while 85-90% of the cases referred from military sources and 11-45% of the Veteran administration population had functional hearing loss. Johnson ('56) also reported that percentage of functional hearing loss since the II world war has gone up by 11-45%.

2.3. **Incidence of Functional Hearing Loss in Children:-**

Chaikline & Ventry ('63) reported that there have been many articles on functional hearing loss in chidren, but none have reported of their incidence (Bailey & Martin '61, Barr '60, Bert & Feldman '58, Brockman & Hoversten '60, Calvert et al '66, Cobb & Butler '49, Dixon & Newby '58, Froeschels '44, Hefferman '58, Kodman & Waters '61).

Doerfler ('51) reported of a survey of audiology centres to determine incidence of functional hearing loss in children and found that 75% of the centres who responded indicated that they saw few or no children with functional hearing loss. While, Feldman ('61) reported that it occured more frequently in children. Rerger ('63) reported an incidence of 7% in children. Brockman & Hoversten ('60), Calvert et al C61) Dixon & Newby ('59), indicated functional hearing loss occured thrice more often in females than in males, but they did not explain the reason.

2.4. Indications of functional hearing loss:-

2.4.1. The Non-test situation:

(1) Source of referral can suggest functional hearing loss (Martin '78, Nilo & Saunders '76). Eg: A case of sudden hearing loss after an accident and being referred by an attorney.

(2) Case history of particular value, especially in compensation cases (Martin '78).

(3) suspicion of functional hearing loss should arise when there are claims for financial gains and secondly when patient reports of sudden or has vague origin of his problem (Feldman '69).

(4) General behavior in clinical evaluations. Johnson et al ('57) have pointed some behavioral clues about functional

hearing loss. They are (i) obvious psychiatric disorders, (ii) unsolicited comments on questions regarding compensation (iii) remarks such as 'I can get along fine when I can read your lips' (iv) Exaggerated attempts to hear (v) Exaggerated staring attempt to impress his ability to lip read (vi) Excessively loud voice (vii) Refusal to attempt lip reading may force examiner to write (viii) obvious nervousness.

Thome ('60) gave the following points, (1) normal voice inflection (2) poor knowledge of hearing aid (3) comments on his health (4) learned lip reading too quickly (5) reluctance in behavior (6) is extremely passive or anxious. Similar points have been put forward by Martin ('78), Chaiklin & Ventry ('63), Nilo & Saunders ('76), Feldman ('69) Beagley ('73).

2.4.2. The Test Situation:

Several authors (Fournier '58, Heller '58, Johnson et al '56, Newby '58, Chaiklin & Ventry '63, Martin '78, Wood '77, Feldman '69, William '69) have given the following characteristics and behavioral cues, as found in functional hearing loss (1) hesitancy or restraint in responding, (2) delayed responses, (3) exaggerated display of effort to hear, (4) ability to understand conversation at hearing levels below SRT, (5) manifest anxiety symptoms, (6) inconsistent response during PTA, (7) half-word responses to spondaic stimulus during SRT MEASUREMENTS, (8) rhyming responses during discrimination testing and (9) Slow and tentative responses.

Martin('78), Chaiklin & Ventry('63) have stressed that the occurance of false negative responses is a very likely behavior with functional hearing loss.

2.5. The Audiometric Examination:

Pure Tone Audiometry:

2.5.1. Test Retest reliability: In functional heading loss there is a lack of acceptable intra test and inter test threshold reliability. It is believed that they cannot maintain a consistent reference loudness level, through out repeated testing and hence thresholds are variable for different tests on repetitive testing. This view has been supported from studies from studies by a number of authors (Heller ('55), Chaiklin and Ventry ('63) (66), Newby ('65), Martin ('78), Shepherd and David '65). But Watson and Jolan ('49) oppose the above view and state that the feigned hearing loss may be repeated accurately by some individuals on repeated measurements of pure tone thresholds. Chaiklin and Ventry ('63) have reported that 66% of functional hearing loss patients they saw were unable to reproduce correctly. Anyway further research is needed on this line to arrive at a conclusive statement.

2.5.2. Inappropriate Liberalization: Inappropriate of pure-tone in unilateral hearing loss is a sign of functional hearing loss. This is reflected by an absence of a shadow curve or an elevation of shadow curve beyond that ordinarily expected, (Chaiklin and Ventry ('63), Williamson ('69), Feldman ('69), Martin ('78). The lack of contralateral response especially for BC, is a very clear and important symptom for unilateral hearing loss (Martin '78, Williamson ('69).

2.5.3 Saucer Audiogram: Some describe the pattern as being relatively flat audiogram (Se Henor '47, Fournier '58). Others feel it is saucer-shaped (Doerfler '51, Carhart '58, Goetzinger and Proud '58, Williamson '69). But the same is found in organic cases also. Martin ('78) has concluded that, there is no typical configuration associated with functional hearing loss.

2.5.4. Bone Conduction Audiometry:

3ohnson ('56) suggested 2 findings on BC audiometry, that could be related to functional hearing loss. 1) BC thresholds significantly poorer than AC thresholds and 2) BC threshold equally depressed for all frequencies tested. Chaiklin and Ventry ('61) did a study to test the above hypothesis, but their results did not support it.

2.6. Speech Audiometry:

2.6.1. a) PTA - SRT relationship:-

There is a high correlation between PTA and SRT in most pathological cases. The agreement between the two is about ± 8dB. The more the difference exceeds ± 8dB, the more likely it is, that it is a functional hearing loss case. Such a lack of agreement between the two is the absence of explanation, such as slope of the audiogram or poor word discrimination (Noble '73) is seen in functional hearing loss. Most frequently SRT is significantly lower than the appropriate PTA (Brockman '60, Carhart '52, Chaiklin et al '59, Dixon and Newby '59, Glorig '54, Goetzinger and Proud '58, Newby '58, Portmann and Portmann'61).

Chaiklin and Ventry ('63) from their study found that 1) a high percentage 45 - 50% of subjects with functional hearing loss have PTA - SRT difference greater than 15dB 2) a small percentage of subjects with functional hearing loss are able to match PTA and SRT with in + 8dB, 3) SRT is usually lower than PTA.

Contrary to the above Morno etal ('77) found that SRT - PTA difference, was the least frequent indicator of functional hearing loss.

2.6.2. b) Test Retest Reliability for SRT:

A number of studies suggest that reasonable variability on repeated SRT measurement in ± 6dB. Menzel reported it to be ± 5dB. The authors say that one can assume that there is no functional hearing loss, if there is good agreement between repeated SRT measurement. On the other hand, failure to repeat SRT's with in ± 6dB is a strong sign of functionality, one that will produce false +ve identification. The SRT presented is usually close to the true SRTs and so if this Is valid, they also have high reliability.

2.6.3. The way in which a patient responds to traditional speech audiometry can itself be an indicator of functional hearing loss(Hopkinson '73). A patient may repeat only one half word of a spondee during SRT measurement, with no valid reason for not being able to repeat the other half of the word.

Chaiklin and Ventry ('63) have worked out a formula for spondee error index, so that a high score contrasted with a low number of false positive response during pure tone testing, identifies a functional patient. Typical responses are also observed while testing discrimination (Hopkinson '73 and '78).

2.6.4. Speech Discrimination:

It is inappropriately low in relation to pure tone threshold configuration. This has been cited as a sign of functional hearing loss by Carhart '60, Johnson '56, Newby '58. But this aspect is still under a controversy.

2.6.5. Again on speech audiometry there may be an inappropriate lateralization in unilateral cases. But its significance in identifying functional hearing loss is same as is seen with pure tones.

2.7. Special Tests for Functional Hearing Loss:

The problem of standardization of the functional tests of hearing has been the "bete - noise" of the Otologists. C.C.Bunch ('31) said this and commented that as much confusion existed then, as it did at the turn of the century. But much has been accomplished since then. But still, areas exist where there is a lack of understanding and standardization. In the following paragraphs is a brief description of the various tests used in diagnosis of functional hearing loss, their advantages and disadvantages.

2.7.1 Pure tones tests which identify threshold of functional hearing loss patients:-

Pure tone Stenaer test:-

Stenger described his test in Germany in 1900 and 1907 (Altshuler, ('71). It is used to identify cases of unilateral functional hearing loss. It is based on the fact that binaural stimulation with tones of identical frequencies but with different sensation levels in each ear will result in tone being perceived only in the ear having the higher sensation level. This is the Stenger Effect (Martin '78). It is used when Inter Aural (IA) difference is significant. There is no standard technique for this test, but usually tones are presented binaurally, slightly above threshold (5 to 10dB) in the better ear and at varying levels below the threshold obtained for the poorer ear. The two most common responses obtained in cases of functional hearing loss are 1) that the patient may cease responding to tones in both ears or 2) that he may continue to respond even though the stimulus in the better ear has been with drawn.

The lowest hearing level of the tone in the poorer ear producing either of the effects is the minimum contralateral interference level and should be with in 20 dB of the true threshold. If the response occurs at a level that is significantly below (15 dB or more) the voluntary threshold for the apparently poorer ear, the test is considered as being'positive!

If loss in the poorer ear is genuine, the patient will be unaware of any signal in the poorer ear and will respond to the tone in the good ear readily. It indicates that the poorer ear threshold is probably true. This is 'negative' stenger (Chaiklin and Ventry '63).

There have been extreme views on the clinical value of the pure tone stenger test. Hood ('59) said ". . . . . . .seldom of value." Whereas Goetzinger and Proud ('58) claim it as "unbeatable." Between the two extremes lie a larger number of the other researchers of this topic. Peck and Ross ('70) reported that Stenger test could identify the general hearing threshold of the poorer ear in unilateral functional hearing loss. Taylor ('49) views that the test is of considerable value in ideal candidates and in some may also help to obtain accurate estimates of threshold. This view has been supported by a majority of researchers (Kinster etal '72, Azzi '62, Davis and Silverman '60, Feldman '62, Menzel '65, Glorig '65 and Monro etal '77).

Other authors like Gibbons and Winchester ('57) and Goetzinger ('58) do not oppose the use of the test but recommend caution with its use, (Cited by Altshuler '71).

Chaiklin and Ventry ('63) are of view that the test is neither as bad nor as good as some of the critics or adherents have suggested and that more research is needed to know its clinical use. Besides the contrary views Martin ('78) is of the opinion that it is an efficient test for quick identification of unilateral non-organic hearing loss. Altshuler ('71) has also concluded that "most certainly the test is best used and in general most valid when used with unilateral cases. With the sophisticated instrumentation the stenger test also appears to be useful, even with bilateral cases."

Methods of Stenger test presentation:

Various methods of test presentations have been grouped into three classes (Altshuler '71).

A) Involves qualitative and quantitative methods:-

Screening tests used to identify functional hearing loss form the major category of the qualitative tests (Ballentyne '60 Heller '55) cited by Altshuler '71). The qualitative tests quickly advise the examiner the existence of non organicity. The method attempts to closely estimate the threshold in the poor ear and are quick and easy to administer.

If qualitative test is positive, then tests of quantitative method may be continued (Goetzinger and Proud '58, Oneill and Oyer '66, Sataloff '66, cited by Altshuler '58). Here, the signal is presented to better ear at near threshold level and to the poorer ear at 40 dBHL. If the subject does not respond at all we can presume that he hears the tone presented to the poorer ear. Usually, the quantitative methods approximate the thresholds of the individual.

B) The second category involves the quantitative method. Here you can observe, if the method, incorporates the use of an ascending or descending signal presentation to the poorer ear. Several authors suggest the use of both techniques. Peck and Ross ('70) did a study where in they determined the IL (interference level) in stenger test by using ascending and descending modes of presentation. They concluded that there was no difference in the IL's determined by either modes, and that a valid threshold can be estimated by using both methods.

C) The third classification involves the use or lack of use of a fading tone. Here, tone in the good ear is taken off, either suddenly or gradually, after increasing the tone in poor ear. If the subject continues to respond, it can be assumed that tone is heard in poor ear and the patient is trying to confound the tester or himself is confused. Gaeth '56 questions the validity of such a method (Altshuler '71).

Factors that effect Stenger Test:-

1. Diplacusis:

Diplacusis can occur in some cases and when it does occur it invalidates the stenger results. This view has been supported by many authors (Newby '58, Watson and Tolan '49). This factor has been overrated, as a barrier to valid Stenger test by Chaiklin and Ventry '63. They have mentioned the possibility that when a critical point is passed regarding perceived loudness, small pitch differences could be obscured by the Stenger effect. Altshuler ('71) has recommended the use of narrow band noise signal as stimuli which could successfully remove any role that diplacusis may have played. Speech stenger has been found to be the other alternative to overcome the problem.

2) Recruitment:-

Menzel ('65) was the one to mention recruitment as being a factor which could effect stenger results. So he suggested, that the presentation to the better ear be very close to the - threshold. Although recruitment is rare in unilateral cases, care should be taken in those subjects showing normal hearing threshold in speech frequencies and a SN dip at 4KHz. Care should be even more in bilateral cases (Altshuler '71).

3) Intensity relationship between ears:-

There are two problems which need to be viewed while considering the interanral difference, l) it involves the threshold difference between the ears, 2) involves signal presentation difference between the ears. Although more research on these topics is needed, Altshuler ('7l) and Kinstler ('72) have commented that as the interaural difference between the ears increases the effectiveness and validity of the test also increases. They also say that the other factor to be considered is the functional component in the better ear.

4) Other considerations:-

The three speech frequencies are most valid with stenger, as below 500Hz, problem of cross over may occur, while above 2K thresholds may be depressed or there may be recruitment, Heller '65, Ventry '62, cited by Artshuler '71). Ear pathology and contralateralization are other factors to be considered but for which further research is needed (Goetzinger and Proud '58, Chaiklin and Ventry '63, cited by Artshuler '71).

Modifications of the Stenger Test:-

(1) Speech Stenger Test:

It is based on the principle of classical pure tone stenger test, except that spondaic words are used as stimuli (Taylor '49, Johnson etal '56, Watson and Tolan '62, cited by Martin '78, Hopkinson '73).

It helps to identify unilateral functional hearing loss and is applied in patient with significant interaural difference in SRTs. Spondees from the same input source are fed to the better ear at a level that elicits 100% correct response. At successively increasing levels the same words are simultaneously presented to the presumed poorer ear. Test is positive, if patient stops responding or continues to respond at levels significantly lower (15dB or more) than his voluntary SRT. The test helps to obtain SRT close to patients true threshold level.

Taylor ('49) says that relatively small interaural difference can produce positive results. Menzel ('60) is of view that the test is most useful, when there is significant 1A difference in SRTs and there is a functional over lay for speech in poorer ear. Newby ('58), says that it helps to overcome diplacusis. Martin ('78) is also of the view that it helps to overcome problems of diplacusie and beats, while it also provides quantitative information of hearing level. The procedure has been described by Carhart ('66), Goetzinger and Proud ('58), Newby ('58) and Watson and Tolan ('49).

(2) Shifting Voice test:-

It is a test which is also a modification of speech stenger and is applicable in cases with unilateral functional hearing loss. The stimuli can be either instructions, questions or even spondees, this stimuli is shifted between the ears. The patient is asked to indicate through which ear he is haring the examiner by pointing to the appropriate ear phone. Johnson etal ('56) and Carhart ('60) suggest that this procedure is also useful with bilateral cases who have slight inter aural threshold differences. Davis and Goldstein ('66) have also found it to be useful in unilateral cases. An individual with psuedo hypacusis responds inconsistently on the shifting voice test (Newby '72) who has also stated that it is difficult to rely on this test as it, in turn relies on putting pressure on the patient which again depends on patients confusion (Watson '49). Thus there is disagreement whether test results approximate true thresholds, (Carhart '60).

(3) Rapid Random Loudness Judgement (RRLJ):-

The test was given by Nagel ('64) and is an outgrowth of Fowler's ABLB test. The aim of RRLJ is to confuse the noncooperative patient and to elicit from him responses to stimuli for which

(5) Using Automatic Audiometry:-

Reger etal ('63) have suggested the use of an automatic Bekesy type audiometer for the Stenger test (Watson and Voots '64, Altshuler '71). Watson and Voots ('64) have modified this procedure. After establishing thresholds of the better ear, the poor ear thresholds were traced using a stonger variable attenuator. Signal intensity decreases or increases in both ears simultaneously as the patient operates the response knob; the test is reported to have high clinical applicability.

(6) Other Modifications:-

Vyasamurthy ('71) has given 2 methods to detect unilateral functional hearing loss. His methods are based on binaural summation although the basic principle is same as in Stenger. These methods Use the finding of Hirsh ('52), that difference between binaural threshold and monaural threshold at 35 dB above the subjects threshold is 6 dB and that binaural threshold is better than monaural by 3 dB at threshold level. Here tones are first present monaurally and then binaurally at 35 dBSLand 7 dBHL, subject will have to match the loudness of the two and say which of the two were louder. Depending on the response that is whether they find the second tone weaker or louder or same in loudness as the first one, they are diagnosed as functional hearing loss. The first and second response is indicative of functional hearing loss.

Altshuler ('7l) tested 12 children on the Stenger test and found the test to be useful in obtaining thresholds. Fournier ('58) he has previously denied sensitivity. It is useful with both unilateral and belateral functional hearing loss cases.

Initially pure tone and speech reception thresholds are obtained after which patient is asked to report which of the two alternately presented tones is louder. Then in rapid succession, tones skipping variously one or more octaves after each paired presentation varying the ear of initial presentation- varying the SL - given equal time to each ear for each pair of tones. Each presentation is preceeded with the announcement - 'This is no. 1 and this is no. 2.' then "which is louder?"

An organic case will follow the random sequence easily and gives responses which are consistent his established sensitivity while the functional hearing loss patient is confused by the task. The evident confusion is a significant finding.

Nagel ('64) has commented that the efficiency of the test can be increased by establishing a more carefully programmed method of stimulus presentation.

(4) FIT (Fusion Inferred Threshold) Test:-

Altshuler ('71) quotes Bergman ('64) who described the use of stenger phenomenon to determine. . . . . . .threshold of hearing sensitivity where standard audiometry yields uncertain results." It has also been emphasized that the FIT test is not an attempt at unmasking nonorganicity but rather to determine close estimates of valid threshold with subjects that are otherwise difficult to evaluate.

(5) Using Automatic Audiometry:-

Reger etal ('63) have suggested the use of an automatic Bekesy type audiometer for the Stenger test (Watson and Voots '64, Altshuler '71). Watson and Voots ('64) have modified this procedure. After establishing thresholds of the better ear, the poor ear thresholds were traced using a stgnger variable attenuator. Signal intensity decreases or increases in both ears simultaneously as the patient operates the response knob; the test is reported to have high clinical applicability.

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Altshuler ('71) tested 12 children on the Stenger test and found the test to be useful in obtaining thresholds. Fournier ('58

Hopkinson ('65) has said that a criticism against the previous classification of Type V Bekesy is an absence of clarity in the definition, as a result of which there is over interpretations of minor differences between continuous and interrupted tracing. So in order to come out with a more appropriate definition Rintelman and Harford ('67) analyzed the Bekesy audiograms from a sample of functional hearing loss cases and concluded their definition as being "The continuous tone tracing occurs at a lower SPL than the interrupted tracing by a minimum of 10 dB, measured at the mid points of the two tracings for a range of atleast two octaves. The break typically includes mid-frequency region. Finally, the break should be complete with no overlap in tracings (no more than two excursions) and should reach a peak or maximum separation of at least 15 dB" (quoted by Ventry '71).

The Type V effect has been related to patients own intep-nal standard for most comfortable level, and the differential effect of memory upon loudness of sustained and interrupted pure tones (Rintelman and Carhart '64, Hattler '68). Some researchers have also stressed that the Type V Bekesy classi-fication should be done based on sweep frequency rather than fixed frequency (Rintelman and Harford '67, Resnick and Burke '62, Dieroff etal '70).

Ventry ('71) from his study has come with some of the major advantages and disadvantages that are involved with

Bekesy Type V. The advantages are the insight it may provide into the listening strategies employed by patients with functional hearing loss, also Bekesy audiometry does not involve any special technique, making it possible for even the experienced clinician to identify the patient. Although the disadvantage of false negative and false positive rates is associated with Bekesy, if the spondee error index (SERI) is associated with it, it would constitute a stranger evidence of functional hearing loss.

The major disadvantage is the special equipment that is required in this test. Also this test cannot be used to determine the extent of functional overlay or to estimate true threshold, thus reducing the value of the test. Peterson ('0 has reported the usefulness of this test in identifying functional hearing loss in children.

Recker ('7l) has analyzed the characteristics of the Bekesy audiograms associated with simulated hearing losses and has reported that -

1. The test - retest discrepancy, consistently present in all subjects was the most reliable criterion.
2. Type V pattern was found in 70% of the cases.
3. Saucer shaped curves and increased Bekesy excursions are not reliable indicators of simulated hearing loss.
4. Bekesy audiometry is a reliable tool in detecting simulated hearing loss.

Hattler ('68) reported that the effect on Bekesy Type V could be enhanced by lengthening the off-time of the Bekesy pulsed signal. From his study in 1970 he reported that this test was helpful in identifying 19 out of 20 patients with functional hearing loss. Martin and Monro ('75) have recommended that the continuous tone should be compared to both the LOT and SOT tones and the two pulsed tone tracings should be compared to each other to increase the efficiency of the test.

Hood, Campbell and Hulton ('64) developed BADGE (Bekesy Ascending descending gap evaluation). This procedure involves a comparison of the differences between the following lOOcps discrete frequency Bekesy tracing types (l) continuous tone with tracing begun well below threshold, (2) pulsed tone with the tracing begun well below threshold, (3) pulsed tone with tracing begun well above threshold. The functional hearing loss group most commonly display readily visible, gaps between the ascending and descending tracing than do the organic group. Hood considers that this happens, as the method distroys patient's yardstick.

Stark '66, Hopkinson '65 are of the view That type V Bekesy may not be a good indicator of functional hearing loss. Price, Shepherd and Goldstein ('65) say that a psychological, but not necessarily psycho-pathologic explanation may be offered for the Type V tracing.

Martin ('78) has concluded that, arguments on the use of Bekesy audiometric techniques for diagnosis of pseudo-hypacusie are bound to continue. At this point, LOT and Badge appears to have certain value, although they do not indicate true threshold. Thus Type V tracing may only suggest non-organicity and is not an end by itself.

2.7.3. Delayed Auditory Feedback (DAF):-

The test was introduced by Ruhm and Cooper in !964. The method used here is that the patient is asked to tap a rhythm, for instance 1,2,3,4, etc, which are heard by him through earphones, at an appropriate intensity and frequency. Once delay is introduced, the transmission of the tone is delayed from reaching the patient by about 200m.sec, this completely upsets the tapping rhythm. The rhythm returns to normal about the threshold. The speech DAF gives an approximation of the SRT, but the tapping technique allows a pure tone audiogram to be plotted. The speech and tapping rhythms are disturbed at a variable level above the threshold for hearing (Alberti '70).

A number of authors (Azzi ('51), Gibbons and Winchester '57, HaHley and Tiffany '54, Hanley '58) Alberti '70, Ruhm and Cooper '62, '64) have reported clinical and research data on the basis of which they suggest that DAF is a useful tool in detecting functional hearing loss. Some writers (Hanley and Tiffany '54), Gibbons and Winchester '57) have said that

DAF is superior to other tests that have traditionally been used to detect functional hearing loss. This claim is based on the assumption that what is true for normal listeners or for lab simulators is also true for patients who have functional hearing loss (Chaiklin and Ventry '63).

It is difficult to decide whether there is unilateral or bilateral functional hearing loss, with this test, nor can the approximate true hearing threshold be found in functional hearing loss (Martin '78, Chaiklin and Ventry '63). Sophistication is found to have little effect on this test (Martin ' %) . Some of the reasons that have been put forward to account for the inability to estimate organic hearing thresholds from DAF results are 1. wide variations among individuals in their ability to resist effects of DAF, it can be at threshold level at 40 to 50 dB above or no effect at all. 2. measures used to detect involvement under DAF have been relatively gross. Chaiklin and Ventry ('63), Beagley ('73) and Martin ('78) have also reported of difficulty of using this test with some subjects. The two other problem cited by Beagley ('73) in the use of this test are (1) recruitment of loudness in a patient with a true cochlear loss may result in a well - marked feedback, (2) hearing may be near normal at some frequencies with severe loss at others, which should be taken care of.

2.7.4. Electro dermal or G.S.R. Audiometry:-

This test has been used to determine both AC and BC thresholds in functional hearing loss. Doerfler and Mc Clure ('54), Burk ('58) and Hanley etal ('58) have reported that GSR thresholds were usually within ± 5dB to voluntary threshold. Chaiklin etal ('64) found a test retest reliability with in ± 5dB. These studies have reported high validity with GSR.

One of the important features of GSR is that it identifies functional hearing loss and simultaneously provides threshold measurements (Chaiklin and Ventry '63). The most important advantage of the test is, it does not appear to be an auditory test at all, (Hanley etal '58).

On the other hand Martin ('78) has commented that a person who is knowledgeable about the test can confound it, as even small movements can increase the sensitivity of the stylus and thus misinterpretation may occur. Goldstein ('56) has viewed that the test may not be very efficient in identifying functional hearing loss. But if systematic methodology is employed GSR audiometry can produce valid and reliable thresholds (Chaiklin etal '61).

Evoked Response Audiome0try and Electro Cochleo Graphy:-

Cortical evoked response audiometry is most popular of tests. The procedure involves no shock or other annoying stimuli and so is more useful. This does not involve the patients cooperation and is elaborate and so is more applicable (Martin '78). McCandles etal ('68) have reported ERA as representing a valid and objective index of auditory sensitivity.

On the other hand Martin ('78) has commented that, as a high correlation has not been found between evoked responses and voluntary thresholds, a caution in the interpretation of results, obtained, is required. Secondly the instrumentation is expensive which also is a drawback.

The results obtained by Electro Cochleography have fewer contaminating artifacts than are seen with ERA or EDR. It is an objective method, but they lack frequency information. Limitations are cost of instrumentation and time required (Martin '78).

2.7.5 Acoustic Impedance Measurement:- (Stapedial reflex threshold

This has been used to identify functional hearing loss since 1950s. Here the stapedius reflex threshold is established. In a normal patient, it is about 80dB above the pure tone threshold. Even in patients with severe menieres disease and positive recruitment tests, there is usually a gap of 30dB between the two. A detectable stapedial reflex change at or even below the admitted voluntary puretone threshold is indicative of an incorrect puretone response. The test is rapid to administer and is objective (Alberti '70).

Besides the ART - PTA difference, the SPAR (Jerger '75) based on work of Niemeyer and Sesterhan ('72) is also helpful in knowing the exact threshold of a patient (Martin '78).

Jespen ('52), Thomsen ('55) and Lamb ('67) Beagley ('73) have all pointed out the ease with which functional hearing loss could be detected with the help of these measurements. Drawbacks of the test are that it is not quantitative test and that it is frequently impossible to elicit a reflex response in the presence of even a minor conductive or a severe SN loss (Alberti '70, Martin '78, Lamb '67). However the test has helped in the diagnosis of several patients with functional hearing loss.

2.8. Speech tests for Functional Hearing Loss:-

2.8.1. Doerfler Stewart (D-S) test:

It was given by Doerfler and Epstein ('56), Doerfler and Stewart ('46). This test has gained a lot of acceptance in functional hearing loss cases (Davis and Goldstein '60, Heller '55, Newby '58, Watson and Tolan '49).

The test compares responses to speech v/s noise. Doerfler and Stewart ('45) have commented on their test as 'most listeners continue to respond even when noise is presented at a level 10 to 15 dB more intense than the speech. The non-organic patients tend to stop responding even when the noise is less intense than speech.' Based on this their test is developed.

Initially in the test SRT is found by a binaural administration of stimuli (speech spondees) in an ascending manner. The SRT so got is SRT.. After this noise is simultaneous introduced with speech which is increased in 10dB steps until

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Altshuler ('71) tested 12 children on the Stenger test and found the test to be useful in obtaining thresholds. Fournier ('5i he no longer repeats the spondees. This level is NIL (noise interference level). If NIL is not equal to SRT_1 + 5 + 20dB the level of noise is further increased to reach it. At this level intensity of speech is reduced until SRT_1 - 15dB level. After this the noise level is reduced to OdBHL.

If patient does not repeat when the levels are reduced a second SRT is got - SRT_2. He is later asked to inform when he hears noise which is raised in 5dB steps. That level becomes NDT (noise detection level). Norms as given by Epstein and Hopkinson '56, Doerfler and Epstein '56 are as follows:

SRT_1 - SRT_2	-4 to +5dB.
SRT_1 - NDT	-7 to +15dB.
SRT_2 - NDT	-7 + 15dB.
SRT_1 + 5-NIL	-18 to +3dB.
NDT - NIL	-31 to -2dB.

Doerfler and Epstein ('56) have said that if a subject has 2 or more + ve signs, the test is +ve. One positive (+) sign is interpreted as equivocal and 0 signs as negative (-). They also said that the number of positive measures was not a critical factor, as were the specific measures on which the positive result was obtained with noise detection and noise interference being most sensitive to the presence of functional hearing loss.

Hopkinson ('78) has put forward the advantage of the test as being the universality of norms which helps in classification and allows an easy communication with professionals.

There is little objection for this test. Menzel ('60) concluded by stating that the test is "......., a sensitive detector of non-organicity.

2.8.2. Lombard Test:-

It is used to identify either unilateral or bilateral functional hearing loss. The basis for the test is the Lombard reflex which is a relatively automatic increase in speakers vocal intensity in the presence of intense noise, (Chaiklin and Ventry '63).

For cases with unilateral deafness, most clinicians advocate application of noise to better ear (Asherson '36, Grove '43, Harbert '43, Morrison '55) although some clinicians advocate it to the poorer ear (Watson and Tolan '49) and still others say that it first be administered to one ear and then the other ear (Heller '55).

In bilateral cases (Watson and Tolan '49) recommend that noise be applied binaurally. Hanley and Harvey ('65) have demonstrated difference in vocal intensity between talking in quiet and when 50 dB saw-tooth noise was given.

There are some disadvantages of this test which have been put forward by Newby as being 1. there is no certainity as to at what SL the reflex begins, 2. a sophisticated patient will be able to control his vocal intensity sufficiently to negate the test results.

Chaiklin and Ventry ('63) have concluded that Lombard test may be helpful when gross changes in vocal intensity occur and that the absence of the lombard effect may often represent a false negative results and so the test, as presently used ie relatively inefficient and should be interpreted cautiously.

2.9. Other tests for Functional hearing loss:-

2.9.1 Tone in Noise test (TIN):-

This test was given by Pang-Ching Glenn in 1970. It is a modification of the D-S test. The test examine an individuals ability to respond to puretones in the presence of a masking noise and has only one criterion measurement, the difference between thresholds in quiet and noise (Pang - Ching '70).

Here first threshold (T_1) is obtained in ascending method. With the intensity at (T_1 + 5), wide band noise is introduced suddenly at 10dB above the (T_1 + 5) level. Again, second time threshold is obtained in this condition but with interrupted tone.

In non-functional hearing loss, threshold in noise is much higher than threshold in quiet; changes exceeding 10dB are common, where as the difference rarely exceeds 5dB in organic cases. Thus changes in threshold of 10dB or greater should alert the clinician of the possibility of functional hearing loss (Pang-Ching '70).

The authors have also concluded that TIN test is a screening device and as such does not provide any estimate of the auditory thresholds.

2.9.2 Story tests:-

It is used with unilateral functional hearing loss cases. Here patient is advised to hear to a story over the earphones and then repeat as much as he can. The levels of presentation should be chosen carefully with it being slightly above the admitted threshold in the better ear. Parts of the story are delivered to either ear. If level chosen is correct, patient repeats parts if story delivered to the poorer ear, then the hearing can be said to be atleast at that level (Chaiklin and Ventry '63).

2.9.3. Eyeblink Response Test:-

Galambos etal ('53) used the cochleo palpabral reflex, which is an involuntary eye-blink in response to the onset of loud auditory stimuli, as a basis for the test. Intensity at which eyeblink is elicited is determined which is about

90 - 100dBSL in normals and more or less the same in organic cases. As a result it only useful in cases with profound functional hearing loss. It does not help to determine absolute thresholds (Chaiklin and Ventry '63).

Galloway and Butler ('56) used this test and reported a difference of 5dB between voluntary and involuntary threshold, But prolonged training is needed. Lowell ('60) pointed that the eyeblink 'response rate' after prolonged conditioning was still below a desirable level for threshold determination. Despite the disadvantage it is recommended (Chaiklin and Ventry '63).

2.9.4 Switched Speech Test:-

It was given by Calearo ('57). Here severeal tests of meaningful short sentences recorded at an average speed of 85 words / minute are used. The sentences are switched back and forth between the ears at 30dB above the better ear threshold with 50% of the signal going to each ear. When on-off ratio is 50% and when two switching rates (2-3/sec.) are used, the patient hears the message in the better ear as relatively unintelligible interrupted speech, but intelligibi-lity increases as switching rate is increased. In functional hearing loss case, he is unaware of which portion of the signal was presented to the poorer or to the better ear. Thus he may have high intelligibility at low switching rates or may report inability to understand message even at high switching rates; Both the responses are supportive of functional hearing loss (Chaiklin and Ventry '63).

2.9.5 **Masking Test:-**

Hood '59 gave the test for unilateral functional hearing loss cases. It is based on the fact that there is a one to one relationship between the levels of the masking noise and of the masked pure tonethreshold. Thus if noise is raised by 20dB, the puretone threshold is also raised by an equal amount. This is the so called shadowing effect. But there are many doubts about this test (Chaiklin and Ventry '63).

2.9.6. Yea - No Test:-

It is a test used for diagnosis of functional hearing loss in children. Here thresholds are determined by a ascending descending procedure and case is Instructed to say 'yes', on presence of stimuli and 'no' when it is absent. Miller and Rehman '70 and Miller '68 reported that the success of the test depended on the child responding immediately after the tone has been presented.

Frank Tom ('76) has commented that degree and type of loss can be determined by this technique. Also the test is easy to administer and does not necessiate the use of special equipment.

2.9.7. Ascending Descending Audiogram:-

Recommended by Kerr etal ('75) * A difference of 25 to 30 dB between the two thresholds obtained by the ascending and descending methods is indicative of functional hearing loss. The author has also stressed that this test is remarkably consistent and that it deserves more wide spread use and publicity.

2.9.8. Modified Conventional Approach:-

This was given by Nilo and Saunders ('76). The method is strict, ascending, calculated and deliberate one. Pure-tone and speech are presented at smaller intervals than usual (2 or 2½ dB) and many signals are given at each interval. The patient is pressured to respond. He is asked to say frequently if the signals were heard and will be reminded that he will be hearing them soon. The test has been said to be useful in obtaining true thresholds and 100% Success has been reported by authors.

2.9.9. Falconers Lipreading Test:-

This test was given by Falconer in 1966. The test contains auditory as well as visual stimuli and consists of mono-syllable, homo-phenous words, which are nearly impossible to perceive by lipreading alone. The patient however does not know this and responds in his usual way to sound and vision. Because most of the correct responses are a result of aucition, the patient inadvertgntly reveals some degree of functional hearing loss. The technique is also effective with patients who demonstrate a much smaller degree of functional hearing loss, (Falconer '66). The exact method and procedure for the test will be discussed in detail in later chapters.

Goldman ('71) used the same test in his study and commented that, the test helps to determine the organic levels definitively. The SRT predicted from the test relates most closely to standard puretone and speech measures and it is remarkable in exposing the functional problem without obviously indicating to the subject that he has been caught.

Besides the above advantages, Goldman ('71) has also pointed that, this test can be used either monaurally or binaurally. It requires no special equipment for its administration. Also the functional hearing loss patient who tries to convince his reliance on lipreading cues in order to communicate, falls as an easy victim to this test. With this Goldman ('71) concluded that psychophysically and psychologically the Falconer test has definite advantages which warrant its inclusion in test battery.

Research considerations. Prevention and_Rehabilitation:-

The electro-physiological methods, electro nystagmography hypnosis, signal detection tasks and in that receiver operating characteristics are, some fertile areas for research (Hopkinson, '73). The audiologist must take positive action to ensure that he does not contribute to the problem already present. Early detection, especially with children would prevent later complications (Hopkinson '73).

Generally treatment and rehabilitation of functional hearing loss, fall into the psychiatric field. The audiologist must be aware of these service facilities. If the problem becomes a question of legal action, the idea about the patients problems must be clear and the patient should be helped to maximum extent (Hopkinson '73 and '78).

Some of the techniques that have been described for the treatment of functional hearing loss are faradifaction, simulated surgery, narco-therapy, hypnosis, psychotherapy, positive suggestion and rational explanation (Chaiklin and Ventry '63).

CHAPTER - 3

Methodology

3.1. Introduction:-

Three plans were basically involved in this study:

1. Development of test material.
2. Testing it on normal hearing subjects and
3. Testing clinical group.

Utley (1940) was the first person, who commented that, standardized lipreading tests could be used in the identification of non-organic hearing loss. Falconer (1966) attempted to test the capacity of lipreading. It is a capacity which is, so often emphasized by functional hearing loss cases, as being, the main reason for their easy and good communication in ordinary situations. His tests consists of monosyllabic homophenous words, which by lipreading cue alone, are impossible to perceive.

Subba Rao (1981) followed Falconer's (1966) principle and developed a lipreading test in kannada language. The present study deals with the development and standardization of a lipreading test in Hindi language for identifying psuedo hypacusis.

Before proceeding, two points need to be mentioned. First, an attempt was made, 'as far as possible' to include those words which are most often used by Hindi speakers, in each subject, the presentation levels were varied. Eg. for a subject with SRT as 10dB, the different levels of presentation levels were 20dB, l0dB, 0dB and -10dB respectively. Each list of set 1, were presented at 4 different levels, so under each set there were 16 different presentation combinations. They can be represented as follows:-

Lists	L_1	L_2	L_3	L_4
Levels	L_1I_1	L_2I_1	L_3I_1	L_4I_1
-10 I_1	L_1I_1	L_2I_1	L_3I_1	L_4I_1
+0 I_2	L_1I_2	L_2I_2	L_3I_2	L_4I_2
+10 I_3	L_1I_3	L_2I_3	L_3I_3	L_4I_3
-20 I_4	L_1I_4	L_2I_4	L_3I_4	L_4I_4

3.3 <u>Subjects</u>:-

3.3.1 <u>Normal Group</u>:—

This group was used to develop norms for the 'Speech Reading test.' 32 students of All India Institute of Speech and Hearing, Mysore, formed the subjects under this group. Their age range was 17 years, 1 months to 24 years, 6 months (mean age 20 years 6 months). The group consisted of 16 males and 16 females. The criteria for the selection of the subjects was, that they should have had Hindi as one of their languages during schooling and secondly they had to pass a his every day life. This point, along with the relatively less number of mono-syllabic words in Hindi, made it necessary to select polysyllabic homophenous words for the test. Homophenous words are those set of words which sound different but look alike on the lips.

3.2. <u>Development of Test Material</u>:-

It was aimed at preparing a test with 160 words. These words were broadly divided into 2 forms. The 80 words which fell under each form were further classified to form 4 lists of 20 words each. Every word in a list had its counterpart in the other 3 lists of the same form.

Example:- 1) /mʌna/(मना) in list 1A of form 1, had /bʰʌla/ (भला) in list 1B, /pʌta/ (पता) in list 1C and /bʌta/ (बता) in list ID.

2) /dām/(दाम) in list 1A of form 1 had /nām/ (नाम) in list 1B, /tāp/ (ताप) in list 1C and /dāb/(दाब) in list 1D.

All the words selected were meaningful words, and attempt was made to equate the two sets, in terms of level of difficulty by equating the phonemic distribution. The words in each list were randomized by using Fisher's random number tables.

Four levels of presentation (with reference to SRT) were chosen. These levels were 1) SRT + 10dB, 2) SRT + OdB, 3) SRT - 10dB and 4) SRT - 20dB. Depending upon the SRT obtained for screening test for hearing at 20dB HL (ANSI, 1969) between frequencies from 250Hz to 8kHz.

These 32 subjects were randomly classified into 4 groups, each group consisting of 8 subjects. Out of the decided 16 presentation combinations, each group was randomly selected for 4 presentation combinations. The manner of testing was maintained across the group, ie. in terms of lists and presentation levels. Besides, the same order was maintained for both the sets. Care was taken not to select the same presentation combinations for any 2 groups.

A random selection of the ear to be tested, was done and only one ear of each of the subjects was tested. Mean scores of the different groups at different levels, for the different lists were computed. The levels of presentation of the different lists for the four groups are shown below;

Group 1	L_1	I_1	L_2	I_2	L_3	I_3	L_4	I_4
Group 2	L_4	I_3	L_2	I_1	L_1	I_2	L_3	I_4
Group 3	L_3	I_2	L_4	I_1	L_2	I_3	L_1	I_4
Group 4	L_2	I_4	L_1	I_3	L_3	I_1	L_4	I_2

(L, refers to the list and I refers to the intensity level)

3.3.2. Sensori Neural Hearing Loss Patients Group:-

Two criteria were used for the selection of subjects in this group - 1. They should have Hindi as their mother tongue or should have known Hindi language, 2. They should have sensori-neural hearing loss of mild to moderate degree. The hearing loss could be either unilateral or bilateral.

Six patients who satisfied the above two criteria were selected. The main aim of administering the tests on the patients was to verify, whether the criteria established for predicting SRT in normal subjects, would apply to the patients also.

The details of the type, degree and configuration of hearing loss are given in Appendix.

3.4. Instruments:-

Madsen 0B70, a two channel clinical audiometer was used. The ear-phones and cushions used were, TDH-39 and MX 41/AR respectively.

Channel One of the audiometer was used for speech audiometric setting. Live voice testing was carried out. The talk-back system was used for noting the subjects responses.

The audiometer was calibrated with the help of Bruel and Kjaer (B & K) calibration equipment. The block diagram of the instrumentation for calibration and the standards are given in the appendix.

3.5. Testing Environment:-

Testing was carried out in a two room situation - the test room and the control room were totally isolated from each other in order to rule out any possibility of leakage of the stimuli across the two rooms.

To facilitate lip reading, the testers face was adequately illuminated by proper light arrangements.

Care was taken to see that the examiners head and the subjects head were approximately at the same level. Further, glass reflections from the observation window were illuminated.

The noise levels in the testing room were well within the maximum allowable noise levels in dBSPL.

3.6. Testing Process:-

Initially, the subject was instructed for obtaining SRT without visual cues. Once SRT Was obtained, they were instructed for the speech reading test, which was then carried on. This involved both visual and auditory cues.

Instructions:-

3.6.1 Instructions for SRT:-

"You are going to hear words, like , , etc. Repeat them loudly. Each item will follow the phrase . Try as far as possible to concentrate on these test items. If you are doubtful about a word try to guess the word." Where ever necessary, the same instructions were given in Hindi language.

3.6.2 Instructions for Lip reading test:-

You can see the examiners face very clearly from the observation window, you will hear different words, as well you can read them on the examiners lips. Use both the cues and try to repeat exactly the word given to you. Let us see how good you are at lip reading. Be alert, as soon as you hear the word phrase   , you will hear the word. In case you fail to follow, you can ask for a repetition.

Instructions were made clear before commencing the test.

3.7. Obtaining initial SRT:-

The Hindi spondee word list, given by Abrol.B.M. in 1971 Was used for determining 3RT.

The test was started at 20 dB above the pure tone average of thresholds obtained at 500Hz, l000Hz and 2000Hz. 2 words were presented at each level and the level was decreased in 5dB steps, until no spondee words were repeated correctly. At this level the intensity was increased in 1dB step and 4 words were presented at each level. The level at which the subject repeated 50% of the words ie. 2 words, was taken as the SRT. This level served as reference for further testing.

3.8. Administering Speech Reading Test:-

1. Once the subject was comfortably seated in the test room, the room was darkened and the door was closed to prevent any sound leakage. After this, the examiners face was illuminated in control room and the line of vision between subject and examiner was adjusted to prevent any reflection from the observation window.

2. The microphone was placed close to the subjects mouth, so as to pick up his speech. Care was taken not to keep the microphone too close to the mouth, so as to avoid any disotortions that would arise in the feed back and in turn could affect the examiners discrimination.

The audiometer microphone was placed about 6" from examiners mouth, and was placed below the chin, so as to avoid any obstruction, in the subject viewing the examiners face.

3. The earlier mentioned instructions, were given to the subject, where in, it was stressed that the tester intended to know how well his (subject's) capacity of lip reading complemented his hearing.

4. Before every word in the test list was spoken, the lips were brought to an abnormal position, by the carrier phrase' ' which preceded every word. The VU meter was constantly adjusted to maintain speech level while test

5. The whole test required about 15 minutes to administer, with each item requiring 3 to 5 seconds to say each item. After presentation of each item, the subjects response was noted down. While presenting the test words, the tester did not exaggerate the articulatory movements.

6. Two normal hearing subjects were asked to respond orally as well as through writing. Their written and oral responses were compared. There was no difference between the two results, thus the tester's discrimination ability as a possible variable in speech audiometric results was checked and found that it was not a variable in the present study.

CHAPTER - 4

Results and Discussion

The average performance of the four normal hearing groups for the eight lists of the two forms at the different levels, viz: -20, -10, 0 and +10dB (reference: SRT), was used as the data for analysis. The data is presented in Table I.

The average SRT for the normal group was 14dB HL (OdB HL = 16 dBSPL for speech). The most suitable criterion for predicting SRT from the lip reading test, was the level at which 11 words were correctly repeated. The SRT so predicted was 13dB HL for form I, 14dB HL for form II and 13.5dB HL for the two forms combined. With the increase in the level of presentation, there was a general increase in the number of words correctly repeated.

The difference in performance of the subjects for the two forms was evaluated using the Wilcoxon matched pair signed rank test of significance. There was no significant difference indicating that the two forms were equal, in their difficulty. The obtained and expected values of T scores have been presented in Table II.

On similar lines the performance of six sensori neural hearing loss patients has been analyzed seperately. Figures 2b to 2g show the articulation gain function for each patient. The criterion chosen for the normal group for predicting SRT

Table - 1

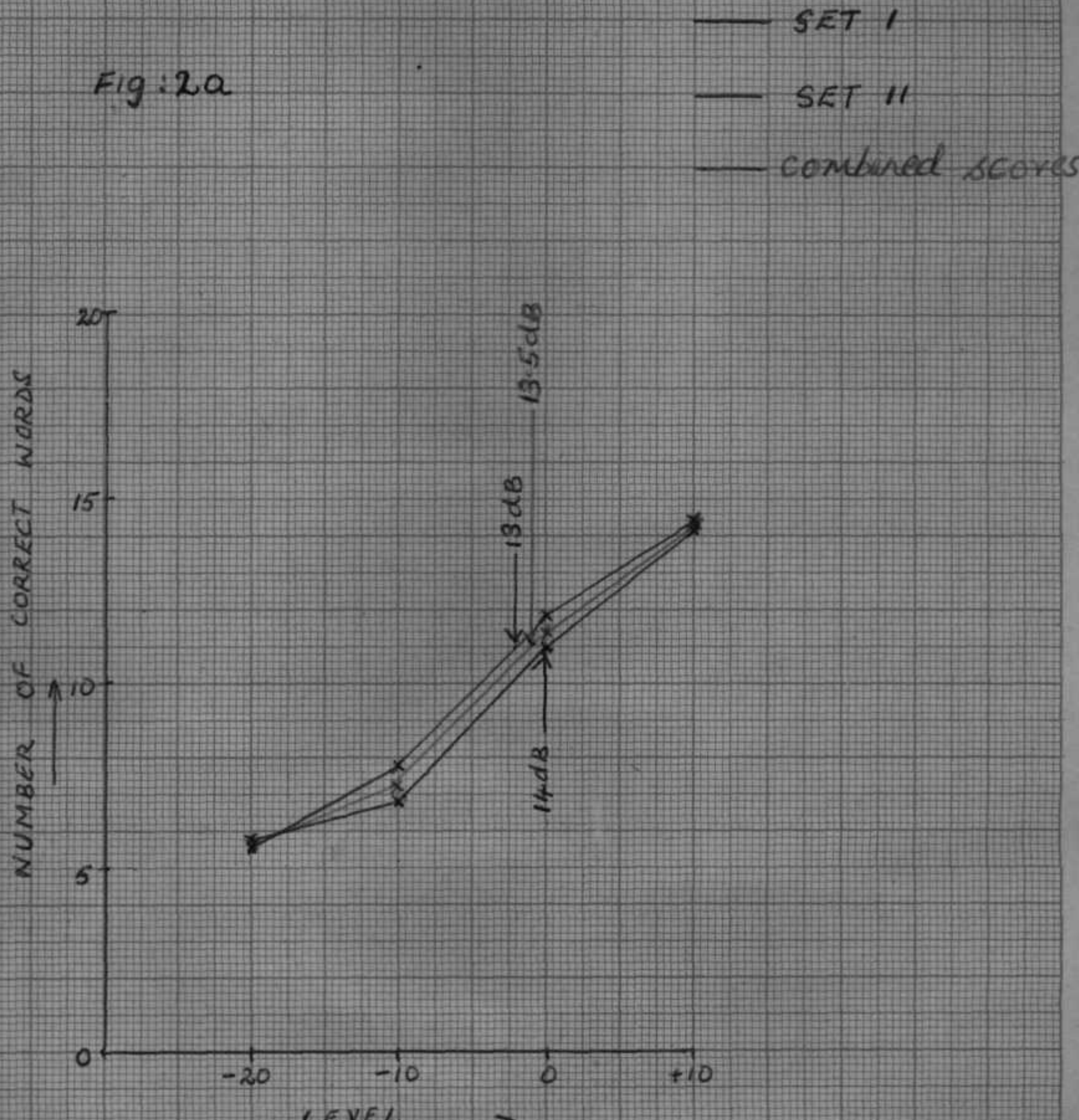
Average number words rented coreetly by normal hearing groups for For. I and Form II lists at four sensation levels.

Mats	Ll		L2		L3		L4		Combines Scores of Form I	Combine Scores Of Form II	Combined Scores of Form I & Form II
Levels dBSL (ref. SRT)	Form I	Form II	Form I	Form II	Form I	Form II	Form I	Form II	Form I	Form II	Form I + Form II
$-20(I_4)$	6.62	5.50	5.25	7.25	4.87	6.12	5.62	4.50	5.59	5.84	5.72
$-10(I_1)$	7.75	6.63	8.12	7.75	7.25	6.37	7.87	6.30	7.75	6.81	7.28
$O(I_2)$	13.75	11.37	11.62	10.50	11.12	11.12	10.75	11.12	11.81	11.03	11.42
$+10(I_3)$	14.50	13.87	13.25	13.37	14.25	14.25	16.00	15.62	14.44	14.28	14.36

<u>Table - II</u>

			I(-20)			I(-10)			I(0)			I(10)			
si. No.	Patients Code	SRT(dBHL) (ANSI 1969)	(Form I	Form II	& II Combin-ed	Form . I	Form II	& II Combin-ed	Form I	Form II	Form I & II Combin-ed	Form I	Form II	Form I & II Combin--ed	Predic-ted SRT (dBHL)
1	G.AG	40	2	3	2.5	6	7	6.5	9	8	8.5	14	15	14.5	44.5
2	A.R	50	2	3	2.5	4	6	5	8	10	9	15	16	15.5	52
3	P.B	50	4	3	3.5	6	7	6.5	12	9	10.5	14	14	14	51
4	SA.H	30	3	4	3.5	7	6	6.5	11	9	10	14	16	15	32
5	S.R.	55	5	5	5	6	8	7	9	10	9.5	13	14	13.5	59
6	S.S	70	1	2	1.5	3	4	3.5	6	7	6.5	9	10	9.5	80

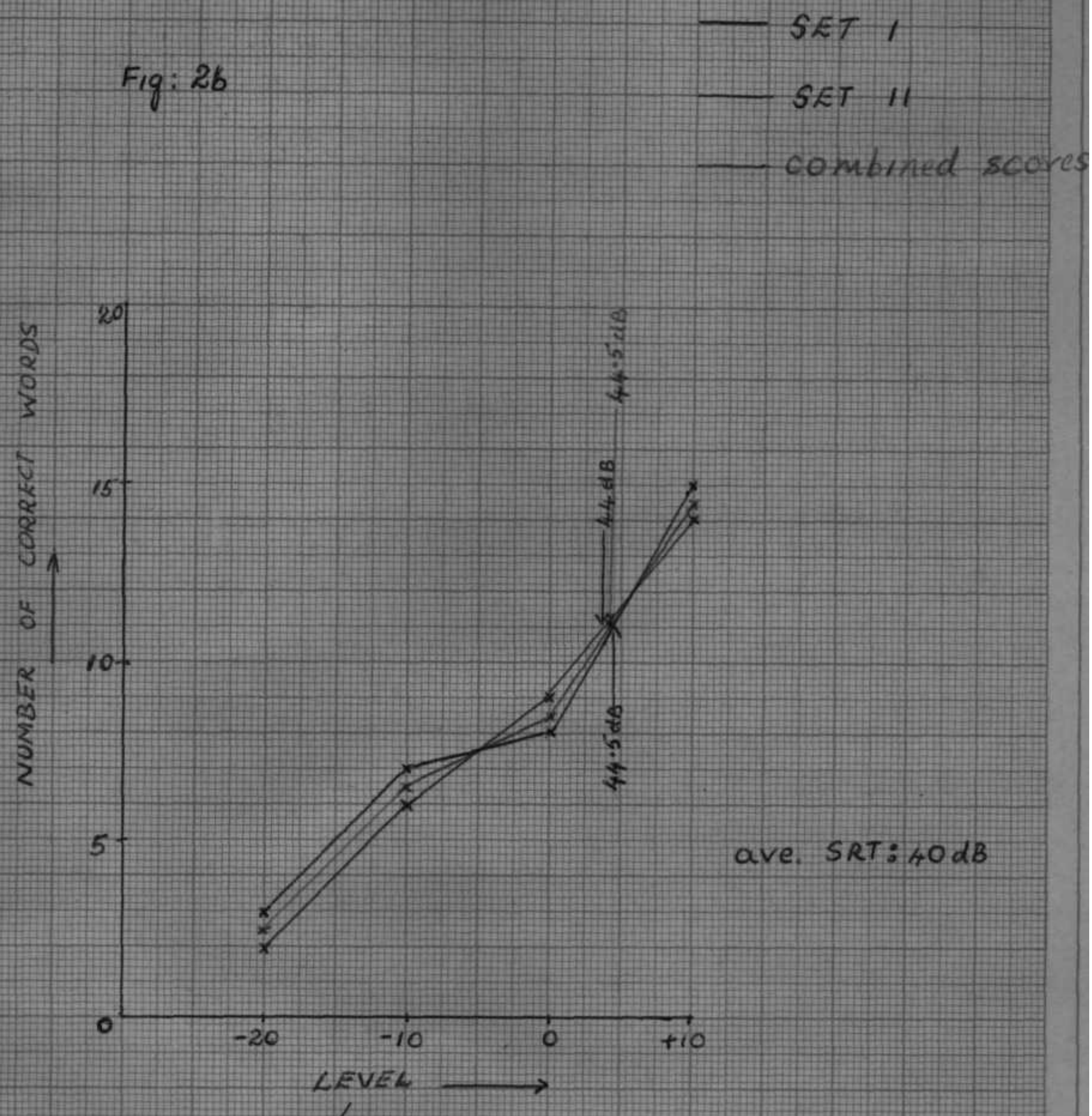
Fig: 2a



ave. SRT = 14 dB

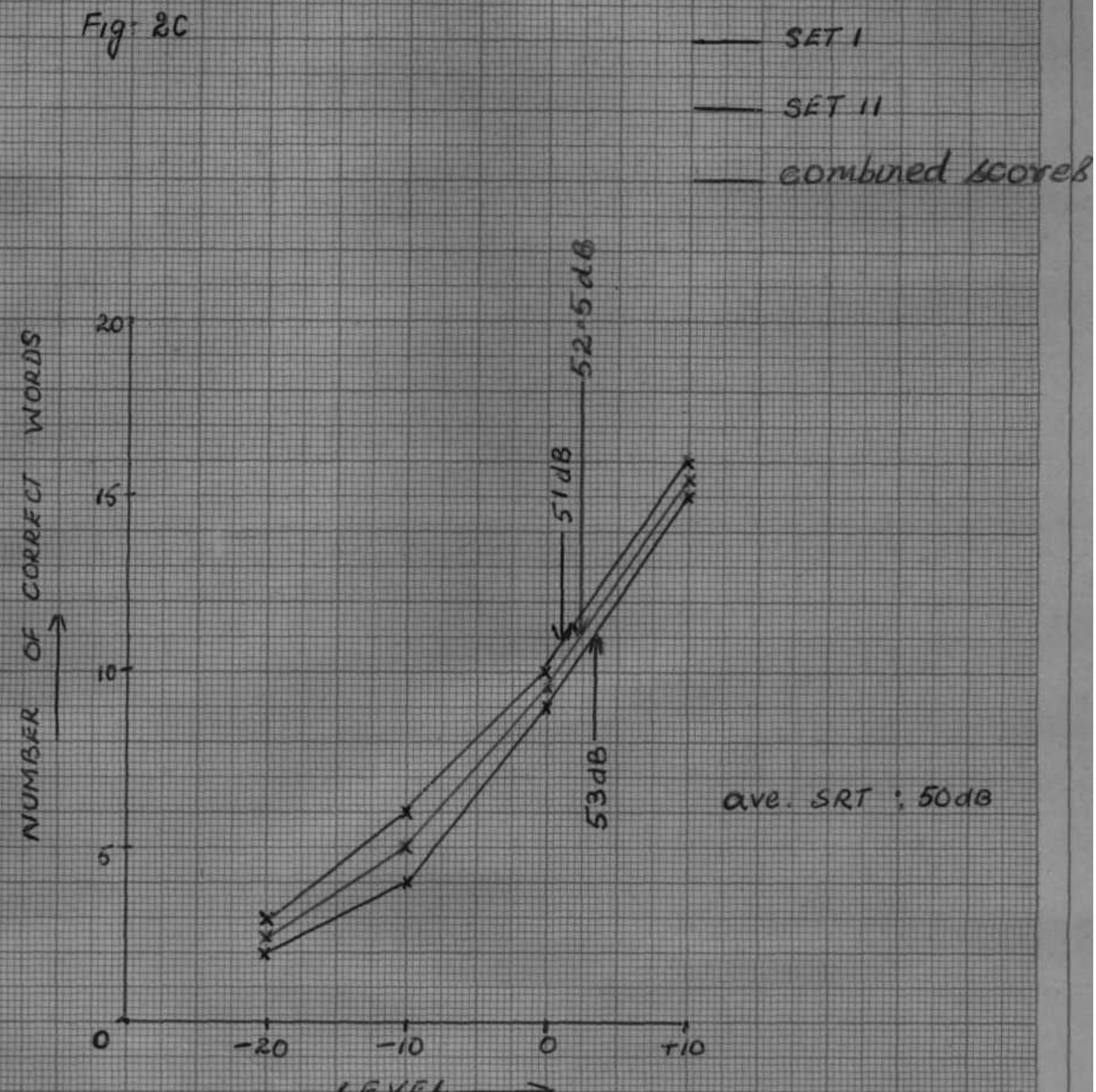
Articulation/gain functions for the normal group along with predicted SRT

Fig: 2b



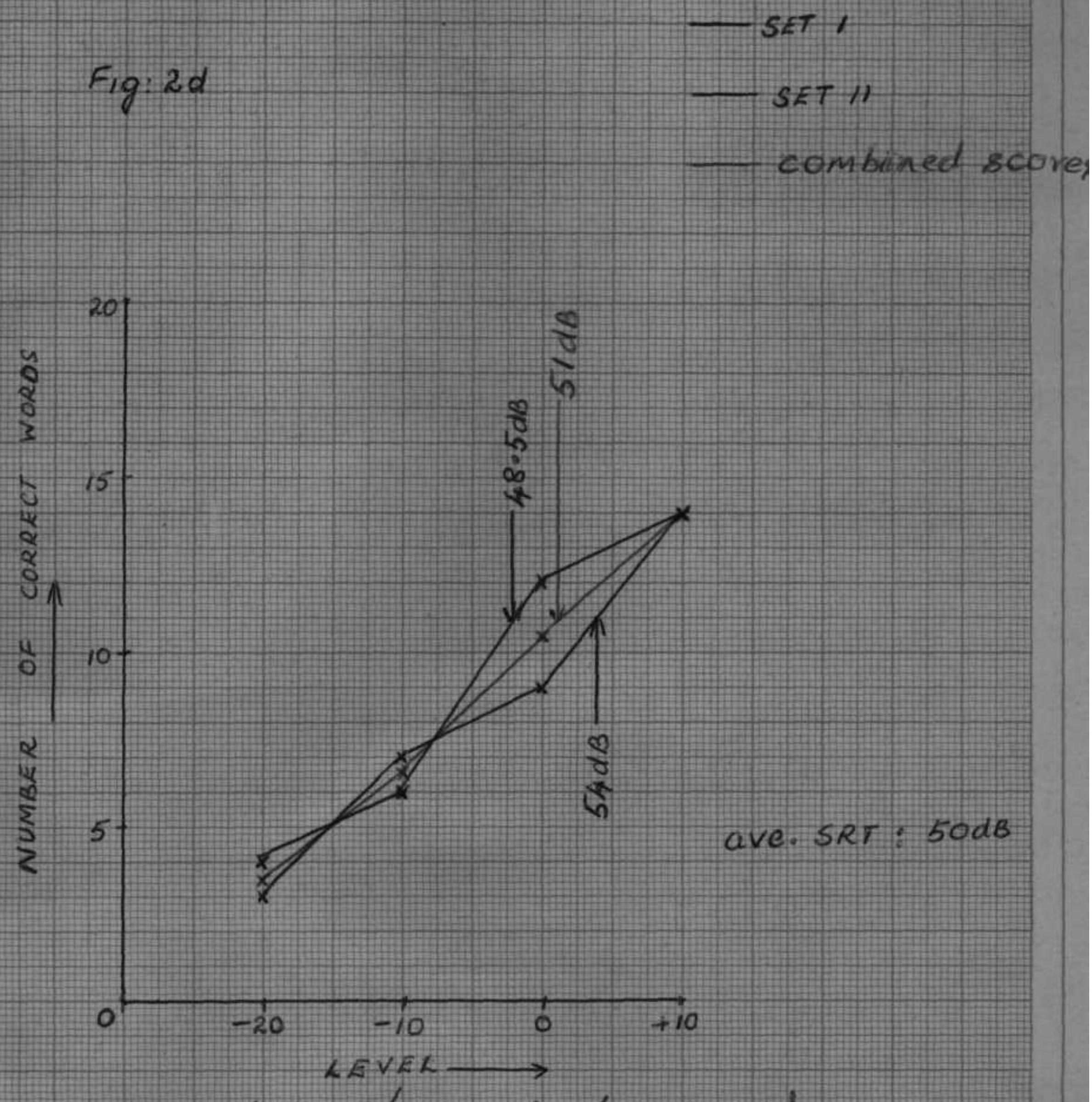
Articulation/gain functions and predicted SRT for the subject 'GAG'

Fig: 2C



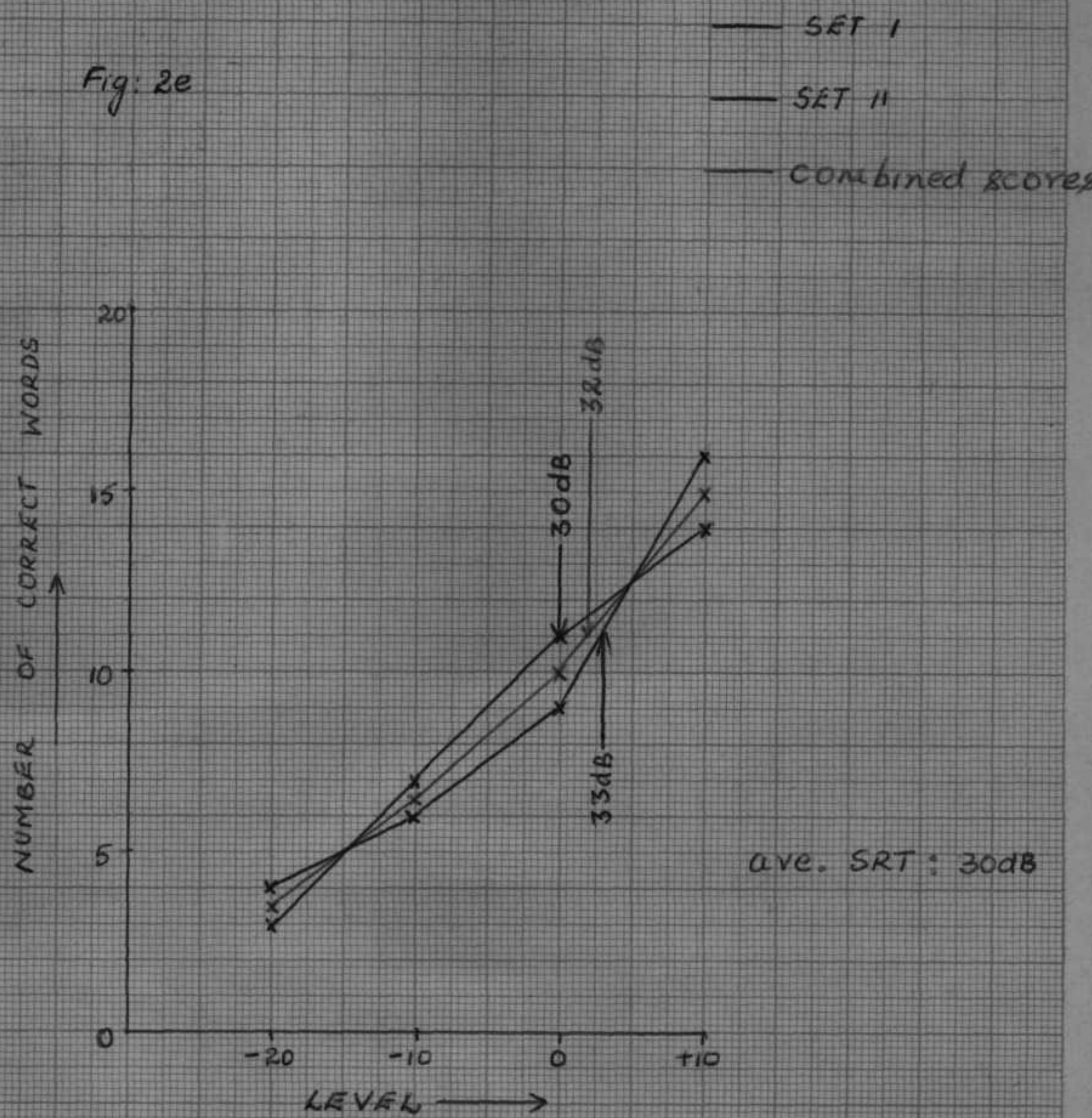
Articulation/gain functions and predicted SRT for the subject 'AR'

Fig: 2d



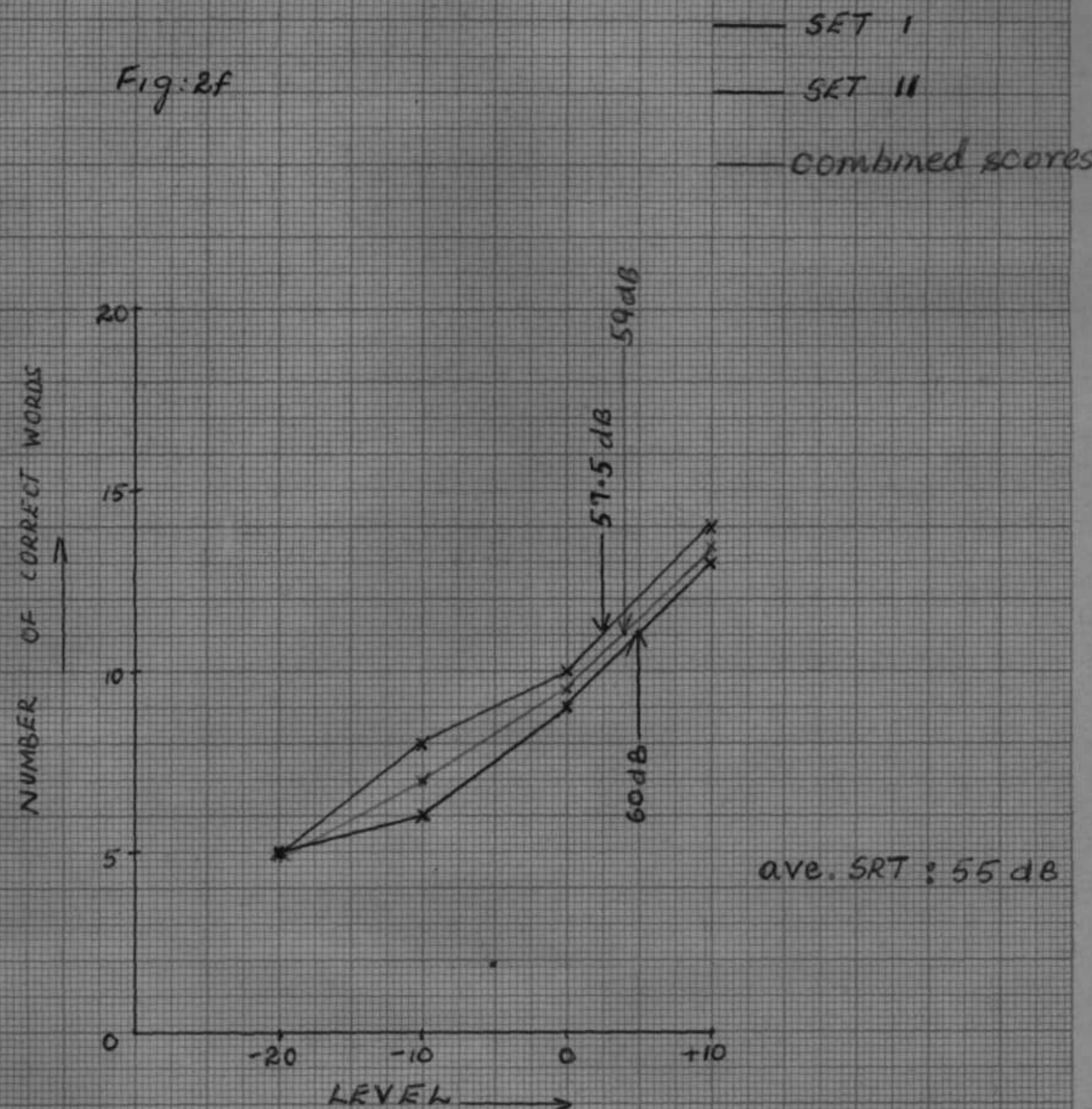
Articulation/gain funtions and predicted SRT for the subject 'P.B'

Fig: 2e



Articulation/gain functions and predicted SRT for the subject 'S.A.H'

Fig: 2f



Articulation/gain functions and predicted SRT for the subject 'SR'

TABLE 11 : Means and standard

	Control group					
Age-yrs.	18 to 22		23 to 27		27 and above	
Sex	Male	Female	Male	Female	Male	Female
n	10	20	4	4	2	-
M	0.36	0.22	0.38	0.26	0.28	-
S.D.	0.2	0.08	0.05	0.18	0.03	-

was also found applicable to the sensori neural hearing loss group. It was noted that, when the patient did not repeat 11 words correctly, the criterion for predicting SRT was the level at which the score nearest to 11 was obtained.

The number of correct responses obtained for each form and at different levels of presentation, for the 6 sensori neural hearing loss group are given in Table III, Because of the non-uniformity among the 6 subjects, the group as a whole was not considered for comparison.

Table III

	T	N	Critical values of 'T' on the Wilcoxon matched-pair signed rank test		
			.05	.02	.01
I_1	42	25	89	77	68
I_2	61	24	81	69	61
I_3	45	25	89	77	68
I_4	53.3	23	73	62	55

As mentioned earlier, the criterion, established to determine the SRT was the level at which the patient repeated 11 words correctly, accordingly, the SRT so predicted, for the normal hearing group was 14 dBHL. The obtained average SRT level was same as the predicted SRT. This can be seen on the articulation / gain function plotted for the normal hearing subjects (Fig. 2a).

The results show that the criterion established in this study varied from those established in earlier studies. The criterion given by Falconer (1966) to establish SRT on his test, was the level at which 5 words were repeated correctly. Goldman (1971) found the same. Subba Rao's (1981) criterion was, 5 dB below the level at which subjects repeated 10 words correctly on the test.

Falconer (1966), Goldman (1971) and Subba Rao (1981), have all reported, that, there was a steady increase in the scores obtained, as the level of presentation was increased. The same was found in the present study.

It was interesting to find that the maximum score obtained in this study, ie. at 10dB SL (with reference to obtained SRT), was closely related to the maximum score reported in earlier studies. In the present study the maximum score obtained was 14*.36, in Falconer's study it was 16.1, while in Subba Rao's study it was 12.25. But the lowest scores obtained here, were very different from those reported by others.

From the graphs, it is clear that the articulation/ gain function curves obtained for form I, form II and the two forms combined, are closely related to each other indicating that any of the forms could be used, individually for testing.

It also appeared that the SRT predicted from the three articulation/gain function curves (form I, form II and the combined form I and II) were not significantly different indicating that the two forms were equal in their difficulty. This was further confirmed by the results obtained on the Wilcoxon, matched - pair sign rank test of significance, which showed insignificant difference between the scores obtained on the two forms, at all levels of presentation, and at .01 level (Table III). Six sensori neural hearing loss patients were also tested. It was found that the criterion established for predicting SET for normals, was also applicable to the pathologic group. This can be seen from Table II and from the figures 2b to 2G.

In all the patients, (except patient with serial No.6) the established criterion helped in predicting SRT. The established criterion helped in predicting SRT that agreed with the obtained SRT in all the five patients (the difference between the predicted SRT and obtained SRT was not more than 5 dB). One patient (S.S) did not obtain 11 correct responses at any of the levels, so the criterion used for predicting SRT was slightly different (as mentioned earlier), ie. SRT, was the level at which the score nearest to 11 was obtained. This was the only case where the difference between predicted and obtained SRT exceeded 5 dB.

Of the five patients, who did not exhibit a difference of more than 5 dB between the predicted and obtained SRT, in one patient (P.B) the difference was just 1 dB, while in 2 patients (A.R., S.A.H) the difference was 2 dB. In two other patients (G,A.G, S.R) a 4 dB difference was found. From this it is evident that the lip reading test can predict a patients SRT accurately.

However, Goldman (1971) reports that when using the predicted SRT, as a guideline to establish or substantiate the organic hearing loss, such factors like sloping audiogram configuration, and poor discrimination should be taken into consideration.

From the population tested, it could be said with certainity that the predicted and obtained SRT were very closely related. In this regard the present study, showed that the subjects SRT could be correctly predicted. It can be recommended that, the lipreading test can be used successfully to predict SRT in psuedo hypacusis patients.

After being able to establish the true organic hearing threshold, even when subjects demonstrated very little non-organic component. Falconer (1966) commented that the test had proved its worth as a clinical tool.

Both Falconer (1966), Goldman (1971) have suggested that the test could be administered binaurally or monaurally, depending on the situation.

From the results of the study, it can be concluded that the lip reading test, can be used to predict the speech thresholds of normals, sensori-neural patients as well as psuedo hypacusis patients.

CHAPTER - 5

Summary and Conclusions

Falconer in 1966 developed a test to evaluate the lip reading capacity of an individual. This test was used to establish organic hearing threshold levels in psuedo hypacusis cases. Goldman (1971) conducted a study to test the usefulness of the above test and concluded that, the test was practical in its application and helped in predicting organic hearing thresholds with atmost efficiency.

Subba Rao (1981) followed Falconer's line of approach and developed a lip reading test in kannada language. He also concluded that the SRT predicted from this test was closely related to organic hearing thresholds.

In this study, a lipreading test has been developed in Hindi language. The test consists of 40 sets of four polysyllabic homophenous words, which have been organized into 2 forms of 20 sets each'. Each form then, is composed of four lists of 20 words. The forms and lists were balanced as far as possible for its phonetic distribution. Each word of a list has its homophenous counter-part in other 3 lists of that form.

Before commencing the test, it was emphasized to the subject, that, his ability to lip read was being measured. Testing was carried out in a two room situation. The examiner's face was illuminated while the room in which the subject was seated, was darkened. The test words were presented through ear phones worn by the subject.

With reference to the initially obtained SRT, 4 levels of presentation were chosen. SRT + 10dB, SRT + 0dB, SRT 10dB, and SRT - 20dB. Auditory and visual cues were simultaneously presented. Homophenous words are those words which laak alike on lips but sound different, they cannot be perceived by lip reading alone. So a person with true organic threshold levels would invariably make mistakes on this test, at least at threshold or below threshold levels.

Since a psuedo hypacusis patient often emphasizes his capacity to lip read, he probably will respond in his customary manner to sound and vision and would inadvertently reveal his organic hearing level.

A group of 32 normal adults were used to develop the norms for this test. The lists and levels were randomly ordered for presentation. To develop a criteria for predicting SRT, the articulation/gain function was drawn for the normal group. The criterion so developed was the level at which the subject repeated 11 words correctly.

To see if this criterion could be applied for pathologic cases, 6 sensori-neural hearing loss patients were tested similarly on the lip reading test. From their articulation/gain function, it Mas found that the above mentioned criterion was applicable to sensori neural loss, cases also ie. using the criterion established for normal subjects, it was possible to predict SRT in sensori neural loss cases also.

Thus the lip-reading test in Hindi language is recommended to detect psuedo hypacusis.

Conclusions:-

1) The lip-reading test in Hindi language can be used successfully to predict speech thresholds in psuedohypacusis patients accurately.

2) Either form I or form II or their combinations can be used for testing the patients.

3) The recommended criterion for SRT prediction is the level at which 11 words are correctly repeated.

4) If this 11 words criterion is not met, any score nearest to 11, can be considered for predicting SRT.

Recommendations:-

1) The two forms containing a total number of 160 words can also be used as teaching materials while giving auditory training to hearing loss cases.

2) More data on the clinical population may be collected.

3) As lip-reading appears to be a very easy and effective test it is recommended that similar tests may be developed in all major Indian languages.

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APPENDIX - I

Test word - lists

Form - I

	I A		I B	
1	kal	काल	gadʰʌ	गधा
2	mʌnʌ	मना	dum	दुम
3	dılı	डिली	bar	बार
4	tʃot	चोट	nam	नाम
5	dam	डाम	aḍʌ	आडा
6	malı	माली	dʰʌnı	घनी
7	tanʌ	ताना	pʌta	पता
8	nʌdı	नदी	dıl	डिल
9	par	पार	dʒıta	जीता
10	kıla	किला	pal	पाल
11	aṭa	आटा	dʌŋt	डाँत
12	mela	मेला	gʌlı	गली
13	tum	तुम	dana	डाना
14	dʒıla	जिला	dʒod	जोड
15	kʌli	कली	bura	बुरा
16	taŋt	ताँत	gıla	गिला
17	bal	बाल	kʰas	खास
18	pura	पुरा	pæenda	पैंडा
19	tıl	तिल	balı	बाली
20	kʌtʰʌ	कथा	panı	पानी

Form -I (Contd)

	IC		ID	
1	bela	बेला	gita	गीता
2	tap	ताप	puda	पुड़ा
3	tʃina	चिना	aʃa	आझा
4	d^hup	धूप	tʌni	तनी
5	gʌti	गति	mar	मार
6	ten	तीन	dal	दाल
7	b^hala	भला	bʌta	बता
8	kala	कला	nalʌ	नाला
9	ara	आरा	niti	नीति
10	dʒor	जोर	d^hum	धूम
11	gal	गाल	tʃor	चोर
12	didi	दिदी	gala	गला
13	pat^h	पाठ	dʒina	जीना
14	bala	बाला	tis	तीस
15	mata	माता	$mæg^hʌ$	मेघा
16	tal	ताल	kan	कान
17	$bud^hʌ$	बूढा	pas	पास
18	nali	नली	dab	दाब
19	kina	कीना	kʌni	कनी
20	basi	बासी	padʒi	पाजी

APPENDIX - I (Contd)

FORM II

	II A		II B	
1	tʃal	चाल	mar	मार
2	natʰ	नाथ	gʌp	गप
3	pila	पीला	dʒoḍi	जोडी
4	kʰol	खोल	bæl	बेल
5	næti	नेति	god	गोद
6	kʰana	खाना	bas	बास
7	tʌn	तन	tʰali	थाली
8	dʒis	जिस	pʌri	परी
9	pæʃa	पेशा	bæta	बेटा
10	tar	तार	dʰar	धार
11	nani	नानी	kʰet	खेत
12	bet	बेत	गिला	gila
13	kʌm	कम	dʰæli	धेली
	.'	चौटी.	ganʌ	गाना
15	pala	पाला	dʒin	जिन
16	dʒis	जिस	dʰʌn	धन
17	mal	माल	dʒal	जाल
18	gænd	गेंद	mala	माला
19	pʌʃi	पक्षी	tʃʰʌla	छाला
20	pad	पाद	tʰan	थान

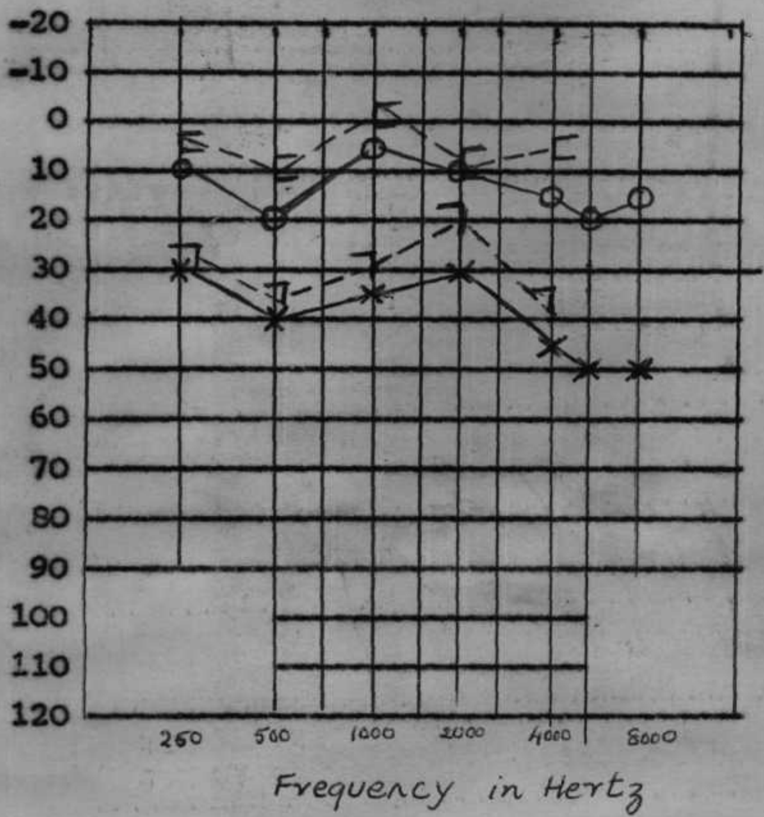
Form II (Contd)

	II C		II D	
1	desi	देसी	dʒan	जान
2	bar	बार	bʌŋt	बाँट
3	dʒat	जात	tʌl	तल
4	nʌl	नल	tʃʰʌna	छाना
5	tʃori	चोरी	naʃ	नाश
6	taʃ	ताश	bal	बाल
7	pina	पीना	kʰʌes	खैस
8	ɡala	गाला	dʌsi	दासी
9	mera	मेरा	bʌnʌ	बाना
10	nali	नाली	kʌb	कब
11	bʌḍi	बडी	dʰʌta	धाता
12	kʰel	खेल	tal	ताल
13	ɡʌm	गम	dʒoʃi	जोशि
14	dʒana	जाना	bina	बीना
15	bʰed	भेद	dʒit	जीत
16	pas	पास	pedʌ	पैडा
17	kos	कोस	ɡol	गोल
18	tʃil	चील	teli	तैली
19	dan	दान	mel	मैल
20	pat	पात	mʌṇi	मणि

APPENDIX - II

Name: G.A.G. **Age:** 40 yrs

Audiometer Used: MA22



AIR CONDUCTION	Rt.	Lt.
Un-masked	O	X
Masked	△	▽
BONE CONDUCTION		
Un-masked	[	]
Masked	⌐	¬
A.C. not heard	O↓	X↓
B.C. not heard	[↓	

	Right	Left	Aid in Ear Rt	Lt
3 frequency average	12	35		
S.R.T.	15	40		
Discrimn. (P.B.Max)	90%	65%		

Ear Tested :- Left

T.D.T :- -ve in both ears

Impedance findings : 'A' type tympanograms, with normal compliance in both ears. Reflexes present bilaterally

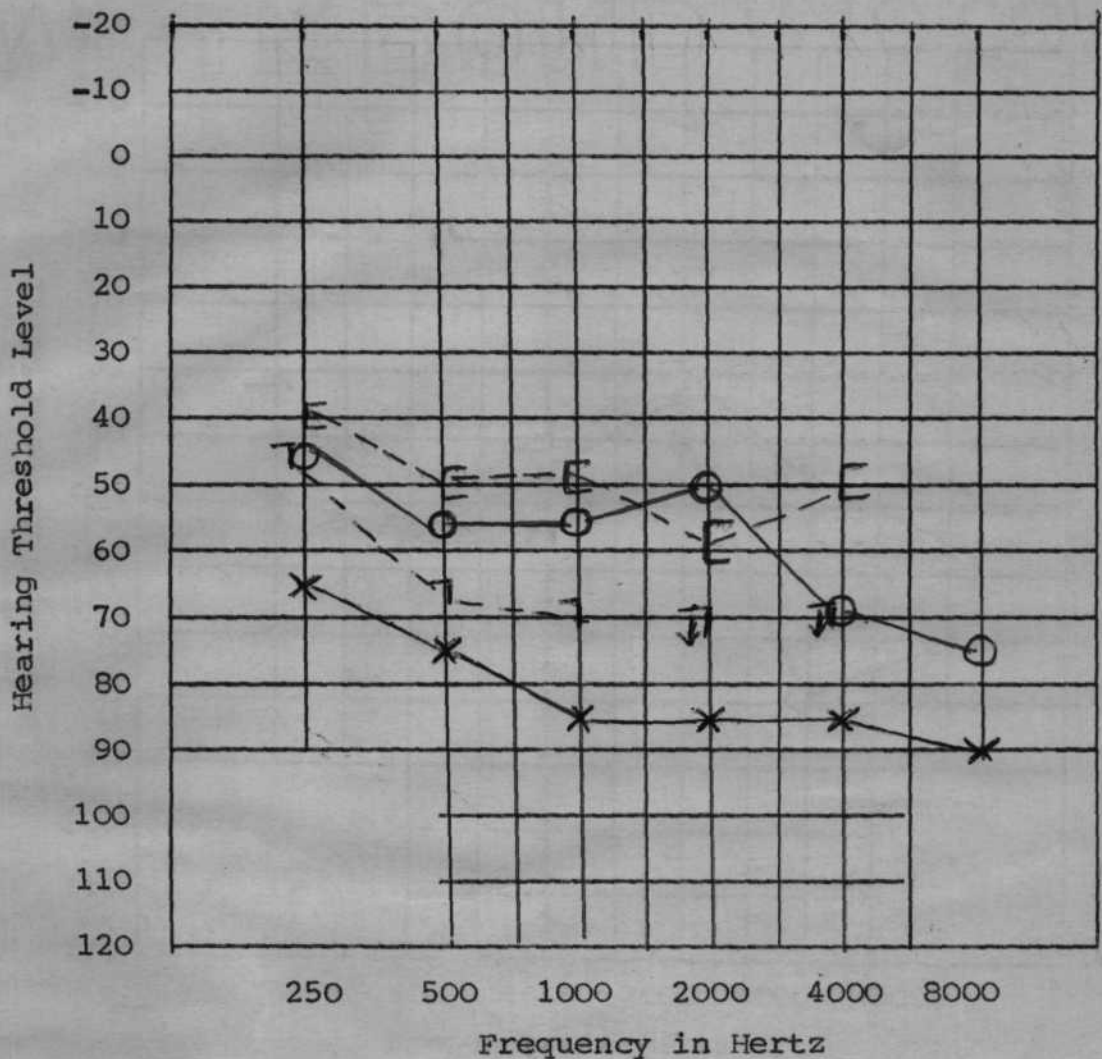
— No middle - ear pathology

Diagnosis : Left ear : Moderate sensori-neural hearing loss.

Recommendation :- Arphi - super hearing aid (with single cord)

Name: AR.I Age: 65 yrs

Audiometer Used: MA22



	Right	Left	Aid in Ear Rt	Lt
3 frequency average	53·3	81·6		
S.R.T.	50	85		
Discrimn. (P.B.Max)	85%	60%		

Ear Tested: Righ

Impedance findings: 'A' type tympanograms, with normal compliance and no reflexes bilaterally

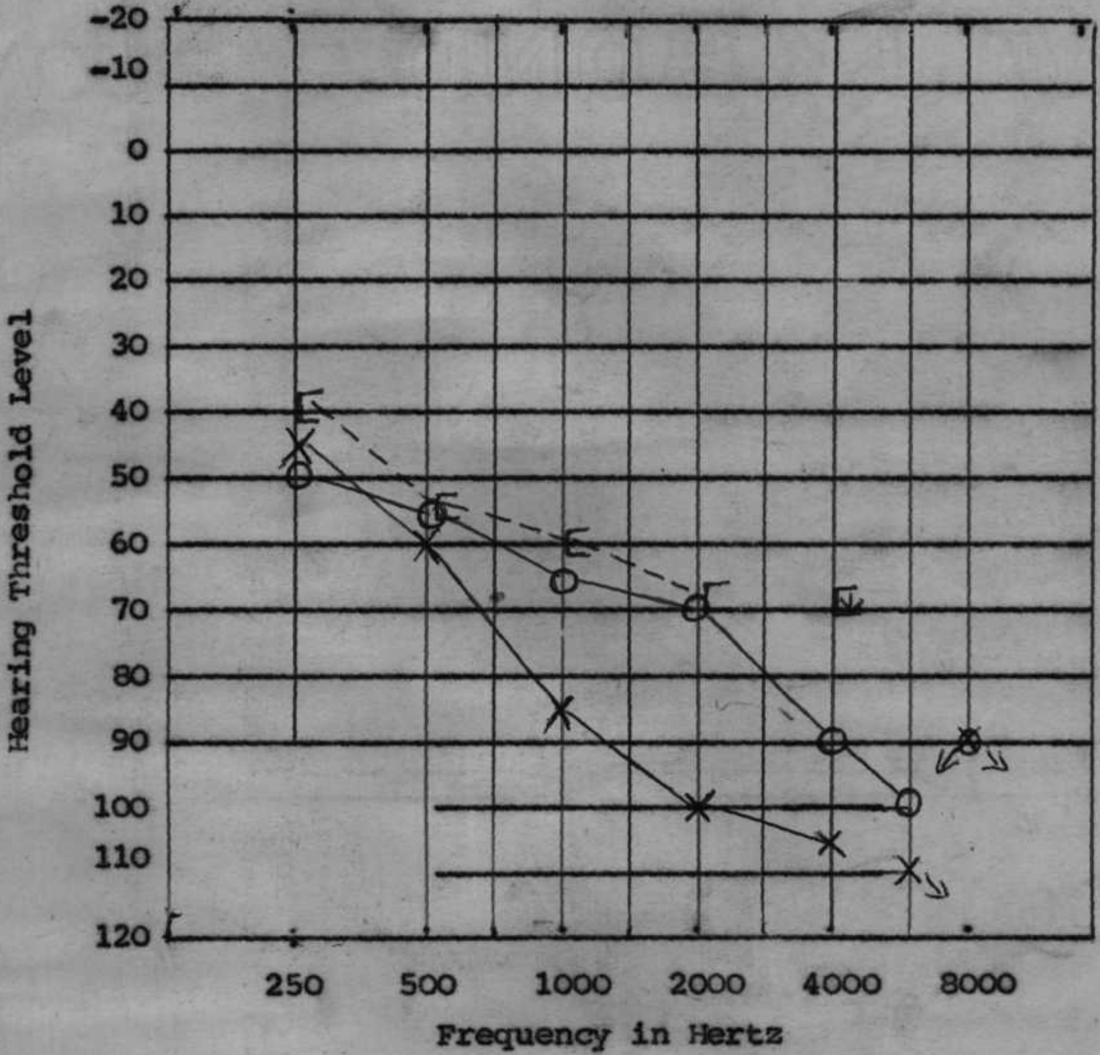
Diagnosis: Bilateral sensori-neural hearing loss.

Recommendation: Arphi-extra super hearing aid.

Name: S.S

Age: 52yrs

Audiometer Used: B-200C

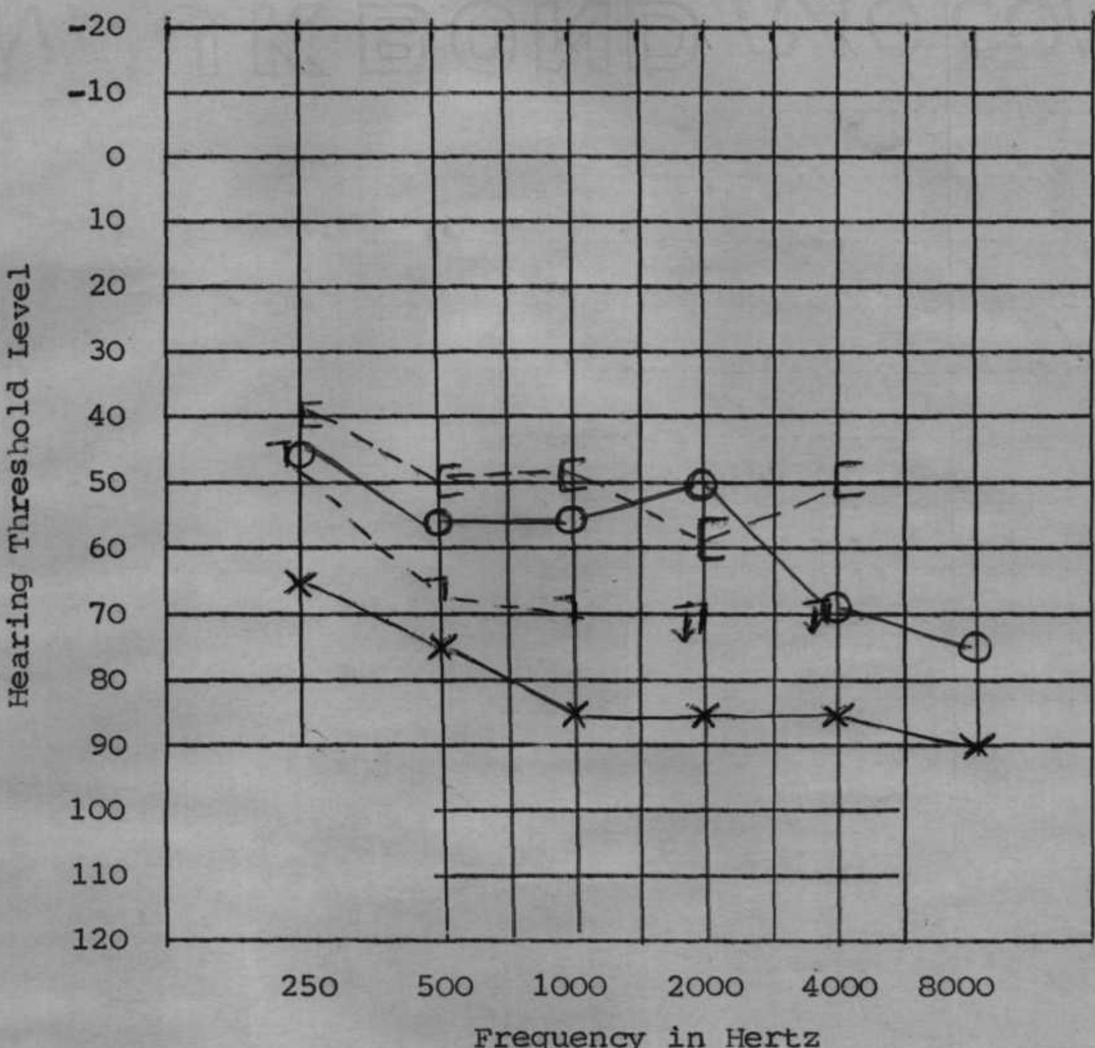


	Right	Left	Aid in Ear Rt.	Lt
3 frequency average	63.3	81.6		
S.R.T.	70	85		
Discrimn. (PB Max.)	65%	55%		

Ear Tested: Right

Name: AR.i Age: 65 yrs

Audiometer Used: MA22



	Right	Left	Aid in Ear Rt	Aid in Ear Lt
3 frequency average	53·3	81·6		
S.R.T.	50	85		
Discrimn. (P.B.Max)	85%	60%		

Ear Tested: Rig

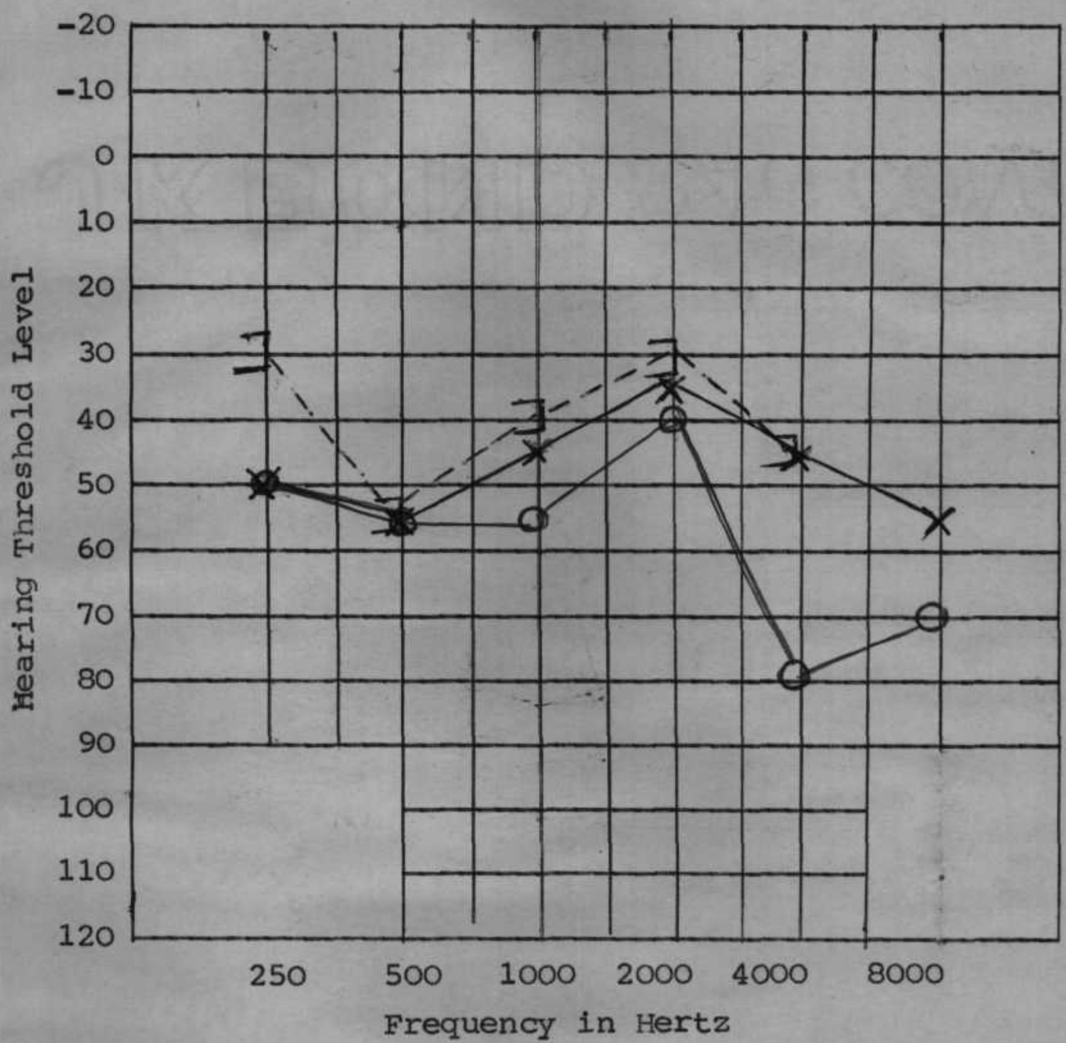
Impedance findings: 'A' type tympanograms, with normal compliance and no reflexes bilaterally

Diagnosis: Bilateral sensori-neural hearing loss.

Recommendation: Arphi-extra super hearing aid.

Name: P.B   Age: 18yrs

Audiometer Used: B. 200C



	Right	Left	Aid in Ear Rt	Lt
3 frequency average	50	45		
S.R.T.	55	50		
Discrimn. (P.B.Max.)	64%	80%		

Ear Tested: Left

TDT :- -ve in both ears

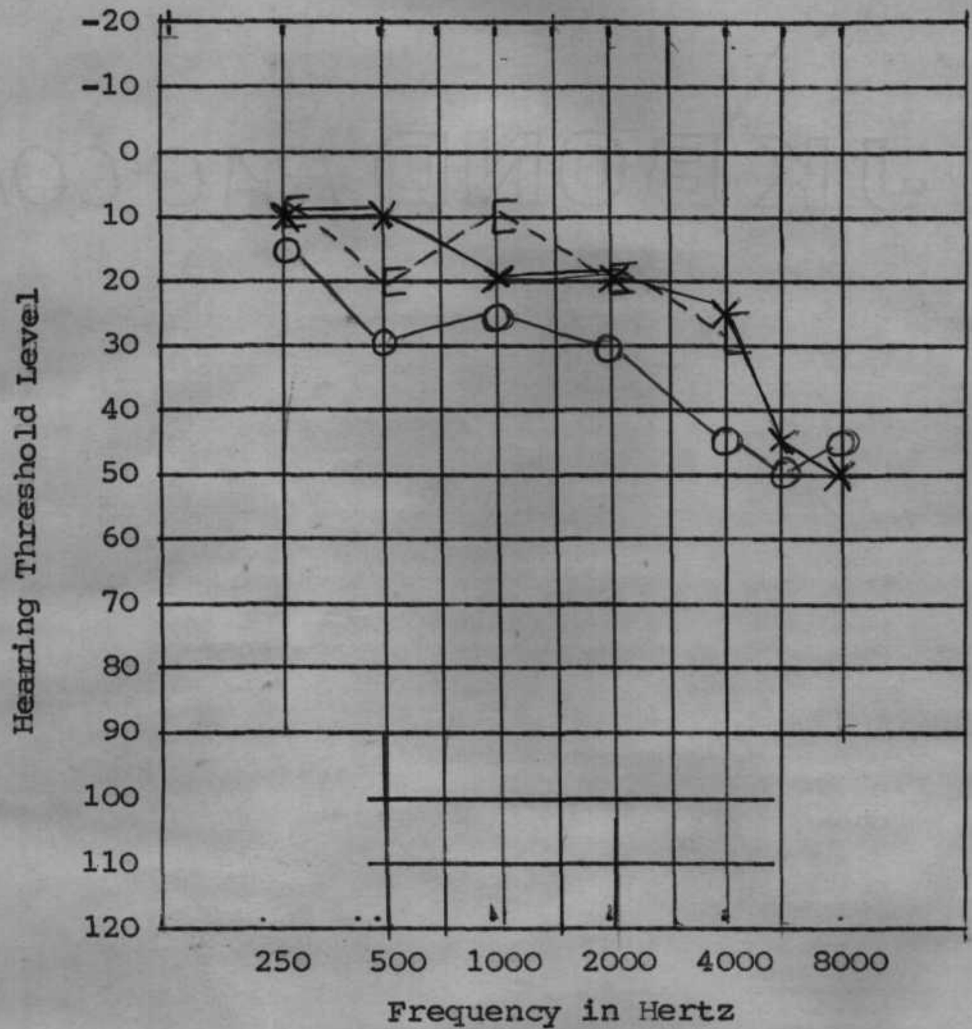
Impedance findings : 'A' type tympanograms with norma[l] compliance in both ears. Reflexes present bilaterally (only at low freq[.]

- No middle-ear pathology.

Diagnosis : Bilateral sensori-neural hearing loss.

Name: S.A.H Age: 60 yrs

Audiometer Used: B.200C



	Right	Left	Aid in Ear Rt	Lt
3 frequency average	28·3	15		
S.R.T.	30	15		
Discrimn. (P.B.Max.)	85%	90%		

Ear Tested: Right

T.D.T : -ve in Right ear.

Impedance findings: 'A' type tympanogram, with norm compliance, and reflexes present bilaterally (elevated in high fr

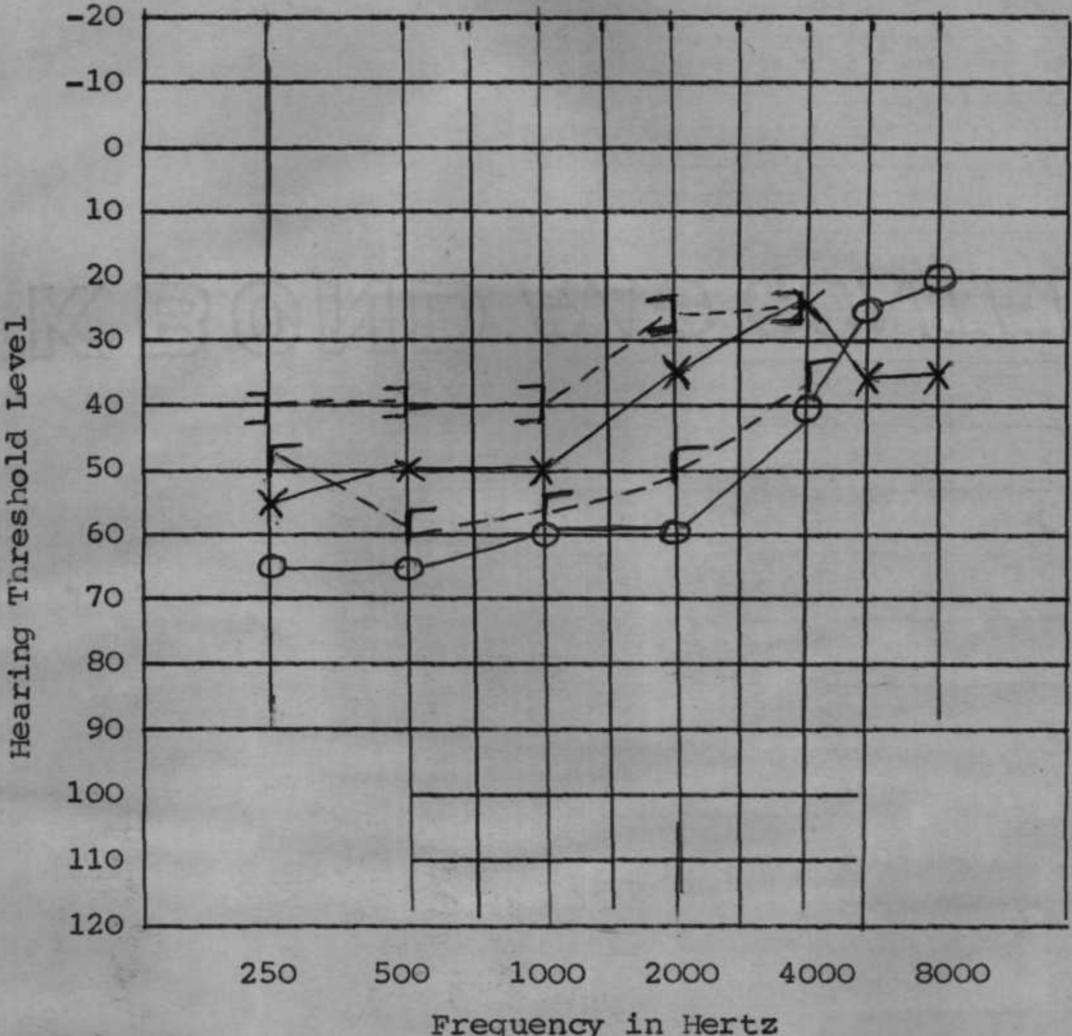
- No middle ear pathology

Diagnosis : Bilateral high-frequency sensori-neural hearing loss

Name: S.R

Age: 26 yrs

Audiometer Used: MA 22



	Right	Left	Aid in Ear Rt	Lt
3 frequency average	61	45		
S.R.T.	65	55		
Discrimn. (P.B.Max.)	70%	75%		

Ear tested: Lef

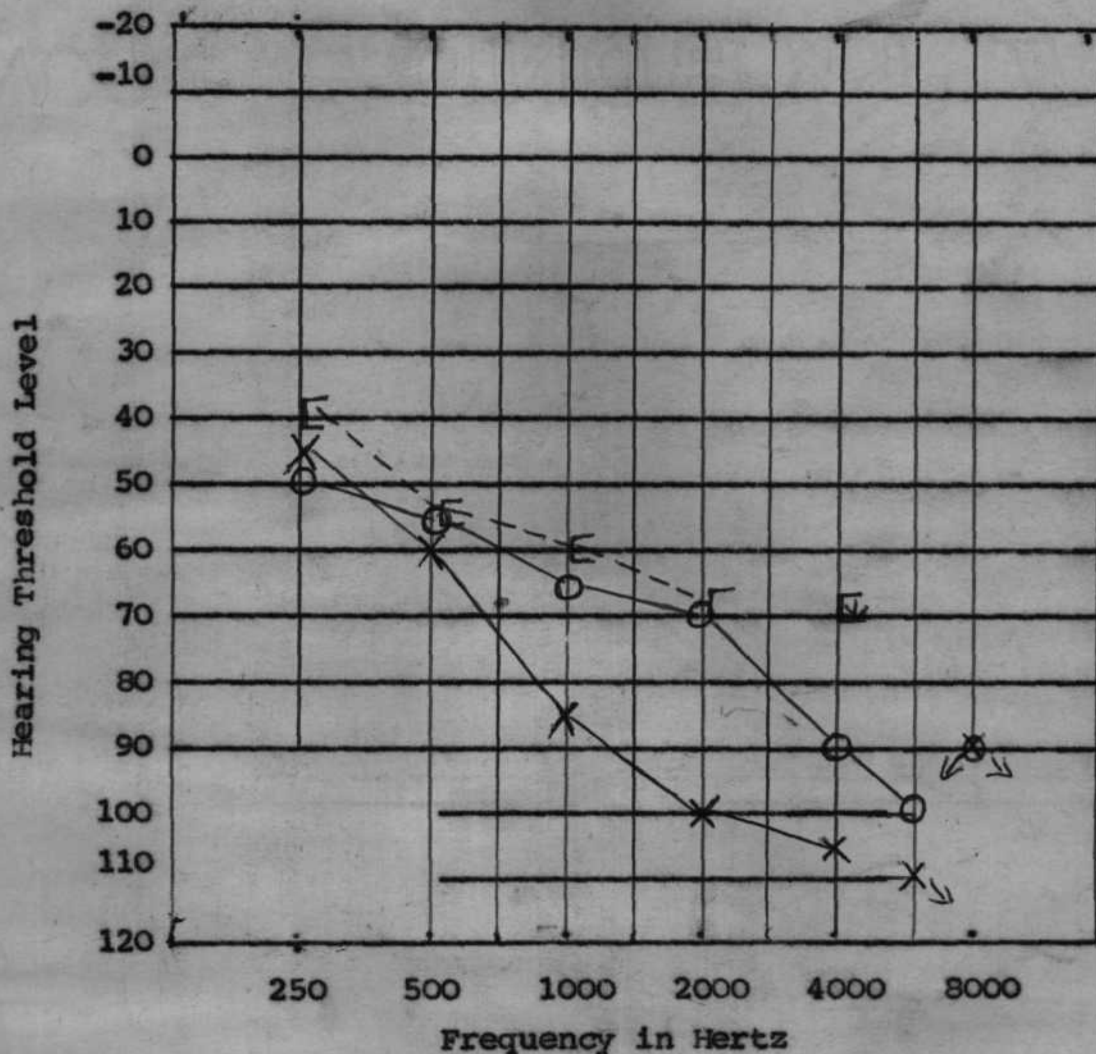
Impedance findings :- 'A' type Tympanogram in both ears with normal compliance. Reflexes present bilaterally.

- No Middle-Ear Pathology

Diagnosis :- Bilateral Moderate Sensori-Neural hearing loss.

Name: S.S **Age:** 52yrs

Audiometer Used: B.200C



	Right	Left	Aid in Ear Rt.	Lt
3 frequency average	63·3	81·6		
S.R.T.	70	85		
Discrimn. (PB Max.)	65%	55%		

Ear Tested : Right

APPENDIX-III

CALIBRATION PROCEDURES-INTENSITY CALIBRATION

Instruments:	AUDIOMETER :	MADSEN 0B70
	Earphone Type:	TDH 39
	Cushion type :	MX41/AR
	Artificial ear type	4152
	Condensor mic type	4144
	B & K AF analyser type'	2107

Fre-quency	Input level	Audio-metric Zero (ISO.1964)	Expected output in dBSPL	OBTAINED OUTPUT IN dBSPL	
				Right Earphone	Left Earphone
250	80dBHL	24.5	104.5	103	101
500	80dBHL	11.0	91.0	87	89
1K	80dBHL	6.5	86.5	86	87
2K	80dBHL	8.5	88.5	88	88.5
4K	80dBHL	9.0	89.0	90	90.5
6K	80dBHL	8.0	88.0	90	92.5
8K	803BHL	9.5	89.5	87	87.5

Internal calibration was done to get the approximate values. Linearity of the dial was checked at 1kHz. These values are given below. Frequency response characteristics of both the earphones was according to the required specifications.

Linearity at 1kHz

Input level	Obtained output in dBSPL
80dBHL	101
85dBHL	106
90dBHL	112
95dBHL	117
100dBHL	122
105dBHL	113
110dBHL	118
115dBHL	122.5
120dBHL	125

BLOCK DIAGRAM OF INSTRUMENTS USED FOR INTENSITY CALIBRATION

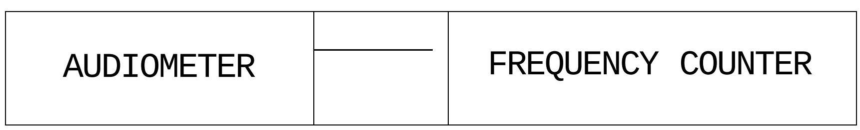
FREQUENCY CALIBRATION

Instruments:- Frequency counter type 203

Internal calibration was done to approximate values and was found to be within the limits of 31 variation. Frequency response of both earphones was flat. Linearily of dial was checked and was found to be in order.

Frequency in Hertz	Intensity in dBHL	Calibrated frequency values (Hz)
125	60	128
250	60	257
500	60	499
1K	60	1006
2K	60	2002
3K	60	3003
4K	60	4004
6K	60	6009
8K	60	8015
10K	60	9936

BLOCK DIAGRAM OF INSTRUMENTS USED FOR FREQUENCY CALIBRATION



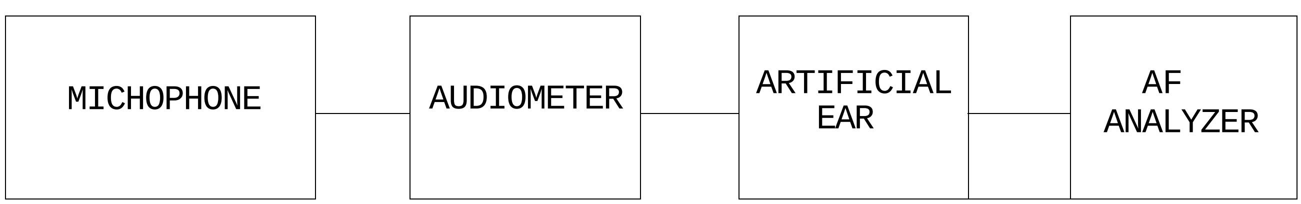
SPEECH OUTPUT CALIBRATION

Instruments

Artificial Ear Type	4152
B & K AF analyze type	2107
Ear phones Type	TDH-39

At 90dBHL attenuator level , live voice calibration was carried out. The VU meter was used for monitoring a steady level of phonation. Both right and left ear phones were in calibration. Output at 90dBHL was equal to 106dBSPL.

BLOCK DIAGRAM OF INSTRUMENTS USED FOR CALIBRATION OF SPEECH OUTPUT



APPENDIX-IV

NOISE LEVELS IN THE TESTING ROOM

INSTRUMENTS

SPL METER TYPE B & K 2209

½" Condensor Microphone type 4165

ISO STANDARDS (1964)

OCTAVE BANDS	MAXIMUM NOISE ALLOWABLE IN dBSPL	NOISE LEVELS IN THE ROOM dBSPL
75-150	31	16
150-300	25	14
300-600	26	12
600-1200	30	15
1200-2400	38	17
2400-4800	51	19
4800-9600	51	18
'C Scale	—	32