Standardization Of N U Auditory Test no. 6 On An English Speaking Indian Population

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C E R T I F I C A T E

This is to certify that the dissertation entitled " STANDARDIZATION of NU AUDITORY TEST No.6" is the bonafide work in part fulfilment for the degree of Master of Science (Speech & Hearing), of the student with Register No.6.

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C E R T I F I C A T E

This is to certify that the dissertation entitled "STANDARDIZATION OF NU AUDITORY TEST No.6" has been done under my supervision and guidance.

Dr.(Miss) Shailaja Nikam

Guide

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 Dr.(Miss) Shailaja Nikam, Professor & Head, Department of Audiology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier at any University for any other Diploma or Degree.

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Chapter I

INTRODUCTION

"Don't keep him waiting, child ! Why,
his time is worth a thousand pounds a minutet!
And don't twiddle your fingers all the time ...
Better say nothing at all.
Language is worth a thousand pounds a word!"

-Lewis Carroll

" Language is worth a thousand pounds a word" indeed. It is the core of intra- and inter-personal communication. It is through intra-rersonal communication that a man plans his actions. Inter-personal communication aids in carrying out these planned activities efficiently. The ability to communicate aids man in adjusting himself to his physical- and social- environments. Transmission of beliefs, attitudes and culture are mediated by communication. Planning for action and carrying it out are therefore, dependent on the efficiency of communication.

In any communication process, three important systems are involved viz., the sender, the transmitter and the receiver. In case of verbal communication, the talker is the sender of the message and the listener is the receiver. The effectiveness of communication is determined by each of these three systems.

Sender as a Variable:

The sender of a message contributes to the efficacy of the communication process. Factors such as the sender's dialect, his/her linguistic, cultural and educational backgrounds and intelligence bring about variations in the message sent. These normal variations with reference to the sender could either increase or decrease the efficiency of communication.

Another factor related to the sender which is considered abnormal and which tends to decrease the efficiency of communication, is defective speech. Speech disorders such as stuttering, voice disturbances or difficulties in the formulation of speech as in the case of aphasia,lesrning disabilities etc., could bring about a reduction in the efficiency of communication.

Transmitting System as a Variable:

Most often, speech sounds are propagated through air. It is probable that during the propagation of a given signal, other sounds may get added. These unwanted sounds, otherwise known as noise, interfere with the perception of speech (Hawley and Kryter 1957; Webster 1968; Lipscomb 1974). Conditions such as reverberant rooms also reduce the intelligibility of speech.

Auditory signals are sometimes transmitted through electro-acoustic systems. For the transmission to be good, circuit noise should be minimum, with little or no impedance mismatch between equipments employed.

Thus, the transmitting system should be free of any disturbance, in order for the sound to be propagated effectively.

Listener as a Variable:

Just as in the case of talker, listener's linguistic, cultural and educational backgrounds, intelligence affect the communication process. In addition, the listener's interests regarding the message, also determine how well the signal is perceived. Physiological states such as fatigue and sleep also bring about a reduction in the efficiency with which signals are perceived. Listeners who are aged (Goetzinger et al. 1961; Miller 1967) or those who have learning difficulties (Katz and Illmer 1972) also present problems in the perception of speech.

Pathological conditions of the auditory system at the receiving (cochlea), at the transmitting (auditory nerve pathway) or at the central processor (auditory cortex) also give rise to deficiency in the perception of auditory signals.

The Communication System and Clinical Audiology:

Identification and diagnosis of auditory disorders, is the aim of clinical audiological evaluation. In other words, a listener's ability to receive and perceive auditory stimuli are assessed. A clinical audiologist's main concern, therefore, is the listener and the variables related to him/her. Nevertheless, the variables related to the talker and the transmitting system cannot be ignored. While the transmitting system is an important variable, irrespective of the type of stimulus, the talker variables become important only if speech stimuli is used. Thus, the contributions of these two systems to the perception of auditory signals, depend upon the type of stimulus employed.

For the purposes of audiological assessment, two types of stimuli are employed viz., puretones and complex signals.

Pure tones:

Puretones are employed mainly to determine the hearing sensitivity, although they are sometimes employed in supra-threshold differential diagnostic tests such as ABLB and SISI. Albeit the valuable information puretones give regarding hearing sensitivity, they alone are inadequate in diagnosis and differential diagnosis of certain auditory disorders. This is because they do not require psychic integration or synthesization in order to be perceived (Willeford 1969).

Complex Signals:

Two kinds of complex signals are used for the purposes of audiological evaluation viz., noise and speech.

Noise:

Noise is seldom used as a primary stimulus, although narrow band noise is sometimes used to obtain thresholds (Orchik and Rintelmann 1978; Stephens and Rintelmann 1978). Noise is more often used in combination with other stimuli. It is used with puretones in masking, in tone-in-noise test (Pang-Ching 1970), masking level difference for tones(O1sen and Noffsinger 1976; Olsen, Noffsinger and Carhart 1976;

Quaranta and Cerevellara 1977). Tests such as Doerfler-Stewart test, masking level difference for speech (Bocca and Antonelli 1976; Findlay and Schuchman 1976; Olsen and Noffsinger 1976; Olsen, Noffsinger and Carhart 1976), SWAMI (Jerger 1964, cited in Berlin and Lowe 1972), employ Boise in combination with speech. A combination of speech and noise is also employed in the evaluation of noise induced hearing loss.

Speech:

Speech stimuli are indispensible in clinical audiological evaluation. They are normally used to supplement pure tone tesing. They aid in determining threshold of detectability, threshold of intelligibility, and speech discrimination score.

Speech stimuli are employed to cofirm the findings of puretone audiometry. A comparison of puretone thresholds and threshold of intelligibility, aids in the detection of functional hearing loss (Feldman 1967; Martin 1972; Williamson 1974).

Speech stimuli aid in detecting disturbances which may go unnoticed if puretones alone are used. Pathologies in the retocochlear region and higher auditory pathways may not result in loss iof hearing for puretones, despite significant difficulty in speech discrimination (Goetzinger 1972; Hodgson 1972). Tests for speech discrimination abilities can be used to obtain performance-intensity functions, which are useful in the diagnosis of VIII nerve lesions (Jerger and Jerger 1971; Jerger and Hayes 1977).

Speech materials are especially preferred in testing the functions of higher auditory centres, because they lend themselves to alterations such as filtering (Bocca and Calearo 1963; Willeford 1969; Hodgson 1972) and time-compression (Luterman, Welsh and Melrose 1966; Sticht and Gray 1960; Beasley, Schwimmer and Rintelmann 1972; Beasley, Forman and Rintelmann 1972; Berlin and Lowe 1972).

Directional audiometry, an important tool in the differential diagnosis of cochlear and retro-cochlear lesions, also employs speech material (Tonning 1971a). Speech materials are thus essential in clinical audiological evaluation.

In addition to their diagnostic utility, speech materials are also useful in choosing appropriate remedial procedures. They aid in the prediction of the outcome of surgical procedures (Kasden and Robinson 1969; Robinson and Kasden 1970). They are utilized in hearind aid evaluation (Davis 1960; Davis and Goldstein 1960; Silverman and Taylor 1960; Carhart 1967; Harford 1967; Duffy 1968; Tonning 1971b, 1972; Lentz 1972; Frank and Gooden 1974; Markides 1977; Orchik and Roddy 1980). Speech materials also contribute to the assessment of communicative ability (Davis 1960; Berger, Keating and Rose 1971).

It may thus beconcluded that, the use of speech materials is a must, for efficient diagnosis and for appropriate choice of remedial procedures. Of the different kinds of speech materials available, monosyllabic words are preferred to disyllabic words or sentences, because they are non-redundant, a property essential for any speech discrimination test (Carhart 1965).

Justification for the Use of English Speech Discrimination Test in India:

When one intends to use speech stimuli for the purpose of audiological evaluation, meaningful materials are preferred (Egan 1948; Carhart 1965). The same is true if one uses speech material for hearing aid evaluation or the assessment of social adequacy. When meaningful materials are chosen to test the speech discrimination ability of a subject, the language used for testing becomes an important variable (Alusi et al. 1974).

It is preferable to employ materials in the individual's native language, when his/her speech discrimination ability is to be assessed. This is because an individual's perception of speech is influenced by his first language or motbertongue (Weinrich 1954; Delattre 1964; Singh 1966; Singh and Black 1966; Gato 1971). This could be explained based on the fact that when an individual learns his native language, he not only learns to speak it but also learns to listen to speech in the same manner. To satisfy this condition, a number of attempts have been made at the construction of speech discrimination tests in different languages such as Arabic (Alusi et al. 1974), Spanish (Benitez and Speaks 1968) and Thai (Chermak and Phanjiphand 1977). Similarly, discrimination tests have been constructed in some of the Indian languages such as Hindi (Abrol 1970; De 1973), Kannada (Nagaraja 1973), Malayalam (Kapur 1971) and Tamil (Kapur 1971; Samuel 1976).

Although it is ideal to have speech discrimination tests in all languages, there are some practical difficulties in achieving this ideal. This is because, in India, there are fifteen languages (Times of India Directory and Yearbook 1979). Constructions of test in all languages would be time consuming, although the time taken is justified.

Another problem in the use of speech discrimination tests in Indian languages is that the tester should be well versed with all those languages in order to be able to score either oral or written responses of the subject. It could be very difficult to be conversant in all the languages that one's clients would possibly speak.

The use of regional languages in constructing speech discrimination tests, is also difficult because of variations in dialect. In India, there are as many as 1,652 dialects (Times of India Directory and Yearbook 1979). In addition, owing to the small number of speech and hearing centres one gets cases from various regions where different languages are in usage. Therefore, a test of regional language would also be of limited utility.

Until tests are devised in Indian languages, English could be used to test speech discrimination. A large population of Indiana know English, This is probably because English is being taught right from primary school education upto University level. In fact, English dailies have maximum circulation (Manorama Yearbook 1976), adding support to the assumption that a large population in India know and use English in their daily life. The choice of English would not be a problem from the point of view of the tester, since all training programmes in speech and hearing are in English medium.

Thus the facts that: (i) English is spoken by many people in India and therefore it is a common language to a large population in India ,(ii) all audiologists in India know English and (iii) the number of speech and hearing centres in India is small, justify the need for a speech discrimination test in English, for Indians.

Need for the Present Study:

Almost a decade ago, Swamalatha (1972) compiled lists in English for Indians. These lists have not been subjected to clinical studies. In addition, there were certain limitations in her study, which age discussed in detail in Chapter II, The NU Auditory Test No.6 was chosen for the study because of the following reasons:

1. The test has already been standardized elsewhere(Tillman and Carhart 1966; Rintelmann and his associates 1974) and therefore the time necessary to construct a test could be economized.

2. The clinical utility of the test has been demonstrated previously (Rintelmann and Schumaier 1974; Sanderson-Leepa and Rintelmann 1976; Orchik and Roddy 1980).

3. The NU Auditory Test No.6 has been used in studies on the perception of time-compressed speech in native speakers (Beasley, Schwimmer and Rintelmann 1972; Beasley, Forman and Rintelmann 1972) and in Indians (Nikam 1974; Sood 1981).

Thus evaluating the performance of normally hearing English speaking Indians would aid in extrapolating the results of previous studies. Since NU Auditory Test No.6 has already been standardized elsewhere, one may question the need for an attempt at the standardization. This, however, seems warranted, since studies have pointed out that an individual's perception of speech may vary depanding upon, if the language used is his native language or second language (Weinrich 1954; Singh 1966; Singh and Black 1966).

Throughout this report, the term "Indians" has been used with reference to people of Indian nationality who have lived in India since birth.

Summary and Statement of the problem:

Speech stimuli are essential in clinical audiological evaluation. Of the different kinds of speech stimuli available, NU Auditory Test No. 6 makes use of mono-syllabic words for testing speech discrimination. An individual's perception of speech material in a given language is likely to vary depending upon whether it is the subject's native language or second language. NU Auditory Test No. 6 has to be re-standardized on an Indian population, because, results obtained with native speakers/listeners of English cannot be applied directly to non-native speakers/listeners of English.

The study aimed at answering the following questions:

1. Does the discrimination score on NU Auditory Test No.6 vary with increase in sensation level?

2. Are the four lists of Form A equivalent?

Chapter II

REVIEW OF LITERATURE

Interest in the use of speech stimuli in hearing evaluation is not of a recent origin. Over a century ago, Wolf (1874, cited in O'Neill and Oyer 1966) pointed out that, speech stimuli could be used to evaluate the status of the auditory system. He constructed a table of intensity values for German sounds, where paces instead of decibels were used as the unit of intensity. The test material consisted of consonant syllables and words.

Although, the utility of speech stimuli in audiological evaluation was stressed by Wolf as early as in 1874, it failed to gain usage for clinical purposes. It however, became useful in another area namely, communication engineering.

Campbell (1920, cited in Berger 1978) used speech stimuli consisting of non-sense syllables for testing the efficiency of sound-transmitting systems. These non-sense syllables consisted of different consonants followed by the vowel /i/. Keeping the speaker and the listener constant, the listener's responses were obtained with different transmitting systems. The accuracy of responses, determined the efficiency with which the systems transmitted acoustic signals.

A modification of Campbell's procedure was suggested by Crandall and his associates (cited in Berger 1978).

Nonsense syllables were constructed by randomly combining consonants and vowels. Fifty such combinations constituted one list and 174 lists were thus derived. The test was called the Standard Articulation Test. However, no follow-up studies using these lists are available.

Harvard PB Lists:

The use of speech materials in routine audlological evaluation began as a result of the work done at the Psycho-Acoustic Laboratories (PAL) of the Harvard University (Egan 1948). In contrast to the experiments done in the area of communication engineering, in these experiments, the speaker and the transmitting system vere held constant, while different listeners served as subjects. The listener's responses to a list of syllables, words or sentences were obtained. It was assumed that the number of correct responses would be a quantitative measure of speech intelligibility. In addition, lists of words were also compiled for the purposes of determining speech discrimination scores.

The words chosen while constructing the lists had monosyllabic structure. Care was also taken to choose words in common usage. An attempt was made to incorporate all the speech sounds in the English language, in each list. The lists were constructed in such a way that the words had equal average difficulty and equal range of difficulty (Egan 1943). Twenty such lists, each containing fifty words were developed. These lists of words came to be known as Harvard PB lists or PB-50 lists.

Thus one finds that the Harvard PB lists included: (i) only monosyllabic words, (ii) all the sounds in the English language and (iii) words in common usage. The use of these constraints while constructing these lists may be explained as follows:

Three kinds of stimuli are available for speech discrimination testing viz., non-sense syllables, mono-syllabic words and sentences. Non-sense syllables have the dis-advantage of being unfamiliar to the listener. They are often abstract and are very confusing to the listener (Carhart 1965). They need special training to be read out in the intended way (Egan 1948). These disadvan-tages outweigh the advantages that they have viz., being independent of the listener's vocabulary (Berger 1978) and being non-redundant, a property essential for a test of speech discrimination (Carhart 1965). Also, it is easier to construct lists of comparable difficulty using non-sense syllables than by using meaningful material (Egan 1948).

Sentences, phrases and multi-syllabic words such as spondees, often contain too much of redundant infor-mation. Owing to this, they provide ample cues to the listener which enables him to correctly guess the correct response. By providing cues thus, these materials could obscure speech discrimination difficulties of a subject (Carhart 1965).

Choice of monosyllabic words for testing speech discrimination reduces the number of limitations posed by non-sense materials and sentences, phrases and multi-syllabic words. They are meaningful to the subject and non-redundant (Carhart 1965). They do not need special training to be read out (Egan 1948).

The second criterion that was stressed in the construction of Harvard PB lists was that the list should contain all the sounds of the English language. In addition, the frequency of occurrence of a given sound in the list had to be proportional to that in the spoken form of language. Such a proportional representation would make the list phonetically balanced.

While constructing the Harvard PB lists, no systemartic studies had been conducted to check if familiarity of the teat stimuli was a significant variable that could affect speech discrimination score. However, care was taken to choose words in common usage (Egan 1948), probably with the assumption that the two may be related. This notion, however, received support later (Rosenzweig and Postman 1957; Oyer and Doudna 1960; Schultz 1964).

Although the investigators at the PAL considered familiarity as being an important factor, the lists were found to contain many unfamiliar words (Hirsh et al. 1952). This led to the construction of other tests such as the PBK word lists (Haskins 1949) and CID W-22 word lists (Hirsh et al. 1952).

Haskins's PBK Word Lists:

Haskins (1949) selected 425 words out of 1000 words that appeared in the original PB-50 lists. Of these,200 words which had appeared in the International Kindergarten list, Horn's list of spoken vocabulary of children and Thorndike lists were chosen. These 200 words were then grouped into four equally long lists. Each of these lists were further divided into two lists of twenty-five words which were phonetically balanced. The lists were called the PBK word lists (where 'K' denotes Kindergarten). These lists have been used mainly with children (Goetzinger 1972). Since recorded versions of the lists are not commercially available, these lists can be administered only in monitored live voice testing.

CID W-22 Word Lists:

While Haskins's PBK lists were constructed with the aim of testing children, Hirsh et al. (1952) constructed PB word lists for use with adults. These lists were constructed with the aim of increasing average familiarity of words, in comparison with the Harvard PB lists. This was done with the aim of making the test suitable even for subjects with minimum education (Hirsh et al. 1952).

The words for the CID W-22 lists were chosen from Thorndike's tabulation of 20,000 familiar words. The words chosen were monosyllabic, like those in the Harvard PB-50 lists. The words so chosen were grouped into four lists of fifty words each. All the lists were phonetically balanced. The word order in the lists were randomized to get six scramblings of each list. Ira Hirsh was the talker (Hirah et al. 1952).

The test was standardized on a small group of fifteen subjects. It appears that the speech material was presented directly through an amplifier and a loudspeaker. The subjects were divided into three groups of five each. The first group of subjects listened to all the twenty-four lists at 100 dB (re 0.0002 microbar). Then they heard each of these lists at levels 10 dB apart ranging from 20 to 70 dB. Lists and levels were randomized. The only constraint applied while randomizing was that, no list would be heard at the same level by any subject. This did not rule out the possibility that the subject might have heard the same list at different levels consecutively, which could have led to practice effect.

The second group of subjects listened to the lists under the same condition as did group I. In addition, they heard the lists at one more level viz., 15 dB. The third group heard each word order at 50, 40, 30, 20 and 15 dB (re 0.0002 microbar). 100% correct responses were obtained at 50 dB itself and therefore the levels 60 and 70 dB were not used.

Hirsh et al. (1952) have not reported the mean scores obtained at the different levels for the four lists. The scores obtained can and should be derived only from the articulation curve reported by them. To demonstrate the significance of difference among lists and among levels, no statistical procedure seems to have been employed. The conclusions are based only on the articulation function. In addition, the equivalence of the scramblings of each list has not been stastistically validated.

The CID W-22 lists were found to be easier than the Harvard PB lists. The former gave high scores at a sensation level of 25 dB. To obtain the same scores, the Harvard lists had to be presented at about 40 dBSL (Carhart 1965). This difference has been attributed to the greater familiarity of the words and speaker intelligibility (Owens 1961) Goetzinger 1972).

However, the utility of W-22 lists has been questioned. In fact Hirsh et al. (1952) themselves pointed out that the preliminary experiments with the lists indicated, "...... W-22 does not satisfactorily separate patients with mixed deafness from patients with pure conductive deafness. The older recordings of Egan lists are effective in this respect." (p.335).

Berger (1978) opined that the W-22 lists had very few words which were of sufficient difficulty for any listener, except to those with very poor discrimination. Similarly, Goetzinger (1972) stated, " The W-22 words although highly familiar, are too easy for fine differential diagnosis."(p.167)

The dissatisfaction with the CID W-22 lists, stems from the fact that they are inadequate as a diagnostic tool in the casea of mild losses and progressive losses. Linden (1965, cited in Geffner and Danovan 1974) reported that in a case with slowly progressive hearing loss, with normal hearing at frequencies below 2000 Hz., discrimination score obtained using W-22 are not affected. In subjects with a loss of about 60 and 80 dBHL at 2000 Hz. and above, the intelligibility functions may appear similar to those in ears with mild loss. In ears with normal hearing or mild hearing loss, one may obtain maximum scores at 16 dB (re SRT) uaing W-22 lists (Geffner and Danovan 1974). W-22 lists may thus be inadequate in uncovering the discrimination problem, if the hearing loas is mild. It may, however, detect discrimination problems, if they are severe. Thus Geffner and Danovan (1974) concluded that there was a need for a more sensitive discrimination test.

While the CID W-22 lists were not useful in casea of mild hearing loss (Geffner and Danovan 1974), they were also found to be inefficient in uncovering the discrimination difficulties presented by cases with retrocochlear lesion (Johnson 1966). Twenty-five out of 163 patients were observed to have good discrimination despite a retrocochlear lesion. Ten out of theae twenty-five subjects could score 90% and above on the W-22 lists.

Based on the above reports, it may be concluded that there is a need for a more difficult test than the CID W-22 test.

It was noted earlier that the Harvard PB lists and the CID W-22 lists aimed at a perfect phonetic balance. However, there is no way of obtaining a true phonetic balance in a list of words. This is because of the large number of variations that can be made on each phoneme when in combination with other phonemes (Martin 1975).

Lehiste-Peterson CNC Lists:

A more realistic approach to the problem of phonetic balance was made by Lehiste and Peterson (1959). They attempted to obtain a phonemic balance rather than a phonetic balance. They selected 1263 monosyllables which had a CNC composition i.e., each word contained an initial consonant followed by a vowel or diphthong which was in turn followed by another consonant. Each word thus had a vowel-like nucleus. Lehiste and Peterson (1959) thus obtained a phonemic balance with respect to the phonemic composition of the 1263 words rather than to the composition of spoken English.

It is interesting to note that the Lehiste-Peterson lists and the Harvard PB lists gave comparable results (Carhart 1965), although they differed in terms of the criterion used for achieving phonetic balance and in terms of the criterion used for achieving phonetic balance and in the composition of words. In addition, Harvard PB lists consisted of CV as well as VC type of combinations, while the Lehiste and Peterson lists contain only CNC combinations.

Lehiste-Peterson CNC lists were originally constructed for research purposes. It was later revised by Peterson and Lehiste (1962) to eliminate unfamiliar words, literary words and proper nouns. The revised version had ten CNC lists with fifty words in each list. Despite their revision, the CNC lists were not put to clinical use.

NU Auditory Test No.4:

Tillman, Carhart and Wilber (1963) at the Northwestern University, compiled lists of fifty CNC words. These lists were said to conform " more perfectly " to the phonemic balance suggested by Lehiste and Peterson (1959). None of the original lists was retained in the same form. However, the words in the new lists, were chosen from the same set of 1263 CNC monosyllables. Two such lists were tape recorded by a male talker with General American dialect. These two lists constituted the NU Auditory Test No.4.

NU Auditory Test No.6:

In addition to the two lists of the NU Auditory TestNo. 4 two more lists of fifty words were compiled. The four lists together formed NU Auditory Test No.6 (Tillman and Carhart 1966). The NU Auditory Test No.6 consists of 185 words from the original CNC lists and fifteen from other sources. Each list has four scramblings of word order. Thus there are four forms A, B, C and D, of the NU Auditory Test No.6.

Detailed studies using NU Auditory Test No.6 were conducted by Rintelmann and his associates (1974). One of the experiments, conducted on normal hearing subjects showed that all four lists of Form A, were equivalent. The study also demonstrated that the inter-subject variability was higher at lower sensation levels (Rintelmann, Schumaier and jetty 1974). It was also noted that the original recording of the lists wag easier than that used by Rintelmann, Schumaier and Jetty (1974) although the talkers were reported to have a comparable dialect.

It was noted earlier that NU Auditory Test No.6 has four scramblings of each list. Rintelmann, Schumaier and Burchfield (1974) investigated if all these four were equivalent, when used with young normal hearing adults. The general trend of results was similar to that obtained using Form A alone (Rintelmann, Schumaier and Jetty 1974), indicating that all the four forms of the test were essentially equivalent. List I was the most difficult and list IV was the easiest. Lists II, III and IV were essentially equivalent.

Rintelmann and Schumaier (1974) compared the performance of normal subjects, young subjects with SN loss and subjects with presbycusis. Bach of these three groups had twenty four subjects in it. Lists I to IV of Form A were used. For all the three groups, list IV was the easiest and lists I, II and III were equivalent. This is slightly different from the results obtained by Rintelmann, Schumaier and Burchfield (1974) who found lists II, III and IV to be equivalent, although neither of these studies showed a clinically significant difference among lists. The scores of the young SN loss group was poorer than the normals', the scores of presbycusic group being the worst of the three groups, indicating phonemic regression (Rintelmann and Schumaier 1974).

On comparing the discrimination scores obtained by normal hearing and hearing impaired subjects using half-lists (both first and second halves) and full list, Schumaier and Rintelmann (1974) found that the difference was very small. Presbycusic subjects, however, are likely to give larger differences. Based on the good equivalency between the half-and the full-lists, the authors suggested that equating the tests based on familiarity could prove to be better than equating them based on phonemic balance.

Contradictory to the findings of Schumaier and Rintelmann (1974) were the results obtained by Jirsa

Hodgson and Goetzinger (1975) who found a poor correlation between the discrimination scores obtained using half list (first half) and the full list. They found that the half list reliability of CID W-22 list was better than that of the NU Auditory Test No.6 (List IA). These contradictory results need to be resolved by further studies.

Schumaier et al. (1974) compared the performance of two groups normal hearing subjects who represented two different dialects of English. Both the groups performed similarly on the NU 6. The order of difficulty of the lists from easy to difficult was, list IV, list II, list III and list I.

Most of the studies on NU 6 have been conducted on native speakers. It would be interesting to investigate the performance of English speaking Indians, on the NU Auditory Test No.6.

While the tests reviewed above require the subjects to choose their response from an open set, the following tests involve a closed response set.

Fairbanks's Rhyme Test:

It employs fifty sets of five rhyming words which vary only in terms of the initial consonant. Eighteen cosonants were incorporated in the test. The subject is required to report the word he has heard, by choosing one word from a set of five rhyming words (Fairbanks 1958).

Modified Rhyme Test:

The Modified Rhyme Teat was constructed by House et al. (1963). This test had six equivalent lists of fifty words each. The response had to be chosen from an ensemble of six rhyming words. This test, unlike Fairbanks's test, tested for discrimination of the sound in initial as well as in the final positions. The criterion for the selection of the words was not very stringent either in terms of familiarity or phonetic balance.

Kruel et al.(1968) attempted to adapt the modified rhyme test to the clinical population. They mixed the test items with noise and the composite signal was finally recorded. Three S/N ratios were chosen so as to give an average score of 96%, 83% and 75% in normal subjects. Although the test appears to be potentially useful for clinical purposes, more studies heed to be conducted to prove its efficiency, especially with the pathological groups.

When one employs words for the purposes of testing speech intelligibility or speech discrimination, certain factors such as the mode of presentation of the stimulus and the response mode,have to be considered.

While testing for speech discrimination, either live voice presentation or recorded presentation may be employed. Of the two, latter is preferred for the former. This is because of the variations that are observed from talker to talker in terms of pitch, articulation,accent etc. (Carhart 1965; Brandy 1966; Creston,Gillespie and Krohn 1966). One must refrain from comparing the discrimination scores obtained by two different talkers, until they have been demonstrated to be equivalent (Carhart 1965). This holds good even for recorded presentations (Carhart, Gillespie and Krohn 1966). Although two recorded versions can vary as much as two live-voice presentations do (Carhart 1965), the difference is kept constant in case of the former.

Irrespective of whether the material in a recorded version or through live voice, it is preferrable to use a carrier phrase. This is especially important when monosyllabic words are the test stimuli. The use of a carrier phrase helps in alerting the listener towards the task. It also aids the tester in monitoring his voice (Gladstone and Siegenthaler 1971).

Whenever the carrier phrase precedes the test word there is a probability of phonemic interaction between it and the test word which may alter the intelligibility of the test word. Considering this point,Gladstone and Siegenthaler (1971) compared three carrier phrases viz., "Say the word ... ", "You will say ... ", and "Point to the ... " . They also included a no-carrier phrase condition. Intelligibility scores were better with carrier phrase and the best with the phrase

"You will say ..." . This is possibly beacuse of the final vowel /ei/ which has greater probability of being influenced by the word that follows (Gladstone and Siegenthaler 1971).

In addition to the mode of presentation of the test words, the response mode also has an effect on the discrimination score obtained by a given subject. It is advantageous to take written responses, while testing speech discrimination, whenever possible. Written responses, unlike oral responses donot involve the tester's discrimination ability. In addition, one can have a permanent record of responses that aid in future analysis. Written responses have yet another advantage i.e., they avoid bias on the part of the tester. When oral responses are obtained, the tester is likely to hear the correct response rather than an incorrect response, especially in conditions when the response sounds questionable (Lovrinlc,Burgi and Curry 1968).

KSU Test:

Yet another test emplying monosyllabic words, but embedded in sentences is the Kent State University (KSU) Test of speech discrimination (Berger 1969). The test consists of 150 sentences. Each sentence contains a key word which is so chosen that four other words could also be used in its place, retaining the meaningfulness of the sentence. The subject has to choose one of these five sentences, which he thinks he has heard. The test has eight equal forms with thirteen sentences in each form which are arranged in an order of progressive difficulty (Berger 1969).

Berger, Keating and Rose (1971) observed that the KSU test was less sensitive to hearing impairment, when compared to W-22 lists. However, this test was better than W-22, in predicting how efficiently one could use his hearing for communication purposes.

The tests of speech discrimination that use monosyllabic words have one inherent disadvantage, i.e., they do not consider the changing pattern of speech over time. Tests which do not employ a closed message set (i.e., those other than Fairbanks's Rhyme Test and Modified Rhyme Test), have an additional disadvantage of eliciting response from an open and undefined set of all the words in the subject's response repertoire.

Synthetic Sentence Identification:

The use of synthetic sentences to assess the discrimination ability was suggested, in order to overcome the disadvantages of the monosyllabic tests (Speaks and Jerger 1965; Jerger, Speaks and Trammell 1968). These sentences are artificially constructed from a set of 1000 familiar words. They simulate the "real" sentences in that they are long enough to retain the temporal characterstics of speech. At the same time they have an advantage of being non-redundant unlike "real"sentences.

The SSI test material is often presented with competing speech of the same talker who has recorded the material. The message-to-competition ratio (MCR) used for clinical purposes is 0 dB.

Jerger, Speaks and Trammell (1968) opined that a closed message set sufficiently controls the effect of linguistic background on the subject's ability to identify the synthetic sentences. They had also speculated that the response obtained was not dependent on key word or phrase recognition. Garstecki and Wilkin (1976), however, found that the results were dependent on key word or phrase recognition. They observed that bilingual subjects had greater difficulty in identifying the Spanish synthetic sentences.

In a study on sixty subjects hearing loss, it was noted that SSI-MCR and the PAL PB lists gave equivalent results when the audiometric configuration was flat (Speaks, Jerger and Trammell (1970). As the slope of the audiometric contour increased, the PB performance worsened while the performance on SSI-MCR remained the same. Based on this, Speaks, Jerger and Trammell (1970) concluded to high frequency sensitivity. Thus despite the advent of the SSI test, monosyllabic tests still seem to have diagnostic utility.

Speech Discrimination Tests Standardized in India:

Attempts have teen made to construct speech discrimination tests in some of the Indian languages. PB word lists are available to test speech discrimination in Hindi (De 1973) and Tamil (Samuel 1976). Synthetic sentences have been constructed in Kannada by Nagaraja (1973). However, these tests can be used only with subjects who speak the respective languages. In addition, there is no information regarding the utility of these tests with subjects who speak different dialects of theae languages.

The problem of testing speech discrimination in Indians may be reduced to some extent by using English word lists. This is possible, because quite a large population of Indians speak English.

Swarnalatha (1972) attempted at the standardization of speechmaterials in English for Indian subjects. She obtained familiarity ratings for 200 words from the Harvard PB lists and 200 words from the W-22 lists. The words were rated as "familiar", "not so familiar" and " not familiar". Two lists of words were compiled,each having words of equal familiarity. Each list had only twenty-five words. Both the lists were phonetically balanced.

The lists compiled using the above procedure were standardized on normal hearing young adults. The subjects were instructed to respond orally. The tester bias in scoring has not been controlled. Since each list consisted of twenty-five words, each word was given a weightage of 4% . Therefore, each error was penalized twice as much as it would have been, if the list had contained fifty words. Another problem with the test is that it has only two lists with one form each (i.e., no scramblings are available). When one is interested in determining the performance-intensity functions, the same lists have to be used repeatedly, which could bring in practice-effect. In addition, list equlvalency has not been statistically established. Yet another practical difficulty with the use of the test is the non-availability of recorded version of the lists.

Another attempt was made by Mayadevi (1974) to construct a speech discrimination test that could be used with the speakers of all Indian languages. She chose a set of twenty consonants which occurred in most of the Indian languages. The consonants were selected from phonetic readers written by linguists. Each consonant was followed by a vowel /a/. Thus all the items had a CV combination. Each test item was preceded by a carrier phrase in Kannada. Data was obtained from normal as well as hearing impaired subjects. Oral responses were considered for the purpose of data collection, as she found no difference between oral and written responses. Six scramblings of the same list was presented at six different levels (at 10 dB steps) to each subject. The equivalency of the six scramblings was not established statistically.

This test cannot be accepted as it is, because of certain drawbacks in the methodology. While the consonants were obviously selected from spoken form, in case of Coorgi, Tulu and Konkani (as they do not have scripts), it is not clear whether the consonants listed in the phonetic readers were selected from spoken or from written materials or from both.

The consonants for the lists, were chosen only based on commonality. By doing so, those consonants which might have been important for a given language might have been omitted. Also, the distributional aspect of the sounds in various languages has not been taken into consideration. In addition, it has been assumed that the consonants chosen, occur in the language in the same form as they do in the list. But this is not true. For eg. in Marathi, the sound /t / occurs as its allophone /ts/ and not as /t / itself. There is a high probability that this sound might not be discriminated as /t / by subjects who know only Marathi. Thus it is probable that the subject may give the response as /ts/, which may be scored as being wrong. Similarly, a response of /b/ for /v/ or /v/ for /b/ given by a Bengali or an Oriyan subject is likely to be scored wrong by the examiner, if he does not consider the subject's language background. Even if he did, and scored it as being correct, it could be erroneous. This is because a response of /b/ for /v/ or /v/ for /b/ could either be indicative of a discrimination problem or of the influence of native language on discrimination and there is no way to differentiate the two.

It is clear if the test would give any variation in the results if the carrier phrase was in the native language of the subject.

Added to all these, the material is not meaningful and tests only recognition and not discrimination. Since it is followed only by /a/, co-articulation effects of other sounds on discrimination cannot be assessed. When phonemes are in isolation, they have no meaning and therefore they donot possess the property of intelligibity(Lehiste and Peterson 1959).

The review of literature points out that, there is a need for a test that can be employed with most Indians. A test similar to that constructed by Mayadevi(1974) does not seem to meet the criteria that a discrimination test should satisfy. The two English lists compiled by Swarnalatha (1972) also seems to be inadequate clinically especially when articulation function has to be established. Thus it seems preferable to try other English discrimination tests on Indians, and to see if they are useful. Since the CID W-22 lists have met with many criticisms, it seems justified to attempt at the standardization of ether tests such aa the NU Auditory Test No.6. Such a test would aid in extrapolating the results of studies conducted in the area of time-compressed speech, as most of these studies in this area have used lists from NU Auditory Test No.6.

Chapter III

METHODOLOGY

The present study aimed at determining the performance of English speaking Indians on the NU Auditory Test No.6. The methodology was planned in such a way as to check if the four of NU 6 were similar and to obtain the articulation function for each of these lists.

Test Material:

The test materials used in this study will be discussed under two heads, viz., English tests and the speech material.

English Tests:

Two English tests were used in order to test the proficiency of the subjects in English.

One of the tests was, " A Test of English Ability" constructed at the Central Institute of English and Foreign Languages, Hyderabad, India. This test was constructed in 1980 based on the SSC syllabus. It was used on under-graduate and post-graduate students and was found useful (Mathew 1981)[see Appendix I] . The test did not have any scoring system, nor did it have any cut-off point to decide if a subject passed or failed. Therefore, an arbitrary scoring system was decided upon, with each item having a credit of 1 point and more difficult items having a credit of 1½ points. The total score was 100 points. A cut-off of 50 points was arbitrarily chosen i.e., only subjects scoring 50 points or more were included in the study.

In addition to the above test, the subjects were also given a vocabulary test, " A Test of Vocabulary Range" (Lewis 1978). This test contains sixty multiple choice items (see Appendix II). Each correct answer gets a score of 1 on this test. A score within twelve to thirty-five falls in the average range of vocabulary (Lewis 1978). Thus the subjects had to score twelve or more to be selected for the study.

Speech Material:

Two kinds of speech material were used viz., spondees and CMC monosyllables.

All the spondees used were from CID W-l (List A). These spondees were used for the purposes of obtaining the Speech Reception Threshold (see Appendix III).

The CNC monosyllables constitute the material used for standardization. The four lists of the Form 'A' of NU Auditory Test No.6 (Appendix TV), were used for this purpose. These lists as well as the spondees were tape recorded.

Recording Procedure:

The test stimuli were recorded in a quiet room, using a tape recorder (Philips Pro' 12) with a stereo microphone (Philips LBB 9050/05). The noise levels in the room were low enough not to interfere with the recording. All the recordings were made on magnetic tapes at a speed of 7½ i.p.s. (19 cms. p.s.).

The recording was made by an young adult male talker with a fundamental frequency of about 125 Hz.. He spoke for over 10 years and his speech was considered as being representative of Indian English.

The spondees were recorded with a carrier phrase "You will say......". The level of the carrier phrase was maintained to peak at 0, while the spondee was allowed to follow in a natural manner. Between successive spondees, a 5 seconds silent interval was given to allow the subject to give a normal response.

The monosyllabic words were also recorded in a similar way. The earrier phrase " You will say.......", was monitored to peak at 0. The words were spoken naturally, but with equal effort. Between successive words a silent interval of 8 seconds was given. The interval was increased to 8 seconds in case of monosyllables in order to allow written responses.

The tape was then played on a stereo tape recorder (Sonnett ST 480). Its output was given to a level Recorder (B and K type 2305). The level of all the words of all the lists were recorded on the level recorder. Peak average was found out separately for each list. A 1000 Hz. tone was then recorded from a Beat Frequency Oscillator (B and K type 1022) at the beginning of each list. Thelevel of the 1000 Hz. tone was at the level of the peak average. The maximum deviation of any given peak with respect to the

1000 Hz. tone was within ± 0.5 dB for lists I, III and IV. It was within ± 1.0 dB for list II.

Instrumentation:

The instruments used for the collection of data were a two channel clinical audiometer (Madsen OB 70) and a stereo tape recorder (Sonnett ST 480). The output of the tape recorder was fed into the tape input of the audiometer. The output of the audiometer was given to TDH 39 earphones with MX - 41/AR ear cushions. The audiometer was calibrated to ANSI (1969) specifications. The calibration procedure is described in Appendix V. The frequency response characteristics of the earphones used in the investigation are depicted in Appendix VI. Objective calibration was done once before the data collection began and once during the period of data collection. In addition, biological calibration was done every day before beginning data collection.

Test Environment:

All the measurements were done in a sound treated, two - room condition. The noise levels in the test room were measured with a Sound Level Meter (B and K type 2209) with a condensor microphone (B and K type 4165). The noise levels were within permissible limits (Appendix VII).

Subjects:

Forty subjects (twenty-seven females and thirteen males) in the age range of 17 years to 24 years served as subjects. The median age of the subjects vas 21 years 4 months. The subjects were either undergraduate or graduate students of the University of Mysore. The criteria for selection of subjecta was as follows:

(i) The subjects should have had English as the medium of instruction at least for five years.

(ii) He/she should pass the two English tests.

(iii) He/she should have an air conduction threshold of less than or equal to 20 dB at frequencies 250 to 8000 Hz. (ANSI 1969) in both ears.

(iv) He/she should have a negative history of ear diseases and head injury.

The subjects included in this study represented fourteen languages spoken in India. Of them twenty-nine subjects spoke languages of the Dravidian family, while the rest eleven represented languages of the Indo-Aryan group.

Test Procedure:

First of all the air conduction thresholds of both ears were obtained using the modified Hughson - Westlake procedure (Carhart and Jerger 1959). Following this, the speech reception threshold of the test ear (chosen randomly) was determined with (CID W-l list, using a procedure similar to that employed by Rintelmann and his associates (1974).

SRT Test Procedure:

The subject was first familiarized with the entire list. Familiarization was carried out by reading the list to the subject in a face-face situation. The subject was instructed as follows:

" You will hear a man's voice saying the words greyhound, schoolboy,....... (and the entire list was read to the subject). Before each word you will hear the phrase " You will say......". You have to repeat the word that follows this phrase. If you are not sure of the word try to guess. Do you have any questions? ".

To determine the SRT, two spondees were first presented at 30 dBHL. If both words were repeated correctly, the intensity was decreased in 10 dB steps. At each level two spondees were presented. This procedure was continued until the subject failed to repeat both the words. Then the intensity was increased by 8 dB. If the two spondees were repeated correctly at this level, the level was decreased in 2 dB steps and two spondees were presented at each level. The descent continued till the subject missed five out of six words. The lowest level at which the subject repeated both words correctly minus 1 dB for those words repeated correctly from then on, was taken as the speech reception threshold.

Speech Discrimination Test Procedure:

Speech discrimination was tested using the four CNC word lists of NU Auditory Test No.6 Form A. Five presentation levels viz., 8, 16, 24, 32 and 40 dB above SRT were employed. All the four lists were heard by all the subjects, but at different sensation levels. The list and sensation level combinations were worked out using a random number table. The criteria used for assigning the levels to different subjects were: (i) no list would be presented more than once to any subject and (ii) no level will be repeated for any subject. Thus the forty subjects heard different list and level combinations. Eight subjects heard the same list at the same sensation level. In addition, equal representation was given for the two ears. Out of eight subjects at a given list-level combination, four heard the lists in the right ear and four in the left ear. Thus, right ear was the test ear for twenty subjects (thirteen females and seven males) and left ear for the remaining twenty subjects (fourteen females and six males). The test ear for a given subject was chosen randomly and only one ear was tested for a given subject.

The subject was provided with four response sheets on which he/she had to write down the response (Appendix VIII). The subject was then instructed as follows:

> " You will now hear four lists of words. Some lists will be louder than the others. In each list there are fifty words. Before each word you will hear the phrase 'You will say......'. Concentrate on the word that follows it and write on the word that follows it and write it down against the serial numbers printed on the sheet. If you are doubtful of the word, try to guess it and

write. If you feel you are unable to guess, leave a blank against the number and go on to the next. Do you have any questions?"

The lists were presented at the previously assigned levels. The order of presentation of list was also randomized. All the four lists were presented in a single session. While presenting the spondees as well as the CNC word units, the tape recorder gain was adjusted so as to peak the 1000 Hz. tone at VU '0', on the audiometer.

Scoring:

The data sheets were scored manually on a "right" or "wrong" basis. Each correct response was given a credit of 2%. Total percentage of correct responses at each level was computed for each list.

The scores obtained were analyzed using statistical procedures. The details regarding these procedures and the results obtained are discussed in the next chapter.

Chapter IV

RESULTS

The data collected were analyzed so as to obtain the mean and median scores for each list at each level. The dispersion of the scores were also determined by computing standards deviation. These three measures viz., mean, median and standard deviation were computed for all the four lists separately. Their values are as given in Table I.

Effect of Level:

From Table I, it may be noted that, in general, discrimination scores decreased with increase in sensation level. Variability in the scores decreased with increase in sensation level, in case of lists III and TV. The reduction in variability with increase in sensation level was also observed in case of list II, with the exception of one level viz., 24 dBSL(re SRT). List I, however, failed to show a consistent reduction in variability with increase in sensation level.

Articulation Function:

Articulation functions for the four lists are shown in Figure I. It may be noted from these articulation functions that, the discrimination score increased with increase in sensation level. However, none of the lists show a plateau in their function, indicating that the scores may improve at higher sensation levels.

The slopes of the articulation function are 2.22%/dB

SL (dB re SRT)	List I			Liat II			List III			List IV		
	Mean	Mdn.	S.D.	Mean	Mdn.	S.D.	Mean	Mdn.	S.D.	Mean	Mdn.	S.D.
8	17.00	19	10.04	38.25	28	19.45	42.50	43	20.76	34.50	40	19.84
16	34.75	29	17.19	30.75	34	14.35	46.00	41	20.73	58.25	64	17.76
24	58.00	56	21.88	62.00	68	19.62	68.25	74	17.29	85.25	88	10.18
32	69.50	71	12.78	67.50	71	12.12	85.50	87	6.78	88.50	89	5.45
40	86.75	90	10.47	88.25	89	4.29	88.00	88	2.44	88.50	90	5.63

Table 1. Mean, Median,and Standard deviation (S.D.) of discrimination scores on the four lists of NU Auditory Test No.6 at five SLs.

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F-Ratio	
Column (List)	7999.00	3	2666.33	9.48	significant at 0.01 level
Row (Level)	73540.15	4	18385.03	65.37	significant at 0.01 level
Interaction (List x Level)	4053.25	12	337.77	1.2	not significant
Error	39374.00	140	281.24		
Total	124966.40	159			

Table 2. Results of Two-way Analysis of Variance for the main effects of lists, levels and their interaction .

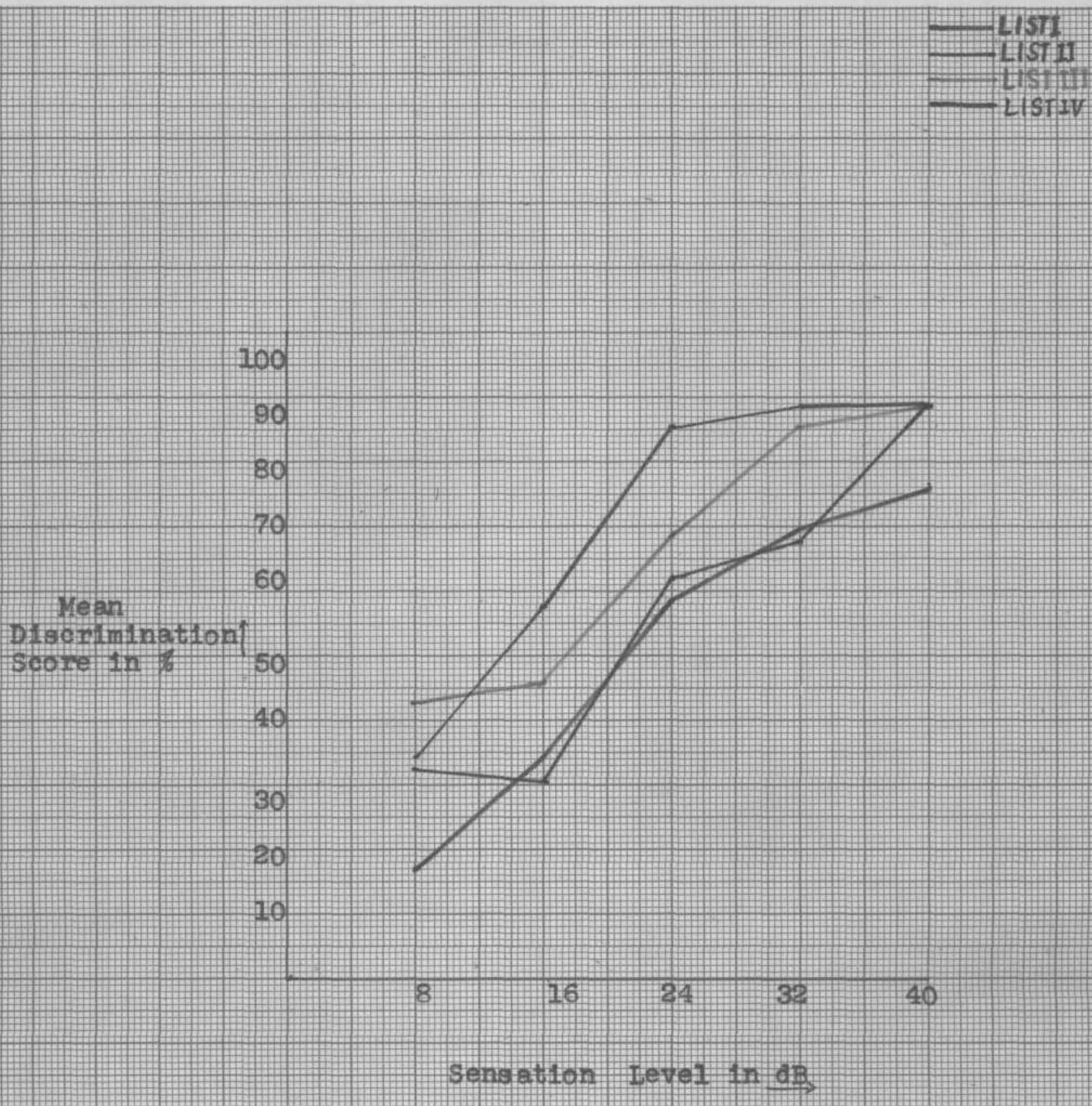

Figure 1. Articulation function for lists I, II, III and IV

(list I), 0-45%/dB (list III) and 2.94%/dB (list IV), between 8 and 16 dBSL. The performance at the same level showed a decrease for list II, with a reduction of 0.15%/dB.

In addition to the measures of central tendency and of variability, two-way Analysis of Variance(ANOVA) [Scheffe 1959] was also computed. Results of the two-way ANOVA are given in Table II. Differences among the sensation levels were significant at 0.01% level.

Inter-list Difference:

Differences among the lists were significant at 0.01 level (see Table II). Interaction between list and sensation level, however, was not significant.

Scores on the English Tests:

The scores on the "Test of Vocabulary Range" varied from 12(20%) to 48(80%) with a mean score of 27.82 (46.36%).

On the "Test of English Ability" the scores ranged from 50% to 95% with a mean score of 79.5% . The wide difference between the mean scores of the two tests could be attributed to the difficult nature of the vocabulary test.

The results obtained in this study are discussed in the following chapter.

Chapter V

DISCUSSION

The results obtained in the present study may be considered along two lines viz., effect of sensation level and difference among the four lists of the NU Auditory Test No.6 Form A.

Effect of Sensation Level:

The effect of sensation level on the mean performance is graphically depicted to give the articulation function (figure 1).

Articulation Function:

The articulation functions for the four lists, show that the discrimination score increases with increase in sensation level. They fail to show a plateau, indicating that there is a probability that the scores may improve further at higher sensation levels.

The slope of the articulation functions (between 8 and 16 dBSL) for the four lists is as follows:

2.2%/dB (list I), -0.18%/dB (list II), 0.43%/dB (list III) and 2.9%/dB (list IV).

When slopes are calculated for the articulation functions obtained by Rintelmann, Schumaier and Jetty (1974), in the same region (8 to 16 dBSL), the values are 3.75%/dB (list I), 2.9%/dB (list II), 3%/dB (list III) and 2.95%/dB (list IV). These values are slightly higher than those obtained in the present study. This implies that the articulation function obtained in the present study has a more gradual slope than that obtained by Rintelmann, Schumaier and Jetty (1974).

Effect of Sensation Level on the Mean Scores and Variability:

It may be noted from Table I that the discrimination scores improve with an increase in sensation level. Conversely, variability decreased with increase in sensation level. These findings are in agreement with those of Rintelmann, Schumaier and Jetty (1974). However, the mean and median scores obtained at any sensation level in the present study, is consistently lower than those obtained by Rintelmann, Schumaler and Jetty (1974). In addition, variability in the scores is also consistently higher in the present study. A comparison of the results obtained in the study by Rintelmann, Schumaier and Jetty's (1974) is given in Table III.

Greater variability in the scores obtained in the present study could be attributed to the difference in the number of subjects employed in two studies. The number of subjects in this study was forty, with eight people listening to each list at each level, while Rintelmann, Schumaler and Jetty (1974) had tested ten subjects on the whole. It is reasonable to expect the variability to increase with increase in the number of subjects. However, in a similar study (Rintelmann, Schumaier and Burchfield 1974) with a different group of subjects, the variability was no different from that

Level (in dB above SRT)		List I			List II			List III			List IV		
		Mean	Mdn.	S.D	Mean	Mdn.	S.D.	Mean	Mdn.	S.D	Mean	Mdn.	S.D.
8	P.S.	17.00	19	10.04	32.25	28	19.45	42.50	43	20.76	34.50	40	19.84
	R.S.J.	51.40	50	7.60	58.60	60	9.50	52.80	52	6.80	60.80	59	10.30
16	P.S.	34.75	29	17.19	30.75	34	14.35	46.00	41	20.73	58.25	64	17.76
	R.S.J.	80.00	83	7.30	81.800	81	8.30	76.80	77	8.75	84.40	86	5.00
24	P.S.	58.00	56	21.88	62.00	68	19.62	68.25	74	17.29	85.25	88	10.78
	R.S.J.	92.20	93	3.50	93.00	94	4.100	87.40	85	4.60	92.00	91	3.70
32	P.S.	69.50	71	12.78	88.25	89	4.29	85.5	87	6.78	88.50	89	5.63
	R.S.J.	96.800	98	2.90	97.40	98	2.80	97.4	98	1.30	98.00	98	2.20

Table 3: A comparison of the mean, median and standard deviation obtained in the present study and in the study of Rintelmann, Schumaier and Jetty (1974)

(Note: P.S. - Present Study

R.S.J. - Rintelmann, Schumaier and Jetty (1974)) observed by Rintelmann, Schumaier and Jetty (1974). This suggests that the greater variability in the present study is not because of the greater number of subjects.

In addition to the difference in terms of mean scores and variability, the results of the two studies also differed with reference to the relative difficulty of the four lists.

Inter-List Difference:

The results of the present study, like those of the previous studies (Rintelmann, Schumaier and Burchfield 1974; Schumaier, Penley and Rintelmann 1974) point out that list TV is the easiest among the four lists, while list I was the most difficult. The order of difficulty of the lists, from easy to difficult, are list IV, list III, list II and list I. While the earlier investigators (Rintelmann, Schumaier and Burchfield 1974; Schumaier, Penley and Rintelmann 1974) found that the difference among the lists was not significant statistically, in the present study the difference was observed to be statistically significant.

Although, the difference among the lists was found to be significant in the present study, it may be observed that the difference collapses with increase in sensation level. This may be because of the greater probability of the difficult words being guessed correctly at higher sensation levels. These observations suggest that familiarity with the test word is possibly playing a role in determining the discrimination score.

The difference in the results of the present study and of the previous studies on the NU Auditory Test No.6 (Rintelmann, Schumaier and Burchfield 1974; Schumaier, penley and Rintelmann 1974) may be explained in the light of results obtained by studies on the effect of familiarity on speech discrimination, the effect of frequency of occurence of words on discrimination and based on cross-language studies on speech perception.

Effect of Familiarity On Speech Discrimination

A number of investigators (Oyer and Doudna 1960; Owens 1961; Schultz 1964) have pointed out that speech discrimination score is affected by familiarity with the speech stimuli employed. As Owens (1961) has suggested, lists characterized even by slightly greater familiarity could prove to be significantly more intelligible.

Oyer and Doudna (1960) analyzed the incorrect responses made by 400 hearing impaired subjects. They found that the words in the highly familiar category constituted the majority of response choice for erroneously identified stimulus words. A superficial examination of the responses obtained in the present study indicated that the erroneous responses obtained in this study also follow a similar pattern or trend as indicated by Oyer and Doudna

(1960). However, detailed analysis needs to be done before any conclusions are drawn.

The differences in the results obtained in the present study and that reported by previous investigators, may thus be attributed to the difference in the familiarity with the words in each of the lists. The same holds good for the list difference also. However, it seems preferable to employ a test with slightly lower familiarity than to use one with highly familiar items, as a test of the latter kind is likely to result in spuriously high discrimination scores (Schultz 1964).

Frequency of Usage of Words:

Another factor related to speech intelligibility and to familiarity, that has possibly played a role in decreasing the mean score, is the frequency of usage of the words. Studies by Rosenzweig and Postman (1957) and Savin (1963) have demonstrated that frequency of usage of word is an important determinant of speech intelligibility (Savin 1963). When a word is heard incorrectly, the response given is chosen from a repertoire of words that occur more commonly and most subjects used the same word in place of their erroneous response (Rosenzweig and Postman, 1957; Savin 1963). The fact that discrimination scores in the present study, increased with level could be attributed partly to Savin's (1963) observation that the threshold of intelligibility increases as the frequency of usage decreases.

Talker Difference:

The differences in the results obtained in the present study and those of Rintelmann, Schumaier and Jetty (1974) and Schumaier, penley and Rintelmann (1974) could also be attributed to the talker difference. Kruel, Bell and Nixon (1969) pointed out that test difficulty could change significantly with changes in the talker. In fact, Hood and Poole (1980) have reported," ...... the characteristics of any recorded word articulation material are determined predominantly by the speaker and the recording technique adopted and are largely independent of other factors." (p.434) and by " other factors" they refer to phonetic construction, Word familiarity and word environment.

Thus, the poorer scores obtained by the subjects of the present study can also be attributed either to the lower familiarity of test words or to the talker difference or to their combined effect. However, either of them considered alone does not seem to be the explanation.

Nikam (1974) and Sood (1981) employed the NU Auditory Test No.6 (Form B) to evaluate the perception of time-compressed speech, by Indian subjects. While Nikam's (1974) study was conducted with English speaking Indians living in the U.S. as subjects, Sood (1981) employed English speaking Indian subjects living in India itself. Both these studies used the tapes recorded by William F. Rintelmann who was also the talker for tapes used by

Rintelmann, Schumaier and Jetty (1974), Schumair, Penley Rintelmann (1974). The present study employed a talker who was considered representative of English as spoken in India. The results obtained in the three studies are similar in that, the scores obtained by Indian subjects is lower than those obtained by the subjects employed by Rintelmann, Schumaier and Jetty (1974).

Thus, Indian subjects as a group, score poorer than do the American subjects. This indicates that familiarity has played an important role in determining the discrimination scores.

The subjects of the present study performed poorer than the subjects in Nikam's (1974) and Sood's (1981) study, at lower sensation levels, although at higher sensation levels they were essentially equivalent. This is possibly due to talker difference. However, no conclusive statements can be made regarding the effect of talker difference on discrimination scores in these studies. This is because these two studies employed fewer subjects than did the present study, as the primary purpose of these studies was different.

The findings of the present study contradicts Hood and Poole's (1980) contention that talker difference is more important than familiarity.

The results of the present study also point out that, standardization of a given test done elsewhere,does not ensure that the same norm holds good for all populations, especially when language is an important variable. This notion is supported by cross-language studies on speech perception.

Cross-Language Studies:

The above discussion points out that English speaking Indian subjects as a group, perform poorer than do the native speakers of English (when the speech material employed is in English). This is not only true of Indian subjects, but is also true of Spanish-3peaking subjects. The results obtained by Nikam (1974) with Mexican-American subjects, point out that the mean score obtained by these subjects were lower, than those obtained by Rintelmann, Schumaier and Jetty (1974). Although these subjects had lived in the U.S. itself, their scores were poorer than those obtained by Rintelmann, Schumaier and Jetty (1974). This suggests that exposure to a given language alone does not ensure that speech processing (in that language) is similar to that of native speakers.

In addition, for the Mexican-American subjects, the order of difficulty of the lists was also different. For them, list I was the easiest and list III, the most difficult.

Similarly, Garstecki and Wilkin (1976) also observed that bilingual subjects (who were native speakers of Spanish), performed poorer than monolingual subjects(native speakers of English) on synthetic sentence identification in English. They concluded that even a closed message set does not sufficiently control the variables associated with the linguistic background.

The above observations suggest that the ease and efficiency with which a given list of words (or any speech material) depends upon the language background of the subject. This contention is supported by the studies of Sapon and Carroll (1957), Singh (1966) and Singh and Black (1966).

Sapon and Carroll (1957) investigated the perception of speech sounds in three groups of monolingual subjects. They represented three mothertongues viz., English, Japanese and Spanish. The stimuli were combinations of vowel plus consonant plus stress patterns. Seven seconds after the presentation of the stimulus word, four words were presented. Of these, one was the stimulus word itself, while the other three varied from it in terms of a phoneme or allophone. The subject had to indicate which of the four words was the key word.

The responses were analysed in terms of distinctive features. They concluded that, (i) the three groups were significantly different in terms of the perception and discrimination of given sounds; (ii) the language of the listener decides/influences the probability of a sound being perceived in a given environment; and (iii) whenever error responses are analyzed it may be noted that the direction and magnitude of many of these erros are systematically related to the language spoken by the listeners. Given the stimulus sound and the language of the listener, one could predict the direction and magnitude of the error (Sapon and Carroll 1957).

In a study using a different methodology,Singh (1966) also observed that the subjects' mothertongue influences their perceptions of speech sounds. He examined the perceptual confusions of plosive phonemes under two conditions of distortions viz., temporal segmentation and filtering. Two groups of subjects - a group of native speakers of English and a group of native speakers of Hindi - were tested. There was a disagreement between the two groups in terms of recognition of voicing. In addition, native speakers of English responded erroneously more often than Hindi speakers on the feature of aspiration. These results indicated that there were differences in the perception of two groups of subjects.

In a similar study Singh and Black (1966) observed that the subjects' mothertongue affected perception of speech sounds. The subjects represented four language groups viz., Arabic, English, Hindi and Japanese. The interaction between the consonants and listeners was found to be significant.

'The effect of one's native language on the perception of a second language could be explained based on Weinrich's (1954) concept of interference. According to him, one language may interfere with another at different levels, such as phonic, grammatical and lexical levels. At the phonic level which is the point of discussion here, interference could result in under-or over-differentiation. The former occurs in the absence of corresponding distinction in the primary language. An example for this would be the lack of phonemic distinction between /v/ and /w/ in most Indian languages and the consequent absence of this distinction in Indian English. Over-differentiation occurs when the primary language makes a distinction between two sounds which is absent in the second language. Thus an individual's first language could affect his perception of a second language.

In the light of the above discussion it may be concluded that the differences in the results obtained in the present study when compared to those of Rintelmann, Schumaier and Jetty (1974) and Schumaier, Penley and Rintelmann (1974) could be attributed mainly to two factors: (i) for the subjects of the present study, English was second language, and (ii) some of the words in the lists were possibly less familiar to them than to the native speakers.

If the test had contained highly familiar words (eg; the lists compiled by-Swarnalatha 1972) the subjects would have possibly performed well enough to obtain maximum scores. However, as was noted earlier a test with highly familiar words is likely to prove less efficient for clinical purposes and may meet with the criticisms levelled against CID W-22. The differences in the results of the present study and that of Swarnalatha's (1978) could also be attributed to the difference in methodology.

The observation that subjects with English as their second language are likely to perform poorer than the native speakers does not imply that these tests should not be used with Indians. It only suggests that the test results obtained with native speakers should not be directly applied for English speaking Indian subjects. The same pre-caution should be taken if one attempts at standardizing a test in Hindi or any other Indian language common to most people in India.

Clinical Implications:

The results of the present study suggest that, the NU Auditory Test No.6 is highly sensitive to the variability in speech discrimination ability across individuals. If this were true with subjects with normal hearing, one could expect it to be an efficient tool for diagnostic purposes. Studies to evaluate the diagnostic efficiency of the test are therefore indicated.

Chapter VI

SUMMARY AND CONCLUSIONS

The present study aimed at evaluating the applicability of NU Auditory Test No.6 for English speaking Indians. The four lists of Form A of the test were recorded on magnetic tapes. They were presented through the tape input of a clinical audiometer (Madsen 0B70), at five levels viz., 8, 16, 24, 32 and 40 dBSL (re SRT).

Forty young adults (age range 17 years to 24 years, median age 21 years 4 months) served as subjects. They were selected only if they met the following criteria:

1. They should have hearing sensitivity within 20 dBHL (ANSI 1969) for pure tones from 250 to 8000 Hz. at octave intervals.

2. They should have had English as the medium of instruction for atleast five years.

3. They should obtain a minimum score of 12 and 50 respectively, on the two English tests employed viz., " A Test of Vocabulary Range" (Lewis 1978) and " A Test of English Ability" (CIEFL 1980).

Twenty subjects were tested for discrimination in the right ear and the remaining twenty for the left. The sensation levels and the lists were presented in a previously determined random order.

The scores obtained were analyzed to determine the central tendency (mean and median) of and the variability (standard deviation) in the scores. In addition, two-way Analysis of Variance (Scheffe 1959) was also computed.

Based on the results obtained in the study, the following conclusions seem warranted:

1. Discrimination scores improve with an increase in sensation level.

2. The scores do not reach the asymptotic level even at 40 dBSL (re SRT), for normal hearing non-native speakers/listeners of English.

3. The four lists are significantly different in terms of difficulty. The order of difficulty of the lists from easy to difficult is list IV, list III, list II and list I. The relative difficulty of the four lists seems to be similar for both native speakers and for English speaking Indians.

As the test seems to be difficult enough for normal hearing subjects, it would probably be diagnostically useful. However, more studies need to be conducted on this line before conclusions are drawn.

Suggestions for Further Research:

1. To evaluate the relative familiarity of the words in the four lists used in this study, for the English speaking Indians.

2. To present these lists at 48 dBSL (re SRT) to see if the scores improve further and an asymptotic level is reached at this level.

3. To present the lists at 0 dBSL (re SRT) and at 8 dB, to check if the slope is steeper than that obtained in the present study, between 8 and 16 dBSL.

4. To study the test-retest reliability.

5. To examine the utility of the test in paediatric (above 7 years) and geriatric populations and to check if the results obtained with children agree with the findings of Sanderson-Leepa and Rintelmann (1976).

6. To investigate the diagnostic utility of the test on a clinical population.

7. To analyze the error responses obtained in the present study in order to check if the error responses follow a consistent pattern and to what extent these patterns differ from those of the native speakers of English and whether these patterns are consistent with the current theories of speech perception.

8. To check if the performance of speakers of languages from Indo-Aryan family, do batter than those who speak Dravidian languages (because the present study included subjects predominantly from the latter group).

9. To investigate whether scores vary if the talker's mother tongue is a language from the Indo-Aryan family, since the mother tongue of the talker in the present study was Kannada, a language from Dravidian family.

10. To check whether the performance of second language speakers/listeners is deficient even on a test of speech discrimination in an Indian language.

11. NU Auditory Teat No.6 involves an open message task and the subjects of the present study did not perform in par with native speakers. It would be interesting to evaluate the performance of English speaking Indians on a test of speech discrimination which employs a closed message task.

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APPENDIX I

A TEST OF ENGLISH ABILITY

SECTION A

(I) Write suitable articles in the blanks in the following sentences.

1. This is________worst thing that could have happened.
2. Mr. Sankar is _________ honest man.

(II) Write suitable prepositions in the blanks in the following sentences.

1. He was born__________ the summer _______ 1969.
2. She fell unconscious _______ hearing the shocking news.

(III) Write suitable pronouns in the blanks in the following sentences.

1. The children have gone for a holiday with _______ parents.
2. Is this cycle_________? I've aeen you using it.

(IV) Write suitable articles, prepositions or pronouns in the blanks in the following sentences.

1. The children are scared of him because _______ shouts at_________.
2. The doctor has advised _______ to live_________ fruits alone as he found that she had _______ very bad liver.
3. There are ______ number of good films in Hyderabad now. I want to see them all. To do that, I must see them at ________ rate of one a day. Even then, I am afraid I may miss some_________ them.

(V) Insert suitable articles, prepositions or pronouns wherever necessary in the following sentences.

Example: Mt. Everest is/ (the) highest peak in the world.

1. As there is lot of money in bank thieves are attracted by it.
2. I asked the teacher to explain me the new topic in Science.

3. The principal wants you to inform as soon as you arrive.

4. Talking about the accident, she said she had seen with own eyes.

5. If you are in need of anything ask it.

SECTION B

(I) Insert the right form of the verb give in brackets into each of the following sentences.

1. He__________(go) there yesterday.
2. She _______ (go) to school by bus everyday.
3. I must _______ (meet) the principal tomorrow.
4. He _______ (have) his tea when I (telephone) him yesterday.
5. He_________(live) here since 1934.

(II) Put a ( ) mark against all the sentences which are grammatically correct and an (X) mark against those not grammatically correct.

1. Last year I walk to school every day. /_____/
2. Last year I have walked to school every day. /___________________/
3. Last year I walked to school every day. /_____/
4. Last year I was walk to school every day. /_____/
5. Hari did not came to class. /_____/
6. Hari has not come to class. /_____/
7. Hari has not came to class. /_____/
8. Hari does not come to class. /_____/
9. Kamal was been swimming since sunrise. /_____/
10. Kamal swimming since sunrise. /_____/
11. Kamal swims since sunrise. /_____/
12. Kamal has been swimming since sunrise. /_____/

(III) Make questions whose answers will be the following statements. Use the words given in brackets to begin the questions.

1. The students like Science fiction. (What)

____

2. Hari has broken my glasses. (Whose)

____

3. The children go to school by bus. (How)

____

SECTION C

(I) Read each sentence and decide if there is an error in any underlined part. Write the letter of the wrong part in the box. If there is no error write D. (NE stands for 'NO ERROR')

1. An object (A) normally (B) becomes hot when (C) place it in the aun. (NE) (D) /____/

2. Ranjit and his sister are studying (A) (B) in (C) same school (C). (NE) (D) /____/

3. Balu and brother came to my (A) (B) house last night (C). /_/ (NE) (D)

4. She does not know anyone who works in that office. (NE) (D) /_/

5. Why did you (A) gave him (B) my book (C)? (NE) (D) /____/

6. I did not been able (A) to pay (B) my fees yet (C). (NE) (D) /____/

7. It waa difficult (A) for me to hearing (B) the speaker (C). (NE) (D) /_/

8. The police complain that cyclista seldom
   A B
   observes traffic rules. (NE) /__/
   C D

9. Mother asked to my friends why they were
   A B
   leaving so soon. (NE) /________________/
   C D

10. I still do not understand that how a
    A B
    steam engine works. (NE)
    D /__/

11. You will lose your purse unless you are not
    A B
    careful. (NE) /____________________/
    C D

12. We searched everywhere but could not
    A B
    anywhere find the watch. (NE)
    C D /__/

13. A friend of her told me that she has passed.(NE) /______/
    A B C D

14. The Principal himself must sign both the
    A B
    copies of the application. (NE)
    C D /__/

15. I was sure he would loin this college although
    A B
    he did not do so. (NE)
    c D /__/

SECTION D

(I) Select words from the list given to fill in the blanks in the sentences:

List of words:

is	what	who	although
are	when	whom	because
was	where	whose	however
were	which	that	therefore
am	while	so that	but

1. He left the place early__________he could reach home before sunrise.

2. I thought he would join the college________he did not do so.

3. When I telephoned him yesterday he told me ______ he ________ returning only next week.

4. _______ are the candidates ______ are to be interviewed today?

5. He does not have the needed qualifications. ______ he has been given a temporary appoihtment.

6. ______ the rains came late, farmers age hopeful of a good crop.

(II) Rewrite the following sentences correcting in them.

1. He used to laughing at others.

2.____

2. How you open this gate?

____

3. He has left the college in 1973.

____

4. Can you tell how does it work?

____

5. Having booking the ticket much in advance, we enjoyed a comfortable journey.

____

6. The man whom I met him yesterday is the new warden.

____

SECTION E

Read each passage and the statements that follow it. Decide whether each statement is true or false, according to the passage, and put a ( ) or a (X) in the box.

(I) Rani asked Raju if he wished to own a scooter. He said he did not mind spending seven thousand rupees on buying one. But he could not spend two hundred rupees a month just for maintaining it.

1. Rani wants to sell a scooter for Rs.7,000/- /__/

2. Raju cannot imagine spending ao much money on buying a scooter. /___/

3. Raju can afford to pay Rs.7000/- for a scooter. /___/

4. Raju thinks that maintaining a scooter is expensive. /___/

(II) "No!" said Julie's father. "It's not right to keep a dog in a flat in the middle of a big town. Wait for a few weeks. Then we will have our own house with a garden.

5. Julie had asked her father to get a pet dog. /---/

6. Julie's father does not like pet dogs. /___/

7. Julie's family were about to move to a new house. /___/

(III) When my aunt was young there was no electricity or running water in the house. She used to walk half a mile everyday to fetch water from the village well.

8. My aunt walks half a mile everyday. /___/

9. She does not go to the village well now. /___/

10. She usually fetches water from the well. /___/

(IV) We lived in Hyderabad many years ago. We were there for four years. Then my family moved to Madras. We haven't been to Hyderabad since then.

11. We axe now living in Madras. /___/

12. We used to live in Hyderabad. /___/

13. We visited Madras from Hyderabad four years ago. /___/

14. We lived in Madras for four years before returning to Hyderabad. /___/

15. We haven't visited Hyderabad for many years now. /___/

SECTION F

(I) Read the passage carefully and answer the questions that follow.

The frail man wearing a jibba and dark glasses, and carrying a walking stick, was a familiar figure all over India. One day, people returning home from Offices in Madras were surprised to find him walking along the road to the Central Railway Station just like an ordinary man. There were surprised looks and excited inquiries. People asked one another, "Why is he walking in this crowd? It could be dangerous." The man they were talking about was Chakravarthi Rajagopalachari, the Chief Minister of Madras State. When Rajaji, as he was popularly and affectionately known, was asked why he was going to the station on foot, he had a simple answer. He had actually come by car. But the traffic jam near the station had forced the car to stop. He had to reach the station in time, so he had got out of the car and was walking. In any case, he did not see any reason why he should not walk a few steps even though he was the Chief Minister of the state.

1. At what time of day did people see Rajaji walking on the road?

   (a) early in the morning (c) at about 10.00 a.m.

   (b) late at night (d) at about 5.00 p.m. ( )

2. What information supports your answer to Question 1 ?

   (a) He was carrying a walking stick. ( )
   (b) He was wearing dark glasses.
   (c) The road near the station was crowded.
   (d) people were returning home from offices.

3. There were surprised looks and excited enquiries because

   (a) it was dangerous for a minister to walk in a crowd. ( )
   (b) Rajaji's train might have been delayed.
   (c) the Chief Minister was walking along the road like an ordinary man.
   (d) the crowd had forced the Chief Minister's car to stop but he was facing the situation bravely.

4. Rajaji's reason for walking to the station was that

   (a) he believed in simple Gandhian principles. ( )
   (b) he thought walking would be more effective in the traffic jam.
   (c) his popularity depended on being close to the common man.
   (d) the crowd was hostile and he would be safer in the station

5. " In any case, he did not see any reason why he should not walk. . . . ." This statement indicates that Rajaji felt ministers should

   (a) always walk and set an example. ( )

   (b) be prepared to walk whenever it seemed necessary.

   (c) walk on the steps of buildings, not on the roads.

   (d) help prevent traffic jams by not using big official cars.

6. Find the word nearest in meaning to the word in capitals which occurs in the passage.

   FRAIL : a) fierce b) weak c) important d) simple (

   INQUIRIES: a) rumours b) slogans c) questions d) notices (

   ACTUALLY : a) really b) usually c) earlier d) accidentally (

APPENDIX II

A TEST OF VOCABULARY RANGE*

Here are sixty brief phrases, each containing one word typed in capitals. Check the closest definition of each such void. To keep your score valid, refrain, as far as possible, from wild guessing.

1. DISHEVELED appearance: (a) untidy, (b) fierce, (c) foolish, (d) peculiar, (e) unhappy.
2. a BAFFLING problem: (a) difficult, (b) simple, (c) puzzling, (d) long, (e) new.
3. LEMIENT parent: (a) tall, (b) not strict, (c) wise, (d) foolish, (e) severe.
4. REPULSIVE personality: (a) disgusting, (b) attractive, (c) normal, (d) confused, (e) conceited.
5. AUDACIOUS attempt: (a) useless, (b) bold, (c) foolish, (d) crazay, (e) necessary.
6. AGILE climber: (a) lively, (b) tired, (c) skillful, (d) careful, (e) stubborn.
7. PREVALENT disease: (a) dangerous, (b) catching, (c) childhood, (d) fatal, (e) widespread.
8. OMINOUS report: (a) loud, (b) threatening, (c) untrue, (d) serious, (e) unpleasant.
9. an INCREDIBLE story: (a) true, (b) interesting, (c) well-known, (d) unbelievable, (e) unknown.
10. a good OCULIST: (a) eye doctor, (b) skin doctor, (c) foot doctor, (e) bone doctor.
11. will SUPERSEDE the old law: (a) enforce, (b) apecify penalties for, (c) take the place of, (d) repeal, (e) continue
12. an ANONYMOUS donor: (a) generous, (b) stingy, (c) well-known, (d) one whose name is not known, (e) reluctant.
13. performed an AUTOPSY: (a) examination of living tissue, (b) examination of a corpse to determine the cause of death, (c) process in the manufacture of optical lenses, (d) operation to cure an organic disease, (e) series of questions to determine the causes of delinquent behaviour.

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14. an INDEFATIGABLE worker: (a) well-paid, (b) tired, (c) skillful, (d) tireless, (e) pleasant.

15. a confirmed ATHEIST: (a) bachelor, (b) disbeliever in God, (c) believer in religion, (d) believer in science, (e) priest.

16. a LOQUACIOUS woman: (a) tall, (b) beautiful, (c) homely, (d) sweet, (e) talkative.

17. a GLIB talker: (a) smooth, (b) awkward, (c) loud, (d) friendly (e) boring.

18. to PHILANDER: (a) work hard, (b) make love triflingly, (c) save money, (d) be in doubt, (e) try unsuccessfully.

19. an OCULAR difficulty: (a) unexpected, (b) insurmountable, (c) pertaining to the eye, (d) real, (e) imaginary.

20. questionable PATERNITY: (a) fatherhood, (b) truthfulness, (c) value, (d) knowledge, (e) wisdom.

21. a NAIVE attitude; (a) unwise, (b) hostile, (c) unsophisticated, (d) friendly, (e) contemptuous.

22. living in AFFLUENCE: (a) dirt, (b) countrified surroundings, (c) fear, (d) wealth, (e) poverty.

23. more pleasant in RETROSPECT: (a) back view, (b) freedom, (c) acceptance, (d) leisure, (e) anticipation.

24. a real GOURMET: (a) teacher, (b) greedy eater, (c) vegetarian, (d) connoisseur of good food, (e) antique.

25. to STMULATE interest: (a) pretend, (b) feel, (c) lose, (d) stir up, (e) ask for.

26. a MAGNANIMOUS action: (a) puzzling, (b) generous, (c) foolis! (d) unnecessary, (e) wise.

27. a CLANDESTINE meeting: (a) prearranged, (b) hurried, (c) important, (d) secret, (e) periodical.

28. the APATHETIC populace: (a) made up of various national stocks, (b) keenly vigilant of their rights, (c) densely packed, (d) indifferent, uninterested, (e) prehistoric

29. to PLACATE his wife: (a) divorce, (b) make a gift to, (c) make arrangements for, (d) help, (e) change hostility to friendliness.

30. VACILLATE continuously: (a) avoid, (b) waver mentally, (c) inject, (d) treat, (e) scold.

31. a NOSTALGIC feeling: (a) nauseated, (b) homesick, (c) sharp, (d) painful, (e) delighted.

32. feel ANTIPATHY: (a) bashfulness, (b) stage fright, (c) friendliness, (d) hostility, (e) suspense.

33. be more CIRCUMSPECT: (a) restrained, (b) confident, (c) cautious, (d) honest, (e) intelligent.

34. an INTREPID campaigner: (a) fearless, (b) eloquent, (c) popular, (d) experience, (e) famous.

35. DIAPHANOUS material: (a) strong, (b) sheer and gauzy, (c) colorful, (d) expensive, (e) sleazy.

36. a TACITURN host: (a) stingy, (b) generous, (c) disinclined to conversation, (d) charming, (e) gloomy.

37. a MALIGN his friend: (a) accuse, (b) help financially, (c) disbelieve, (d) slander, (e) discard.

38. a CONGENIAL deformity: (a) horrible, (b) crippling, (c) slight, (d) incurable, (e) occurring at or during birth.

39. a definite NEUROSIS: (a) plan, (b) emotional maladjustment, (c) mental derangement, (d) feeling of fear, (e) physical reaction.

40. took an UNEQUIVOCAL stand; (a) indecisive, (b) well-intentioned (c) unexpected, (d) definite, (e) dangerous.

41. VICARIOUS enjoyment: (a) complete, (b) unspoiled, (c) occurring from a feeling of identification with another, (d) long continuing, (e) temporary.

42. PSYCHOGENIC ailment: (d) incurable, (b) contagious, (c) caused by the emotions, (d) intestinal, (e) imaginary.

43. an ANACHRONOUS attitude: (a) unexplainable, (b) religious, (c) belonging to a different time, (d) out-of-place, (d) unusual.

44. his ICONOCLASTIC phase: (a) artistic, (b) sneering at tradition, (c) troubled, (d) difficult, (e) religious.

45. a TIRO: (a) dominating personality, (b) beginner, (c) accomplished musician, (d) dabbler, (e) serious student.

46. a LACONIC reply: (a) immediate, (b) assured, (c) terse and meaningful, (d) unintelligibel, (e) angry.

47. SEMANTIC confusion: (a) relating to the meanings of words, (b) pertaining to money, (c) having to do with the emotions, (d) relating to mathematics, (e) scientific.

48. CAVALIER treatment; (a) courteous, (b) high-handed, (c) negligent, (d) incomplete, (e) expensive.

49. an ANAMALOUS situation: (a) dangerous, (b) intriguing, (c) unusual, (d) pleasant, (e) unhappy.

50. POSTHUMOUS child: (a) cranky, (b) brilliant beyond his years, (c) physically weak, (d) illigitimate, (e) torn after the death of his father.

51. feels ENERVATED: (a) full of ambition, (b) full of strength, (c) completely exhausted, (d) troubled, (e) weak.

52. shows true PERSPICACITY: (a) sincerity, (b) mental keen-ness, (c) love, (d) faithfulness, (e) longing.

53. a SYCOPHANTIC attitude: (a) sneering, (b) unbelieving, (c) bootlicking, (d) surprising, (e) contemptible.

54. GREGARIOUS person: (a) calm, (b) company-loving (c) untrust-worthy, (d) vicious, (e) self-sacrificing.

55. sufficiently PHLEGMATIC: (a) satisfied, (b) annoyed, (c) high-strung, (d) emotionally calm, (e) irritating.

56. CONSUMMATE scoundrel: (a) repentant, (b) punished, (c) perfect, (d) vicious, (e) unreformable.

57. an EGREGIOUS blunder: (a) outstandingly bad, (b) slight, (c) irreparable,(d) unnecessary, (e) humourous.

58. CACOPHONY of the city: (a) political administration, (b) crowded living conditions, (c) cultural advantages, (d) harsh sounds, (e) foul odors.

59. a PRURIENT adolescent: (a) tall and gangling, (b) sexually longing, (c) clumsy and awkword (d)pimply faced, (e) soft-spoken.

60. UXORIOUS husband: (a) henpecked, (b) suspicious, (c) guilty of infidelity, (d) fondly and foolishly doting on his wife,(e) lovesick.

APPENDIX III

CID AUDITORY TEST W-1

1. greyhound
2. schoolboy
3. inkwell
4. whitewash
5. pancake
6. mousetrap
7. eardrum
8. headlight
9. birthday
10. duckpond
11. sidewalk
12. hotdog
13. padlock
14. mushroom
15. hardware
16. workshop
17. horseshoe
18. armchair
19. baseball
20. stairway
21. cowboy
22. iceberg
23. northwest
24. railroad
25. playground
26. airplane
27. woodwork
28. oatmeal
29. toothbrush
30. farewell
31. grandson
32. drawbridge
33. doormat
34. hothouse
35. daybreak
36. sunset

APPENDIX IV

NU AUDITORY TEST NO. 6

FORM A

	LIST I	LIST II	LIST III	LIST IV
1.	laud	pick	base	pass
2.	boat	room	mess	doll
3.	pool	nice	cause	back
4.	nag	said	mop	red
5.	limb	fall	good	wash
6.	shout	south	luck	sour
7.	sub	white	walk	bone
8.	vine	keep	youth	get
9.	dime	dead	pain	wheat
10.	goose	loaf	date	thumb
11.	whip	dab	pearl	sail
12.	tough	numb	search	yearn
13.	puff	juice	ditch	wife
14.	keen	chief	talk	such
15.	death	merge	ring	neat
16.	sell	wag	germ	peg
17.	take	rain	life	mob
18.	fall	witch	team	gas
19.	raise	soap	lid	check
20.	third	young	pole	join
21.	gap	ton	road	lease
22.	fat	keg	shall	long
23.	met	calm	late	chain
24.	jar	tool	cheek	kill
25.	door	pike	beg	hole

	LIST I	LIST II	LIST III	LIST IV
26.	love	mill	gun	lean
27.	sure	hush	jug	tape
28.	knock	shack	sheep	tire
29.	choice	read (to read)	five	dip
30.	hash	rot	rush	rose
31.	lot	hate	rat	came
32.	raid	live	void	fit
33.	hurl	book	wire	make
34.	moon	voice	half	vote
35.	page	gaze	note	judge
36.	yes	pad	when	food
37.	reach	thought	name	ripe
38.	king	bought	thin	have
39.	home	turn	tell	rough
40.	rag	chair	bar	kick
41.	which (or witch)	lore	mouse	lose
42.	week	bite	hire	near
43.	size	haze	cab	perch
44.	mode	match	hit	shirt
45.	bean	learn	chat	bath
46.	tip	shawl	phone	time
47.	chalk	deep	soup	hall
48.	jail	gin	dodge	mood
49.	bum	goal	seize	dog
50.	kite	far	cool	should

APPENDIX V

CALIBRATION PROCEDURE

1. Pure Tone Calibration:

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

1.1 Intensity Calibration:

All intensity measurements were done when the audiometer output was set at 70dBHL. The acoustic output of the audiometer was given through earphones (TDH 39 with MX-41/AR ear cushions) to a B and K condensor microphone type 4144, which was fit into a B and K artificial ear type 4152. The microphone was connected into a B and K pre-amplifier type 2616. The signal was then fed into a B and K Audio-Frequency (AF) analyzer type 2107. The SPL values at the corresponding frequencies were noted. Whenever the difference between the observed SPL value and the expected value (ANSI standards 1969) was more than 2.6dB, internal calibration was done by adjusting the presets in the audiometer. Thus the output levels of the audiometer was well within 2.5dB with reference to the standards.

1.2 Frequency Calibration:

The frequency of the pure tones were checked using a Rodart 203 timer/counter. For this the electrical out-put of the audiometer was given. The frequency generated was very close to the frequency reading on the dial and the difference between the two never exceeded 3% of the dial reading.

2. <u>Calibration of Tape Input</u>:

Two different measurements were done to check the calibration of the tape input.

2.1 To check if there is any mismatch between the tape output and the audiometer input, the following procedures/ was used:

Four pure tones of frequencies 250, 500, 1000 and 2000Hz were recorded separately on a magnetic tape. For this recording, the electrical output of a Beltone - 200C clinical audiometer was given to the tape recorder. The frequency of the tones generated by the audiometer were previously checked and were found to be satisfactory. The tape recorder used for this recording was the same as the one used for data collection (Sonnett ST480).

The tape recorder out-put was then given to the tap input of the Madsen 0B70 clinical audiometer. The levels of the 250, 500 and 2000Hz. tones were found to be within ± 3dB with reference to the lOOOHz. tone (at 70 dBHL). All the measurements were done with the same set up as in section 1.1 . Thus it was established that there was no mismatch between the tape recorder output and the tape input of the audiometer.

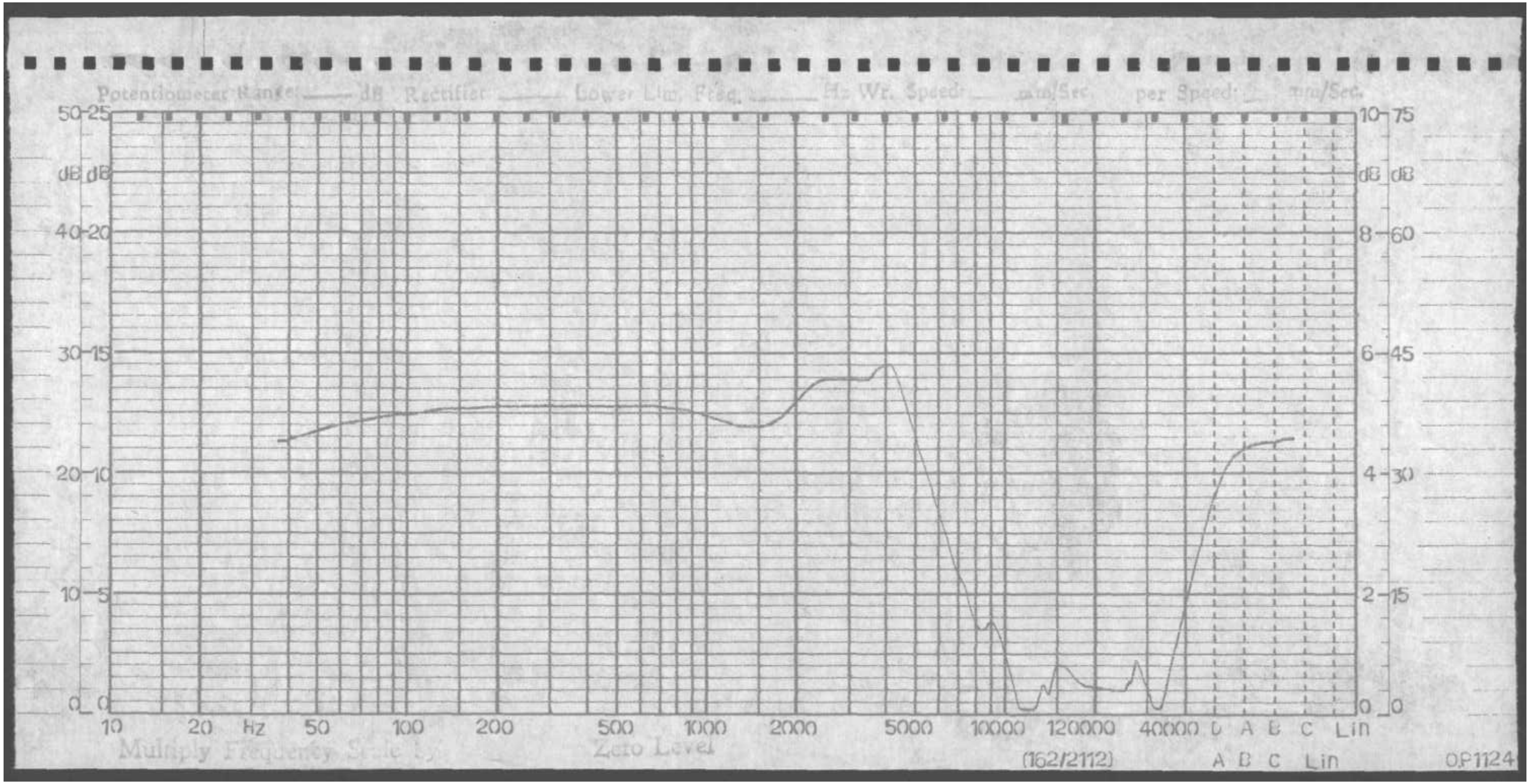
2.2 To check the tape output of the audiometer a speech spectrum noiae was used. The noise was recorded on magnetic tape, using the same tape recorder (Sonnett ST480). The electrical output of a Beltone 200C audiometer was used for recording the noise on the tape.

The tape was then played with the output being given to the earphones (TDH 39 with MX-41/AR ear cushions) through the Madsen 0B70 clinical audiometer. The intensity dial reading of the audiometer was 70 dBHL. The SPL value obtained on the AF analyzer (a procedure similar to that described in section 1.1 was employed) was 90 dBSPL, which is in agreement with the ANSI specifications.

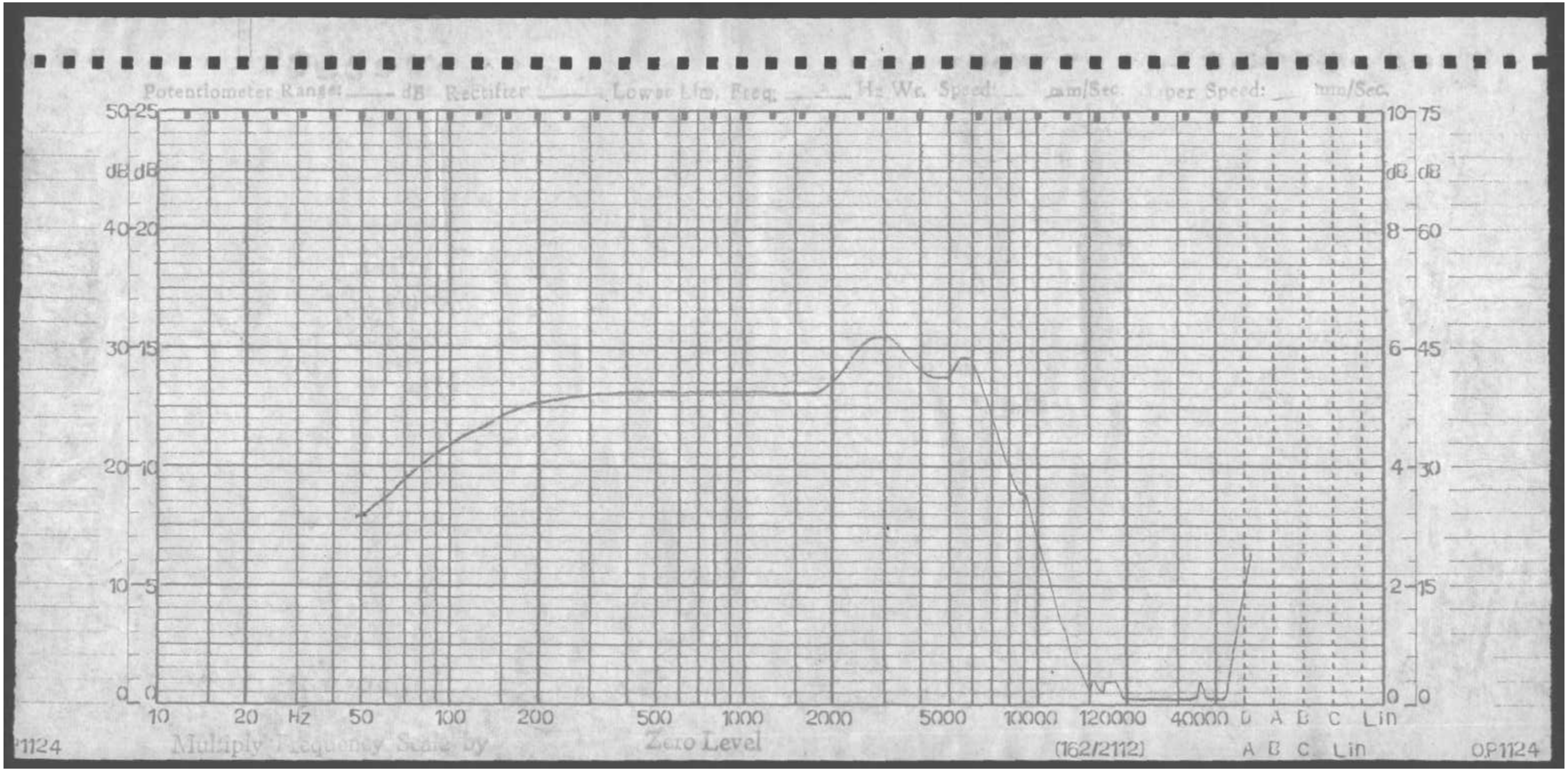
3. Earphone Frequency Response Characteristics:

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

APPENDIX VI



Frequency Response Characteristics of Earphone 1



Frequency Response Characteristics of Earphone 2

APPENDIX VII

Noise levels in the test room were as follows:

Octave Frequency	Level in dBSPL
125Hz	18
250Hz	21
500Hz	14
l000Hz	12
2000HZ	11
4000Hz	11
8000Hz	12
C-Scale	33

******