DEDICATED

TO

PARENTS,BROTHER & SISTER

"THE RELIABILITY OF SIMULATED HEARING LOSS"

Register No. 8401
Anju - Thapher

An ndependent project work submitted as part fulfilment for M.Sc. (Speech and Hearing to the University of Mysore, Mysore..

MAY 1984

CERTIFICATE

This is to certify that the Independent Project entitled **"THE RELIABILITY OF SIMULATED HEARING LOSS"** is the bonafide work done in part fulfillment **for** First Year M.Sc (Speech and Hearing) of the student with Register No. 840/

Director
All India Institute of
Speech & Hearing
Mysore - 570006

Date :1.5.84

CERTIFICATE

This is to certify that the Independent Project Entitled -

"The Reliability of Simulated hearing loss"

has been prepared under my guidance and supervision.

GUIDE

Dr. M.N. Vyasamurthy
Lecturer in Audiology, All India
Institute of Speech and Hearing,
Mysore - 6

DECLARATION

This Independent Project entitled "The Reliability of Simulated Hearing Loss" is the result of my own work undertaken under the guidance of Dr. M.N. Vyasamurthy, Lecturer in Audiology, All India Institute of Speech and Hearing, Mysore - 6, and has not been submitted earlier at any University or Institution for any other Diploma or Degree.

Register Number: 8401

Mysore
Dated

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C O N T E N T S

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CHAPTER I.

INTRODUCTION

Regarding Non-organic hearing loss, a committee on Hearing and Bioacoustic reports as follows (Glorig 1965).

1 "Non-organic hearing impairment designates auditory dys-function for which no plausible anatomical or chemical basis can be found. The term includes auditory disorders ranging from con-scious purposeful malingering to non-conscious, 1 apparently purpose-less disorders variously called hysterical deafness, Psychogenic deafness, and the like conditions existing outside the auditory system, such as mental deficiency, senility and brain injury, which tend to affect hearing adversely, constitute a seperate problem. However, these conditions must be identified and excluded in order to establish a diagnosis of non-organic deafness or hearing loss.

The specification of types of non-organic hearing impair-ment at present rests on no precise terminology framework. Descriptioh tends to depend on factors such as motivation, causa-tion and degree of impairment. For example, the factor of motive may be regarded as extending from deliberate seeking of tangible reward to unconscious avoidance of unpleasant circumstances. In the individual case, unfortunately, motive is more easily infe-rred than specified with any degree of assurance. The extent of conscious volition is difficult to determine short of a frank confessions. The causes of non-organic hearing impairment are not known, although plausible contributing factors occasionally can be discovered. Athe present time, only the presence of non-organic auditory disorders can be determined with reasonable assurance. The amount of non-organic hearing loss may be measured only with difficulty if at all."

1.1

It is generally believed that most of the pseudohypacusis patients employ a loudness yard stick. The response of the Pseudohypacusis patients are in relation to the loudness yard stick employed. Any test designed for detecting pseudohypacusis should disrupt the loudness yardstick employed by the subject. Forexample, in D.S, test (Doerfler & Epstein 1956) the loudness yard stick employed by the subject is disrupted by asking the subjects to respond to spondee words in the presence of noise. Since subject use different loudness yard stick for interrupted tone and continuous tones. This aspect has been made use of in Bekesy V pattern test (Jerger 1960). Lengthened off time (LOT) (Hattler 1968) and BADGE (Hood, Campbell and Hulton 1964).

Tests like shifting voice and DAF are also designed to disrupt the patients loudness yardstick.

The above discussion points out that the loudness yard stick employed by the pseudohypacusis, is an important factor.

[illegible]

1.2

The present study is designed to find the reliability of simulated hearing loss. Further the present study tries to find the answers for the following questions:

1. Does the reliability of simulated hearing loss depend on the intensity level of the stimulus.
2. Does the reliability of simulating hearing loss depend on the frequency of the stimulus.
3. What is the maximum percentage of false responses that can be expected in simulated hearing loss?

CHAPTER II

REVIEW OF LITERATURE

2.1 Terminology

Many terms have been used to describe a hearing loss which appears greater than can he explained on the basis of pathology in the auditory system. According to Martin (1978) the most popularly used terms in the literature are "Non-organic hearing loss", "Pseudohypacusis", "Psychogenic hearing loss" and "Malingering." Williamson (1974) cautions that such terms do not necessarily describe the same phenomenon. Martin (1978) reported since clinician typically do not know whether an inflated auditory threshold is the result of conscious or unconscious motivation, it seems appropriate to use generic terms. Martin (1978) support the term "Pseudohypacusis" which was proposed by Carhart (1961), as it appears most descriptive.

Over the years a number of related terms have been proposed. Chaiklin & Ventry (1963) prefer the term "Functional" to describe hearing disorder with either no organic pathology or with pathology insufficient to explain the extent of a hearing loss. Other terms used for this purpose include: "Pseudo deaf muteness." (Fromm 1946); Psycho organic deafness (Getz 1954); Pseudo deafness (Hefferman 1955); Pseudoneural hypacusis (Brokman &

Hoversten 1960), & Pseudo hypacusis (Carhart 1961). The term "auditory malingering" refers to those persons who deliberately falsify their responses on hearing tests for some personal gain (Guttman 1938; Doefler & Stewart 1946. Fournier 1958).

Many terms have been used to describe exaggerated performance on hearing tests which are unconsciously motivated. The literature reveals such label as "Psychic deafness" (Froschels 1944; MyKlebust 1954), "Hysterical deafness" (Rosenberg & Moore 1946) and "Psychogenic Deafness" (Martin, 1946, Doerfler 1951 & Truex 1946). The term hysterical deafness was popular several years ago, but is used little today. This term implies a form of conversion neurosis wherein the patient losses emotional conflict. "Psychogenesis literally means begining (genesis) in the mind (Psyche). Even such exotic labels as Sinistrosis (Fournier 1958) appears in literature.

The terms "Psychogenesis" and"Non-organic hearing loss" has been used interchangeably by Martin (1978).

2.2 Importance of the problem

Prior to World War II little recognition was given to the problem of functional hearing loss. The reasons for the apparent lack of interest may have been related to failure to recognize the problem, the limited number of standardized hearing tests, inadequate audiometric equipment, and possibly a lower incidence of functional hearing loss.

The importance of functional hearing loss as a problem of considerable magnitude was first widely recognized in the armed forces aural rehabilitation programs developed during World War II (Morrissett, 1946). Following the war, many of the problems first recognised in the aural rehabilitation programs became a vital concern to United States Veterans Administration (VA). The Incidence of functional hearing loss in a VA population has been estimated as 11% to 45% (Johnson etal 1956). Since approximately 80000 veterans have service connected hearing impairments (Anderman 1960) it can be estimated that at least 9000 veterans have had or continue to have a functional hearing problem.

Unfortunately, functional hearing loss is not restricted to a VA population. Recently more emphasis has been given to this problem in children. However, little is known about the incidence, audionetric manifestations and dynamics of functio-nal hearing loss in children.

Another area of concern is the problem of functional hearing loss within an industrial setting. In some states there has recently been an increase in compensation for hearing loss sustained in the course of employment. Similar increase are anticipated in other states (Williams 1957). The increase in industrial claims will probably be accompanied by substantial increases in cases of functional hearing loss, since the incidence of functionality tends to be high among persons whose hearing loss is evaluated for compensation purposes.

Finally, Functional hearing loss may occur within the ordinary otologic or audiologic setting. In fact, functional hearing loss may arise whenever hearing is measured (J.B. Chaiklin & I.M. Ventry 1962).

2.3 Incidence of functional hearing loss

2.3.1 Incidence in Adults: Although systematic large scale approach to the problem is needed some authors reported incidence.Feldman 1969 stated that 3% of the general population may fall into this category. Nilo and Saunders 1976 found that 1% general population had the same, while 85-90% of the cases referred from military sources and

11 to 45% of Veteran Administration population had functional hearing loss. Johnson (1956) also reported that percentage of functional hearing loss since the II World War has gone up by 11 to 45%.

Barelli and Ruder (1970) gathered data on 162 medico-legal patients and found that 24% of the 116 workers applying for compensation proved to have a nonorganic hearing loss.

2.3.2 <u>Incidence in Children</u>: Chaiklin & Ventry (1963) reported that there have been many articles on functional hearing loss in children, but now have reported their incidence (Bailey & Martin 1961; Barr 1960; Best & Feldman 1958; Brochman & Hoversten 1960; Newby 1958; Froschels 1944; Hafferman 198; Kodman & Waters 1961).

Doerfler(1957) reported a survey of audiological centers to determine incidence of functional hearing loss in children and found that 15% of the centers who responded indicated that they saw few or no children with functional hearing loss. While Peldman (1961) reported that it occurred more frequently in children

Jerger (1961) reported an incidence of 7% in children. Brokmen & Hoversten (1960); Calvert et al (1961); Dixon & Newby (1959) indicated functional hearing loss thrice more often in females than in males, but did not explain the reason.

2.4. Diagnosis of Functional Hearing Loss

2.4.1 Non Test Situations: (1) Frequently the source of referral will suggest the possibility of pseudohypacusis (Martin 1978; Nilo Saunders 1976). We can suspect pseudohypacusis in a case of sudden hearing loss after an accident and being referred by an attorney.

2. Case history is of particular value especially in compensation cases (Martin 1978).

3. Suspicion of functional hearing loss should arise when there are claims for financial gains and secondly when the patient reports of sudden or has vague origin of his problem (Feldman 1969).

General behaviour in clinical evaluations:Johnson et al (1957) have pointed some behavioural clues about functional hearing loss. [They are (1) obvious psychiatric disorders, (2) unsolicited comments on questions regarding compensation (3) remarks such as 'I can get along fine when I read your lips' , (4) Exaggerated attempts to hear (5) Exaggerated starting (6) excessively loud voice, (7) refusal to attempt lip reading may force examiner to write (8) obvious nervousness.

Thorne (1960) gave the following points (1) Normal voice inflection (2) Poor knowledge of hearing iad (3) Comments on his health (4) reluctance in behaviour (5) Learned lipreading too quickly, (6) is extremely passive or anxious.

Similar points have been put forward by Martin (1978), Chaiklin & Ventry (1963), Wile & Saunders (1976), Feldman (1969), Beagley (1973).

2.4.2. Pure Tone Audiometry : (1) Test situations: Several authors (Fournier, 1958; Heller, 1958; Johnson et al 1956; Newby, 1958; Chaiklin & Ventry, 1963; Martin, 1978; Wood, 1977 Feldman, 1969; Willia, 1969) have given the following characteristics and behavioural cues, as found in functional hearing loss - [(1) hesitency 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) inconsistent responses during PTA (6) Manifest anxiety symptoms (7) half word responses to sporadic stimulus during SRT measurements (8) rhyming responses during discrimination testing & (9) slow and tentative responses.

2. The Audiometric configuration: [A number of authors have suggested that an audiometric pattern emerges which is consistent with pseudohypacusis. Some have described this pattern as a relatively flat audiogram showing an equal amount of hearing loss across frequencies] (Semenor 1947; Fournier 1958). Others have suggested that the "Saucer-shaped audiogram" similar to a supraliminal equal loudness countour is the typical curve illustrating non-organicity (Doerfler 1951; Carhart 1958; Goetzinger & Proud 1958). On the other hand, Chaiklin et al (1959) observed that saucer-shaped audiograps can also occur in true organic hearing loss. [They conclude that there is no typical pure tone configuration associated with nonorganic hearing loss] may attempt to give responses that are equal in loudness at all frequencies, ignorance of the manner in which loudness grows with respect to intensity at different frequencies does suggest that the result should be a saucer-shaped audiogram. The logic of this is apparently not borne out in fact.

In a study of 64 men with non-organic hearing loss and 36 men with true organic loss, Ventry & Chaiklin (1965) asked a panel of three rations of the audiograms. Saucer shaped curves appeased in only 8% of the non-organic cases and were also seen in true organic losses. This research indicates, as many experienced audiologists have observed, that the saucer audiogram has limited utility in identifying non-organicity.

3. <u>Test retest Reliability</u>: [One indication of non organicity is lack of consistency on repeated measures. Counselling the patient about the inaccuracies may encourage more accurate responses;] however, it should seem obvious that if this counselling is done in a belligerent way it can hardly be expected to increase cooperation if pseudohypacusis is being attempted. Sometimes a brief explanation of that discrepancies encourages improved patient cooperation. By with holding any allegations of guilt on the part of the patient the audiologist can superficially assume responsibility for not having conveyed instructions properly. This provides a graceful way out for many patients even if they are highly committed to * nonorganic hearing loss. Berger(1965) found that some children can be coaxed into "Listening harder", thereby improving results on pure tone tests.

4. Inappropriate lateralization: Inappropriate lateralization 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 & Ventry 1963; Williamson 1969; Feltman 1969; Martin 1978). The lack of control lateral response … especially for BC, is a very clear and impotant symptom for unilateral hearing loss (Martin 1978; Willamson 1969).

5. Bone Conduction Audiometry: Johnson (1956) suggested two 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 frequency tested* Chaiklin and Ventry 1961 did a study to test the above hypothesis, but their results did not support it.

2.4.3 Speech Audiometry: (1) PTA-SRT Relationship: There is a high correlation between PTA and SRT in most pathological. cases. The agreement between two is about $\pm$ 8 dB. The more the difference exceeds $\pm$ 8 dB, 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 1973) is seen in functional hearing loss. Most frequently SRT is significantly lower than the appropriate PTA.(Brockman 1960; Carhart 1952y Chaiklin et al 1959; Dixon & Newby 1959; Glorig 1954; Goetzinger & Proud 1958; Newby 1958; Portman & Portman 1961).

Chaiklin & Ventry (1963) from their study found that (1) a high percentage 45-50% of subjects with functional hearing have PTA-SRT difference greater than 15 dB (2) A small percentage of subjects with functional hearing loss are able to match PTA & SRT within 18 dB (3) SRT is usually lower than PTA.

2. The test retest reliability for SRT: A number of studies suggest that reasonable variability on repeated SRT measurement in 16 dB. Menzel reported it to the ± 5dB. The authors 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 within ±6dB is a strong sign 6f functionality, one that will produce false (+ve) identification. The SRT presented is usually close to the true SRT's and sa if this is valid, they also have high reliability.

3. The way in which a patient responds to traditional speech audiometry can itself be an indicator of functional hearing loss (Hopkinson 1973). A patient may repeat only one half

word of a spondee during SRT measurements with no valid reason for not being able to repeat the other half of the word.

Chaiklin & Ventry (1963) have worked out a formulae 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 1973 & 1978).

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 (1960, Johnson 1956; Newby 1958; but this aspect is still under a controversy.

5. Again on speech audiometry there may be an lateralization in unilateral hearing loss cases.

2.4.4. Speech tests for Pseudohypacusis: The purpose of administering special test is to confirm or reject, the impressions of patients behaviour obtained through routine testing (Newby 1972). The following paragraphs are a brief description of the various tests used in diagnosis of functional hearing loss, their advantages and disadvantages.

I. Pure tone tests for detecting Pseudohypacusis

(a) Automatic Audiometry: Use of Bekesy audiometry with functional hearing loss started mainly after Jerger {1960) reported Type V. Bekesy being associated with functional hearing loss. Jerger stated that unlike the first four types of Bekesy tracings,in V type, the continuous tone was heard much more distinctly than the pulsed curve. This behaviour he said could be regarded the presence of true simulated or aggravated condition. Resnick & Burke (1962) also support the Rove. But with what certainity this can be said is still a question (Dieroff et al).

Hopkinson (1965) 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 tracings. So, in order to come out with a more appropriate definition, Rintleman & Harford (1967) analyzed the Rekesy audiograms from a sample of functional hearing loss cases and concluded that their definition as being "The continuous tone tracings occur at a lower SPL than the interrupted tracing by a minimum of 10 dB, measured at the midpoints of two tracings for a range of atleast two octaves.

The break typically includes midfrequency region. Finally, the break should be complete with no overlap in tracings (no more than two excursions) and should reach a peak of maximum operation of atleast 15 dB" (quoted by Ventry 1971).

The type V effect has been related to patients' own internal standard for most comfortable level and the differential effect of memory upon loudness of sustained and interrupted puretones (Rintleman & Carhart 1964; Hattler 1968). Some researchers have also stressed that the type V Bekesy classification should be done based on sweep frequency rather than fixed frequency (Rintelman & Harford 1967; Resnick & Burke 1962; Dieroff et al 1970).

Ventry (1971) 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 the 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 (SERI) is associated with it, it would constitute a stronger 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 (1963) has reported the usefulness of this test in identifying the functional hearing loss in children.

Recher (1971) has analyzed the characteristics of the Bekesy audiograms associated with simulated hearing loss and has reported that -

1. the test-retest discrepancy, consistently present in all subjects were 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 (1968) reported that the effect on Bekesy type V could be enhanced by lengthening the offtime of 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 Mouro (1975) have recommended that

the continuous tone should be compared to both the LOT & SOT tones and the two pulsed tone tracings should be compared to each other to increase the efficiency of the test.

Hood, Campbell & Hulton (1964) developed BADGE (Bekesy Assembly Descending Gap Evaluation). This procedure involves a comparison of difference between the following lOOcps discrete frequency Bekesy tracing type (1) Continuous tone with tracing begun well below threshold (2) pulsed tone with 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 destroys patients' yardstick.

Start (1966), Hopkinson (1965) are of the view that type V Bekesy may not be a good indicator of functional loss. Price, Shephard and Goldstein (1965) say that a psychological, but not necessarily psycho-pathologic explanation may be offered for the type V tracing.

Martin (1978) has concluded that, arguments on the use of Bekesy audiometeric techniques for diagnosis of Pseudohypacusis are found 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 nonorganicity and is not an end by itself.

S.K. Kacker (191) did a study on 10 normal hearing volunteers, all otolaryngologists and audiometricians. The subjects were asked to simulate a 50 dB hearing loss in one ear on Grason Stadler Bekesy Audiometer. The result indicated (1) a test retest discrepancy present in all the subjects with simulated hearing loss (2) type V indicate simulated hearing loss and present in 70% of subjects (3) Saucer shaped curves and increased Bekesy excursions are not reliable indicators of simulated hearing loss (4) the Bekesy audiometer is a reliable tool indicating simulated hearing loss'.

5. <u>Pure tone test with ipsilateral masking</u>

Most subjects find it difficult to maintain consistent suprathreshold responses to auditory signals in the presence of several levels of noise in the same ear. Martin & Hawkins (1946)used this principle in discovering nonorganic hearing disorders. Pang Ching (1970) also found that introduction of noise to the test ear confuses the patient with a nonorganic hearing loss, causing him to lose his loudness yardstick.

Rintlemann & Harford (1963) found the SAL to be helpful in identifying nonorganic hearing loss.

The introduction of noise to the test ear, either by air conduction or bone conduction, may cause elevations in auditory threshold which suggest nonorganic hearing disorders because of their inconsistencies with predicted findings on patients with true hypacusis. While such methods identify the probable presence of some nonorganic hearing disorder they fail to provide evidence regarding the true thresholds of hearing (Martin 1978).

C. Miscellaneous tests for detection of Pseudohypacusis

Most of these tests are based on confusing the patient so that he cannot recall a previously established level at which he responded to an acoustic signal.

The use of both an ascending and discending approach to puretone threshold measurements was recommended a number of years ago as a rapid and simple procedure (Harris 1958). A greater than 10 dB difference between these two measurements suggests a non-organic problem since the two should be identical. For some pseudohypacusis subjects the difference is as large as

30 dB. For patients with nonorganic loss the ascending method generally reveal lower (better) thresholds than the descending approach. The harris test is quick and easy to perform with the simplest clinical audiometer and is basis for the BADGE test. Recently Kerr, Gillepie & Eastin (1975) modified Harris' original procedure and suggested that the test is improved slightly by performing the descending portion in 10 dB rather than 5 dB steps.

Some tests may be carried out by presenting a number of puretone pulses in rapid succession and asking the patient to count and recall the numbers of the pulses he has heard. The intensity of the tones may be varied above and below the admitted threshold of the tone in one ear (Ross 1964) or above the threshold in one ear and below the threshold in other ear (Nagel 1964). If the originally obtained threshold are valid the patient should have no difficulty in counting the pulses. Inconsistency should occur only if all the tone pulses are above threshold the patient has to sort out the number of louder ones from the number of softer ones. This can be very difficult to do.

One procedure has been suggested (Gaynor 1974) which requires that the patient be tested for puretone thresholds in normal fashion, and while humming both audibly and inaudibly.

The humming produces masking and elevation of threshold in subjects with normal hearing. The practicle value of such procedures in dealing with the larger problems of Pseudo-hypacusis is yet to be determined (Martin 1978).

2. Puretone tests which suggest thresholds of Pseudohypacusie patients

a) The Stenger test (Puretone): Stenger described his test in Germany in 1900 and 1907 (Sltshuler 1971). 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 having the higher sensation level. This is Stenger Effect (Martin 1978). 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 10 dB) in the better ear and at varying levels below the threshold obtained for the poor 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 responding 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 within 20 dB of the true threshold. If the response occur at a level that is significantly below (15 dB or more) the voluntary threshold for apparently poor 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 & Ventry 1963).

There have been extreme views on the clinical values of the puretone stenger test. Hood(1959) said"...seldom of value "whereas Goetziner & Preud (1958) claim it "unbeatable". Between the two extreme lies a larger number of the other researchers of this topic. Peck & Ross (1970) reported that stenger test could identify the general hearing threshold of the poorer ear in the unilateral functional hearing loss. Taylor (1949) 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 et al 1972; Azzi 1962; Davis & Silverman 1960; Feldman 1962; Menzel 1965; Glorig 1965; Monro et al 1977).

Other authors like Gibbons and Winchester (1957) and Goetzinger (1958) do not oppose the use of the test but recommend caution with its use (cited by Altshuler 1971).

Chaiklin and Ventry (1963) are of the view that the test is neither as has 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 (1978) is of the opinion that it is an efficient test. For quick identification of unilateral nonorganic hearing loss. Altshuler (1971) has also concluded that "most certainly the test is best used and in general more 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 (Altschuler 1971).

A) Involves qualitative and quantitative methods

Screening tests used to identify functional hearing loss form the major category of qualitative tests (Ballentyne 1960; Meller 1955; cited by Altshuler 1971). The qualitative tests quickly advise the examiner the existence of nonorganicity. The method attempts to closely estimate the threshold in the poor ear and are quickly and easy to administer.

If qualitative test is positive, then tests of quantitative method may be continued (Goetzinger & Proud 1958; Oneill & Oyer 1966; Sataloff 1966 cited by Altshuler 1958). Here the signal is presented to better ear at near threshold level and to the poorer ear at 40 dB HL. 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. There you can observe, if the method, incorporate the use of an ascending or descending signal presentation to the poorer ear. Several authors suggest the use of both techniques. Peck & Ross (1970) did a study wherein 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 good 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 patient is trying to confirm the tester or himself is confused. Gaeth (1956) questions the validity of such a method (Altshuler 1971).

Factors that affect stenger test

1. Diplacusis: Diplacusis can occur in some cases and when it does occur it invalidates the stenger result. This view has been supported by many authors (Newby 1958; Watson & Tolan 1949). This factor has been overrated, as a barrier to valid stenger test by Chaiklin & Ventry 1963. 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 (1971) 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 (1965) 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 rate in in unilateral cases, care should be taken in those subjects showing normal hearing threshold in speech frequencies and a SN dip at 4 KHz. Care should be even more in bilateral cases (Altschuler 1971).

3. **Intensity relationship between ears:** There are two problems which need to be viewed while considering the interaural difference: (1) It involves the threshold difference between the ears (2) Involves signal presentation difference between the eats. Although more research on these topics is needed, Altshuler (1971) and Kinstler (192) have commented 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 val. with strenger as below as 500 Hz, problem of crossover may occur, while above 2K thresholds may be depressed or there may be recruitment. Miller (1965), Ventry(1962), cited by Altshuler (1971). Ear pathology and contra lateralization are other factors to be considered but for which further research is needed (Goetzinger & Proud 1958; Chaiklin & Ventry 1963, cited by Altshuler 1971).

Modifications of Stenger test:

A number of modifications have been done using Stenger phenomena. Among them are:

1. Speech stenger test
2. Shifting voice test
3. Rapid Random Loudness Judgement (RRLJ)
4. Fusion Inferred Threshold (FIT) test
5. Using automatic audiometry
6. Other modifications

Among these (1) and (2) will be dealt later as they come under heading Speech Special Test.

1. Rapid Random Loudness Judgement (RRLJ)

The test was given by Nagel(1964) and is an outgrowth of Fowler's ABLB test. The aim of RRLJ is to confuse the non co-operative patient and to elicit from his responses to stimuli for which he has previously denied sensitivity. It is useful with both unilateral and bilateral functional hearing loss cases.

Initially puretone 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 preceded with 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.

Negal (1964) has commented that the efficiency of the test can be increased by establishing a more carefully programmed method of stimulus presentation.

2. Fusion Inferred Threshold (FIT)test

Altstuler (1971) quotes Bergman 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 estimate of valid threshold with subjects that are otherwise difficult to evaluate.

3. Using Automatic Audiometry

Reger et al (1963) have suggested the use of an automatic Bekesy type audiometry for the Stenger test (Watson & Voots 1964; Altshuler 1971;). Watson & 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 increases in both ears simultaneously as the patient operates the response knob, the test is reported to have high clinical applicability.

4. Other modifications

Vyasamurthy (1971) has given 2 methods to detect unilateral hearing loss. His methods are based on binaural summation although the basic principle is same as in stenger. These methods use the findings of Hirsh (1952) 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 presented monaurally and then binaurally at 35 dB SL and 7 dB HL, subjects 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 the loudness as the first one, they are diagnosed as functional hearing loss. The first and second response is indicative of functional hearing loss.

Altshuler (1971) tested 12 children on the stenger test and found that test to be useful in obtaining thresholds. Fournier (1958) described four methods each of which allows the examiner to establish a threshold and thus to plot an audiogram.

Recommended stenger test model by Altshuler (1971)

1. A simultaneous presentation and withdrawal of a puretone signal should be ntilized.

2. One should begin with the tone to the good ear close to the threshold which will precipitate a constant response from the subjects.

3. The ascending technique should be used starting from 0 dB HL.

4. Discrete presentation should be in 5 dB steps with the pulse time and stimuli time sporadically altered to avoide rhythmicity.

5. Tone to the good ear should be faded away.

6. The test should be accomplished quickly and incorporated into the routine pure tone audiometry which is preceded by adequate instructions.

b) Acoustic Impedance Measurement

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 80 dB above the pure tone threshold. Even in patients with severe menieres disease and positive recruitment tests, there is usually a gap of 3odB 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 1970).

Besides the ART-PTA difference, the SPAR (Jerger 1975) based on work of Niemeyer and Sesterhan (1972) is also helpful in knowing the exact threshold of a patient (Martin 1978).

Jespen (1952 and Thomsen (1955) and Lamb (1967), Beagley (1973) have all pointed out the case with which functional hearing loss could be detected with the help of these measure-" ments. 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 1970; Martin 1978; Lamb 1967). However the test has helped in the diagnosis of several patients with functional hearing loss.

3. **Pure Tone Tests which Identify Thresholds of Pseudohypacusis Patients**

(i) Electrodermal Audiometry: This test has been used to determine both AC and BC thresholds in functional hearing loss. Dorfler and McClare 1954, Burk 1958, and Manley et al 1958 have reported that GSR were usually within ± 5dB to voluntary threshold. Chaiklin et al 1964 found a test retest reliability within ± 5 dB. 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 & Ventry 1963). The most important advantage of the test is it does not appear to be an auditory test at all (Hanley et al 1958).

On the other hand Martin (1978) 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 (1956) 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 et al 1961).

ii) Evoked response Audiometry and electrocochleography: Cortical evoked response audiometry is the most popular of tests. The procedure involves no shock or other annoying stimuli and so is more applicable (Martin 1978). Mclandles et al (1968) have reported ERA as representing a rated and objective index of auditory sensitivity.

On the other hand Martin(1978)has commented that as a high correlation has not been found between evo-ked responses and voluntary thresholds, a caution in interpretation of results is required. Secondly the instrumentation is expensive which also is a draw back.

The results obtained by electro-cochleography have fewer contaminating artifícts 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 1978).

iii) Delayed Feedback Audiometry: The test was introduced by Rulim and Cooper in 1964. The method used here is that the patient is asked to tap a rhythm 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 200 msec, this completely upsets the tapping rhythm. The rhythm returns to normal about the threshold.

A number of authors (Azzi 1951; Gibbons & Winchester 1957; Hanley and Tiffany 1954; Hanley 1958; Alberti 1970, Rulim and Cooper 1962, 1964) 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 & Tiffany 1954, Gibbons & Winchester 1957) have said that DAF is superior to other test that they 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 & Ventry 1963).

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 1978, Chaiklin & Ventry 1963). Sophistication is found to have little effect on this test (Martin 1978). 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 or no effect at all. Measures used to detect involvement under DAF have been relatively gross. Chaiklin & Ventry (1963), Beagley 1973 & Martin 1978) have also reported difficulty of using this test with some subjects.

The two other problems cited by Beagley (1973) in the use of this test are (1) recruitment of loudness in a patient with a true cochlear loss may result in awell-marked feedback (2) hearing may be near normal at some frequencies with severe loss at others, which should be taken care of.

2. **Speech tests for Pseudohypacusis:**

1. **Doerfler Stewart Test(ES):** It was given by Doerfler and Epstein (1956), Doerfler and Stewart (1946). This test has gained a lot of acceptance in functional hearing loss cases (Davis & Goldstein 1960; Miller 1955; Newby 1958; Watson & Tolan 1949).

The test compares to speech v/s noise. Doerfler and Stewart(1945) have commented on their test as "Most listeners continue toirespond even when noise is presented at a level 10 to 15 dB most intense than the speech. The nonorganic 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_1. After this noise is simultaneous introduced with speech which is increased in 10 dB steps until he no longer repeats the spondees. This level in 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. - 15dB level. After this the noise level is reduced to 0 dB HL.

If patient does not repeat when the levels are reduced a second SRT is got - SRT_2. He is latter 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 (1956) Doerfler and Epstein (1956) are as follows:

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

Doerfler and Epstein (1956) have said that if a subject has 2 or more +ve signs, the test is +ve. One (+)ve 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 +ve result was obi ned noise detection and noise interference being most sensitive to the presence of functional hearing loss.

Hopkinson (1978) 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 (1960) concluded by starting that the test . . . . "... a sensitive detector of non-organicity.

2. Speech Stenger Test

It is based on the principle of classical pure tone Stenger test, except that spondiac words are used as stimuli (Taylor 1949; Johnson et al 1956; Watson & Tolan 1962 cited by Martin 1978; Hopkinson 1973).

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 (15 dB or more) than this voluntary SRT. The test helps to obtain SRT close to patients true threshold level.

Taylor (1949) says that relatively small interaural difference can produce positive results. Menzel (1960) is of the view that the test is most useful when there is significant. If difference in SRTs and there is a functional overlay for speech in poorer ear. Newby (1958) says that if helps to overcome dyplacusis. Martin (1978) is also of the view that it helps to overcome problems of diplacuses and beats, while it also provides quantitative information of hearing level. The procedure has been described by Carhart 1966; Goetzinger & Proud 1958, Newby 1958 and Watson and Tolan 1949.

3. 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 either be instructions, questions or even spondees, this stimuli is shifted between the ears. The patient is asked to indicate through which ear he is hearing the examiner by pointing to appropriate earphone. Johnson et al (1956) and Carhart (1960) suggest that this procedure is also useful with bilateral cases who have slight inter aural threshold differences. Davis and Goldstein 1966 have also found it to be useful in unilateral cases. An individual with pseudo hypacusis responds inconsistently on the shifting voice test (Newby 1972) who has also stated that it is difficult to rely on this as it in turn relies on putting pressure on the patient which again depends on patients confusion (Watson 1949). Thus there is disagreement whether test results approximate true thresholds (Carhart 1960).

4. 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 & Ventry 1963).

For cases with unilateral deafness, most clinicians advocate application of noise to better ear (Asherson 1936; Grove 1943; Harbert 1943; Morrison 1955) although some clinicians advocate it to poorer ear (Watson & Tolan 1949) and still others say that it first be administered to one ear and then the other ear (Heller 1955).

In bilateral cases (Watson and Tolan 1949) recommend that noise be applied binaurally. Hanley and Harvey (1965) have demonstrated difference in vocal intensity between talking in quiet and when 50 dB sae tooth noise was given.

There are some disadvantages of this test which have been put forward by Newyby 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 (1963) 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 is relatively inefficient and should be interpreted cautiously.

3. 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 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 at least at that level (Chaiklin & Ventry 1963).

6. Delayed Auditory Feedback (DAF)

The effects of delayed speech feedback was studied before it became evident that it was appropriate for investigating hearing thresholds (Lee 1950).

College students with normal hearing "Feigned Malingering" were subjects in one of the early attempts to use DAF as a test of hearing levels (Tiffany and Hanley 1952). The effect on reading was significant when the signal was 75 dB HL. In auditory procedures used delay 0.l to 0.2 sec. They have suggested that the test is effective at high levels of feedback signals "(Tiffany and Hanley 1952; Chaiklin and Ventry 1963). Investigators reporting on DAF have stressed that a great deal of individual narration have been shown in response to feedback and that in general the test is not helpful in obtaining a quantifiable threshold (Martin 1978). Thresholds are inferred as 20 dB or more below the lowest level of positive effect. The test can be used either binaurally or monaurally with equal effectiveness (Gibbons and Winchester 1957). If the monaural procedure is used, appropriate contralateral masking is necessary.

Earliest investigations suggested starting the test at high feedback level and then decreasing the intensity for successive readings until the effect no longer occured (Hanley & Tiffany 1934). Others have suggested starting without feedback for a baseline and then increasing the hearing threshold levels until a change in reading rate occur. (McGranahan, Causer and Studebaker 1960). A speech time analyser may be used for precision of measurement (McGranhan et al 1960), however a stop watch is sufficient in view of special equipment.

7. SWITCHED SPEECH TEST

It was given by Calicero (1957), Here several tests of meaningful short sentences recorded at an average speed of

85 words per minute are used. The sentences are switched back and forth between the ears at 30 dB 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 per sec) are used, the patient hears the message in the better ear as relatively unintelligible interrupted speech, but intelligibility 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 ear or to the better ear. Thushe 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 & Ventry 1963).

8. Yes 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 Rachman 1970, Miller 1968 reported that the success of the test depended on child responding immediately after the tone has been presented.

Frankton (1976) has commented that degree and type of loss can be determined by this technique. Also the test is easy to administer and does not necessitate the use of special equipment.

8. Falcovers lip reading test:

This test was given by Falcover in 1966. The test contains auditory as well as visual stimuli and consists of monosyllable homophenous words, which are nearly impossible to perceive by lip reading 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 audition, the patient inadvertently reveals some degree of functional hearing loss. The technique is also effective with patients who demonstrate a much smaller degree of functional hearing loss (Falcover 1966).

Goldman 1971 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 pure tone 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 1971 has also pointed that this test can be used either monaurally or binaurally. It requires no special equipmentfor its administration. Also the functional hearing loss patient who tries to convince his reliance on lip reading cues in order to communicate falls as an easy victim in this test. Goldman (1971) said that Psycho-physically and physiologically the Falcover test has definite advantages which warrant its inclusion in test battery.

9) Speech measures by ElectrodermaR Audiometry (EDA)

Classical conditioning of Speech Signals

Rulum and Carhart (1958) did a validation study of speech by EDA using normally hearing subjects and conductively impaired subjects. Menzel and Rulum 1959 follow up 30 pseudohypacusis patient diagnosed by EDA with speech and found EDA with speech successful.

The following procedure and interpretation are suggested for classical conditioning speech signals. The patient was instructed to listen to the words and not to repeat them. He was made aware that the shock would be part of test. The procedure reported by Rulum and Carhart 1958 involved conditioning the skin response to a spondaid word that was presented in a group of spondees by monitored live voice. The unconditioned stimulus (shock) was always used when the key word was presented during the conditioning schedule. All of the words were presented at a level that could be heard easily during conditioning.

The threshold for intelligibility was established by omiting the shock and presenting words at supposed subthreshold levels. In brief, a series of words, the key word or conditioned stimulus was always one of the spondees. Other words may have been shown minimal ink writer movement but not of sufficient amplitude to be identified as conditioned word.

(b) Instrumental Avoidance Conditioning

A test was described that used instrumental avoidance conditioning to obtain verbal responses to the speech signals (Hopkinson, Katz and Shull 1960). The test took 2 practical measurements of SRT at the same time, the GSR recording to the conditioned speech signals as well as the actual verbal response.

A comparison of two conditioning techniques in a study of GSR speech audiometry with normal showed that instrumental avoidance technique was superior in the following: (1) more rapid acquisition of conditioning (2) greater resistance to extinction (3) wider intensity generalization and (4) less stimulus intensity dynamism (Katz & Conelly 1964). Similar finding noted in a study instrumental versus classical conditioning using puretones by Shepherd (1964).

2.5 Treatment of Functional hearing loss

Research on treatment of patients with functional hearing loss has been grossly neglected. This neglect is probably due to lack of knowledge about the possible etiologies of functional hearing loss. There are probably psychological, neurophysiological and general medical conditions (or combinations of these conditions) that are significant in theetiology of functional hearing loss but the limited knowledge available about these conditions has restricted treatment efforts and consequently has restricted related research. The electrophysiological methods, electronystagmography hypnosis, signal detection tests and in that receiver operating characteristics are some fertile areas of research (Hopkinson 1973). Early detection, especially with children would prevent later complications (Hbpkinson 1973).

A number of techniques have been described for the treatment of functional hearing loss as hypnosis, nacrotherapy, psychotherapy simulated surgery, faradification and retional explanation (Chaiklin and Ventry 1963).

Research on treatment is needed to answer which of the many theapeutic techniques available is most efficient and suitable for majority of patients with functional hearing loss. Why do some patients easily resolve their functional problem while others do not? How permanent is resolution achieved by superficial counselling techniques? Do other functional symptoms replace symptoms of hearing loss? What is the role of aural rehabilitation in the over-all rehabilitation process? The treatment of functional hearing loss concern medical as well as non-medical disciplines (Chaiklin & Ventry 1963).

It is known that most of the pseudohypacusis subjects employ a loudness yardstick. Any test designed to detect pseudohypacusis should try to break the yardstick employed by the subjects. The efficiency of a test for pseudohypacusis depends on how well it disrupts the patients loudness yardstick. The survey of literature shows lack of data on reliability of feigning hearing loss. It is not clear how efficiently the pseudohypacusis cases feign a hearing loss. The data on the reliability of simulated hearing loss are needed to establish the efficiency of pseudohypacusie patient in simulating hearing loss.

CHAPTER III

METHODOLOGY

3.1. Subjects

A group of 40 normal hearing subjects from All India Institute of Speech and Hearing, Mysore was selected- Their age range was 17 years 10 months to 28 years.

The group consisted of 18 males and 22 females. The criteria for selection of subject was that they had to pass a screening test for hearing at 20dB HL ANSI 1969 for frequencies from 250 Hz to 8KHz.

Out of 40 subjects, 20 subjects were randomly classified into four groups,each group consisting of 5 subjects. Each group was asked to simulate a particular degree of hearing loss i.e. the groups A, B, C and D were asked to simulate 50, 60, 70 and 80 dB at 1 KHz hearing loss respectively.

Additionally four groups of 5 subjects (viz. Group E, F, G and H) were asked to simulate a hearing loss of 50 dB and 70 dB at 2 KHZ and 4 KHz. E and F groups were asked to simulate hearing loss of 50 a Bat in & 4 KHz. respectively. & G & M to stimulate Fed Bat zu & 4k respectively.

3.2 Instruments

Lotus type I a 8112 audiometer was used. The earphones and earcushions used were TDH 39 and MX 41 AR respectively.

The instrument was calibrated with B & K calibration equipment The block diagram for calibration is given in the Appendix.

3.3 Testing environment

Testing was carried out in a single room situation i.e. in one of the sound treated rooms at AIISH.

The noise levels in testing room were well within the maximum allowable noise levels (in dB SPL).

3.4 Instruction

"You are going to hear some puretones. First 5 tones will be at the same level. Later a number of tones will be presented at different levels. You have to raise your finger when you feel that the loudness level of the tones which follow the first five tones is greater than loudness level of first five tones; otherwise don't raise your finger i.e. you should not respond to the tone if its loudness is weaker than or equal to the loudness of the fixed level tone (the tone which would be presented five times in the beginning."

3.5 Presentation of tones

First the tone was presented at a fixed level.(i.e. criterion level) for five times (The subject was asked to remember the loudness of the tone). Later the tone was presented at different levels randomly for 30 times).

Based on the subjects response false positive and false negative responses were found out for each subject seperately The response was considered as false positive if the subject responded below or equal to the criterion level. The response was considered false negative if the subjects did not respond even though the level of the tone was above the criterion level.

* * *

CHAPTER IV

RESULTS AND DISCUSSION

Table 1 shows the number of false responses for all the subjects in such group (Group A, B, C & D). The results show that the false responses observed for groups A and B are more than the false responses observed for groups C and D. This implies that it is difficult to simulate a hearing loss at lower levels (at 50 dB or 60 dB)

Table II shows the percentage of false responses for each group (A, B, C & D).

Table III shows the false responses for Group A, E and F. The false responses observed in groups E and F are more than the false responses observed in group A. This indicates that it is difficult to simulate a hearing loss at higher frequencies.

Table IV shows the percentage of false responses for groups A, E and F.

Table V shows false responses from groups C, G and H. The false responses observed in groups G and H are more than the false responses observed in group C. This also shows that it is difficult to simulate a hearing loss at higher frequencies even at higher levels (at 70 dB).

Table VI gives the percentage of false responses for each group C, G and H.

TABLE I - Number of False responses of the FOUR GROUPS of subjects at 1 KHZ (A,B,C & D.)

Sl. No.	Group A (50 dB)		Sl. No.	Group B (60 dB)		Sl. No.	Group C (70 dB)		Sl. No.	Group D (80 dB)	
	False(+ve)	False(-ve)		False(+ve)	False(-ve)		False(+ve)	False(-ve)		False(+ve)	False (-ve)
1.	- - 5 False responses out of 30 trials.	4(60dB)* 1(70dB)	1.	4 (60dB)* 4 false responses out of 30 trials	-	1.	1 (70dB) 1 false response out of 30 trials	-	1.	3 (70dB) 3 false responses out of 30 trials	-
2.	1 (50dB) 1 false response out of 30 trials	-	2.	- 3 false responses out of 30 trials	3 (70dB)	2.	1 (70dB) 1 false response out of 30 trials	-	2.	- No false response out of 30 trials	-
3.	- 1 false response out of 30 trials	1(60dB)	3.	- 3 false responses out of 30 trials	3 (70dB)	3.	- 1 false response out of 30 trials	1 (80dB)	3.	1 (70dB) 1 false response out of 30 trials	-
4.	- - 5 false responses out of 30 trials	4(60dB) 1(70dB)	4.	- 2 false responses out of 30 trials	2 (70dB)	4.	1 (70dB) 1 false response out of 30 trials	-	4.	- no false response out of 30 trials	-
5.	- 1 false response out of 30 trials	1(60dB)	5.	- 2 false responses out of 30 trials	2 (70dB)	5.	2 (70dB) 2 false responses out of 30 trials	-	5.	2 (70dB) 2 false responses out of 30 trials	-
Mean false responses		2.6	Mean false responses		2.8	Mean false responses		1.2	Mean false responses.		1.2
S.D.		2.01	S.D.		0.75	S.D.		0.4	S.D.		1.17

* Figures in parenthesis indicate the level of the tone

TABLE II - Percentage of false responses of the FOUR GROUPS of subjects at 1 KHz
(A, B, C & D)

Sl. No.	Group A (50 dB) % falls (+ve)	% false (-ve)	Sl No.	Group B (60 dB) % false (+ve)	% false (-ve)	Sl. No.	Group C (70 dB) % false (+ve)	% false (-ve)	Sl. No.	Group D (80 dB) % false (+ve)	% false (-ve)
1	-	80 (60* dB) 20 (70 dB)	1	80 (60dB)	-	1	20 (70 dB)	-	1	60 (70 dB)	-
	16.67			13.33			3.33			10	
2.	20(50dB)	-	2	-	60(70dB)	2	20 (70 dB)	-	2	-	-
	3.33			10.00			3.33			0	
3.	-	20 (60 dB)	3	-	60(70dB)	3	20 (70 dB)	-	3	20 (70 dB)	-
	3.31			10.00			3.33			3.33	
4.	-	80 (60 dB) 20 (70 dB)	4	-	40(70dB)	4	-	20(80dB)	4	-	-
	16.67			6.67			3.33			-	
5.	-	20 (60 dB)	5	-	60(70dB)	5	40 (70 dB)	-	5	40 (70 dB)	-
	3.3			10.00			6.67			6.67	
Mean false response	8%			10%			3.99%			4%	

figures in parenthesis indicate the level of the tone
Figures in the rectangle indicates % of false responses, ie.,(No.of false responsa
30

TABLE III - Number of false responses for Groups A, E & F at different frequencies at 50dB criterion

Sl. No.	Group A (50 dB) at 1 KHz		Sl. No.	Group E (50 dB) at 2 KHz		Sl. No.	Group F (50 dB) at 4 KHz	
	False (+ve)	False (-ve)		False (+ve)	False (-ve)		False (+ve)	False (-ve)
1.	- -	4 (60 dB)* 1 (70 dB)	1	- -	4 (60 dB) 2 (60 dB)	1	- -	4 (60dB) 2 (70 dB)
	5 false responses out of 30 trials			6 false responses out of 30 trials			6 false responses out of 30 trials	
2.	1 (50 dB)	-	2	1 (50dB) 1 (40 dB)	3 (60 dB) 2 (70 dB)	2	- -	5 (60 dB) 2 (70 dB)
	1 false response out of 30 trials			7 false responses out of 30 trials			7 false responses out of 30 trials	
3.	-	1 (60 dB)	3	-	2 (60 dB)	3	-	1 (60 dB)
	1 false response out of 30 trials			2 false responses out of 30 trials			1 false response out of 30 trials	
4.	- -	4 (60 dB) 1 (60 dB)	4	- -	4 (60 dB) 3 (70 dB)	4	- -	5 (60 dB) 5 (70 dB)
	5 false responses out of 30 trials			7 false responses out of 30 trials			10 false responses out of 30 trials	
5.	-	1 (60 dB)	5	2 (50 dB) -	3 (60 dB) 1 (70 dB)	5	-	5 (60 dB)
	1 false response out of 30 trials			6 false responses out of 30 trials			5 false responses out of 30 trials	
Mean false responses	1.6		Mean false responses		5.6	Mean false responses		5.8
S.D.	2.2		S.D.		1.85	S.D.		2.93

* Figures in parenthesis indicate the level of the tone

TABLE IV - Percentage of false responses for Groups, E & F at different frequencies at 5odB criterion

Sl. No.	Group A (50dB at 1 KHz)		Sl. No.	(Group E (50 dB at 2 KHz)		Sl. No.	Group F (50 dB at 4 KHz)	
	% false (+ve)	% false (-ve)		% false (+ve)	% false (-ve)		% false (+ve)	% false (-ve)
1	-	80(60* dB) 20(70 dB)	1	-	80 (60 dB) 40 (70 dB)	1	-	80 (60 dB) 40 (70 dB)
	Total 16.67			Total 20			Total 20	
2.	20 (50 dB)	-	2	20 (50 dB) 20(40 dB)	60 (60 dB) 20 (70 dB)	2	-	100 (60 dB) 40 (70 dB)
	Total 3.33			Total 10			Total 23	
3.	-	20(60 dB)	3	-	40 (60 dB)	3	-	20 (60 dB)
	Total 3.33			Total 6.7			Total 3.3	
4.	-	80(60 dB) 20(70 dB)	4	-	80 (60 dB) 60 (70 dB)	4	-	100 (60 dB) 100 (70 dB)
	Total 16.67			Total 23			Total 33.33	
5.	-	20(60 dB)	5	40 (50 dB)	60 (60 dB) 20 (70 dB)	5	-	100 (60 dB)
	Total 3.33			Total 20			Total 16	
% Mean false responses		8.66	% Mean false responses		28%	% Mean false responses		19.12

* Figures in parenthesis indicate the level of the tone.

Figures in rectangle indicate percentage of false responses i.e. (No.of false responses x 100)
30

TABLE V - Number of false responses for C, G & H at different frequencies for 70 dB criterion

Sl. No.	Group C (70 dB) at 1 KHz False (+ve)	Group C (70 dB) at 1 KHz False (-ve)	Sl. No.	Group G (70 dB) at 2 KHz False (+ve)	Group G (70 dB) at 2 KHz False (-ve)	Sl. No.	Group H (70 dB) at 4 KHz False (+ve)	Group H (70 dB) at 4 KHz False (-ve)
1.	1 (70* dB)	-	1	-	-	1	-	-
	One false response out of 30 trials			No false response out of 30 trials			No false response out of 30 trials	
2.	1 (70 dB)	-	2	-	-	2	-	3 (80 dB)
	One false response out of 30 trials			No false response out of 30 trials			3 false responses out of 30 trials	
3.	1 (70 dB)	-	3	4 (70 dB)	-	3	2 (70 dB)	2 (80 dB)
	One false response out of 30 trials			4 false resonses out of 30 trials			4 false responses out of 30 trials.	
4.	-	1 (80 dB)	4	-	1 (80 dB)	4	-	4 (80 dB)
	One false response out of 30 trials			1 false response out of 30 trials			4 false responses out of 30 trials	
5.	2 (70 dB)	-	5	-	-	5	2 (70 dB)	-
	2 false responses out of 30 trials			No false response out of 30 trials			2 false responses out of 30 trials.	
Mean false responses	1.2		Mean false responses	1		Mean false responses	1.6	
SD.	0.4		S.D.	1.61		S.D.	1.8	

* Figures in parenthesis indicates the level of the tone

TABLE VI - Percentage of false responses for groups C, G & H at different frequencies for 70 dB criterion.

Sl. No.	Group C (70 dB) at 1 KHz % false (+ve)	Group C (70 dB) at 1 KHz % false (-ve)	Sl. No.	Group G (70 dB) at 2 KHz % false (+ve)	Group G (70 dB) at 2 KHz % false (-ve)	Sl. No.	Group H (70 dB) at 4 KHz % false (+ve)	Group H (70 dB) at 4 KHz % false (-ve)
1	20 (70 dB)	-	1	-	-	1	-	-
	Total 3.33			Total = 0			Total = 0	
2	20 (70 dB)	-	2	-	-	2	-	60 (80 dB)
	Total 3.33			Total = 0			Total = 10	
3	-	20 (80 dB)	3	80 (70 dB)	-	3	40 (70 dB)	40 (80 dB)
	Total = 3.3			Total =13.33			Total = 13.33	
4	-	-	4	-	-		-	80 (80 dB)
	Total = 0			Total = 0			Total = 13.33	
5	40 (70 dB)	-	5	-	20 (80 dB)	5	40 (70 dB)	-
	Total = 6.67			Total = 3.33			Total = 6.67	
Mean % of false responses	3.33		Mean % of false responses	3.33		Mean % of false responses	8.66	

* Figures in parenthesis indicate the level of the tone.
Figures in Square indicate % of false responses $\frac{\text{(No. of falseresponses X 100)}}{30}$

CHAPTER V

SUMMARY AND CONCLUSION

The present study was carried out in order to findout the reliability of simulated hearing loss. For this purpose, 40 normals hearing subjects were selected from All India Institute of Speech and Hearing. The group consisted of 18 males and 22 females, with the age range 17 years 10 months to 28 years.

Out of the 40 subjects, 20 subjects were divided into 4 groups, viz. A, B, C and D. Group A had to simulate a hearing loss of 50 dB, Group B had to simulate a hearing loss of 60 dB, Group C had to simulate a hearing loss of 70 dB and Group D had to simulate a hearing loss of 80 dB.

All the subjects were presented with 5 tones at a criterion level. Later, 30 tones were presented at different levels randomly. The subjects had to respond by raising his finger whenever the tone level was louder than the tone presented at the criterion level. The response was false positive of the subject responded to a tone at a level below or equal to the criterion level. The response was considered false negative if the subject did not respond even though the level of the tone was above the criterion level.

The total number of false responses was noted. The results of the present study have revealed that it is difficult to simulate a hearing loss at a lower level than at a higher level.

The remaining twenty subjects were divided into four groups (viz E, F, G and H). Group E had to simulate a hearing loss of 50 dB HL at 2 KHz, Group F had to simulate a hearing loss of 50 dB HL at 4 KHz, Group G had to simulate a hearing loss 70 dB HL at 2 KHz, and Group H had to simulate a hearing loss of 70 dB HL at 4 KHz. The false responses were noted for groups E, F, G and H groups when compared to the false responses of E and F groups. This implies that it is difficult to simulate hearing loss at higher frequenci

CONCLUSIONS

1. The overall performance of the subjects shows that the subjects can simulate hearing loss reliably.

2. The performance of the subjects has showed that it is difficult to simulate hearing loss at low intensity levels.

3. The performance of the subjects has showed that it is difficult to simulate hearing loss at higher frequencies.
4. The results of the present study showed that the maximum percentage of false responses was 28% .

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