Development and Standardization of a Lip-Reading Test In Kannada Language to Detect Pseudohypacusis

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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 Kannada language to detect Pseudohypacusis", is the bonafide work in part fulfilment for the degree of Master of Science (Speech & Hearing), of the student with Register No.11.

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CERTIFICATE

This is to certify that the dissertation entitled "Development and Standardization of a Lip-Reading Test in Kannada language to detect Pseudohypacusis" has been done under my supervision and guidance.

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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.

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CONTENTS

Chapter I

INTRODUCTION

1.1 The patients encountered in an audiology clinic vary widely on the continum of cooperation. We can obtain an exact and precise audiogram, if only, the patient is ready to carry out the instructions and would make necessary efforts of attention to the perception of test stimulus. This goodwill among patients is not always taken for granted. Occassionally, the patient is not cooperative for testing. The reasons for this non-copperation might vary from, not understanding the test procedure to deli-berate feigning a hearing loss.

Usually these non-cooperative patients exhibit functional hearing loss or an exaggeration of existing hearing loss. Functional hearing loss is a common entity, occurs both with children and adults. Rarely a patient professes to have a total loss of hearing. These patients do not respond even at highest audiometric output levels. But remarkably, these patients respond to ordinary con-versation quite adequately. This ability can be observed both with and without a hearing aid. The reason they forward, for their ability to respond in a conversation situation, so well, is that they are good in lip reading. It can be expected that such patients do make use of their hearing ability. It is usually very difficult to respond so well, solely on the basis of vision only.

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The aspect of lip reading ability has been extensively used in the detection of functional hearing loss. The lip reading ability can be checked by using minimal visual cues, or by eliminating voice and then switching to whisper or by continuing a conversation while turning away from the patient (Feldman 1967). Falconer (1966) reported that, these patients who claim a lip reading ability can be evaluated using a "lip reading test".

The lip reading test contains auditory as well as visual stimuli. It consists of monosyllabic homophenous words, which are nearly impossible to perceive by lip reading alone. But the patient is unaware of this, and continues to respond in his usual way to sound and stimuli. As can be expected, the correct responses.Would be the result of audition and inadvertently, the patient reveals some degree of functional hearing loss. According to Falconer the test is also effective with much smaller degrees of functional hearing losses. The test is simple and has many comparable forms.

There is always a need for simpler and more reliable tests to reveal the extent of functional hearing loss exhibited. The Falconer's lip reading test, would be very useful in quantifying the speech thresholds of functional hearing loss patients. This test has a remarkable ability in exposing functional problems without obviously indicating to the subject that he has been caught (Weiss, 1971).

Weiss continues to say that, psychophysically and psychologically the Falconer's"lip reading test" has definite advantage which/warrants its inclusion in the test battery.

1.2 Need for the study:

The 'Lip reading Test' is in English language and there is a great need for such tests in Indian languages. This 'Lip reading Test' has not been developed in any Indian language. As " Lip reading Test" is a very useful test for detecting pseudo-hypacusis, there is an urgent need for development and standardiztion of "Lip reading Test" in Kannada language, for detecting pseudo-hypacusis cases who speak Kannada only. With this purpose the present study was undertaken.

1.3 Plan of the study:

The study was planned to develop test material in Kannada language, and then to test it on normals, as well as, on clinical groups.

Chapter II

REVIEW OF LITERATURE

2.1 Definition and Terminology:

Usually functional defect is contrasted with organic defect. An organic defect is one when structural alteration is an important contributing cause. In contrast to this, when a structural alteration can neither be demonstrated nor inferred, a functional defect is said to be present(Wood 1957, cited by Hopkinson, 1974. p.175). The operational definition of functional hearing loss is usually baaed on clearly specified intratest and intertest audiometric discrepancies, as well as medical examination to rule out organic involvement.(Ventry and Chaiklin, 1962).

Many authors have pointed out to the ambiguities created by large number of terms, that have been used to denote a functional hearing loss.(Ventry and Chaiklin, 1962; Williamson 1974; Martin 1978). These terms include, non-organic hearing loss, psychogenic hearing loss, psychic deafness, auditory malingering, pseudoneural hypacusis, histrical 'deafness', pseudo deafness and others. Williamson (1974) warns that these terms may not explain the same phenomenon. Martin (1978) prefers the use of generic terms, since the clinicians do not know whether the exaggerated auditory thresholds are due to conscious or unconscious motivation. A generic term is a general term which includes several categories with one or more common characteristics. Martin (1978) supports the use of terms "Pseudohypacusis" given by Carhart (1971), and "non-organic hearing loss" because of their specific reference to hearing loss. But 'pseudo-hypacusis' is a pejorative term and the terms malingering, psychogenic, psychic deafness etc., become too specific, to be defined accurately (Chermak, 1977; Hopkinson, 1973). Ventry and Chaiklin (1962) have attempted to resolve the confusions in the terminology of functional hearing loss. They prefer the term 'functional hearing loss', which is neither the antonym of organic nor the synonym for psychogenic. When correctly used as diagnosis, the term 'functional hearing loss' means that the patient's problem has been thoroughly investigated with the best available instruments and methods, and that no organic factor was found to account for his symptoms (Landis and Bolles, 1950, quoted by Ventry and Chaiklin, 1962). Many authors use these terms interchangeably, for Eg: Martin (1978) uses the terms pseudohypacusis and non-organic hearing loss, interchangeably, to describe responses obtained on hearing examination which are above the patient's true organic thresholds.

2.2 Types and Causes of Functional Hearing Loss:

Many authors distinguish between 'malingering' and 'psychogenic' types of functional hearing loss. In fact, Ventry and Chaiklin (1962) opine that, for patients who receive a diagnosis of functional hearing loss of apparently psychological origin can be appropriately labelled as 'psychogenic hearing loss'. But it should be noted that, the term 'psychogenic' does not distinguish between conscious and unconscious motivation. Ventry and Chaiklin (1962) do not support the idea of a distinction between malingering and psychogenic types, because;

1. The etiology of malingering presumably rests in patient' mind, hence malingering by definition is psychogenic.

2. Both conscious and unconscious dynamics may operate in the same patient to cause malingering.

3. The term has strong negative connotations for some people. Sometimes when used as diagnosis, it is an expression of examiner's disapproval of the motivation he suspects in the patient and finally,

4. The judgement of whether or not a patient is malingering is not within an audiologist's realm of responsibility. It is more properly a question for a judge. Here adequate legal defence should be maintained.

Goldstein (1966) has severely criticised the psychogenic component of non-organic hearing loss. He suggests that, when a hearing loss or hypacusis is false, the term pseudohypacusia should be applied to it. This holds good even in overlay cases. Goldstein proposes 2 criteria which are essential for an unequivocal diagnosis.

1. The patient consistently falls to respond during behavioural audiometry to sounds weaker than a given level, but during electrophysiologic audiometry or under hypnosis, or under nacrosynthesis he does respond to weaker sounds.

2. The patient's apparent sensitivity to sounds in daily life is aa good as but not better than would be expected

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from the sensitivity shown by the behavioural audiometric responses.

The medico-legal problems, financial and other benefits, have been attributed to functional hearing loss. As already mentioned, the existence of a psychogenic component in functional hearing loss is much discussed, and many deny its existence. Still others, agree for its existence but are unable to substantially prove it (Goldstein 1966: Hopkinson 1973). It should be kept in mind that, audiologist's function is to determine the extent of organic component rather than to determine the precise reason for the non-organic results.

2.3 A Note on Functional Hearing Loss in children:

Data on children who show functional hearing loss are difficult to interpret(Hopkinson 3.973). Williamson (1974) quotes Doerfler (1957) who has reported varied incidence figures from 0 to 7%. Barr (1963) reported 32 cases with psychogenic hearing loss. He has stressed that the mono-organic difficulty must be detected as early as possible before the child learns to enjoy secondary gains from it (quoted by Martin, 1978, p.278). Interestingly for unexplained reasons, functional hearing loss in children appears three times more often in females than in males (jerger, 1963). Martin (1978) adds that, performance or supervisionn of hearing tests on young children by an audiologist may serve to avert what may later develop into serious psychological or educational difficulties.

2.4 Identification:

2.4.1. Referral sources:

Frequently the source of referral will suggest the possibility of pseudohypacusis (Martin, 1978). When an individual is referred by a court or from defence section, following an accident with sudden loss of hearing, it is quite natural to suspect non-organicity. This is also true, when a patient comes with a complaint of hearing loss and requests for a handicapped pension certificate. Martin(1978) reports that, majority of these patients are cooperative for testing. But some of them with their behaviour, establish their functional hearing loss.

2.4.2. Case History:

Usually an adult patient answers all questions positively. He tries his best to provide as many symptoms as he can. Yet when finally analysed, too many symptoms cast suspicion and his symptoms will not supply enough veracity (Hopkinson, 1973). Obviously, it is helpful if an audiologist himself taks the history so that the responses offered as well as the manner in which these responses are offered can be observed (Martin 1978). Usually a sudden hearing loss is reported. The patient might dramatize his answers and may explain in detail about the accident, or bleeding of blood from his ears or any such embellished occurrences. Some times the material obtained through case history does not match with information obtained through other means (Hopkinson, 1973).

2.4.3. Behavioural Observations:

The patient's behaviour must be observed before, during and after testing. These patients might show over-reliance on 'lip reading'. Through the same reason, they defend their easy communications during a conversation (Falconer, 1966). He might ask for inappropriate repetitions of words, might cup his hands over his ears and appear very keen on listening to the speaker (Martin, 1978). When these patients are compared with organic patients, the behaviours look many times illogical and exaggerated. (Gibbons, 1962). The patients of functional loss do not show a deterioration in melody or in production of consonants. Whereas patients with total loss of hearing follow a pattern of deterioration in speech production(Gibbons, 1962). These patients are observed to show poor cooperation regarding appointments for testing, they came too early or too late (Johnson et al. 1956 cited by Hopkinson, 1973. p.182) The functional patient might show any behaviour to convince that he has a hearing loss.

Generally, a functional hearing loss patient exhibits inconsistency on repeated testings. This inconsistency has been attributed to the difficulty in maintaining a consistent signal parameter for reference (Shepherd, 1965). A certain amount of variability is expected of any individual, however, when the magnitude of variability exceeds 10 dB for any threshold measurement, one must consider the possibility of non-organicity (Martin, 1978). It is also possible for a functional patient to be very consistent on tests. The inconsistencies can be intertest and intratest. Usually,

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2 types of responses are frequently observed: false positive and false negative. False negative responses are characteristics of functional hearing loss. A highly responsive patient gives false positive responses, which are characteristics of true hearing loss (Martin, 1978). These peculiarities of behaviour constitute a variable syndrome of insincerity and the expert can scarcely mistake them.

2.5. Formal testing:

A functional patient is expected to experience considerable difficulty in maintaining consistency of responses, if he is asked to respond repeatedly to test stimuli. This behaviour is generally used as an example of non-organic behaviour. Actually, the functional patient may be no less or no more consistent than organic patient during repeated measurements of threshold (Hopkinson, 1973).

Some authors describe a flat audiogram pattern in functional patients (Semenov, 1947, cited by Martin 1978. p.279; Foumier, 1958). Others describe a saucer type audiogram similar to a supra-liminal equal loudness contours, as a typical curve illustraing non-organicity (Doerfler, 1951; Carhart 1958; Goetzinger and Proud, 1958, cited by Martin 1978.p.280). However, Chaiklin et al. (1958) have observed that the saucer type audiograms have also been obtained with true organic patients. They conclude that there is no typical pure tone configuration associated with non-organic hearing loss (MartJn, 1978).

A unilateral hearing loss patient should show a shadow curve, the response of better ear, when the signal is raised to a sufficient level which enables contralateralization. Unless, clinical masking is applied, the shadow curve should be seen. A functional patient denying hear in one ear would fail to show this shadow curve. The lack of contralateral response, especially by bone conduction, is a very clear ' symptom of unilateral organic hearing loss(Martin, 1978).

The relation between air conduction and bone conduction responses, often is an indication of poor coooperation.of If bone, conduction thresholds are larger than air conduction thresholds, the patient may have difficulty in making accurate loudness judgements via bone conduction. On the other extreme, patients have demonstrated a conductive component. And these bone conduction thresholds were later found to represent organic thresholds (Hopkinson, 1973).

The Speech Reception Threshold (SRT) is generally expected to compare favourably with the average of the best of the three thresholds obtained at 500Hz., 1000 Hz., and 2000 Hz.(Carhart 1958) Founder, 1958; Siegenthaler and strand 1964; quoted by Martin, 1958 p.280). Lack of agreement between PTA and SRT is a good sign of non-organicity. This is particularly important, in the absence of explanations of such as sloping audiogram, poor word disciminations, etc.(Feldman, 1967; Nilo and Saunders, 1976; Martin, 1978). In a study by Ventry and Chalklin (1965),,33 out of 47 subjects had significantly lower speech thresholds than their

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pure tone averages. This finding is common in both children and adults (Menzel, 1960; Rintelmann and Harford 1963, cited by Hopkinson, 1973.p.186)

Patient's responses to traditional speech audiometry can also prove to be useful in detecting functional hearing loss. (Hopkinson, 1973). A patient repeats only half word of a spondee during SRT measurements, when he can repeat ½ of a spondee, there is no valid logic, why he should not repeat other half. Some patients do not respond to any speech signal on the affected side, regardless of the level. Frequently the patient substitutes words, which have little likeliness to the spondee presented. They also show disproportionate number of no responses. Inconsistency on repeated SRT measurements is also well noted. However, Glorig (1965) warns that the person's problem is not organic. Chaiklin and ventry (1965) have worked out a formula for spondee error index, so that a high score contrasted with a low number of false positive responses during pure tone testing, identifies a functional patient. Typical responses are also observed while testing discriminations also (Hopkinson 1973 and 1978).

Shepherd (1965) has reported that individuals with non-organic bearing loss were as consistent as normal hearing subjects and sensori-neural loss patients, when reproducing puretone thresholds measured at 1000 Hz. by identical psycho-physical methods. It is also reported that the method of constant stimuli clearly differentiates non-organic subjects from normals and sensori-neural loss subjects. However, 'shock threat' failed to bring about changes in response pattems, with all three groups. Working on similar lines Chaiklin and Ventry (1966), recommended 1 KHz. threshold measurements at different time intervals. By including GSR measurements, along with 1KHz. threshold measurements, they could identify 66% of functional hearing loss patients. They compared 1st and 4th test-retest thresholds. A 15 dB difference between test-retest thresholds was considered aa positive. When compared 1st and 2nd test-retest measures only 11% were positive. However, Chaiklin and Ventry(1966) feel that testing 2 or 3 frequencies for retesting is an inefficient method for identifying functional hearing loss.

Kerr (1975) reports a modification of Harris (1958) test 'the ascending and descending audiogram'. It is agreed that descending method of obtaining thresholds yields a better threshold. But malingerers trace a better threshold through an ascending method. The testing starts at a higher intensity, say 90 dB, and intensity is reduced in 10 dB steps until no response is obtained. Now, the intensity is ascended in 5 dB steps, until a response is again obtained. The usual discrepancy observed at one or two frequencies, is around 25 to 30 dB. The results are attributed to malingerers difficulty in starting off with an inaudible stimulus. This is similar to Bekesy type V audiogram, obtained with functional loss cases.

Nilo and Saunders (1976) suggest a modified conventional approach to detect functional loss. The audiometric meth is strict ascending, calculated and deliberate. Pure tone and speech are presented at smaller intervals than usual (2 to 2½ dB) and many signals are given at each interval. The patient is pressured to respond. He is asked 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.

Frank (1976) has reported a 'yes-no' test for non-organic hearing loss cases, particularly used with children. This test necessitates a judgement of presence or absence of tone. The test would be a better success, if immediate responses after tone presentation are obtained. Three patients are reported, on whom, valid hearing thresholds were established using Yes-No test. The test is easy to administer and does not need special equipment.

Wood et al. (1977) suggest that, a functional patient is expected to experience, considerable difficulty in maintaining consistency of responses, if he is asked to respond rapidly. This inconsistency has teen attributed to reduced decision time. If lengthened decision time is maintained, it suggests functional hearing loss. The authors recommend that auditory reaction time measures can be employed to determine the existence or non-existence of functional loss. They further recommend to study auditory reaction times on a signal detection task to rule out the influence of subject's decision criteria.

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As can be observed, most of the formal tests fail to accurately quantify hearing thresholds. This aspect has necessitated the development of special tests.

2.6 Special tests for Functional Hearing Loss:

2.6.1 Interest in functional hearing loss was reawakened after Second World War (1945). The main reason was the large number of service linked pension claims from the veterans. Since then many tests to detect and to quantity functional hearing loss have been developed (Albert!, 1970). Keeping the view point of economy of time and energy, simple and rapid tests are always preferred (Pang Ching, 1970). The purpose of administering special tests is :to confirm or reject, the impressions of the patient's behaviour obtained through routine testing(Newby, 1972]

2.6.2 Lombard or voice reflex test:

The Lombard test is based on the principle that the listener can regulate his vocal intensity so that he accommodates to the noise in this environment (Hopkinson, 1973). Unless one does not hear the noise in his environment, he will raise his vocal intensity to compensate for the level of noise (Hopkinson, 1978).

In the Lombard test, the patient is asked to read some material while a masking noise is fed into the ear phones, he is wearing. As the noise level is increased and decreased, the changes in the voice intensity are noted. The test is positive, if increase in voice intensity is noticed, when the masking noise is increased. If the noise level which brings changes in intensity of voice, is less than the admitted hearing levels, func-

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tional component can be suspected. The test is negative, if no changes in voice level are seen regardless of the noise level. But this test is not standardised and can easily be 'beaten' by a sophisticated patient(Newby, 1972). The test is usually administered to bilateral cases.

Harris (1965), recommends the use of 'VU' meter of speech audiometer to observe voice intensity changes, while administering Lombard test. Fricke (1968) demonstrated that the introduction of masking noise in the feed back channel results in measurable increases, in syllable duration. This effect begins at levels as low as 10 dBSL noise, and is a monotonic linear function.

2.6.3 Story tests:

Story tests are used mainly to verify a monaural hearing loss and if controlled for this purpose quantitative results can be obtained (Hopkinson, 1973; 1978). A two channel speech audiometer is necessary, with the facility for switching from one ear to the other and to the binaural position.

As the audiologist tells the story, parts of it are delivered to better ear, parts to the poorer ear and parts to both ears. The story must be designed so that each part of it stands alone as a separate story(Hopkinson, 1973)

If the patient repeats the parts of the story delivered to the poorer ear, then the hearing can be said to be at least as good as at that level. If the repeated story in major part is the one delivered to the better ear, then hearing in poorer ear is probably worse than that level. To be successful the test must provide the listener with the feeling of continuity. He must not be aware that story is switched from ear to ear (Hopkinson, 1973). The levels are not changed in this procedure because the differing levels may cue the patient that the poorer ear is louder than the other, then he would respond to signals only in better ear (Hopkinson, 1978). The technique may be changed a little, to find approximately true speech thresholds. The story is delivered at a selected intensity level (10 dB below the ' admitted threshold), and at the end a long pause is given, for the patient to respond. If a response is forthcoming, a better threshold can be searched again (Hopkinson, 1978).

2.6.4. The Stenger Test;

The stenger test is one of the best ways to detect unilateral functional hearing loss. The stenger principle states that, when two tones of same frequency are introduced simultanesouly into both ears, only the louder tone will perceived (Martin, 1978).

Altshuler (1971) has provided a detailed history of the stenger test. His work has been briefed here: Stenger originally described his test in Germany in 1900 and 1907. It involved two matched tuning forks. The stenger test began to take a quantitative form when Priest (1945) indicated the use of audiometer as a source, of sound. Taylor (1949) reported that, variations in the administration of the test, were effective in proving malingering in every instance. Watson and Tolan (1949) considered the Stenger Test as most reliable and effective test. This view has been supported by many authors (Azzi, 1962; Davis and Silverman, 1960; Feldman, 1962; Menzel, 1965; etc.) Still many others do not have any negative comments about the test, but they caution about the negative aspects (Gibbons and Winchester, 1957; Goetzinger, 1958; cited by Altshuler 1971; Kinstler, et al. 1972; Weiss, 1971). Altshuler (1971) has 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 cages'.

Methods of the stenger test presentation: Various methods of test precautions have been grouped into three classes (Altshuler, 1971)

A. Involves qualitative and quantitative methods:

Qualitative tests are mainly screening tests for non-organicity (Ballentyne, 1960): Heller, 1955: cited by Altshuler 1971; Martin 1978). If qualitative test is positive many continue to test with a quantitative method (Goetzinger and proud, 1958: O'Neill and Oyer, 1966; Sataloft 1966; cited by Altshuler, 1958). 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 quantitative methods and uses an ascending or descending signal presentation to the poorer ear. No rationale is provided for this, peck and Ross, (1970) compared ascending and descending modes with respect to interference levels (IL). No trend was seen for either mode to yield smaller ILs and mode was not a relevant factor. When the subject does not respond to tone in poorer ear, but when it is supposed to be heard, the stenger is said to be positive. It is suggested that by using both methods a valid threshold can be estimated.

C. The third classification involves the use or lack of use of a 'fading tone'. Tone in the good ear is taken off, either suddently or gradually, after increasing the tone in poor ear. If the subject continues to respond, it cnn be assumed that tone is heard in poor ear and the patient is trying to confound the tester or himself is confused. Gaeth (1956) questions the vplidity of such a method (Altshuler, 1971).

Factors that affect Stenger Test;

1. Diplacusis: At times diplacusis can invalidate the test. However, Chaiklin and Ventry (1963), suggest that diplacusis may be vastly overrated, as a barrier to the valid stenger test. They mention a possibility that, when a critical point is passed regarding perceived loudness, small pitch differences could be obscured by the stenger effect. It is

suggested either to use a speech stenger test or to use a narrow band noise signals as stimuli for the stenger test (Altshuler, 1971)

2. Recruitment:Information by a stenger test is misleading on a recruiting ear, particularly if the poorer ear is not recruiting. But recruitment would be a rare occurrence in the case of strict unilateral loss (Menzel, 1965, cited by Altshuler, 1971). Altshuler (1971) cautions about the subjects who show normal hearing through speech frequencies and a sensorineural dip at 4 KHz. While dealing with a bilateral case of course, recruitment is more than a minimal consideration.

3. Intensity relations between ears: Larger the interaural difference the effective and valid the stenger test would be. The size of the functional component in the better ear is also an important factor (Altshuler, 1971; Kinstler et al. 1972).

4. Other factors: Three speech frequencies are probably the most valid to use with the stenger (Heller 1965; Ventry 1962, cited by Altshuler, 1971). Similarly, ear pathology and contralateralization are considered (Goetzinger and proud, 1958; Chaiklin and Ventry 1963; cited by Altshuler, 1971).

Modifications of the Stenger Test;

1. Speech Stenger: A test using speech signals to verify a monaural loss of hearing has based on the classical pure tone stenger test (Taylor, 1949; Johnson et al. 1956; Watson and Tolan, 1962 cited by Martin 1978. p.297; Hopkinson, 1973).

The spondee words are used and the patient is asked to repeat each word. The signal initially is given to the good ear at 5 to 10 dBSL. After the patient repeats several words correctly, the speech signal is directed on to the poor ear. The intensity of signal in poor ear is raised gradually until its level is more than the level in good ear. If the patient ceases to repeat the spondee words at any hearing level below his admitted SRT, the speech stenger is positive (Newby 1972). Slight modifications of this procedure are also used (Hopkinson 1973 and 1978).

2. Shifting Voice Test: This is a special modification of speech stenger and is useful in unilateral functional hearing loss cases. The speech (questions, instructions etc.,) shifts between ears, occassionally the spondees are inserted and the patient is asked to repeat. The patient is asked to indicate through which ear he is hearing the examiner, by pointing to the appropriate ear phone. Johnson et al. (1956) suggest that this procedure is also useful with bilateral cases who have slight interaural threshold differences. An individual with pseudo hypacusis responds inconsistently on the shifting voice test (Newby, 1972).

3. RRLJ: A similar confusion technique using tones instead of speech has been reported by Nagel (1964) called as' rapid random loudness judgements' (RRLJ). Although it is an outgrowth of Fowler's ABLB test it is different in both presentation and purpose. After obtaining patients voluntary SRT and pure tone thresholds in each ear, the patient is asked to repeat which of the two alternatively presented tones is

louder. Then in rapid succession, the tones are presented - skipping one or more octaves after each paired presentation. The ear of initial presentation is varied as well as the sensation levels. Equal time of presentation to each ear is maintained. The evident confusion is a significant indication of functional hearing loss. The test can be used with both unilarteral and bilateral cases.

4. FIT (Fusion Inferred Threshold) Test: Altshuler (1971) quotes, Bergman (1964) who described the use of stenger phenomenon to determine "..... thresholds of hearing sensitivity where standard audiometry yields uncertain results". It is emphasized that the FIT test, is not an attempt at unmasking nonorganicity but rather to determine close estimates of valid thresholds with subjects that are otherwise difficult to evaluate.

5. Using Automatic Audiometry: Reger et al. (1963) have suggested the use of an automatic Bekesy type audiometer for the stenger test (Watson and Voots 1964; Altshuler 1971). Watson and Voots (1964) have modified this procedure. After establishing thresholds of the better ear, the poor ear thresholds were traced using a stenger 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: As there was no literature on the use of the stenger test on children available, Altshuler (1971)

tested 12 selected children on the stenger test and found the test to be useful in obtaining thresholds.

Fournier (1958) describes four methods, each of which allows the examiner to establish a threshold and thus to plot an audiogram. Using Beltone 15CX audiometer, the stenger test can be administered to equal bilateral loss cases(Vyasamurthy, 1971).

7. Recommended Stenger Test model by Altshuler (1971):

(a) A simultaneous presentation and withdrawal of a pulsed tone signal should be utilized.

(b) One should begin the tone to the good ear close to the threshold to precipitate constant response from the subjects.

(c) An ascending technique should be used in the poorer ear starting at 0 dBHL.

(d) Discrete presentations should be in 5 dB steps with the pause time and stimuli time sposradically altered to avoid rhythmicity.

(e) The tone to the good ear should not be faded away.

(f) The test should be accomplished quickly and incorporated into the routine pure-tone audiometry which is preceded by the adequate standard/instructions.

2.6.5 Bekesy Audiometry:

The use of Bekesy audiometry in identifying individuals with functional hearing loss dates from Jerger and Herrer's clinical report in 1961 (Ventry 1971). They have reported a type V Bekesy audiogram, which is characterized by continuous tones being traced at lower (better) hearing levels than interrupted tones for most of the frequency range. This type V pattern is in contrary to Jerger's (1960) other patterns (Resnick and Burke, 1962: cited by Dieroff, 1970) Riantelmann and Harford, 1967; Ventry, 1971; Dieroff, 1970; Kacker, 1971; Martin, 1978).

Ricntelmann and Harford (1967) have proposed a specific definition of the type V pattern: "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 at least 2 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, 1971). Although Bekesy audiometry provides better insight into the listening strategies employed, the high rate of false positives and false negatives, limits its use (Ventry 1971).

Kecker (1971) 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 patterns were found in 70% of the cases.

3. Saucer shaped curves and increased Bekesy excurscions are not reliable indicators of simulated hearing loss .

4. Bekesy audiometry is a reliable tool in detecting simulated hearing loss.

Hattler (1970) reports that 'lengthened off time' (LOT) is an efficient screening method for non-orgamicity. The Lot Test has the effect of increasing the tracing level of interrupted tones for the non-organic patients. 95% success in identifying functional loss has been reported.

The use of Bekesy audiometry, to administer stenger test (Watson and Voots, 1964) has been already been mentioned. Martin and Monro (1975), caution that practice and sophistication do assist the subject, if motivated to avoid type V pattern, when a hearing loss is simulated.

Hood,Campbell and Hutton (1964) have reported that that BADGE (Bekesy Ascending Descending Gap Evaluation) is obviously confusing to the patient and therefore, is more useful in the diagnosis of exaggerated hearing threshold (pseudohypacusis).

Martin(1978) concludes that, arguments on the use of Bekesy audiometric techniques for diagnosis of pseudohypacusis are bound to continue. At this point, LOT and BADGE appear to have certain value, although they donot indicate true threshold. Type V tracing may only suggest nonorganicity and is not an evidence in and of itself.

2.6.6. Delayed Auditory Feedback (DAF)

Originally, the concept of DAF by Lee and Back (1950; 1951). They reported that many normal speakers would exper-

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ience changes in their speech similar to stuttering, when they heard themselves through ear phones under various conditions of the delay (Newby, 1972).

The delay is produced by modifying a tape recorder, to produce different amounts of time lag or delay (Newby 1972). A delay of 0.1 to 0.2 seconds has been found to have maximum effects (Ruhm and Cooper, 1964; Newby 1972)

The feed back is provided at a level lower than the admitted threshold and changes in test tasks are noted down. A change in a given task is expected when a person hears the delayed feed back. Generally speech and tapping tasks are employed. The test can be useful with both unilateral and bilateral cases (Newby, 1972; Hopkinson, 1973; Martin, 1978; Alberti, 1970; Ruhm and Cooper, 1964).

Gibbons and Winchester (1957) (quoted by Newby, 1972. p.164) have used DAF test as a screening procedure for functional hearing loss, when the voluntary SRTs suggest a unilateral hearing impairment. Ruhm and Cooper (1962) have developed a procedure with DAF to determine pure tone thresholds within 5 to 10 dB of their actual levels. Ruhm and Cooper (1964) have validated the 'DAF audiometry' on different subjects and have found it to be very useful in determining hearing levels.

Karlovich and Graham (1966) (quoted by Hopkinson, 1973 p.200) used normal subjects to study the modifications of the key tapping methods. Avisual signal (flash) was also incorporated in the study. It was found that, long delay times were more effective causing subjects to increase tapping pressure. Tapping pressure was inversely proportional to sensational level of the auditory feed back, in both synchronous and delayed conditions.

The DAF needs certain amount of manual conrdination which cannot always be expected (Ruhm and Copper, 1964). Since, generally delayed speech feed back does not affect an individual at threshold levels of intensity, it cannot be used as a. test to determine organic thresholds (Newby, 193!2). It has been observed that, DAF was affected less by patients' sophistication (Monro and Martin 1977). Strong relationship between skin resistence changes and side tones in auditory malingering are reported (Hanley et al. 1958).

2.6.7 Doerfler-Stewart Test:

The Doerfler-Stewart test is used to detect binaural peeudohypacusis. The test compares responses to speech versus noise. Most normals are not affected even when the noise level is 10-15 dB greater than the speech level. But the non-organic patient tends to stop responding even when the noise is less intense than speech (Doerfler and Stewart, 1946; quoted by Newby 1962: p.171; Hopkinson 1973 and 1978).

The theory of the teat is that, if a patient has a functional loss, the masking noise will interfere with his ability to judge the/level at which he should no longer be able to 'hear' the test material (Newby, 1962. p.171).

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Briefly, the procedure employs the following steps: (1) establishing SRT1 (SRTl and SRTl 5), (2) finding noise interference level (NIL) and now under the cover of noise speech level is decreased, (3) SRT2 at reduced levels and (4) noise detection thresholds (NDT).

Interdependence among these measures is evident. Interpretations are based on the comparisons of the above measurements. Norms have been developed for Doerfler-Stewart Test (Epstein and Hopkinson, 1956; Doerfler and Epstein 1956 cited by Martin 1978, p.293). The first and second SRTs should relate closely. SRT1 and SRT2 have a close association with the detection of noise. Noise interference and speech reception above threshold are relevant to one another. NIL and NDT should correlate each other. The results of these calculations are compared with the norms to provide an overall positive or negative interpretation (Hopkinson, 1973).

Ventry and Chaiklin (1965) have questioned the efficiency of Doerfler-Stewart test in detecting pseudohypacusis and they strongly recommend that even as a screening device, it is too difficult and complex to administer. Following these findings PangChing (1970) has reported a modification of D-S test. The modification is a simple monaural procedure, called'tone-in-noise (TIN) test '. The TIN test examines an individual's ability to respond to pure tones in the presence of masking noise. A single sensation level is used and only the difference between thresholds in quiet and noise are considered. The TIN test has been reported to be 100% successful in identifying functional hearing loss. The TIN test is said to be advantageous over a monaural approach by Martin and Hawkins (1963), another modification of D-S test (Pang Ching, 1970).

2.6.8. Modifications of few general tests and principles to detect functional hearing loss:

Thompson and Denman (1970) have studied the role of occlusion in unilateral functional hearing loss. The bone conduction tests were administered, under two conditions* with and without occlusion of the non test ear. The occlusion effect draws low frequency bone conducted signals to occluded side in a predictable manner. When the non-test ear was occluded by an earphone, but no masking wag used, the low frequency b.c. signals are expected to be heard on occluded side. When the bone oscillator was placed on the good side, generally subjects did not respond, apparently because the signals were heard on the poorer side. As expected high frequency signals did not produce any occlusion effect. It was implied that the occlusion effect could be used to differentiate functional from true unilateral hearing loss.

Alternate Binaural Loudness Balance (ABLE) Test (automatic) can be used to identify unilateral functional hearing loss (Vyasamurthy, 1972). The rationale of the test is based on the presumption that all unilateral sensori-neural loss cases exhibit complete recruitment (within the limits of ± 20 dB) at high intensity levels irrespective of tone decay on ABLB (automatic) test. At the point of balance, if the hearing level of the tone presented to suspected ear is lower by 20 dB or more functional

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hearing loss is indicated. However, if no significant . , difference is seen, i.e. recruitment is present, functional hearing loss cannot be ruled out (Vyasamurthy, 1972).

Two methods have been developed by (Vyasamurthy 1971) using the principle of binaural summation, to disclose unilateral functional hearing loss. One method uses the principle (Hirsh, 1952) that the difference between binaural threshold and monaural threhold at 35 dBSL is 6 dB. The subject is presented a tone both menaurally and binaurally at 35 dBSL and is asked to match the two. Author describes 4 expected responses :(a) binaural stimulus weaker than monaural tone (b) no response (c) binaural tone is louder than monaural tone and (d) both are similar. First 3 responses are characteristics of unilateral functional loss. Increase in loudness is expected only when the suspected ear has normal hearing and same threshold as the better ear. The fourth type of response is based on subjective judgments and is a. limitation. Five normals have been tested and were found to support the findings.

The second method is baaed on another principle(Hirsh 1952), that the binaural threshold is better than monaural threshold by 3 dB at threshold level. If the patient responds to binaural stimulus, the test is positive. However, negative results do not rule out organic loss. Both methods require equal thresholds bilaterally and hence have a limitation (Vyasamurthy, 1971).

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2.6.9. Evaluation of tests for Functional Hearing Loss:

Taylor (1949) evaluated 4 tests (Beker's bone conduction, speech stenger, pure tone stenger and the Lombard test) on feigned unilateral deaf cases. Except for Lombard, all the other 3 tests were generally useful and thresholds could be established. However, no single test was completely appropriate for all individuals.

Martin and Monro (1975) worked on the effects of sophistication on the Bekesy traces of continuous tones,standard off-time (SOT) and lengthened off-time (LOT) for pulsed tones. It was found that type V patterns decreased as sophistication increased. The LOT test was a more frequent indicator of non-organicity, than SOT.

Monro and Martin (1977) investigated 3 degrees of sophistication on 4 different procedures, commonly used for detection of non-organic hearing loss. The tests used were: (1) SRT-PTA differences (2) Ascending-descending (A-D) differences, (3) pure tone stenger test, and (4) pure tone DAF. The three levels of sophistication were* unsophisticated, instructed and instructed-trained.

The tests were significantly effected by the sophistication level of the listener. DAF was less affected, than PTA-SRT or A-D difference. The stenger test was unaffected by sophistication. Stenger test and DAF were most frequent indicators of non-orgonicity regardless of the level of sophistication.

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2.6.10 Electrophysiological/objective tests:

1. Galvanic Skin Response (GSR):

The primary advantage of this test is that, the threshold exploration of pseudohypacusic patients, can be made with a high degree of validity and reliability, provided careful methodology is applied. The limitation of the test is that it requires the use of a noxious stimulus (electric shock) and every case cannot be conditioned. It is also very difficult to maintain conditioning for long testing schedules (Newby, 1972; Martin, 1978; Hopkinson 1973).

The conditioning GSR audiometry requires carefully controlled procedures (Newby, 1972). The test is less often used today and its primary function is to determine pure tone thresholds on patients with suspected/pseudohypacusis(Martin, 1978). The classical conditioning paradigm is considered less effective than instrumental conditioning (Shepherd, 1964, cited by Hopkinson, 1973, p.199). In general the electro dermal audiometry is slowly being replaced by other electrophysiological tests (Martin, 1978). Using speech measures, in electrodermal audiometry could be very useful in determining hearing levels (Hopkinson, 1973).

2. Evoked response audiometry ERA):

Since this method does not use any noxious stimulus it appears useful in determining pure tone thresholds for non-cooperative patients (Bcagley , 1973; Beagley and Knight,1968; Mc Candless and Lentz, 1968; Coles and priede, 1971, cited by Beagley, 1973; Alberti, 1970). Alberti (1970) has found that voluntary pure tone threshold and ERA thresholds agree within 10 dB.

The evoked response allows the use of pure tones. Using an electroencephalograph (EEG) and an averaging computer, the later components (50 to 300 msecs) of the evoked response are analyzed. Examinations of the earlier components of brain stem, (BSER) Brain Stem Evoked Response has an advantage of a stable and repeatable response(Schulman Galambos and Galambos 1975, cited by Martin, 1978, p.285; Sohmer et al. 1977; Mc Candless and Lentz, 1968; Alberti, 1970, Beagley, 1973). A hearing loss evident during routine testing, but is not evident after electro-physiological tests is almost certainly non-organic. However, confirmation of this result through other tests is advisable (Beagley 1973; Cody & Townsend, 1973).

An advantage with electro-cochleography (EBoch§) is that actual hearing measurements can be made with fewer contaminating artifacts are seen with either EDA or ERA procedures. The electro-cochleography measures eighth nerve potentials. Although lot of limitations are imposed on electro-cochleography, it is gaining popularity in recent years (Martin, 1978).

"But what is certain is that electro-physiological tests of various types have placed in the hands of the audiologist a number of extremely powerful tools for the investigation of cases suspected of having non-organic hearing loss".(Beagley, 1973).

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3. **Acoustic Impedence measurements:**

One quick simple and valuable method in determining the presence of a pseudohypacusis is measurement of stapedial reflex activity (Lamb and Peterson, 1967; Hopkinson, 1973; Martin, 1978). Obtaining a low SL reflex might suggest the presence of recruitment. But when the SL is very low (5 dB or less), an explanation of loudness recruitment is also not accepted and what should be considered is the non-organicity (Lamb and Peterson, 1967; Feldman, 1963). Using acoustic reflex measurements hearing levels can be calculated and various procedures in this have been identified (Jerger et al. 1974; Keith, 1977; Hall, 1978; Jerger et al. 1978; Baker and Lilly, 1976;Rizzo and Greenberg, 1979; Popelka et al. 1976; cited by Hall and Bleakney, 1981). Albertl (1970) warns that, in cases where conductive pathology exists caution should be exercised. Martin (1978) recommends this approach as one of the most reliable and useful deterrent to pseudohypacusis.

2.6.11 **Modified Speech Tests:**

Modified conventional speech tests, used in conjunction with a threshold measure may serve a purpose (Martin, 1978). These tests include, repetition of three spondiac words in a sequence; monosyllables presented at lowsensation levels; repeating discrimination measures; and many similar tests (Martin, 1978). The combinations of methods may also be used (Hopkinson, 1973).

Falconer (1966) hag developed a lip-reading test, to explore organic hearing levels. His test uses lists of homophenous words, presented at different levels, giving both auditory and visual stimuli simultaneously. The fjrst list is presented at a higher level well above the threshold (12dB) and the intensity for each subsequent list is reduced until only visual cues are available. Since homophenous words look alike and sound different, they are unlikely to be perceived correctly through lip reading alone. Using suitable criteria, one can establish a valid speech threhold.

Weiss (1971) explored the Falconer's lip reading test in the light of other tests, to determine its usefulness in resolving discrepancies and in establishing organic hearing levels. Weiss tested normals, organic patients and functional subjects in the study. Prior to the lip reading test, AC, BC, SRT and D-S tests were administered. Original Falconer's procedure was followed. The predicted SRT was the level at which 5 words were repeated correctly out of 20 words, When a 5 word correct response was not met, the predicted SRT for 6 to 10 correct words could be extrapolated from an articulation/gain function as provided by Falconer (1966). Weiss also aimed at determining effects of visual perception and word repetition on percent-correct response. It was clearly indicated that audition must play an important role and the visual and learning cues are not significant factors.

It was recommended that, the factors, sloping audiogram, and poor speech discrimination should be taken into consider-

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tion, while predicting SRT. With the functional group there was a very good agreement between the final thresholds and SRTs predicted. The Falconer's test predicted speech thresholds better than any other test used in the study.

The Falconer's lip reading test can be administered monaurally or binaurally; it requires no special equipment for administration and helps to determine/organic hearing levels definitively. The test is remarkable in exposing the functional problem without affending the patient. The non-organic patient who frequently tries to convince the examiner that he relies on his lip reading for communication, is an easy victim for this test.

2.7 **Research considerations. Prevention and Rehabilitation:**

The electro-physiologic methods, electronystagmography, hypnosis, signal detection tasks and in that receiver operating characteristics are, some fertile areas for research (Hopkinson, 1973).

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, 1973).

Generally treatment and rehabilitation of functional hearing loss, fall into the psychiatry field. The Audiologist must be aware of these service facilities. If the problem becomes a question of legal action, the idea about the patient's problems must be clear and the patient should be helped to maximum extent(Hopkinson, 1973 and 1978).

Chapter III

METHODOLOGY

3.1 Introduction:

The study involves three main phases:

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

The development of the test material in Kannada language was in line with the method followed by Fdlconer (1966). F&lconer (1966) developed the test in English, using monosyllabic homophenous words. Relatively there are less number of monosyllabic words in Kannada. For this reason, the test in Kannada language includes polysyllabic homophenous words. The homophenous words look alike on lips, but they sound different.

3.2 Development of the test material:

It was aimed at preparing 8 lists of 20 homophenous words each. The 8 lists were devided into 2 sets of 4 lists each. Each word in one list would have its homophenous counterpart in other 3 lists of that set.

The sounds of Kannada alphabet, were grouped according to their place of articulation. The homophenous words were selected, taking into account, the sounds which have same place of articulation i.e., these sounds look alike on lips, but they sound different. For example, bilabial sounds are /m/, /p/, /b/ and their aspirated sounds. If /m/ is to be replaced, it would be done by either /p/ or

/b/. This way, each word was choaen, such that it could give 3 homophenous forms of that word. For example, in set I, /kala/ (33-) in list 1A; has /gala/ (n%) in IB; /kata/ (g^y) in 1C; and /gSna/ (f)fsr) in ID. As far as possible, the phonemic distribution, in 2 sets was equated. This made it easy to maintain equal difficulty in both sets. All the words are familiar spoken words and are meaningful. Totally 160 words were selected (Appendix I, for prepared lists). The words in each list were randomised, using Fisher's random number tables.

Four levels for presentation were chosen, with reference to the Speech Receiption Threshold (SRT) of each subject. The levels were (1) SRT+10 dB, (2) SRT-t-0 dB, (3) SRT - 10 dB, and (4) SRT - 20 dB. The test uses both auditory and visual cues. Each list in I set was presented at 4 different levels. Thus there were 16 presentation combinations in each set. They Mre**a?epresented as follows:

	Lists -----> Levels	L_1	L_2	L_3	L_4
-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 Subjects:

3.3.1 Normal groups:

20 subjects, students and staff of All India Institute

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of Speech and Hearing, Mysore-570 006, formed the normal group. The age range was 18 years 2 months to 31 years (Mean age = 22 yrs. 8 months). There were 12 females and 8 males. All subjects passed a screening test for their hearing at 20 dBHL at frequencies from 250 to 8KHz. All subjects were fluent speakers of Kannada language and they were good in English also. This normal group was used for developing norms for the "Speech Reading Test".

These 20 subjects were randomly classified into 4 groups, each group consisting of 5 subjects. Out of the decided 16 presentation combinations, each group was randomly selected for 4 presentation combinations, i.e., subject of the same group were tested in the same manner, in terms of lists and presentation levels. This was maintained for both sets of the test. Care was taken not to select same presentation combinations for any 2 groups.

Each subject was tested in one ear only. The ears were also randomly selected. By averaging the results for all 4 groups, the normative data wag established.

The groups and their randomly selected presentation combinations are given below:

Group 1.	L2I3	L3I1	L4I3	L1I4
Group 2.	L1I2	L2I4	L4I1	L3I4
Group 3.	L3I3	L1I1	L4I4	L2I1
Group 4.	L2I2	L1I3	L4I2	L3I2

('L' refers to list and I refers to intensity/level)

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3.3.2 Sensori-Neural Hearing Loss Patients group:

Seven Kannada speaking sensori-neural hearing loss patients were test on "Speech Reading Test". This was to verify the value of the 'predicted SRT' from this test. Thess subjects (6M &1F) had varying degrees of sensori-neural hearing loss; only one ear was used for testing.

The age range was 18-71 years and mean age 30 years.

(Brief history of these patients and their audiological inveatigations are given in Appendix II).

These patients had reported to the Institute to get their hearing tested and they were requested to participate in this work.

3.4 Instruments:

Madsen OB 70, a two channel clinical audiometer with TDH-39 earphones and MX41/AR cushions, was used in this study. Settings for speech audiometry, on channel one was utilised. Live voice testing was carried out. The subject's responses were noted through a talk-back system. The talk-back gain control was adjustable.

The audiometer was calibrated to meet IS0(1964) standards. The B & K calibration equipment was used. The ealibration standards and block diagrams are given in Appendix III.

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3.5 Testing environment:

A two room situation was utilized for testing. The testing room was isolated and sound treated. The test, stimuli were presented from the control room. The control room was brightly illuminated, and the examiner's face was clearly seen, to facilitate lip reading. The subject's head and the examiner's head were approximately at the same height. Further, glass reflections from the observation window were eliminated. The testing room was darkened while administering the test. This dramatized the lip reading aspect of the test.

The noise levels in the testing room were well within the maximum allowable noise levels in dBSPL (Appendix IV).

3.6 Testing Process:

3.6.1 The testing process proceeded from instructing the subjects obtaining SRT without visual cues; and administering the"Speech Reading Test" with both visual and auditory cues.

3.6.2 Instructions:

Instructions for SRT:

"You are going to hear words like doorstep, starlight, etc. . . . . .; repeat them back loudly. Each word preceds the phrase, 'say the word - '. Whenever your are doubtful, try to guess the word ". Same instructions were told in Kannada language.

Instructions for 'Lip Reading Test':

"You can see the examiner's face very clearly from the observation window. You will hear different words; as well you can read them on examiner's lips. Use both 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 phrase **(iga heli)** ' ಈಗ ಹೇಳಿ ' , you hear the word.

Instructions were made clear before the testing commenced.

3.6.2 Obtaining initial SRT:

The Hanvard adult spondee lists, standardized to Indian population (Swamalatha, 1972) were used in the study.

The testing started at 15 to 20 dB above the admitted threshold. 1 word was presented at each level and the level was decreased in 10 dB steps, until no spondee word was repeated correctly. Then intensity was increased in 5 dB steps and at each level 4 words were presented, if 2 words were repeated correctly, the level was again decreased by 5 dB, whenever necessary, by 1 dB steps. This was continued until the lowest level at which 50% of the words presented were repeated correctly. This level was taken as obtained SET. This served as reference, for presentation of test lists.

In the case of clinical subjects who did not know English Kannada spondee list was used to obtain SRT. This list has been in use at the department of Audiology, AIISH.

3.6.3 Administering Speech Reading Test:

1. The patient was seated comfortably, in the darkened, isolated and sound treated room. When the testing room door was closed, it was ensured that,no sound leaked into it. The tester's face was illuminated in the control-room. As already mentioned the line of vision between the subject and tester was maintained, and reflection from the observation window was avoided.

2. The microphone was placed close to the pubjects mouth, so that the consonants were well picked up. The audiometer microphone was placed 6" away but, below the chin of the tester.

3. Instructions, as mentioned earlier were given. Instructions were stressed, to complement the subject on his lip reading ability and to indicate that the tester liked to measure his ability to lip read. Also, the point of empha^ sis was that, how much does lip reading helps his hearing.

4. The carrier phrase '[illegible] '(īga heḷi / was spoken before presenting each word. This carrier phrase helped the lips to assume abnormal position before each word was spoken. The VU meter was constantly checked to maintain speech level while testing.

5. Each word, with the carrier phrase required 3 or 4 seconds to articulate. The whole testing took around 15 minutes to complete. After each presentation, a pause was

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given, until the response from the patient was obtained. The words were spoken at average conversational loudness and the articulation was unexaggerated. Whenever the subject felt that he was not attentive for a particular word, a second chance was given for him to respond, by repeating that word. No facial cues or gestures about patient's responses were given.

A slighly different procedure was used while testing sensory neural hearing loss patients. The first list of the set I was presented at 106B above the obtained SRT. Then the subsequent lists were presented at the levels SRT 0 dB, SRT - 10 dB and SRT - 20 dB respectively. The same procedure was followed for set II also.

6. Responses were noted, as number of words repeated correctly at each presentation level. An articulation gain function was plotted with the number of words repeated correctly at each level.

7. To check the role of examiner's listening, two normal subjects were again asked to write the words, presented to them instead of repeating them. Other steps of test administration were not altered. Sufficient time was allowed for the subject to write the words. The light passing through the observation window, wag enough to facilitate writing. Before presenting each word, these subjects were asked to indicate verbally, that they were watching the examiner's lips. These two subjects had a gap of more than 25 days, between initial testing and this repeated testing. As there was 25 days gap practice effect can be ruled out in these subjects.

Chapter IV

RESULTS

The results were analysed in terms of numbers of words correctly repeated at each level of preservation.

The results obtained on the normal group were averaged and are shown in Fig. 1. The articulation gain function plotted includes the results obtained for set I, set II and for both sets combined. The average SRT level for the normal group was 15 dB. The most suitable criterion for predicting SRT from the lip reading test was the level 5 dB below at which 10 words were repeated correctly. Generally, an increase in the number of words repeated correctly was observed, with increase in the level of presentation. The predicted SRTs were 16 dB for Set I, 15 dB for Set II and 16 dB for both sets combined. The scores obtained for each set and the combined form were averaged for each level and are given in Table I.

A paired 'T' test of significance was employed at each level of presentation betweesn set I and set II. This was to find, whether the two sets differed in terms of their difficulty level. The 'T' test showed that, the two sets were not signifjcantly different, at all four levels of presentation. The T values were far below the values expected at both 0.01 and 0.05 levels of significance. The 'T' values are shown in Table II.

On similar lines, the seven sensori-neural loss patients were compared. Figures 2a to 2h show the articulation gain functions, for each patient. It was observed that, the best

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Lists	L1		L2		L3		L4		Average		Combined scores
Levels	Set I	Set II	Set I	SetII	Set I	Set II	Set I	Set II	Set I[	Set II	(I+II)
-20 I4	6.8	5.8	3.4	4.4	1.8	3.8	3.2	4.6	3.8	4.7	4.22
-10 I1	5.6	5.6	5.0	4.8	3.6	4.2	3.6	3.8	4.5	4.6	4.52
-+ 0 I2	7.2	8.2	7.2	6.2	8.2	8.0	6.2	7.0	7.2	7.4	7.27
+ 10 I3	13.8	14.0	11.2	10.8	13.0	. .12.2	11.8	12.2	12.2	12.3	12.25

Table 1: Showing averaged scores obtained by the normal group with with scores shown separately for Sets I, II and the combined sets.

T values Levels	Obtained values	value at 0.05 level	'T' value at 0.01 level
I1(-lO)	0.0666	2.09	2.86
I2(+O)	0.0416	"	"
I3(+lO)	0.0503	"	"
I (-20)	0.4035	"	"

Table II: The significance 'T' values obtained at 4 levels of presentation (df = 19)

SI. No.	Patients Name	Levels Obtained SRTs(dB)	I (-20)			I (-10)			I (0)			I(10)			Predicted SRT (dB)
			SET I	SET II	SET I+II	SET I	SET II	SET I+ II	SET I	SET II	SET I+II	SET I	SET II	SET I+II	
1	SMR	45	1	1	1	4	3	3.5	5	9	7	9	13	11	47.5
2	RCS	70	2	2	2	4	2	3	4	5	4.5	5	8	6.5	75.0
3.	SL	70	3	3	3	3	4	3.5	6	7	6.5	8	12	10	75.0
4.	CAM	35	3	4	3.5	7	4	5.5	9	11	10	15	16	15.5	30.0
5.	SSP	30	1	1	1	3	2	2.5	4	4	4	14	11	12.5	30.0
6.	SNI	25	3	5	4	4	4	4	8	10	9	18	16	17	23.00
7.	ARN	70	2	2	2	8	5	6.5	10	9	9.5	11	14	12.5	68.0

Table III: Showing scores obtained by 7 sensori-neural loss patients on lip-reading test along with their predicted SRTs from the combined (I+II) curve

Subject I Presentation combinations	L3I3		L1 I1		L4I4		L2I1	
	Set I	Set II	Set I	Set II	Set I	Set II	Set I	Set II
Written response scores	9	10	5	1	3	1	3	2
Oral response scores	6	7	1	4	2	2	1	4

Subject II Presentation Combinations	L2I2		L1I3		L4I2		L3I2	
	Set I	Set II	Set I	Set II	Set I	Set II	Set I	Set II
Written response scores	9	9	19	15	5	3	6	3
Oral response scores	15	4	16	14	4	2	5	5

Table IV: Showing written and oral response scores obtained for 2 normal subjects

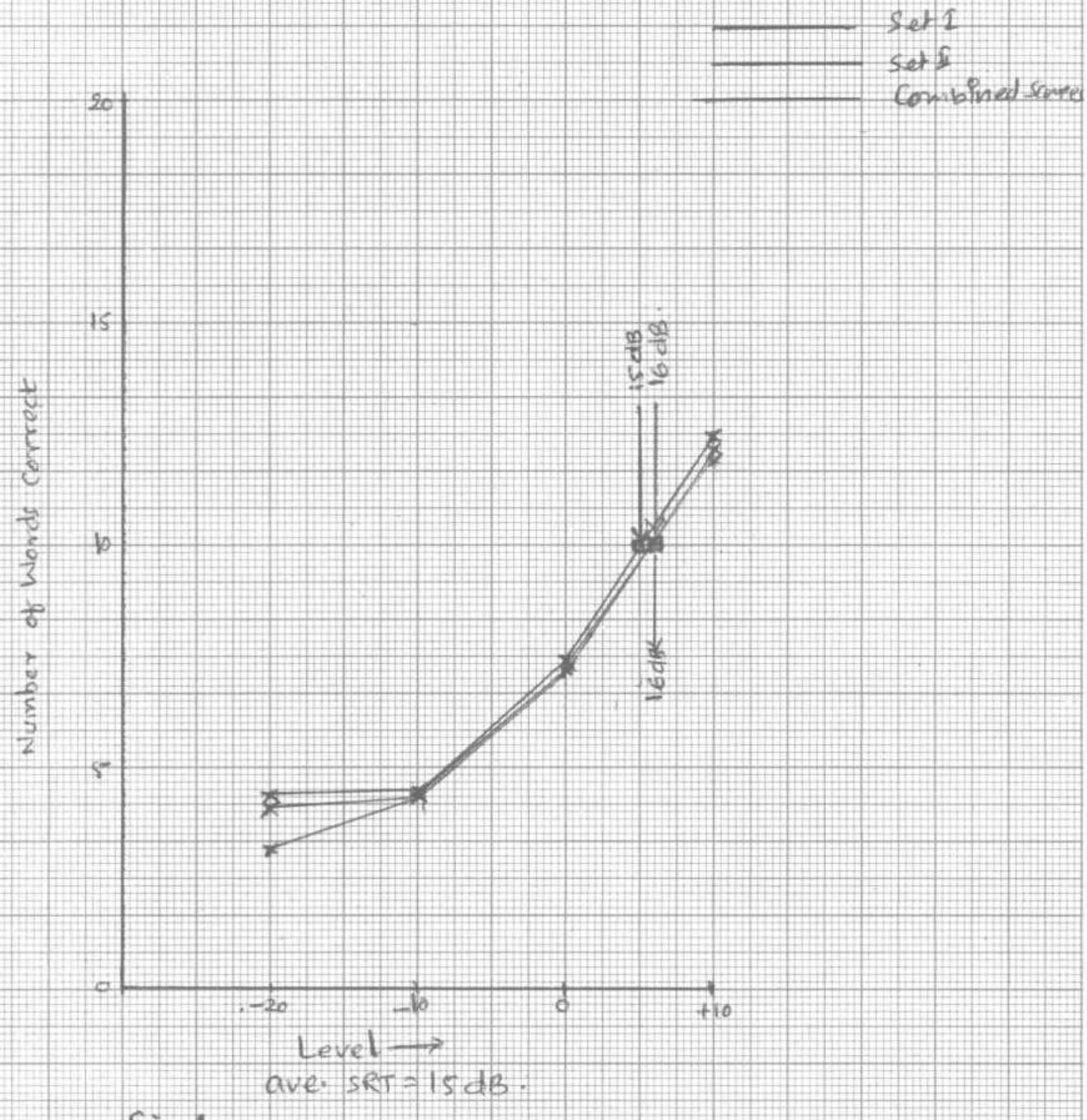
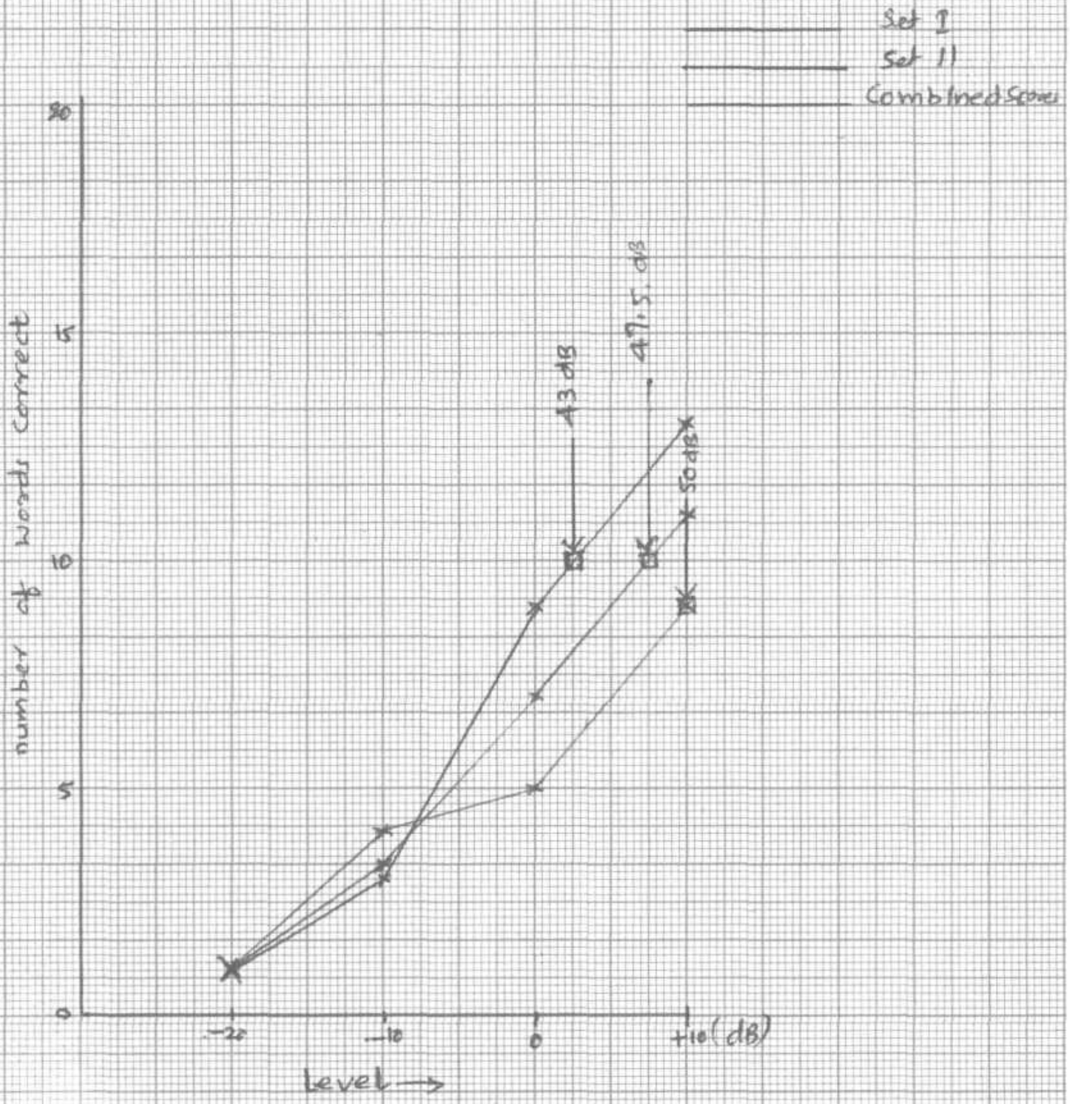


Fig. 1

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



SRT = 45 dB

fig. 2a. SMR.

Articulation/gain function and the predicted SRT for the subject 'SMR'

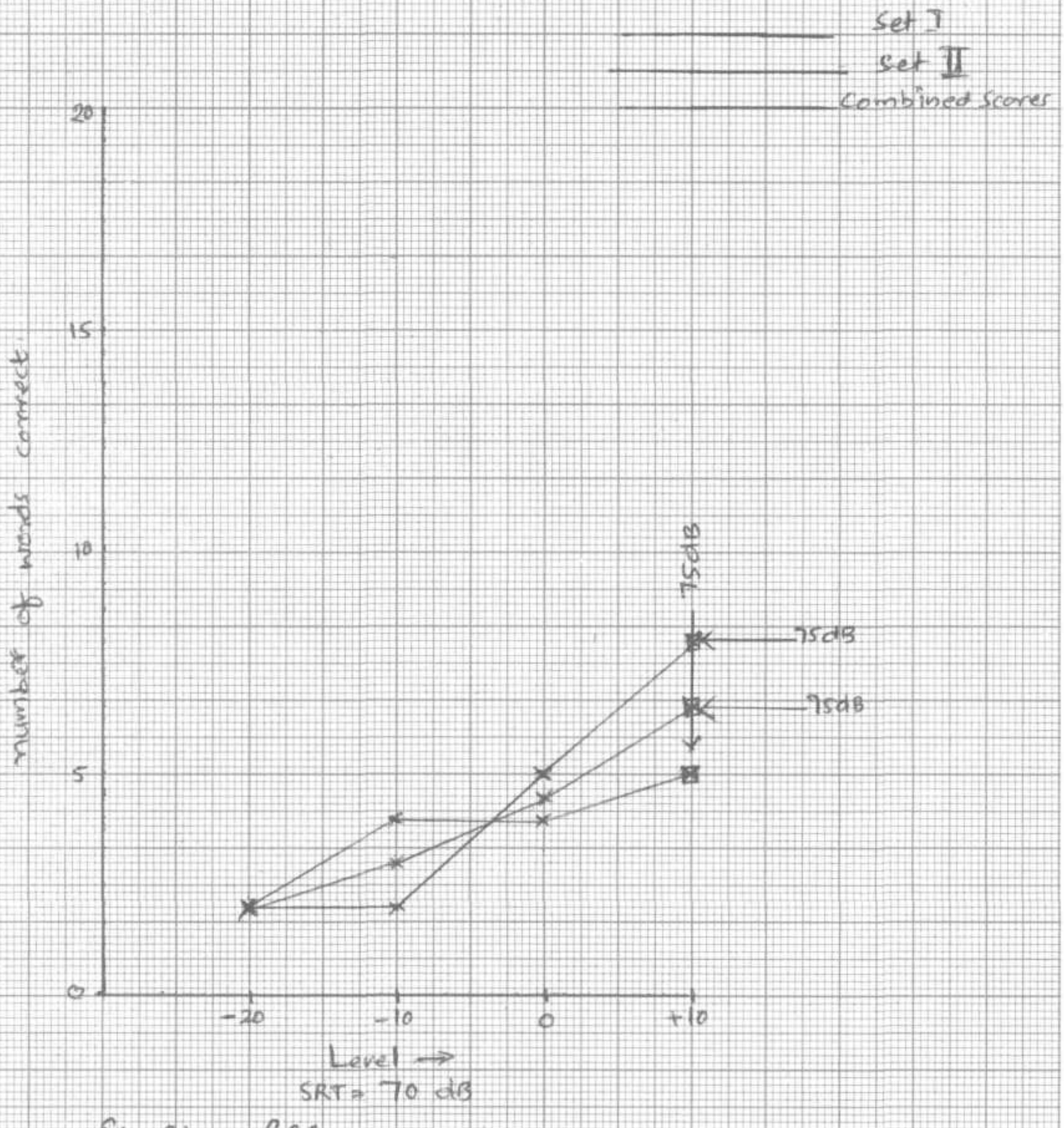


Fig 2b. RCS

Articulation/gain function for the subject 'RCS' and the prdicted SRT

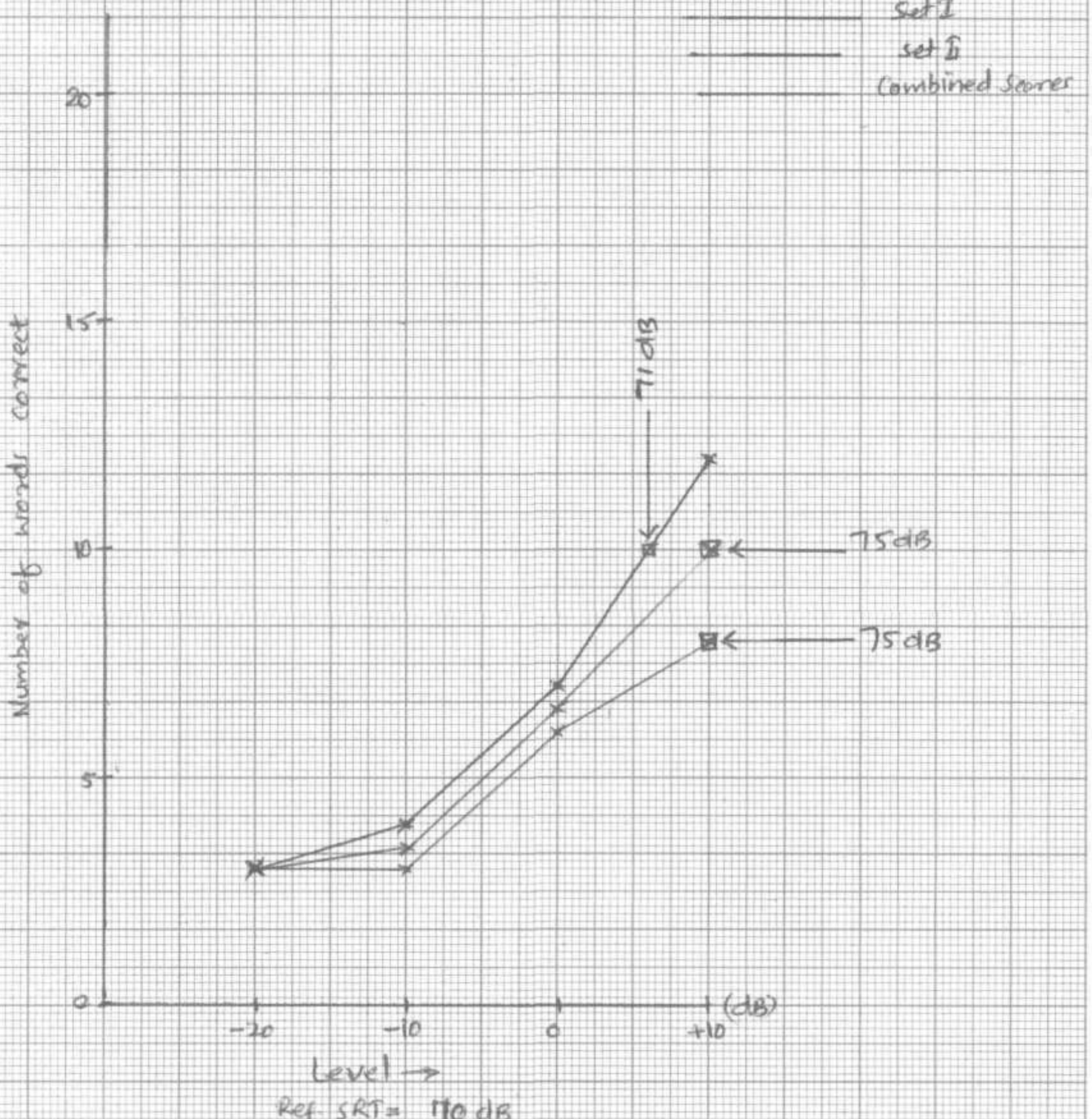


Fig. 2C. SL

Articulation function and the predicted SRT for the subject 'SL'

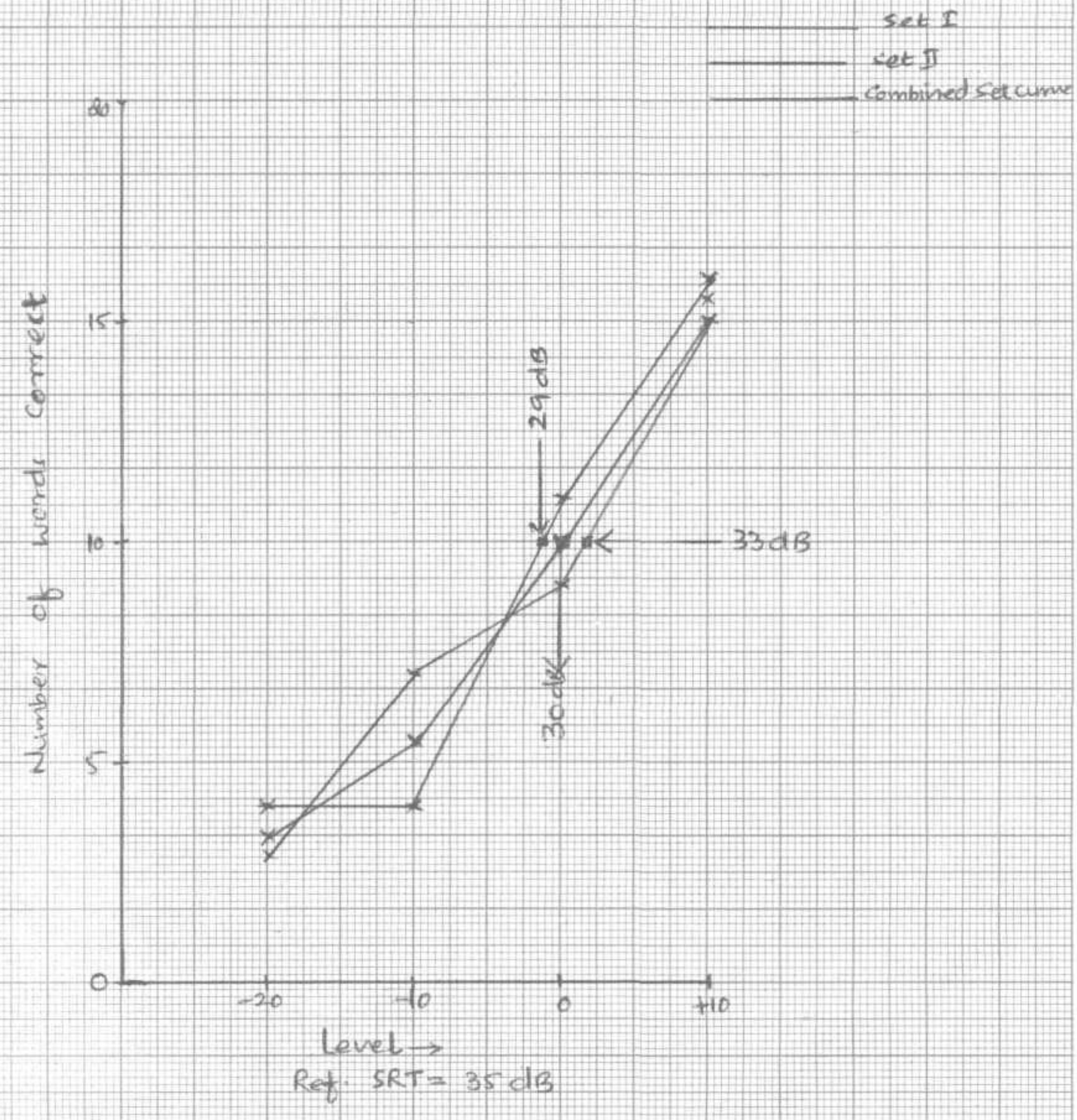


fig. 2d CAM

Articulation function and the predicted SRT for the subject 'CAM'

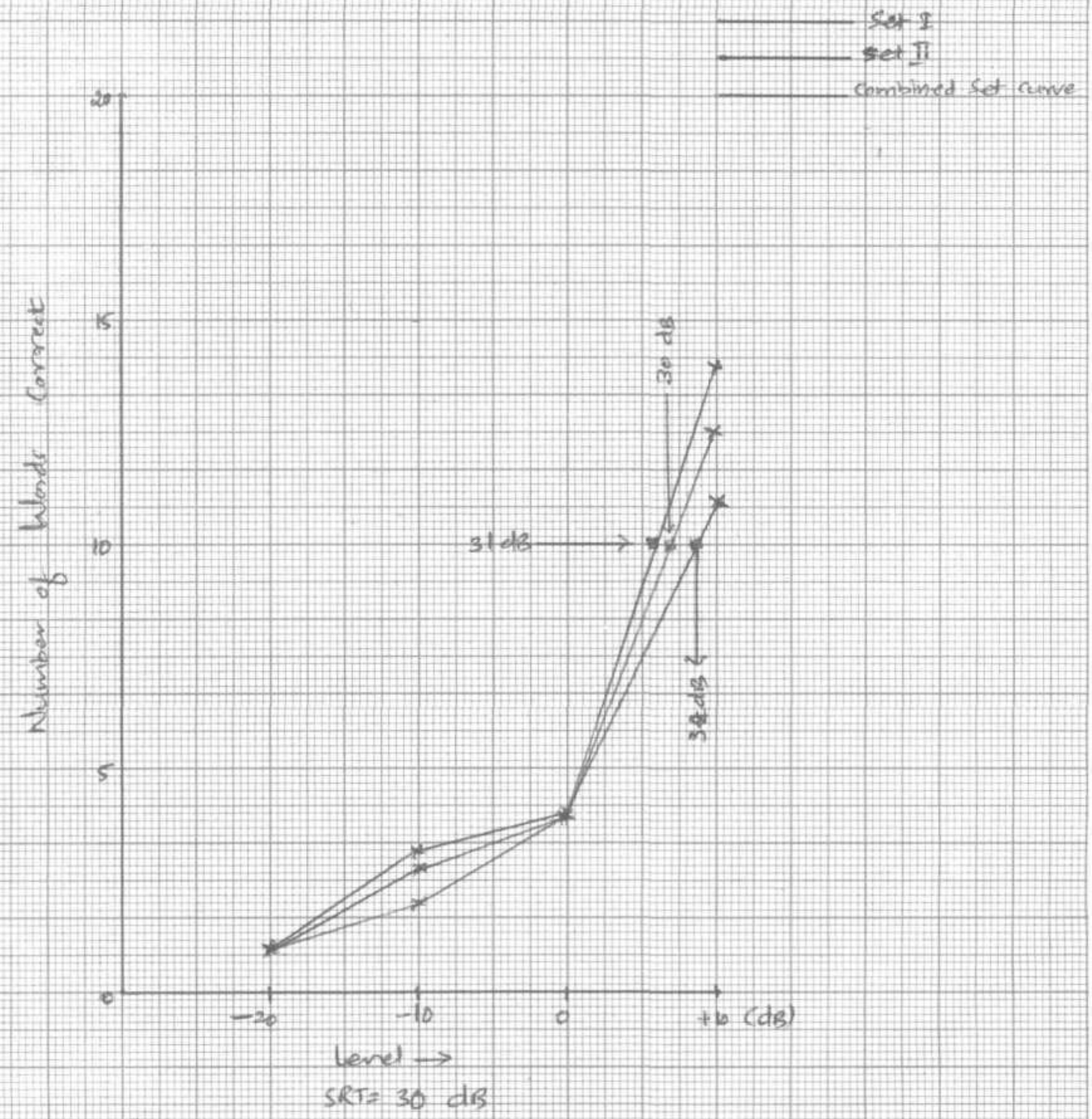
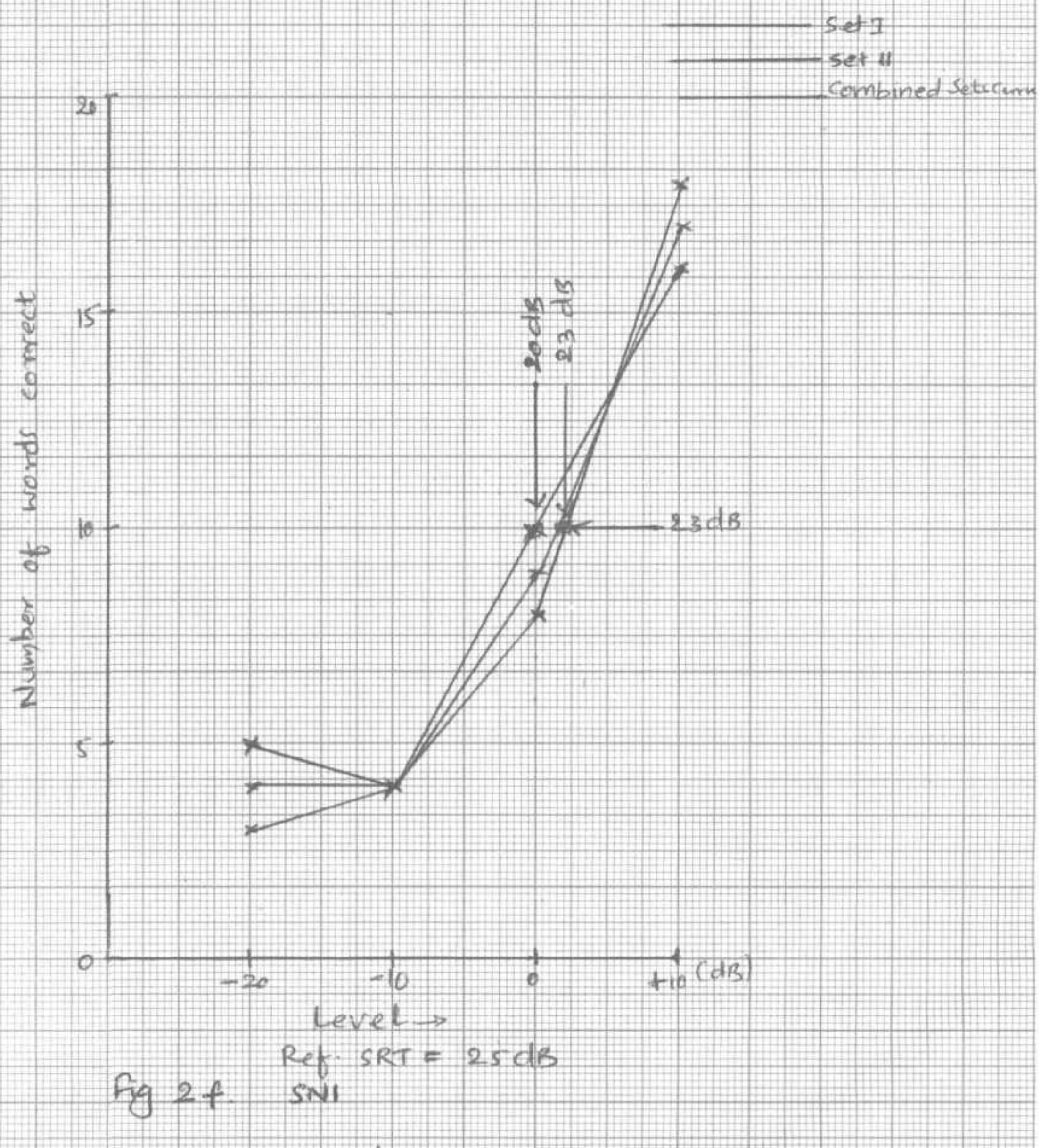


fig. 2e SSP

Articulation/gain function and predicted SRT for the subject 'SSP'



Articulation/gain function and predicted

SRT for the subject 'SNI'

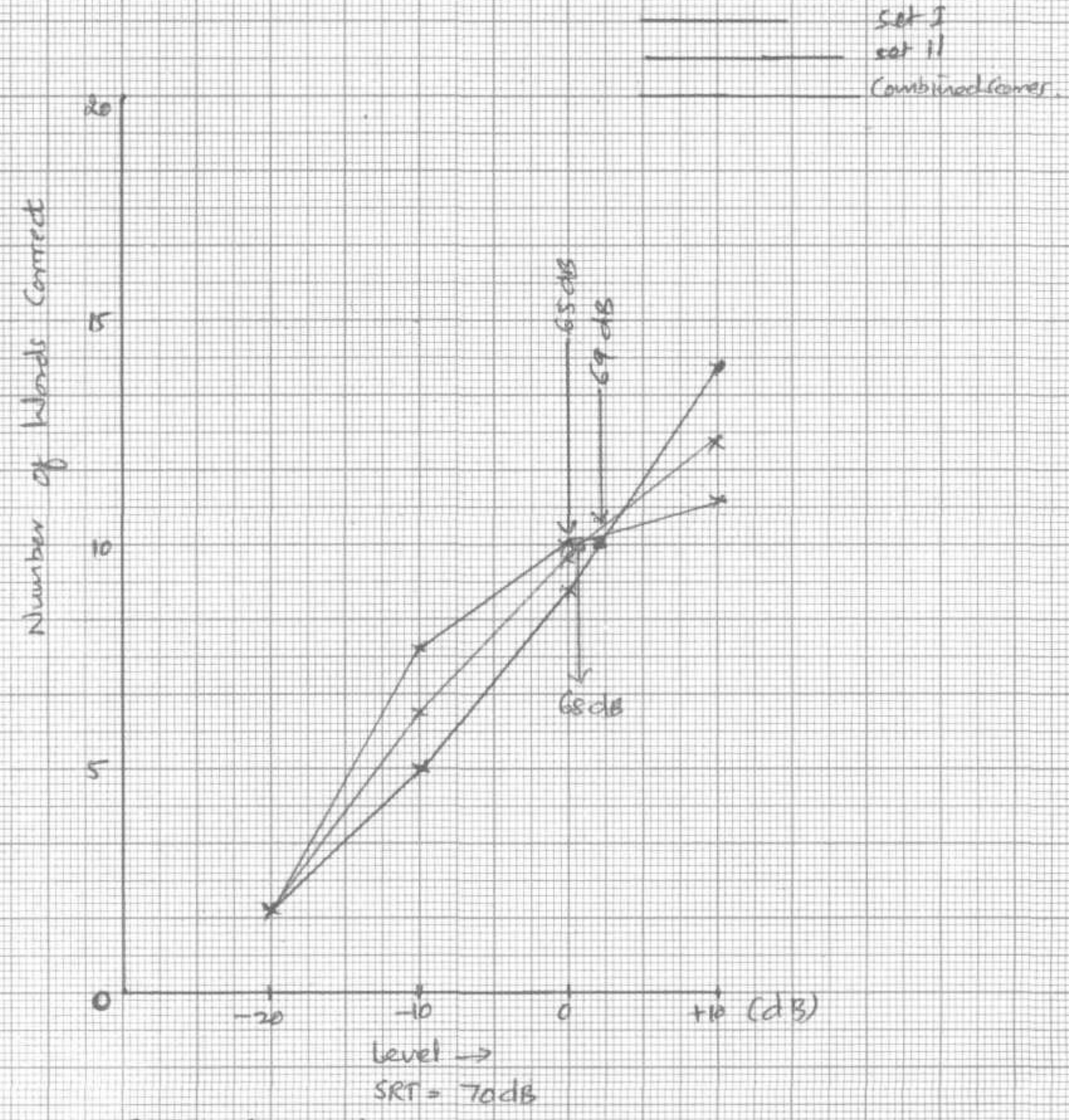


Fig. 2h ARN

Articulation/gain function and predicted SRT for the subject 'ARN' criterion for predicted SRT was 5 dB below the level at which 10 words are repeatedlycorrectly. It was noted that, when the patients did not repeat 10 words correctly, the criterion for predicting SRT was the level at which the score nearest to 10 was obtained.

The scores obtained by each patient on the test and the details are given in Table III. Because of the non-uniformity among the seven subjects, the sensori-neural group as a whole was not considered for comparison.

Written and oral responses of two normal subjects were compared. A close examination of scores at each presentation combination reveals that, the two modes were similar. This indicated that examiners listening was not a variable in the collection of the data. The scores are tabulated in Table IV.

The results are discussed in detail in the following section.

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Chapter V

DISCUSSION

In recent years as audiologic diagnostic methods have been refined, it has become apparent that non-organic hearing problems are more prevalent among the adult population than had previously been assumed (Dixon and Newby, 1971). Many disadvantages are evident in almost all tests for functional hearing loss. Many tests either lack the aspect of quantification of their results or they are less sensitive to minor degrees of non-organic components. Particularly bilateral pseudohypacusis patients encounter many more difficulties in establishing organic thresholds (Weiss, 1971). Many times a battery of tests will be necessary to conclude on the patient's organic hearing levels (Alberti, 1970).

Many pseudohypacusic patients claim to use lip-rending, to understand a conversation. A number of tests have been devised to extrapolate this aspect. In general lip-reading ability is checked by minimizing visual cues or by minimizing auditory cues or both (Feldman, 1967). But these tests fail to give a measurable idea about a patient's organic hearing levels. In this regard the Falconer's lip-reading test is a successful attempt (Weiss, 1971).

The present study tested normals and clinical population on the lip-reading test in Kannada language. The normal group was used to develop the test in Kannada language. The maximum scores obtained at maximum and minimum intensity

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levels used for presentation differ from the study of Falconer (1966). At the level of 10 dB above SRT, the maximum score obtained in the present study is 12.25, where as in Falconer's study it was 16.1 . Similarly, the maximum scores at minimum intensity levels are 4.22 in the present study and 0.7 in Falconer's study.

In the present study the averaged SRT level (15 dB) for normals, could be predicted by finding the level - 5 dB below the level at which 10 words are repeated correctly. This level can be easily traced, Fig.l. From the examination of the graphs, it can be observed that, the three curves (for Set I, Set II and combined scores) 'follow the same pattern and do not differ regarding the scores. A steady increase in the scores, as the presentation level increased, is in agreement with the results obtained by Falconer (1966) on normals.

Weiss (1971) has demonstrated that audition must play a part in obtaining the 5 correct response, which wag used at the criterion to predict SRT, in Weiss (1971) study. It was also reported that visual and learning cues are not significant factors.

As the three curves agree very closely either set I or set II alone can be used for testing. It can be observed that scores at -10 and -20 dB levels (with reference to SRT obtained) do not differ widely, indicating the consistency of responses by normals. In Falconer's study the normal group showed a uniform increase in number of words correct, as the presentation level increased. This difference can be attributed to the 10 dB steps used in the present study versus the 6 dB steps used by Falconer (1966).

The combined scores curve predicts the SRT more closely than the other two curves. To keep the bias minimum, the presentation order of lists and levels were randomized. The results for normal group were obtained by combining the data of all 20 normal subjects.

When the averaged scores for set I and set II were compare the set I yielded a consistently smaller scores than set II (Table I). But the paired 'T' test employed showed that the this small difference was very insignificant at all four presentation levels. Thus the two sets do not differ on their difficulty levels. The 'T' values can be observed to be very much less than the values expected at both levels of significance (0.05 and 0.01)(Table II).

Table II and figures 2a to 2h describe the performance of seven sensori-neural patients. The sensori-neural patients also agree well with the criterion of 5 dB below the level at which 10 words are repeated correctly. Out of the seven patients only one patient RCS did not meet this criterion of 10 words to be repeated correctly. In this patient, a different criterion 5 dB below the level at which a score nearest to 10 is got, predicts the SRT closely. And this is in agreement with the other consistent findings. The details about these patients' audiological evaluations are given in Appendix II.

Of the seven patients, 2 patients (RCS and SL) had their predicted SRTs in excess of 5 dB over their actual obtained SRTs. One patient (SMR) had his actual SRT 2.5 dB less than the predicted SRT. One patient (SSP) was estimated very accurately and his obtained and predicted SRTs were same. Three patients (SAM, SNI and ARN) were underestimated by not more than 5 dB. (Table III). In any case the predicted SRT did not differ by more than 5 dB; this 5 dB variation can be accepted. From the results of these seven patients, it is evident that the lip-reading test can predict a patient's speech thresholds accurately.

These seven patients do not make up a single group, as they cannot be matched for age, or for severity of hearing loss or on discrimination loss. By examining the articulation/gain functions of these seven patients (Figs. 2a to 2h), it can be seen that set II curves can be a better predictor for SRT than set I. The best way is to predict SRT from the combined scores curve. This difference might be due to the fact that, subject were first administered set I and they had just started responding correctly there.

The finding on the sensori-neural loss patients are similar to the finding obtained by Falconer (1966). Weiss's (1971) study also supports these results. Weiss showed that there was an excellent agreement among the test measures (AC thresholds, speech and Falconer's lip-reading test). Weiss has indicated that, the sloping audiogram, poor speech discrimination and other such factors, should be taken into consideration, when using the predicted SRT as a guide line in establishing and substantiating organic hearing levels. In the present study, the Lip-reading test accurately (within 5 dB variations) predicted the speech thresholds in thses patients.

The present study aimed at establishing a relationship between the obtained SRT and the predicted SRT^ in normals and sensori-neural hearing loss patients, using the lip-reading test in Kannada language. In this regard the present study is a success. Based on this study it can be recommended that, the'lip-reading test' can also be used successfully to predict SRTs in pseudohypacusis patients. The usefulness of the lip-reading test has been well documented by Falconer (1966) and Weiss (1971).

Falconer (1966) has presented three ideal cages to illustrate broadly representative usage of the test. In these patients, the hearing impairments were much smaller; and non-organic components were very little. In all these patients the lip-reading test predicted SRTs very accuresely " The effectiveness of lip-reading test for 'no deafness has proved its worth as a clinical tool on a number of occasions" (Falconer, 1966).

Weiss (1971) studied 54 ears of 39 subjects on Falconer's lip-reading test. These subjects had shown discrepancies which were unexplained. Final pure tone and spondee thresholds were obtained after exhaustive testing and they were considered the best possible measures of organic hearing levels. Good agreement between these final thresholds and SRTs predicted was noted. Weiss used the criterion, the level at which 5 words were repeated correctly to predict SRT. When a 5 word correct response did not occue, the predicted SRT for 6 to 10 correct words could be extrapolated from the articulation/gain function as provided by Falconer. Weiss had also used pure tone, speech and D-S tests prior to the administration of the lip-reading test. The smallest overall deviations occurred between the Falconer predicted SRT and final PTA, and spondee SRTs. Among other tests administered pure tone stenger and PGSR were more sensitive in revealing and resolving discrepancies. However, the predicted SRT was more definitive in revealing organic hearing levels.

In the present study, written and oral responses of two ' normal subjects were compared to rule out the examiner's listening as a variable in the collection of data. On examination of the scores obtained by these two subjects (Table IV) it can be seen that the two modes agree well most of the times. This rules out the examiners listening as a variable in the data collected.

From this study it can be proposed that the lip-reading test, can be used to predict the speech thresholds of normals, sensori-neural; patients as well as pseudohypacusis patients.

It is indicated by the studies of Falconer (1966) and Weiss (1971) that, the test can be administered monaurally or binaurally, so that it can be used with both unilateral and bilateral pseudohypacusis patients. Weiss (1971) emphasises that, the test has a remarkable ability to expose the functional component without obviously indicating to the patient.

The lip-reading test appears to be useful in patients whose audiometric discrepancies are unexplained.

Chapter VI

SUMMARY AND CONCLUSIONS

Following Falconer's (1966) study, a lip-reading test in Kannada language was developed. The test consisted of 8 lists having 20 homophenous words each. The 8 lists were divided into 2 sets of 4 lists each.

The test is used to determine organic hearing levels of pseudohypacusic patients. The test emphasised the measurement of a subject lip reading ability. During testing the subject wore head phones and watched the illuminated face of the examiner from a darkened, isolated sound treated room. Visual and auditory cues were simultaneously presented. With reference to obtained SRT level, 4 levels of presentation were chosen: SRT l0dB, SRT OdB, SRT-l0dB and SRT - 20dB. Since the homophenous words look alike but sound different they are not likely to be perceived correctly by lip-reading alone. If the patient is unaware of the examiner's intention he will probably respond in his customary manner to sound and vision, and inadvertantly reveal his organic hearing level.

A group of 20 normal adults were used to develop this test. The lists and levels were randomly ordered for presentation. The articulation/gain functions for the normal group enabled to develop a criterion to predict SRT. The criterion developed was 5 dB below the level at which 10 words are repeated correctly. To validate these findings seven sensori-neural loss patients were tested similarly on

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the lip-reading test. The criterion to predict SRT was consistently successful in predicting SRTs of these patients.

This Lip-reading test in Kannada language is recommended to detect pseudohypacusis.

Conclusions:

1. The lip-reading test in Kannada can be used definitively to predict the speech thresholds in pseudohypacusis patients.
2. Either SET I or SET II or their combinations can be used for testing.
3. The proposed criterion for SRT prediction is 5 dB below the level at which 10 words are repeated correctly.
4. If this 10 word criterion is not met, then the level which gives the score nearest to 10, will be considered.

Recommendations:

1. The lip- reading test may be used on pseudohypacusis patients.
2. More number of normals and sensori-neural patients may be tested to validate this study.
3. On the lines of the present study, the lip-reading test to detect pseudohypacusis in all other Indian languages may be developed.

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APPENDIX I

Test Word-lists

Set I

	1A		1B	
1.	paṭṭi	ಪಟ್ಟಿ	d̪akka	ದಕ್ಕ
2.	kaḷa	ಕಳ	gallu	ಗಲ್ಲು
3.	lāḍu	ಲಾಡು	d̪aṇi	ದಣಿ
4.	manǰa	ಮಂಜ	t̪uṭi	ತುಟಿ.
5.	nuḍi	ನುಡಿ	t̪āḍi	ತಾಡಿ
6.	paṇa	ಪಣ	giṭṭu	ಗಿಟ್ಟು
7.	pāḷu	ಪಾಳು	t̪āgu	ತಾಗು
8.	nāma	ನಾಮ	bāḷu	ಬಾಳು
9.	kaṭṭi	ಕಟ್ಟಿ	mana	ಮನ
10.	t̪aṇi	ತಣಿ	gōṭu	ಗೋಟು
11.	čāṭi	ಚಾಟಿ	t̪ōṭa	ತೋಟ
12.	nōṭa	ನೋಟ	manča	ಮಂಚ
13.	kallu	ಕಲ್ಲು	d̪āṭu	ದಾಟು
14.	t̪āḷi	ತಾಳಿ	čāṭi	ಚಾಟಿ
15.	t̪āku	ತಾಕು	baṇa	ಬಣ
16.	bala	ಬಲ	lābha	ಲಾಭ
17.	kōṭu	ಕೋಟು	kūṭu	ಕೂಟು
18.	kiṭṭu	ಕಿಟ್ಟು	gāḷa	ಗಾಳ
19.	kūḍu	ಕೂಡು	baṭṭi	ಬಟ್ಟಿ
20.	t̪akka	ತಕ್ಕ	gaṭṭi.	ಗಟ್ಟಿ.

Set I (Contd.)

	1C		1D	
1.	māḍu	మాడు	d̪uḍi	దుడి
2.	lāku	లాకు	kaḷḷi	కళ్ళి
3.	pañča	పంచ	bāḍu	బాడు
4.	t̪uḷi	తుళి	d̪hāma	ధామ
5.	kāṭu	కాటు	bana	బన
6.	maḷḷi	మళ్ళి	lakka	లక్క
7.	kiṇṇu	కిణ్ణు	gat̪t̪u	గత్తు
8.	māṭu	మాటు	gōḷu	గోళు
9.	kaḍḍi	కడ్డి	d̪āḷi	దాళి
10.	lōṭa	లోట	giṇṇu	గిణ్ణు
11.	t̪āpa	తాప	baḷḷi	బళ్ళి
12	dāḍi	దాడి	panǰa	పంజ
13.	maṇa	మణ	nāku	నాకు
14.	kūḷu	కూళు	gūḍu	గూడు
15.	jāḍi	జాడి	t̪ōḷa	తోళ
16.	kat̪t̪u	కత్తు	čāḷi	చాళి
17.	t̪aḍi	తడి	naṭi	నటి
18.	pala	పల	paṭa	పట
19.	t̪agga	తగ్గ	gāṇa	గాణ
20.	kōḍu	కోడు	nāḍu	నాడు

Appendix I (Contd.)

<u>Set II</u>

	2A		2B	
1.	pāna	పాన	t̪ōḍi	తోడి
2.	t̪abbu	తబ్బు	ĉaḍi	చడి
3.	čaḷi	చళి	kēḷu	కేళు
4.	paḍi	పడి	gaḍi	గడి
5.	puṭṭi	పుట్టి	bēḍa	బేడ
6.	d̪ūku	దూకు	d̪ani	దని
7.	t̪āt̪a	తాత	d̪āḷa	దాళ
8.	pālu	పాలు	buṭṭi	బుట్టి
9.	t̪aḍa	తడ	d̪abbu	దబ్బు
10.	t̪ōṭi	తోటి	nūku	నూకు
11.	t̪āḷa	తాళ	guggu	గుగ్గు
12.	kaḍi	కడి	d̪āta	దాత
13.	pēḍa	పేడ	bālu	బాలు
14.	kāḷi	కాళి	bagga	బగ్గ
15.	kēḍu	కేడు	baḍi	బడి
16.	t̪ani	తని	māna	మాన
17.	pakka	పక్క	gāḷi	గాళి
18.	mat̪i	మతి	t̪aḷa	తళ
19.	kukku	కుక్కు	nāṭi	నాటి
20.	nāḍi	నాడి	pat̪i	పతి

Set II (Contd.)

	2C		[illegible]	
1.	dāna	ದಾನ	nōḍi	ನೋಡಿ
2.	bala	ಬಲ	ǰaḍi	ಜಡಿ
3.	ǰaṭi	ಜಟಿ	gaṇi	ಗಣಿ
4.	baḍi	ಬಡಿ	gukku	ಗುಕ್ಕು
5.	p[illegible] tāṇa	ತಾಣ	tāna	ತಾನ
6.	dāḍa	ದಾಡ	tappu	ತಪ್ಪು
7.	kāli	ಕಾಲಿ	mātu	ಮಾತು
8.	dammu	ದಮ್ಮು	tūgu	ತೂಗು
9.	pēṭa	ಪೇಟ	makka	ಮಕ್ಕ
10.	gēṇu	ಗೇಣು	tāḷa	ತಾಳ
11.	bātu	ಬಾತು	bali	ಬಲಿ
12.	tūku	ತೂಕು	māla	ಮಾಲ
13.	lāṭi	ಲಾಟಿ	baḷi	ಬಳಿ
14.	maḍi	ಮಡಿ	mēḷa	ಮೇಳ
15.	kaṇi	ಕಣಿ	daḷa	ದಳ
16.	kuggu	ಕುಗ್ಗು	gāli	ಗಾಲಿ
17.	dōṇi	ಡೋಣಿ	lāḍi	ಲಾಡಿ
18.	muṭṭi	ಮುಟ್ಟಿ	nali	ನಲಿ
19.	nadi	ನದಿ	gēṭu	ಗೇಟು
20.	magga	ಮಗ್ಗ	buḍḍi	ಬುದ್ಧಿ

APPENDIX II

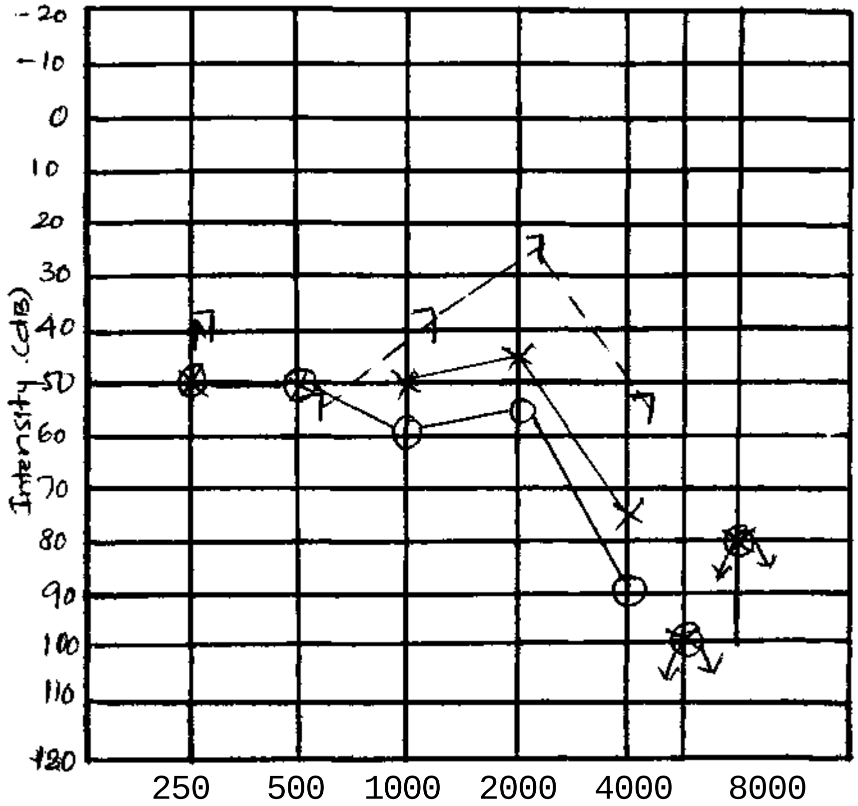
Audiological findings of the seven Sensori-
neural loss patients

Key to audiogram symbols

	Right ear	Left ear
A.C. (Unmasked)	0	X
A.C. (Masked)	Δ	∇
B.C. (Unmasked)	[	]
B.C. (Masked)	┌	┐

Name: SMR Age; 68yrs. Sex; Male

Audiometer used;Madsen 0B70



	Right	Left
PTA	55	48.3
SRT	60	55
SDS	60%	70%

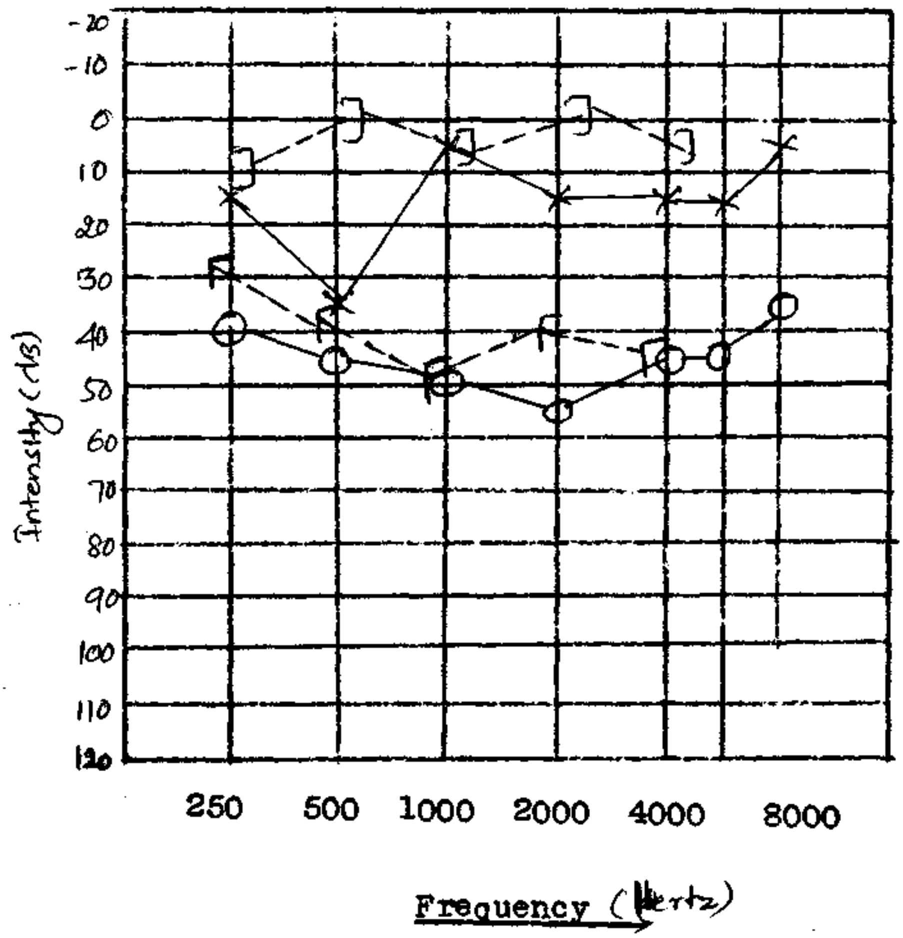
Impedence findings: Reflex absent bilaterally. Air tight seal is not obtained.

Diagnosis: Bilateral Sensori-neural loss

Recommended: Elkon hearing aid with single cord.

Name: RCS   Age; 18 years   Sex: Male

Audiometer used; Maico MA 22



	Right	Left
PTA	50	18 .
SRT	35	30
SDS	55%	60%

Tone decay positive at 1 KHz. and 2 KHz.in Right .ear(STAT)

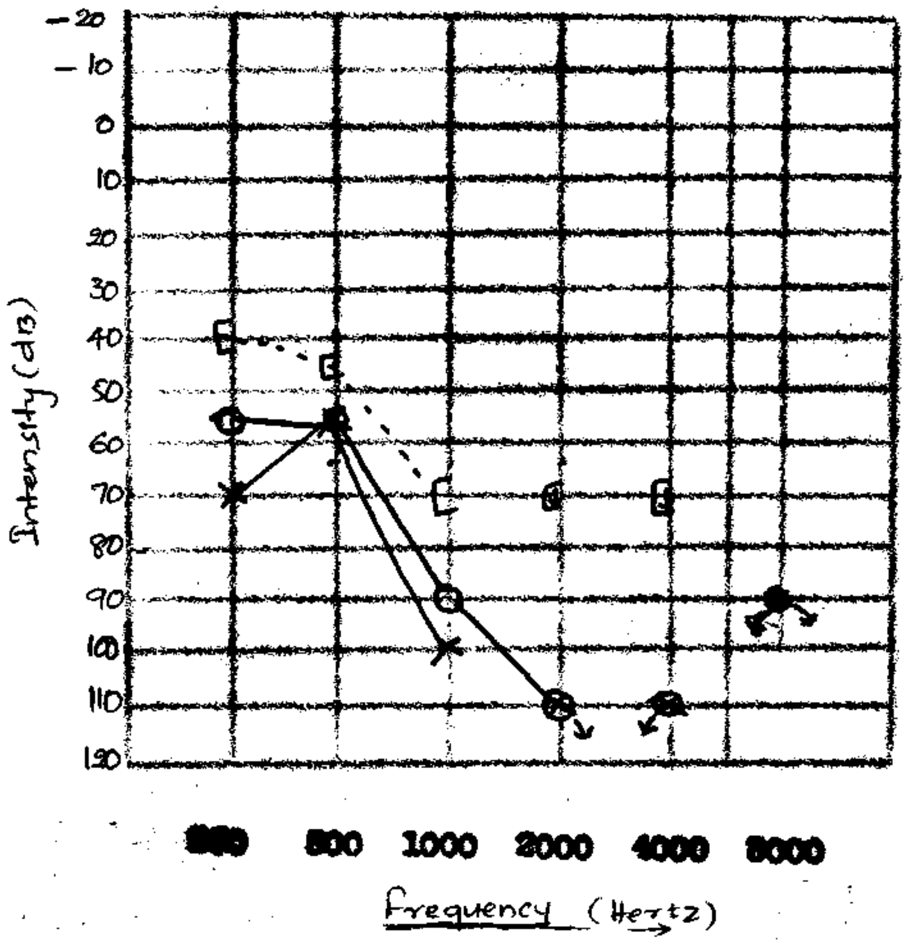
Impedence findings: Reflex absent bilaterally

Diagnosis: Right; Moderate sensori-neural hearing loss.

Recommended Neurological Examinations.

Name: SL Age: 21 years Sex: Female

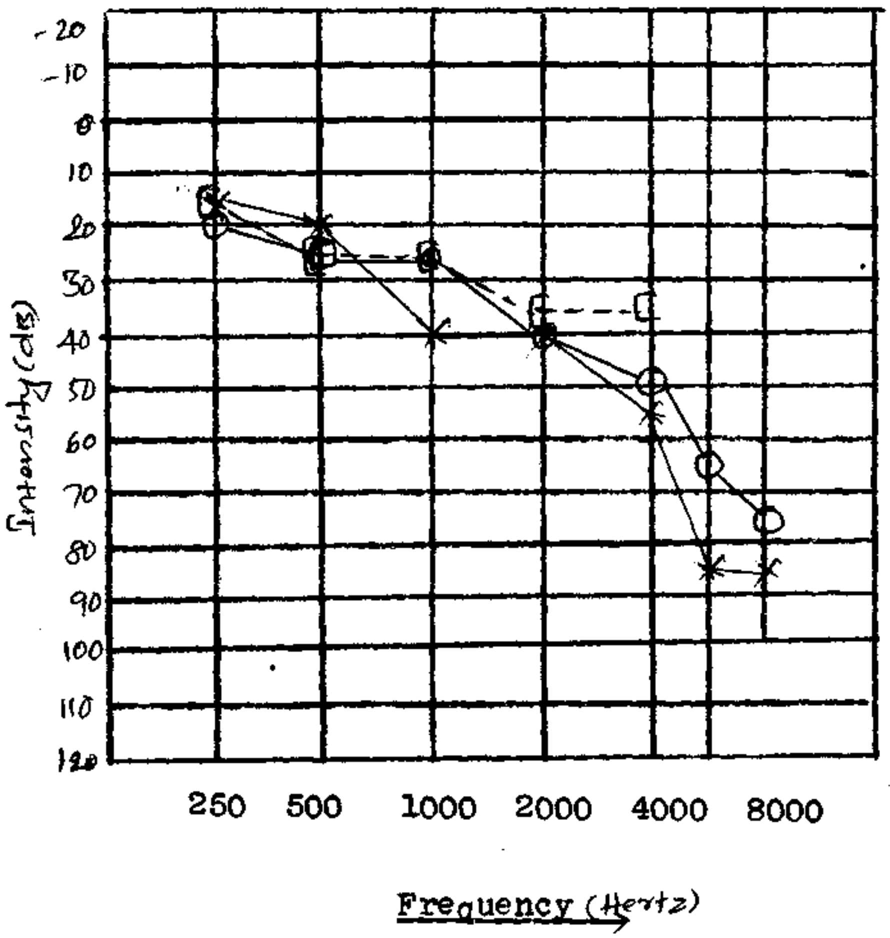
Audiometer used: MA 30



Diagnosis: Bilateral profound Sensori-neural loss

Name; CAM Age: 71 years Sex: Male

Audiometer used: Madsen 0B70



	Right	Left
PTA	30	33.3
SRT	40	45
SDS	90%	90%

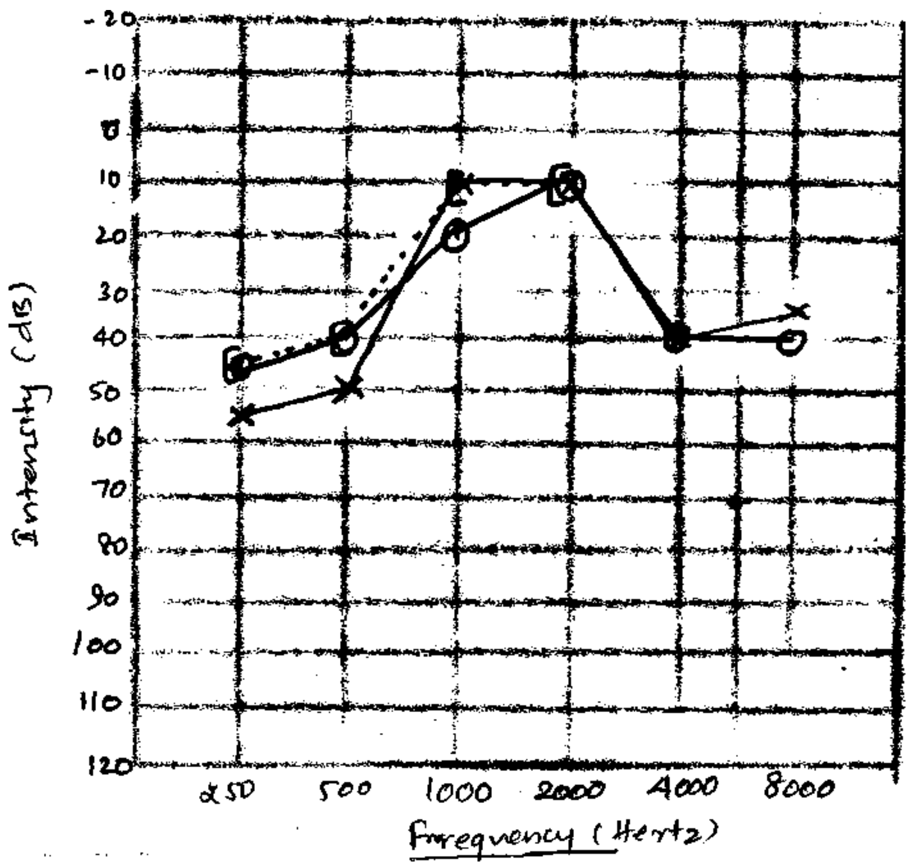
-ve tone decay at all frequencies in both ears.

Diagnosis: Bilateral moderate Sensori-neural loss

Recommended: Hearing aid trial.

Name: SSP Age; 30 years Sex: Male

Audiometer used: Maico MA 22

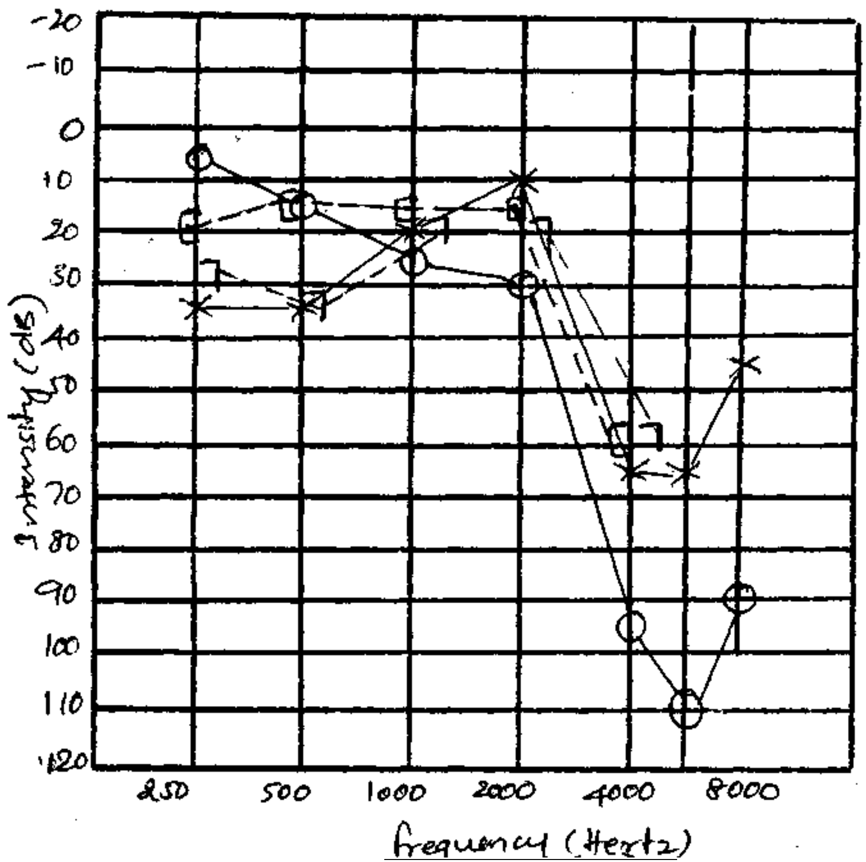


Impedence findings: Reflex thresholds present in Right ear at 1 KHz. at 115 dBSPL and at 2 KHz. at 125 dBSPL.
Reflex Absent in Left ear .

Diagnosis : Bilateral low frequency Sensori-neural loss

Name; SNI   Age: 38 years   Sex: Male

Audiometer used: Maico MA 22



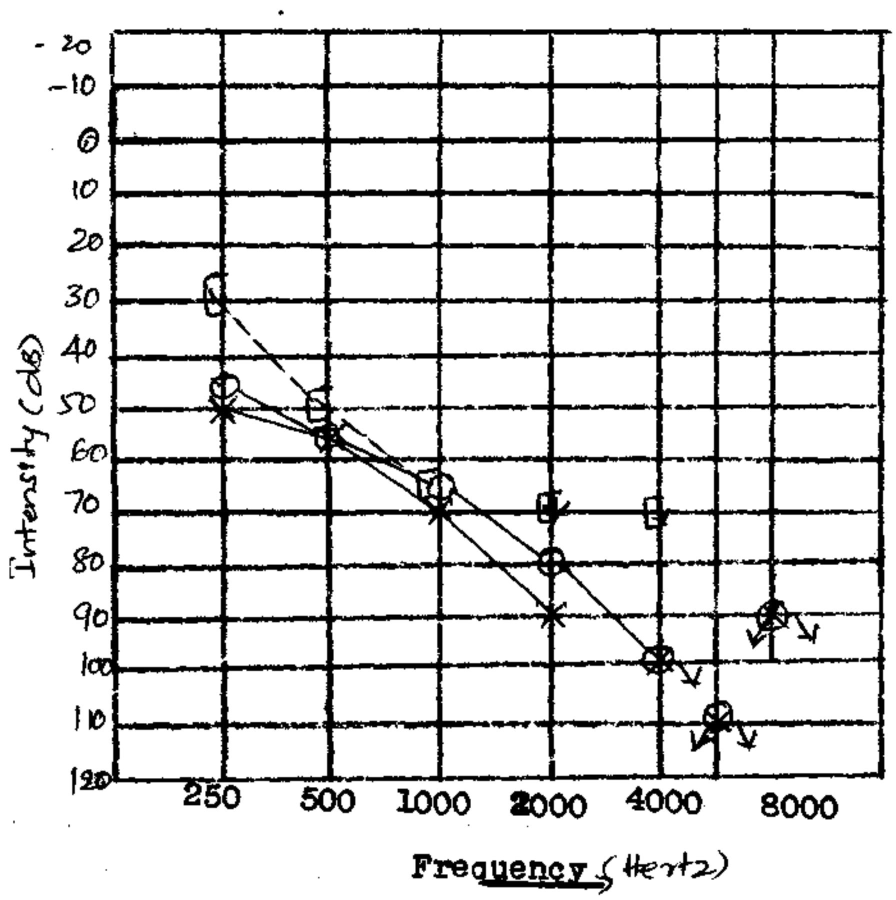
Impedence findings:		500	1K	2K	4K
	Right (Probe)	90	95	110	A
	Left (Probe)	95	95	105	A

Diagnosis: Bilateral high frequency Sensori-neural Io3s(noise induce).

Recommended: Ear Protectors.

Name: ARN Age; 19years Sex: Male

Audiometer used: Maico MA 22



	Right	Left
PTA	66.6	71.6
SRT	70.0	80.0
SDS	55%	60%

Diagnosis: Bilateral Severe Sensori-neural loss

Uses D-1 hearing aid

A P P E N D I X III

Calibration - Procedures

Intensity Calibration

Instruments: Audiometer: Madsen 0

Ear phone type : TDH 39

Cushion type : MX41/AR

Artificial ear type : 4152

Condenser mic. type; 4144

B & K AF analyser type : 2107

Frequency	Input level	Ref. in dBSPL	Expected output in dBSPL	Obtained output in dBSPL
250	60 dBHL	24.5	84.50	83.00
500	"	11.0	71.00	71.00
1K	"	6.5	66.5	66.00
2K	"	8.5	68.5	69.00
4K	"	9.0	69.0	67.00
3K	"	8.0	68.0	74.50
SK	M	9.5	69.5	73.00

Internal calibration was done to get the approximate values. Linearity of the dial was checked at 1KHz. and was found to be in agreement with the standards. Frequency response characteristics of the right Ear phone was flat and this ear phone was used in the study.

Block diagram of instruments used for intensity calibration

Frequency Calibration

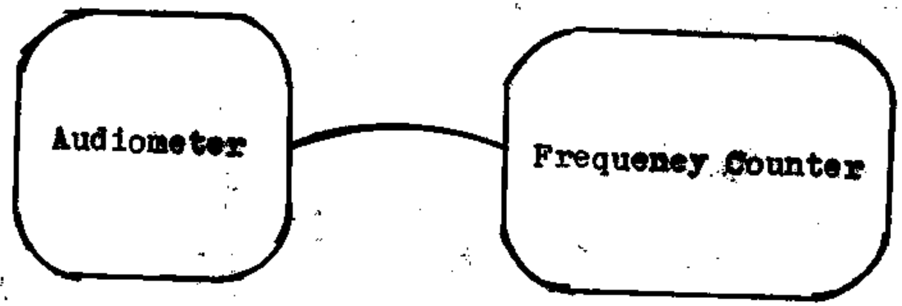
Instruments: Frequency Counter Type 203 Radard

Internal Calibration was done to approximate values and found to be in within the limits of 3% variation.

Frequency in Hertz	Intensity in dBHt.	Calibrated fre-ctuency values.(Hz.)
125	60	126
250	"	257
500	"	498
1K	"	1003
2K	"	2001
3K	"	3003
4K	"	4006
6K	"	6010
8K	"	8021
10K	"	9872

Frequency response of right ear phone was flat.

Linearity of the dial was checked and was found to be in order.

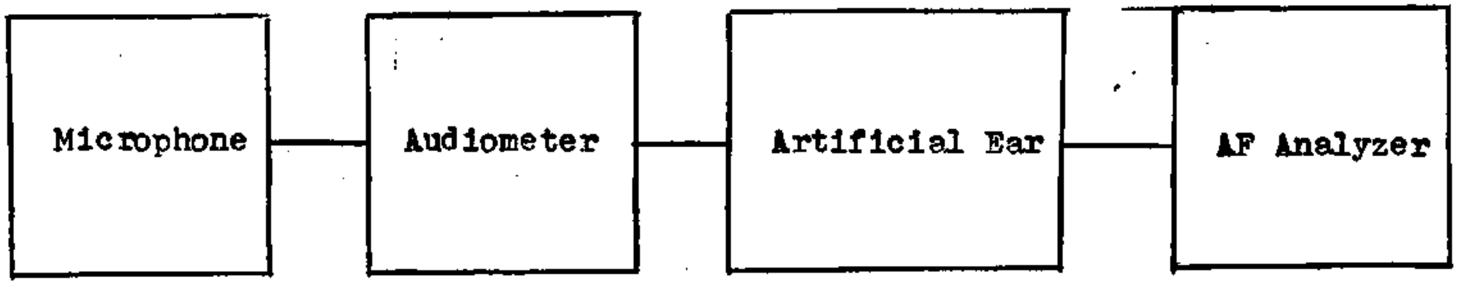


Block diagram of instruments used for frequency calibration

Speech Output Calibration

Speech output calibration was done using Artificial Ear type; 4152; AF analyser type B & K 2107 and TDH-39 Ear phones

At 60 dBSPL attenuator level, live voice calibration was carried out to obtain an output of 79.5 or 80 dBSPL (ISO 1964). The VU meter was used for monitoring a steady level of phonation. Both Right and Left ear phones were in calibration.



Block diagram of instruments used for calibration of speech output

APPENDIX IV

Noise levels in the testing room

ISO (1964) Standards.

SPL meter type; B & K 2209 with ½" condensor microphone 4165

Octave Bands	Maximum noise allowable in dBSPL	Noise levels in the room dBSPL
75- 150	31	14
150- 300	25	18
300- 600	26	10
600-1200	30	12
1200-2400	38	10
2400-4800	51	11
4800-9600	51	11
'C Scale	-	32