DEVELOPMENT AND STANDARDIZATION OF SPEECH TEST MATERIALS IN BENGALI LANGUAGE

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Ghosh. D.

A Dissertation Submitted In Part Fulfilment For The Degree Of Master Of Science (Speech & Hearing) To The University Of Mysore,

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Mysore-5700 06

Dedicated to

My Baabaa-O-Maa

for all their Ashirwad

AND

My brother Anjan for all
his inspiration and encouragement
and support.

CERTIFICATE

This is to certify that the Dissertation entitled "DEVELOPMENT AND STANDARDIZATION OF SPEECH TEST MATERAILS IN BENGALI LANGUAGE" is the bonafide work in part fulfilment for the degree of M.sc., (Speech and Hearing) of the student with Register No.8603.

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CERTIFICATE

This is to certify that this Dissertation entitled "DEVELOPMENT AND STANDARDIZATION OF SPEECH TEST MATERIALS IN BENGALI LANGUAGE" has been prepared under my supervision and guidance.

Dr.M.N.VYASAMURTHY
GUIDE

DECLARATION

This dissertation entitled "Development and Standardization of Speech Test Materials in Bengali Language" is the result of my own study undertaken under the guidance of Dr.M.N.Vyasamurthy, Lecturer in Audiology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other Diploma or Degree,

Mysore Register No. 8603

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INTRODUCTION

INTRODUCTION

Speech is one of the most important vehicles of human communication system. To be able to hear and comprehend normal speech, requires normal auditory integrity. For the purpose of identification of auditory integrity, speech audiometry is essential. According to Levine (1960) "To hear is as natural and effectless an occurance as it is invisible. Man would as soon ask himself how breathing keeps him physically alive as how hearing keeps him physiologically alive" (Cited by R.R.Rupp 1980).

Pure tone audiometry is the basis for any audiological assessment. It reveals the degree and type of loss. It facilates the decision as to the need for further tests or medical interventions. The knowledge of pure tone audiometry gave way to the development and standardization of further tests such as S.I.S.I., A.B.L.B., etc. The process of pure tone audiometry is uncomplicated and is easily administered* "Identification of the stimulus by the listener presumes a relatively simple neural apparatus and the response, usually raising the hand is not complex one" (Herman Allan Schill, 1982).

Inspite of having such advantages, pure tone audiometry, alone has many limitations. It serves the possibilities, but not realities. It helps in esimation only. Pure tones are not common in everyday life situation. Speech sounds are more meaningful. It reflects the critical activities of life sad the comprehension of social communication. The conventional pure tone proceedings fail to provide any information about a person's ability to hear above the threshold. Ability to perceive pure tones does not require any psychic integration or synthesization thus the results are inadequate in the diagnosis and differential diagnosis of various auditory dis-order (Willeford, 1969).

Speech audiometry reveals more information regarding auditory functions, when comparing to pure tone audiometry. The advantages of speech audiometry are:

1. Sensible to use the sounds of speech to measure the threshold for speech intelligibility rather than to approximate that threshold by simply averaging pure tones (Hirsh,I, et al 1952)
2. Confirms pure tone thresholds (Garhart, 1971; Hodgson,1980).
3. Facilitates the evaluation of auditory capabilities by proceeding from simple pure tones to more complex speech stimulus (Olsen, Matkin, 1979).

Speech audiometry too, has limited diagnostic value but when combined with other battery of tests it gives many useful information.

Role of speech audiometry:

1. Assessment of basic communicative competence for aural language input.

2. Corroborative information in the identification of slte(a) of lesion.
3. Assessment of language input competence in population* with linguistic limitations.
4. Measurement of effectiveness of personal amplification devices.
5. Identification of the possibly pseudohypocusis listener.
6. Measurements on central auditory dysfunction with emphasis on identification of central lesion site.
7. Measurements on central auditory processing abilities. Identification systems for locating the individual with auditory perceptual deficits.
8. Evaluating the effectiveness of aural therapeutic intervention. The quantification of the remedial approach.
9. The recommendations for clinically appropriate speech protocols. (R.R.Rupp and Kenneth, G.S. 1980).

The materials used for speech audiometry are words (monosyllabic, disyllabic and polysyllabic), nonsense syllable, sentence, continuous discourse etc. which helps in establishment of speech reception threshold, threshold of detectibility, threshold of tolerance, or discomfort level, social adequacy index, speech discrimination scores etc.

Head for the study:

In recent years, speech audiometry has gained widespread acceptance in the audiological test batteries. As a result, it becomes essential to develope different types of test materials.

According to 1971 census, 1652 mothertongues are there there in India. Its not possible to have a common speech material. The available speech material in Indian languages are Hindi (Abrol, 1970; De, 1973); Kannada (Nagaraja, 1973; Rajashekhar, 1976; Hemalatha, 1981); Malayalam (Kapur, 1971); Tamil (Kapur. 1971; Samuel, 1976); Gujarathi (Mallikarjuna, 1984) and Manipuri (Taauja, 1984).

Purpose of the study:

Administration speech test in native language is ideal since perception of speech is influenced by his mother tongue (Weinrich, 1954; Delattre, 1964; Singh, 1966; Singh and Black 1966; Gate, 1971). Speech audiometry being an important diagnostic tool, it is essential to develop speech material for Bengali population.

The present study attempts at constructing and standardizing speech test materials in Bengali language.

1. To develope speech test material in Bengali language to determine SRT and speech discrimination scores.
2. To standardize the teat materials by finding the articulation gain function curves in Bengali speaking normal hearing subjects.

GLOSSARY:

- Binanral - listening with both ears to either the same or different stimuli.
- Carrier phrase - The phrase, such as "say the word ..."or" "you will say ..." which proceeds the stimulus word during speech audiometry. It is designed to prepare the patient for the test word and to assist the clinician (if monitored live voice is used) in controlling the input loudness of the test word.
- Cold running speech - Rapidly delivered speech, either pre-recorded or by monitored live voice. Such that the output is monotonous and the peaks of the words strike zero on the VU meter.
- Consonant - nucleus consonant (words) - Monosyllabic words used in testing. Word discrimination each word is comprised of three phonemes, the initial and the final phonemes being consonants and the middle phoneme a vowel or dipthongs.
- Monaural - listening with one ear.
- Monitored live voice (MLV) - Introduction of a speech signal (as in speech audiometry) by use of a microphone. The loudness of the voice is monitored visually by means of a VU meter.
- Most comfortable loudness (MCL) - The hearing level designated by a listener a the most comfortable listening level for speech.
- PB Max - The highest speech discrimination score for PB words obtained on a performance - intensity function regardless of level.

- Performance-intensity function - A graph showing the percentage correct of speech discrimination materials as a function of intensity. The graph usually shows the discrimination score on the ordinate and sensation level on the abscissa. Its also called articulation gain function curves.
- Phonetically balanced words - A list of fifty - monosyllabic words used for determination of word discrimination scores. Theoretically, each list contains the same distribution of phonemes that occurs in connected discourse.
- Range of comfortable loudness (RCL) - The range in decibels, between threshold for speech and the point that speech becomes uncomfortably loud. It is determined by subtracting the S.T. from UCL (Uncomfortable level for speech - speech thresholds in dB). It is also called dynamic range for speech.
- Saw tooth noise - A noise comprised of a fundamental frequency of 120Hz, with equal amplitude at all harmonic frequencies.
- Signal to noise ratio (S/N) for speech - The difference in decibels between a signal (such as speech) and a noise presented to the same ear (ears). When the speech has greater intensity than the noise, a positive sign is used? when the noise has greater intensity than the signal, a negative sign is used.
- Social adequacy index -A measurement of hearing handicapped determined by the speech threshold and word discrimination score.

- Speech audiometer - Aa audiometer calibrated in dBHz for speech. It should be capable of presenting speech materials by monitored live voice, tape or disc recording. Signals may be fed into either or both earphones or into the sound field by means of one or more loudspeakers.
- Speech detection threshold (SDT) - The hearing level at which a listener can just detect the presence of an ongoing speech signal and identify it as speech. Some times called the speech awareness threshold (SAT).
- Speech reception threshold - The threshold of intelligibility of speech.
- Spondaic word (spondee) - A two syllable word (having common usage in the language) pronounced with equal stress on both syllables.
- Spondee threshold - The lowest hearing level at which 50% of a list of spondees is correctly identified.
- Synthetic sentence identification (SSI) - A method for determination of speech discrimination by means of seven word sentences that are grammatically correct but meaningless.
- Threshold - Least audible sound pressure level.
- Uncomfortable loudness level - That sound pressure level (often reff. to in dBHL) at which speech becomes uncomfortably loud.
- Word discrimination score - The percentage of correctly identified items on a word diaerimination test. Often termed discrimination score (DS) or PB scores.

- Word intelligibility by picture identification (WIPI) teat - A word discrimination test using picture for testing the speech discrimination of young children.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The science of Audiology, as a different entity was born following II World War. World War II saw many handicapped individual. To habilate the war victims, who lost communication abilities, to assess the extant of their hearing loss with or without communication disabilities and to differentiate organic and nonorganic deafness (such as pseudohypocusis). This branch of hearing science and measurement of hearing acquity came into existence.

Te gather information, regarding a hearing impaired individual, is reflected, in his ability to handle speech input. The classical basic audiologic battery for each ear includes four essential measures of (1) pure tone air conduction thresholds (2) pure tone bone conduction thresholds (3) spondee thresholds (4) an estimation of his discrimination ability.

Foundation stone in the field of hearing science was layed as early as 1800. G.W.Pfingsten 1804 and Itard (1821) used various methods to show and reveal improvements in hearing speech (cited by Feldman 1940). The efforts thus putforth, facilated for the identification of speech discrimination as a separate concern, By 1821.

Literature reveales that phonographs were used in Germany that utilized cylinders to present materials to the listener.

In this, the reception was found to be poor and hence whispered tad live voice technique were used. The distance of the aubject and the tester was varied.

In the late 1800, various instruments and their modification were incorporated. Instruments such as phonometer, micro-phenautographs were used. But this results had minimal diagnostic significance. Live voice was the primary mode of conveying the message, general speech was used to determine understanding. Nonsense syllables were developed in the early 20th century, to make the measures mere critical which was further facilated by telephone research and later certain vowels lists were prepared (Fletcher and Steinberg, 1929 cited by R.R.Rupp 1980). At that time Fletcher was concerned with developing a test of intelligibility so as to determine human sensitivity. One of the tests he used was fading number teat using group audiometry.

With the advent of technical knowhow, sophisticated instruments and technique in measurement of speech intelligibility was beginning to be employed. Hughson and Thompson in 1942, incorporated such techniques in the measurement of speech intelligibility.

Monosyllabic words were first developed by W.H.Bristol in 1926 for children. In 1927, Fletcher produced an intelligibility test at Bell Labs. and was mainly used for hearing aid testing.

Administration of paired - word list along with monosyllable words were developed in late 1930 was chiefly imported for hearing consideration and usage. One of the pioneer in this consideration was West (1938). List that was developed by West used to test various speech parameters in diagnosing hearing handicaps.

The psychoacoustic laboratory at (PAL) Harvard University carried an extensive research on speech communication during World War II. During war time, communication was extremely important, hence three areas were given more important i.e. teat materials, speakers, and systems of transmitting messages. The PRL developed 14 tests using specific testing criteria.

According to Eldert and Davis (1951) the PAL testing systems are inadequate for testing human hearing losses. Hirsh developed the W-22 lists. In this the calibration of the recording and a carrier phase was included (even the SPL for presentation was also of concern). The list, the W-22 gained wide popularity. A great amount of research by several invastigator such as Brandy, 1966; Campbell, 1965; Carhart, 1965; Creston et al, 1966; Elper 1960; conducted studies to determine the reliability of W-22 lists. Studies made during 1961 to 1964 had questions on its reliability and use of full lists. Suggestions were also made regarding the use of abbreviated lists (Elpern, 1961; Grubb, 1963; Lynn, 1962; Resnick, 1962? Tobias, 1964). There exists significant difference between the list and vocabulary, which was a major deficiency.

The investigator of the PAL gives more importance to familiarity. Harvard PB lists were phonetically balance. The W-22 lists developed at central institute for the deaf were found to be easier than Harvard PB lists. But Hirsh (1952) stated that one of the short comings of W-22 lists is that the results fails to differentiate satisfactorily between mixed deafness from conductive deafness.

In 1959, Lehiste and Peterson attempted at formulation of a list of phonetic balance than phonemic balancing. They selected consonant - nucleus consonant (C.N.C) syllables. According to Carhart, 1965. This C.N.C. lists (which has 1263 words and ten lists) and Harvard PB list yields comparable results though the criterion used is different (Harvard lists has consonant vowel or vowel consonant combination).

In 1963, the north western University auditory test No.4 (NU) was developed (Tillman, Carhart and Wilber). It has 95 words plus same additional words. In 1966, Tillman and Carhart developed test No.6, which consists of CNC monosyllabic words and were phonetically balanced.

Later multiple choice tests, rhymes tests and modified rhyme tests were developed. One of the widely used discrimination tests is rhyme tests developed by Hense et al (1965). The rhyme test uses a semiclosed set and the listener writes down the initial consonant to a provided word stem. Whereas the modified rhyme test is a closed response format.

The Kansas University developed the K.U. speech discrimination tests. Specialize test lists for different frequency regions were prepared by Glaaen 1974 to assist in hearing aid selection. An abbreviated list for screening purposes was prepared by Rose (1974)

In the development of these test materials, frequency of words in conversational use and the phonetic balance of the words were not considered in the tests development.

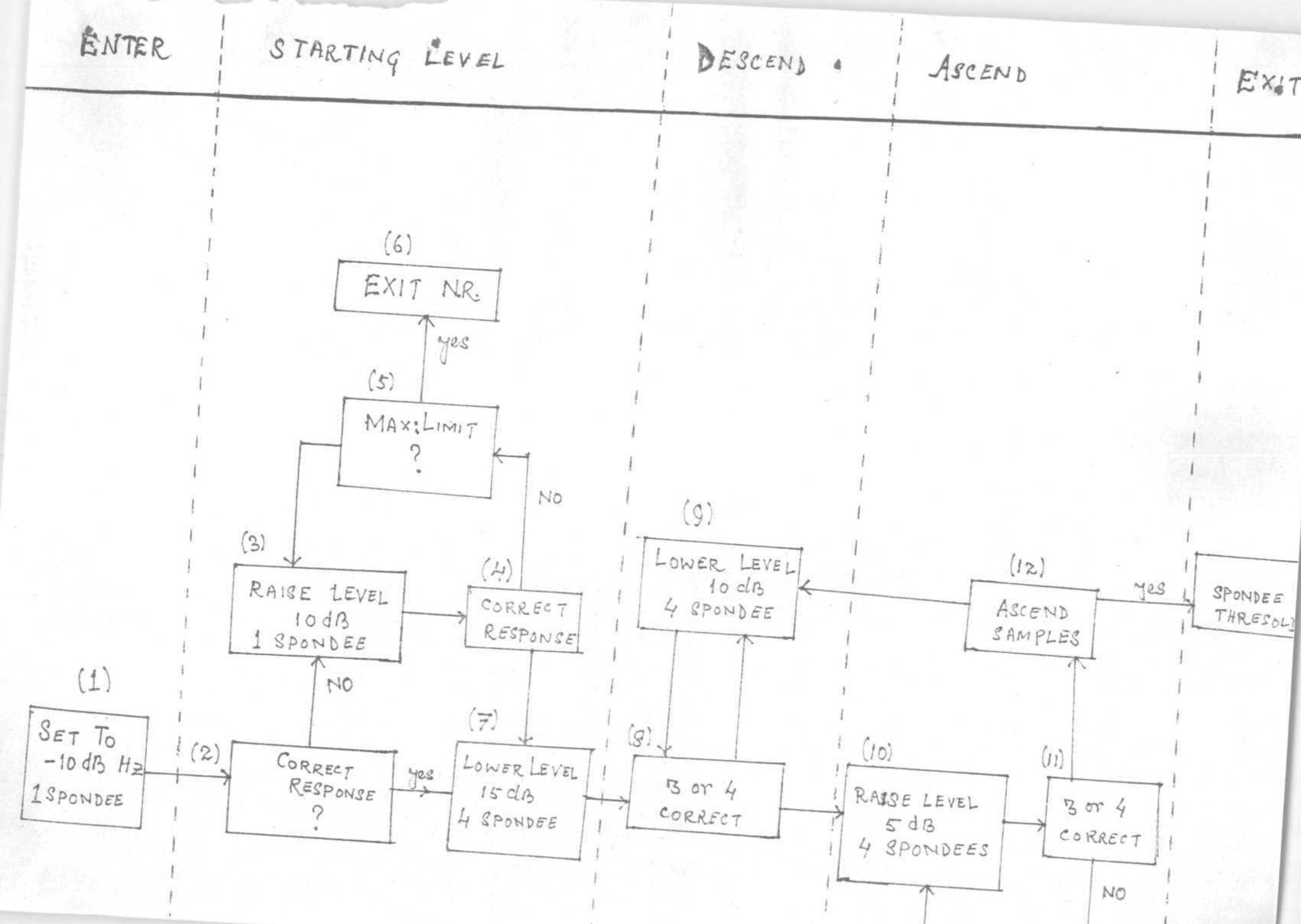
Approach For Determining The Spondee Thresholds:

The clinical determination of spondee threshold is been discussed which is in practise since mid-seventies. It presumes a mature, co-operative and motivated adult. It incorporate monitored live-voice presentation of the stimuli, an ascending 3dB intensity step series in the threshold probe phase, and a reinforcement closure procedures as its completion exercise. The procedures that are involved are:

1. Familiarization of the word list
2. Instructions to the listener
3. Orientation-attending phase
4. Threshold probe phase
5. Reinforcement and closure phase.

Familiarization:

At this level, the clinician reads out the spondees at a suprathreshold level (35-40dBSL) to the patient. The patient



ENTER
STARTING LEVEL
DESCEND
ASCEND
EXIT
(6)
EXIT NR.
yes
(5)
MAX: LIMIT ?
NO
(3)
RAISE LEVEL 10 dB 1 SPONDEE
(4)
CORRECT RESPONSE
NO
(1)
SET TO -10 dB Hz 1 SPONDEE
(2)
CORRECT RESPONSE ?
yes
(7)
LOWER LEVEL 15 dB 4 SPONDEE
(9)
LOWER LEVEL 10 dB 4 SPONDEE
(8)
3 or 4 CORRECT
(10)
RAISE LEVEL 5 dB 4 SPONDEES
(11)
3 or 4 CORRECT
NO
(12)
ASCEND SAMPLES
yes
SPONDEE THRESOLD

is seated in the sound treated room, facing the audiologist at an approximate 45° angle. If the subject understands all the stimuli words then next steps are followed. Otherwise, the list is read out once again with subject repeating after the tester. The unintelligible words or the words that are missed are removed from the list.

Instruction:

An excessive instruction may confuse the task. Hopkinson 1978 (cited by R.R.Rupp, 1980) advocates usage of short instruction such as:

" New I am going to read these words, but one at a time. I want you to repeat each word after me. The words will be getting softer and softer. This is deliberate for I want to find the level where you can just understand the word as you listen carefully. It is all right to guess if you are not sure. Please listen carefully. Repeat each word if you can. Please guess if necessary. Do you have any questions?"

Orientation-Attending phase:

Two spondees are presented at 25-30 dBSL. The intensity level is than decreased in 5dB steps, with two words presented at each level. This phase may end in zero dB en the attenuator dial of the audiometer, or when the listener misses one or both words at same dial level above this normal base line level.

Threshold probe:

In this phase, the audiologist attends a 50% correct response criteria using 2dB steps attenuation or increment.

Reinforcement and closure phase:

This phase gives the listener enough satisfaction regarding his own performance. After threshold probe, the tester increases the intensity by 5dB and cheeks for the better response. This phase also checks or the initial evaluation.

Guidelines for determining the threshold level for speech 1979 state that "Speech audiometry is a procedure for measuring an individual intelligibility threshold for speech materials. An individual's threshold for speech is defined as the intensity level at which he can respond correctly 50% of the material presented to him.

Purposes for assessment:

1. Hearing level for speech - The SRT scores establishes a hearing level for speech stimuli, both in the sound field and also independently for each ear, thereby providing us the estimation of the listener's communicative listening abilities. It establishes a basic hearing level (or 'loss) for speech.

2. A base intensity level in calculating word discrimination scores - The SRT helps in the establishment of the intensity level above which the audiologist gathers speech discrimination information. Forbis and Martin (1978) from their study reported 38% of the audiologist uses 40dBSL in relationship to SRT for checking suprathreshold understanding

ability through the use of monosyllabic phonetically balanced word list. Some use 25dBSL to 45dBSL but majority of the clinicians uses SRT as the base intensity level to determine the subsequent intensity dial level in administering monosyllabic word lists.

3. Consistency check with pure tone average - By comparing the pure tone thresholds with spondee threshold of the ear under test, especially 'speech' carrying frequencies (namely 500, 1000, 2000, 3000Hz), which is ±5dB considered to be clinically acceptable (Berger, 1971y cited by R.R. Rupp, 1980); Hopkinson proposes a formula to make such consistency probe easy "The SRT should correspond to the best of the three pure tone speech frequencies by minus 8 to plus 6 dB" (cited by J.Katz).

Diagnostic and prognostic information: This can be made by comparing the SRT of bone conduction and SRT of air conduction.

Assessing amplification assistance:- The scores of SRT enables an audiologist in the assessment of possible hearing aid/management modalities.

Research:- The received data may be employed for research purposes by various professionals such as Audiologist, Speech Language Pathologist, Otologist, Occupational Therapist, social Worker etc.

One of the major responsibilities of an audiologist is to provide and interpret data to identify the site of lesion in the aberrant auditory system. Studies confirms that speech intelligibility testing particularly speech discrimination testing is useful in differeatiating sensorineural sites of lesion, i.e. cochlear, retrocochlear pathology.

Shambaugh (1967, cited by Steven C.White) states that speech discrimination testing is one of the most useful tool in early diagnostic tests for tumors within the internal auditory meatus, and Carhart (1965) reported that a moderate reduction in discrimination is a frequent symptom in Meniere's disease.

Walsh and silverman (1946) reported that if a patient's articulate score increases proportionately with intensity, i.e. as with the normal ear, the patient have normal cochlear function.

"A very poor PB Max scores should continue to be thought of as a symptom +f neural pathology, while good scores should not preclude further evaluation of eighth nerve function and appearance. Audiologic data can remain only a part of a complete evaluation"(Steven C.White, 1980).

Presbycusis may be classified interns of two aspects of whether the patient have suffered a breakdown in clearity of speech perception (that may be out of proportion to the pattern of their pure tone loss) schuknecht (1955? 1964) states that such a breakdown characterizes presbycusis due to neural rather than epithetial atrophy.

In early otosclerosis, the discrimination scores are within normal range. In advanced otosclerosis, there is a tendency to produce discrimination loss depending en the degree of deafness.

Thorton and Erber (1978) used sentence materials to assess the ability of hearing impaired children to perceive speech under sensory input mode. The information can be used as a predictor of success ia mainstreamed educational environment.

Byman (1974) suggests that since speech perception involves the simultaneous processing of auditory, visual, and situatienal cues in relation to linguistic constraints, thus these processes should be evaluated using materials that would utilize all of the information.

To assess the speech reception thresholds, a number of stimuli may be used. The most common ones are, sentences, connected discourse, spondaic words, spoken digits etc.

The stimuli used for speech discrimination testing are monosyllables, nonsense syllables, synthetic sentences etc.

The national council on hearing and bioacoustic found that monosyllables do not represent everyday speech. Also the use of single words, have severe limitations such as vocabulary relative range of difficulty, meaningfulness which limits the parameter of speech and its changing over time. Carhart (1970) suggests use of spondaie words and monosyllabic word aa teat stimull for assessing SET and speech discrimination testing respectively.

Test material:

There were impeding question regarding as to the material* for the test of speech discrimination. Monosyllable words were most popular. They are presented under one of two response formats, open-or-closed-set. Open set tests includes the Harvard PB-50 list (Egan, 1948), CID W-22 word lists (Hirsh, 1952) and NU auditory test No.6 lists (Tillman and Carhart, 1966). The PB list of Harvard were designed to be "phonetically balanced" in that the phonetic composition of the worts in each test list was intended to be representative of the types of sounds found in sample of 100,000 words in news print. The CID W-22 word lists were more rigidly balanced using a different set of criteria.

Lehiste and Peterson (1959), took into consideration the influence of words in designing word lists in which each initial and final consonant and each medial vowel appeared with the same frequency. Later their list included only those words having a high frequency of occurrence (1962). Tillman and Carhart in 1966 revised Lehiste and Peterson's lists to increase phonetic balancing resulting in the development of NU auditory test No.6. Studies shows differences in scores when different test materials are used (Olsen and Matkin,1979).

In closed set, word familiarity effects are minimized and the respondent is not required to recall previously learned vocabulary.

Haagan (1945, cited by Dean C Garstacki, 1981) was one of the first to develope closed set material and concluded that the score do not differ when compared to the results of open set.

Fairbank (1958) developed a multiple choice test in which rhyming monosyllables were presented, but the initial consonant differed. Observing the limitation, House (1963) modified Fairbanks original test to include discrimination of final consonants in monosyllabic words sad this was called modified rhyme test. The words were neither phonetically nor phonemically balanced.

Hutton, Curry and Arm Strong (1959) developed the semi-diagnostic test to assess a person's candidacy for aural rehabilitation and to measure progress through the rehabilitation program. The test offers a closed-set response format for monosyllable discrimination of pairs. The listener should identify two correct monosyllables from a choice of four words which differ only in vowels or consonants. It provides an estimate of auditory discrimination and assess the visual and combined auditory-visual discrimination ability.

Clarke in 1965 developed phonetically balanced rhyme test. This test consisted of three individual tests of phonemic identification in pre, medial and post vocalic position (cited by Dean C Garstecki, 1980) but its clinical applicability ha* not been established.

Pederson and Studebacker (1972) developed the Oklahome University closed-response test. This test attempts to evaluate the ability to discriminate among minimally contrasting initially and final consonants as well as medial vowels. Thus response alternative varies only in phoneme place of articulation. This test, when administered to the hearing impaired, yields prescriptive informatien since they have difficulty in auditory discrimination of minimally paired words differing only in place of articulation.

The California consonant test, developed by Owens and Schubert (1977) in very recent origin. This test has 100 items, 36 initial and 64 final consonant words with three foils for each. The test is useful for subjects with high frequency sensorineural deafness and persons having phonemic confusion (owens and Schubert, 1977; Schwartz and Surr t979). The informations also provides the audiologist regarding probable remediation to subjects with phonemic confusions.

Disyllabic words:

During World War II, attention was given at a efficient communication system of the military. Harvard University carried on studies in this ragard. Here, at psychoacoustic lab, speech recaption tests, based on the concept of threshold of hearing was constructed. The first was test No.9 and the auditory test No.14. Difference between the two was that test No.8, recorded at attenuated levels and test No.14 at a constant level. For both of these tests, same lists was used. Limitations of the lists used are the vocabulary was too large for many clinical patients.

Hudgien's (1947) selection of spondaic word was based on the following criteria:

1. familiar to listener
2. dissimilar in phonetic construction
3. a normal sampling of English, speech sounds
4. homogeneously audible.

To over came the limitations of test No.9 and auditory test No.14, Hirsh et al (1954) modified by the Harvard lists at the central institute of deaf and called it CID W-1 and W-2 test which is recorded versions of auditory test No.14 and No.9 respectively. They tried to restrict the vocabulary, so that it suits the clinical population. The familiarity was determined,had originally 84 words and selected 36 familiar words, which than recorded into six different forms. The words which were too easy, were reduced by 2dB and the most difficult words were increased by 2dB. The difference between the Harvard tests and CID W-l and W-2, ia that lower thresholds were obtained with the latter test. Threshold for the original spondee were on the order of 22dB while an average SRT of 14-15 dB was obtained for W-1 lists. Also, different thresholds were obtained when the attenuated recording (W-2). The difference was on the order of 4dB (18dB as compared to 14dB or 15dB for the W-1 test).

Monosyllabic words:

The analytic units of speech are monosyllabic words and are more easily repeated than nonsense syllables. Attempts have been made to balance the sound in any one list according to their normal frequency of occurrence in normal conversational English.

Carhart (1965) recommends the use of monosyllabic words for discrimination test, since they are meaningful to the patient and are nonredundant.

Egan (1948) developed PB-word list, at Harvard University to assess the intelligibility. The words were selected based on the following criteria.

a. monosyllabic structure
b. equal average difficulty
c. composition representative of English speech and
d. words in common usage.

Sentences:

The words used in the list in the measurements of intelligibility and the words used in spontaneous speech in daily life situation do not necessarily reflect ones hearing acquity. The relationship between them is not clear. Thus sentences are considered to be more valid and are better indicator of intelligibility.

There are few speech discrimination tests have been developed using sentences materials. At Bell telephone laboratory, Fletcher and Steinberg (1929) used sentences. The sentences were interrogative and had to be assured instead of repeating the presented stimulus. The list was not very useful since the patient inaddition to hearing the words of the sentence had to provide answers to some fairly difficult question. The case was also expected to know about New York city and its environment.

In 1942 Hudgins et al at Psychoaceustic laboratory developed a simpler lists of sentences and named it as auditory test No.12. There was provision for group testing where the subjects would write down the single word answers. The questions were easier, and could be answered by a single word for individual testing, the subject had to repeat the sentence he heard (cited by Hirsh, 1952; O'Neill and Oyer 1966). Hughson and Thompson (1942) found good amount of correlation between the SRT for sentences and the pure tone average.

The Kent State University speech discrimination testing developed by Burger (1969) has phonetically similar key words within sentences. Each sentences has five key words and any one of five key words in each sentence can be used meaningfully and correctly in the sentence. Subjects are instructed to identify the correct key word presented in a sentence context. The scoring is made based on the number of correct responses. The test material may be presented using audiotape or menitored live voice.

Jerger, Speaks and Trammal (1968) developed syntactic sentence material to control for word familiarity word and sentence length syntactical structure in sentence discrimination. The sentences are not meaningful but the word sequence within a sentence follows normal rules of English syntax. Sentences are presented in a closed-set response format usually with a competing message of continuous discourse at OdB signal to noise ratio.

For clinical purposes, Grant Fairbanks and a working group of Armed Forces - National Research Council Committee on hearing and Bio-acoustics (Davis and Silverman 1970) have been used for informal evaluation purposes. The sentences have high face validity but no standardized test has been developed using this material. Sentences have been grouped in sets of ten. Responses are scored on the basis of the listeners ability to recognize 50 key words incorporated within the sentences.

Speech Perception in Noise: To measure sentence discrimination, Kalikow et al (1977) developed the speech perception in noise (SPIN). Sentences were recorded in twelve speakers background babble with primary and competing messages on separate channels to permit variation in P/CM ratio. Half of the 500 sentences (50/form) were constructed to end in monosyllabic nouns of high predictability and the remaining half ending with nouns of low predictability. Scoring was based on the subjects ability to correctly identify the final word in an open-set response format. According to Hutcherson et al 1979, results of SPIN test results provide a more realistic estimate of speech discrimination ability under everyday listening conditions.

Connected discourse:

Though connected discourse la difficult to quantify with respect to the response of the observer, but its still considered to be a valid representation of speech.

Fletcher and Steinberg (1929) used lists of questions to which the listener has to give answers.

Falconer and Davis (1947), used the sample of connected discourse to which the subject listened and could adjust the level of the recorded speech to a point where he could just understand what was being said. The results were experimentally compared to auditory test No.l and the thresholds were found to be identical. The advantage of this test is in terms of speed, interest for the listener, less mental fatigue, high face validity, good reliability and negligible learning effect. The disadvantage is that they are subjective in nature and some subjects could give an erratic threshold (Falconer,1948).

Hudgins et al (1947) developed an easier tests in which, the listener was simply required to repeat the questions.

Dodds et al (1968) Eversten et al (1970) used lip-reading teats ia an auditory visual presentation mode te estimate the level of everyday communication disability.

Factors influencing speech thresholds and discrimination abilities:

There are various factors which affects the speech thresholds and discrimination abilities. Some of them are:

a) Recorded or live voice presentation
b) Descending vs ascending method
c) familiarity
d) Homogeneity of intelligibility
e) Carrier phrase
f) Phonetic balancing.

a) Recorded or live voice presentations:

Although, either recorded or monitored live voice technique can be employed to obtain speech threshold, ASHA (American speech and Hearing Association), 1979 recommends recorded presentation. The recorded version has advantage of standardized composition of words, standardized presentation, intensity consistency with in the list, and the same testing materials and presentation for each subject. The procedure ensures, presentation of each word will be unique to every client. The disadvantages of recorded presentations are that clinician may have to stop the recording in order to permit the client to respond to the test word before the next one is presented, in addition to wear and contamination of the records and disc after certain period (thus distortion may be introduced).

The monitored live voice testing has advantages such as its flexible pacing to the subjects speed of response, "Flexibility in choice of words necessary because of severe discrimination problems, age, maturational levels,normal use of language other than English ..."(ASHA Guidelines 1979; cited byR.R.Rupp 1980). According to Hopkinson 1978 monitored live voice testing fits the test to the clients needs. The disadvantages are that its difficult in monitoring the test words to a consistent intensity level and may not be possible to present each spondee in the same manner to every subject.

Studies by O'Neill and Oyer (1966), Beattie, Svihorec and Edgerton (1975) and Beattie, Forrester and Ruby (1977) suggests that there is no much difference between live voice testing and recorded SRTs.

Since testers presentations acts as a greater variability hence recorded presentations are more reliable than live voice presentation (William T Brandy, 1966). The monitored live voice routing of spondees is favoured by Portman and Portman (1961) Geston et al (1966) as it permits greater flexibility.

b) Descending vs ascending method:

ASHA guidelines (1977) propose that "threshold for the hearing level for speech is defined arbitarily as the lowest level in which half oar more of the spondaic words are repeated correctly with the minimum requirements of two ascending sample series". (Cited by R.R.Rupp, 1980).

In 1978 Hopkinson, reports that based on existing research, there is no clinically significant difference in SRT obtained in ascending or descending technique. But it is important, that the audiologist should differentiate between orienting segment of the search and the actual probing for the intensity level that would give fifty percent spondees responses. If we begin at 20 to 30dB level above the projected ST and then moves rapidly down to bracket the ST in 5-dB steps. The actual ST probe comes as the clinician moves up and down in established intensity increments within a brocketed intensity range.

Martin (1975), Chaiklin and Ventry (1964, 1971), Tillman and Olsen (1973), and Wilson, Morgan and Dirks (1973) proposed a suprathreshold beginning point at an intensity level 25-39dBn above the estimated threshold followed by a descending orientation approach and finally a descending threshold probe search for the 50 percent success level.

Robinson and Koengus (1979) reported that slightly lower speech thresholds resulted from the use of descending procedure.

Jerger, Carhart, Tillman and Peterson (1959) proposed Jumping around "from level to level in 2dB steps". But they don't specify an ascending or descending series of intensity-progressions.

c)Pamiliarity:

Familiarity depends upon the frequency of use by word count, various studies shows that repetition of list results in intelligibility scores.

Tillman and Jerger (1959) showed that the short term practise in the task of responding to spondes at threshold intensities does not influence spondee threshold SPL in normal hearing subject. However, when the prior knowledge of the test vocabulary given threshold was lowered by 4-5 dB compared to subjects which such knowledge was not given. The spondee thresholds established after familiarization were not only lower in the mean SPL values but also were less variable upon repeated testing (Jerger, et al 1959; Tillman and Jerger,1959). Therefore familiarization with test spondee was considered to be important step during establishing the spondee thresholds.

Carhart (1965) found that unfamiliar materials makes the test more difficult. But he concludes that it does not necessary mean that highly families word must always be used since at times we have to administer relatively difficult test.

Elmer Owens (1961) study on the intelligibility of words in familiarity showed that tests characterized by greater familiarity even to a slightest degree were significantly more intelligible.

In 1975 Conn Dancer and Ventry constructed a list of spondees which ware selected from CID W-1 teat to eliminate the need of familiarity. The result substantiated the importance of familirization.

d) Homogeneity of intelligibility:

Intensity homogeneity is essential with respect to audibility for the sentences that comprised their speech threshold materials. According to Tillman and Olsen (1973) homogeneity increases the probability of articulation function to rise from 0-100 percent with in a narrow range of intensity levels and also it helps in determining the threshold for speech with as small and number of items as possible.

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

e) Carrier Phrase:

The main purpose of using carrier phrase in speech audiometry is to alert the listener for the test word and allowing the announcer to monitor his voice. The content of the carrier phrase is not given much attention. Recorded forms of the PAL auditory test No.9 and No.14 and the CID w-1 tests all employ carrier Phrase.

Martin (1975) do not feel its essential that carrier phrase be used specially when monitored live voice testing is used. Hopkinsen (1978) does not pushes or against the use of carrier phrase. The ASHA guidelines has not reviewed this issue. Nixon (1969) also reports that carrier phrase do not any significant effect on intelligibility.

Kruel et al (1969) found significant differences in scores as a function of carrier phrase.

While studying the possible differences in intelligibility Gladstone and siegenthaler (1979) concluded that the intelligibility with the phrase "you will say" is best may be because of the long vowel /ei/ at the end and thereby giving additional cues to intelligibility. According to Lynn and Brotmen (1981) the phrase 'you will say...' phrase contains perceptual cues that enhances identification of place of articulation of the initial consonant of the test word.

f) Phonetic balancing:

The phonetic balanced lists (PB list) refers to the list of words consists of a group of single syllable words so selected that the frequency of occurance of speech sounds within the group is same as the frequency of occurance of the same sound in an average vocabulary of conversational language material.

Carhart (1965) concluded that difference is phonetic balance among lists are of only secondary influence as long as these are only moderate differences. In 1970 he concluded that precise balancing does not seem to be major importance from clinical point of view.

Fletcher (1965) data of relative frequency of occurance of English phonemes in telephone conversation was widely used.

According to Black and Heagen (1963) Lafer, Z.C.(1966), words should not be choosen based on phonetic balancing, but should be choosen based on information they carry.

SRT and pure tone averages:

Most of the audiologist and authorities have found a great positions correlation between PTA and SRT. Thus some authorities feel its not necessary to determine SRT (Silverman and Hirsh, 1955). According to Martin (1958) any discrepancy between PTA and SRT, then its important for determining accuracy of both PTA and SRT.

For practical purposes, the average pure tone thresholds for 500, 1KHz and 2KHz is considered for prediction of relationship between puretone and speech thresholds (Hepkinson, 1978).

Studies conducted by Fletcher (1980), Carhart and Porter (1971) opines that the average of the two smallest threshold levels among the three speech frequency, is also clinically useful.

When the testing equipment is calibrated to ANSI reference levels and that audiometric contour is not taken into account, the following formula may predict the SRT from pure tone average (Carhart, 1971).

$$SRT_{(Spondee)} \simeq -2dB + 0.57_{500Hz} + 0.57_{1000Hz}$$

(2dB is minor correct constant and T = thresholds).

Using regression aquation te predict the SRT Gjaevenes (1964, 1974) found a linear relationship between SRT and PTHL. The following formula was proposed by him for predicting the SRT from puretene hearing levels.

SRT - 0.8+0.34 HL (.5) +0.12 Hz (1) + 0.34 HL (2) +0.15 Hz (3) using this relationship he also found that the cochlear hearing loss cases yield same what lower SRTs than conductive hearing loss cases.

Jerger (1959) epines that the relationship between the pure tone average and SRT varies depending upon kind of speech threshold investigated, type of test material used and method of testing.

The interdependence of SRT and PTA becomes poorer at higher frequencies. Carhart (1946) found that if the notch is present beyond 2048Hz, its difficult to differentiate it from flat loss. Further it was also evaluated that acquity between 512Hz and 1024Hz is more clearly related to speech reception for equated words than is acquity between 1024Hz and 2048Hz.

Glorig et al (1954) conducted a survey and revealed a difference of 15dBSPL between threshold value at lKHz and spondee words for all ears in the selected normal group. Carso (1957) made similar observation, though he use used different criteria for selection of subjects. He reports a difference of 14dB SPL between the threshold for PT and for SRT obtained using CID auditory test W-2.

A difference of 16.5dB was observed by Lightfoot (1956) while studying 31 otologically normal subjects, between the threshold for lKHz and for spondee words.

"Carhart and Porter (1971) established the effects of audiometric configuration on the relationship between pure tone threshold and spondee threshold. It was found that l000Hz was a good predictor of SRT. Adding a second frequency improved the accuracy of prediction slightly. This second frequency varied with audiometric configuration. Adding a third frequency did not produces any practical improvement in predictability for SRT. Thus it was indicated that the audiometric pattern influences the threshold for spondees" (Cited by Tanuja, 1985).

Children's material:

The material used for children are different than those used for adults. Some of the tests lists are printed which may be administered by live voice testing or by self recorded presentation (Katz, 1982). These tests may have numbers, or environmental sounds. Both open and closed set formats are employed, and that mode of response may be by verbal or psycho-motor (such as pointing).

Speech material with children depends upon the age, and linguistic sophistication. One of the important factors that is considered is whether the child has intelligible speech. More intelligible the speech is, more the precise assessment.

Haskin (1949) developed 50 item phonetically balanced Kindergarten word list (PBR-50). Ross and Lerman developed word intelligibility by picture identification test. The WIPI uses a closed set response mode and is found to very useful with four and five year old children. It consists of 25 sets of coloured pictures. Each set of six pictures consists of four which rhyme and two others as foils to decrease scores due to guessing.

Since testing young children is a challenging task, selection of material (which should be within vocabulary of the child), conditioning strategies play an important role. some of the children may refuse to accept earphones and hence testing through Bowe conduction receiver may be attempted. (Edgerton, 1977? Vallentena and Stask, 1971). But this procedure do not permit, masking of the nontest ear.

Studies done in India:

Nikam (1968) in her research on "Adaptation of speech test material in English to Indian conditions" combined the words from W-22 and children's spondee list, and administered to seventy two undergraduates in Mysore for familiarity ratings. Out of eighty words, forty four words were rated as very familiar by seventy percent of the subjects. The words were intended to be used with the cases with a minimum high school education.

In 1970, Abrol, developed spondee and phonetically balanced word lists in Hindi, which was one of the early advances in India, with regard to speech audiometry. Though it was based on the frequency analysis of the speech components and familiarity, it faced the following drawback.

1. S.R.T. level not mentioned.
2. Articulation curve not given.
3. It did not include practice effect.

Using similar methodology in Tamil, Telugu and Malayalam Kapur (1971) developed speech test materials. In Malayalam languages, bisyllabic words were used for both SRT and PB word list as very few monosyllables words were available in that language. In Tamil language, the list failed to represent all the sounds which do occur in Tamil language and are used as an distinctive feature in the perception of speech in Today's Tamil (Somasundaram, 1973).

Swarnalatha (1972) made an attempt to standardize spondee and PB word list in English on Indian population. The test is meant only for literates.

Nagaraja, (1973) developed synthetic speech identification test in Kannada language.

N.S.De (1973) developed spondee and PB word list in Hindi and claimed that it could be used all over India. However ability of this test is retricted only to -Hindi speaking population.

Maya Devi (1979) constructed a speech discrimination test which could be used with the Indians.

PB word lists in Tamil language was developed by Dayalan (1976) and yielded similar results when compared to any other valid test of discrimination.

Rajashekhar (1976) developed picture SRT test for adults and children in Kannada. Words were not Homogeneous since articulation function for this word list extended over 30dB.

Hemalatha (1981) developed SRT test in Kannada for children, picturable polysyllabic words were used as stimuli. The subjects were between age range of 3 to 5 years and mean SRT was found to be 11dBHL. The test is standardize only to school children.

In 1983 Asha studied effect of word familiarity on speech discrimination scores and found that words that were highly familiar were more correctly discriminated than those which were less familiar.

Mallikarjuna (1984) developed spondees and monosyllabic word lists in Gujarathi language.

In 1985, Tanuja, developed speech material in Manipur language. Her findings were that obtained SRT was 13dB (ref. 0dBHL = 20dBSPL) and maximum discrimination score was attained at 40dBSL.

METHODOLOGY

METHODOLOGY

Purpose of the present study was a* follows:

1. To develop speech material in Bengali language.
2. To standardize the speech material (SRT and discrimination test materials) in Bengali language, using Bengalies as subjects.

To facilitate the purpose of the study, the methodology had the following proceedings.

1. Collection of polysyllabic and monosyllabic (CVC) words and familiarizing them.
2. Construction of lists of 'most familiar' polysyllabic and monosyllabic words.
3. Standardizing the speech materials with Bengali speaking adult subjects.

Procedure:

Polysyllabic and monosyllabic words were collected from periodicals, journals, phonetic books, and spontaneous speech. This resulted in accumulation of collecting about 525 poly-syllabic and 125 monosyllabic words. These words were sent to persons residing in various district of West Bengal for the purpose of familiarity. They were instructed to rate the familiarity using three point scale i.e. Highly familiar, familiar and unfamiliar.

From the list, the words which were most familiar, were choosen and as such 90 polysyllabic and 75 monosyllabic words were rated to be most familiar. Of this, 60 polysyllabic and 75 monosyllables were taken randomly.

Thus the lists, which aims at assessing SRT consists of 60 polysyllabic words choosen, randomly from, a list of most familiar polysyllable words. The material, which aims at assessing speech discrimination ability, consists of 75 monosyllabic words, choosen randomly from a list of most familiar words (These lists are shown in Appendix-I and II).

Recording: Recording was done by using Philips Deck, Cassete tape recorder, in sound treated room.

The recording was made by an adult male talker whose mother tongue is Bengali. All the test item was recorded proceeded by a carrier phrase "এখন বলুন" "dek^{h}an Bolun". The words had interstimulus interval of 5 seconds.

Subjects:

Six subjects, whose mother tongue is Bengalee and were fluent in reading, writing and speaking in English and Bengali, was choosen for this study. The age range is from 18 years to 25 years average age being 21.8 years. They have normal hearing (less than 20dB, ANSI 1969) with no history of otorhinolaryngological disorders. Of this 4 were males and 2 females. (The average PTA of the subjects were 10.16dB).

Instrumentation:

A 2 channel diagnostic audiometer GSI-16 (Grason-Stadler Incorporated), which is calibrated in accordance with ANSI Standards was used. A cassete deck (Philips) was used to feed the speech material. The recorded words were played by tape recorder and was fed to the tape input of the audiometer which in turn fed to earphone (TDH-39) coupled with MX-41/AR ear cushion. B&K equipments (Bruel and Kjaer) were used for objective calibration of the audiometer, (Artificial ear B&K type 4952? Sound Level Meter B&K type 2203, Octave Filter B&K 1613 and 1" condenser microphone B&K type 4144 were used) in a sound treated room.

Test environment:

Study was conducted in two situated room sound treated room. One of the room was used for control room and the other for testing room. The noise level of the test room was regularly checked, using a sound level meter, B&K type 2203 with octave filter set, B&K type 1613 and a 1" condenser microphone, B&K type 4144. It was done to ensure that noise level of the audiometric room is with in permissible limits.

Test procedure:

All the subjects were subjected to routine audiological testing pure tone thresholds at 500, 1000 and 2000Hz were obtained for each subject, using 10 down of 5 up method of threshold measurement (David S.Green).

Standardization of SRT test material:

The most familiar words, obtained, were divided in to three lists randomly. Each list thus obtained was again randomised six times forming six different lists. This was done to eliminate practise effect. Thus the 3 lists had 18 randomized lists. Each list was presented at six different intensity levels at an interval of 5dB, such as 0dB, 5dB, 10dB, 15dB, 20dB and 25dBHL (ref. to 0dB HL = 20dB SPL). Each one of the eighteen lists, was presented only at one intensity level. The subjects were Instructed to respond only to the test word. A time gap of 5 seconds was given to the subject to respond. Responses were converted to percentage.

The level at which subject repeats correctly 50% of the test items, was taken as SRT level.

Standardization of speech discrimination test materials:

The 75 monosyllabic words which were most familiar as collected were divided into three list consisting of 25 words. Each list was again randomized into five list and was presented at five different intensities levels such as 5, 10, 20, 30, 40dB above subjects established SRT responses were noted down in the similar manner like polysyllabic words. Scores were then converted to percentage.

Recording of responses:

For scoring and noting subjects response, talk back system was used. The subject repeated the word and the examiner recorded the correct responses. The number of correct response obtained was converted into percentage at every intensity levels. This was done for further analysis.

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

Articulation gain function curve for the three polysyllabic word lists are shown (in figure 1-3). From the tables and the figures it is evident that percentage of correct response (intelligibility) increases with increase in sensation level. Figure 4 shows the articulation.

Gain function curve for lists A to C (combined) for poly-syllable words. Table-2 shows the mean percentage of correct response at various intensity level.

In this study, the mean SRT level was attained at 12dBHL (ref. 0dBHL - 20dBSPL). The average pure tone average of the subjects take for the study was 10l6 dB. The difference between PTA and SRT for the polysyllable word list is thus 1.84dB which shows that all these three lists yield almost equivalent scores at different hearing levels.

Figures 5-7 shows the scores obtained with the monosyllabic words lists maximum discrimination scores obtained is 30dB SL (ref.SRT) for list A and list C whereas for list B the maximum level was obtained at 40dB SL (ref.SRT). In this list (B) at 30dB SL the maximum score was 92%. Figure 8 shows the combined articulation function curve for lists A - C using monosyllable words.

Table-3 shows percentage of current response at various intensity level (Ref.SRT). This result is in close agreement with other findings. Abrol (1971) obtained 100% articulation score using Hindi PB worts at 30dB SRT, Kapur (1971) obtained 100% discrimination score at 45dB (relative intensity) and at 44dB (relative intensity) using Malayalam and Tamil word lists respectively, Dayalan (1976) obtained 100% discriminatien score at 35dB SL (Ref.SRT) using Tamil words. Mayalam (1974) obtained 100% score at 30dBSL (ref.PTA) using English words, where as Swamalatha (1972) at 33dB SL (Ref.SRT) for adults and 36dBSL (SRT) for children using English lists. Tanuja (1985) obtained maximum score at 40dB SL (Ref.SRT).

Thus the speech discrimination test clinically in Bengali may be administered at 30dB SL using list A&C and 40dB SL using list B above SRT.

Table-1: Showing the Discription of the subjects (Total number of subjects=6.

NO.	Age	Sex	Hearing Level In dB			PTA in dB	S.R.T. (English)	S.D.% (English
			500HZ	1KHz	2KHz			
1	25 years	M	5	10	15	10	15	100%
2	21 years	M	5	10	10	8	10	100%
3	20 years	F	5	10	15	10	10	100%
4	25 years	M	0	10	15	8	15	100%
5	18 years	F	10	5	15	10	5	100%
6	22 years	M	15	10	20	15	15	100%
Average	21.8 years					10.16	11.66	100%

PTA - Pure Tone Average

SD% - Speech Discrimination Score Using English Monosyllables

SRT - Speech Reception Threshold Using English Spondees.

Table-2: Showing the mean of the percentage of correct polysyllabic words at six hearing level.

Hearing level in dBHL	Mean value in percentage		
	List-A	List-B	List-C
0	10%	5%	10%
5	25%	20%	30%
10	40%	45%	45%
15	65%	60%	60%
20	90%	85%	90%
25	100%	100%	100%

Table-3: Showing mean discrimination scores (%) at different sensation levels for the List A to D.

Sensation level in dB (Ref.SRT).	Mean value in percentage		
	List-A	List-B	List-C
5	28%	24%	32%
10	72%	64%	68%
20	88%	88%	92%
30	100%	92%	100%
40	100%	100%	100%

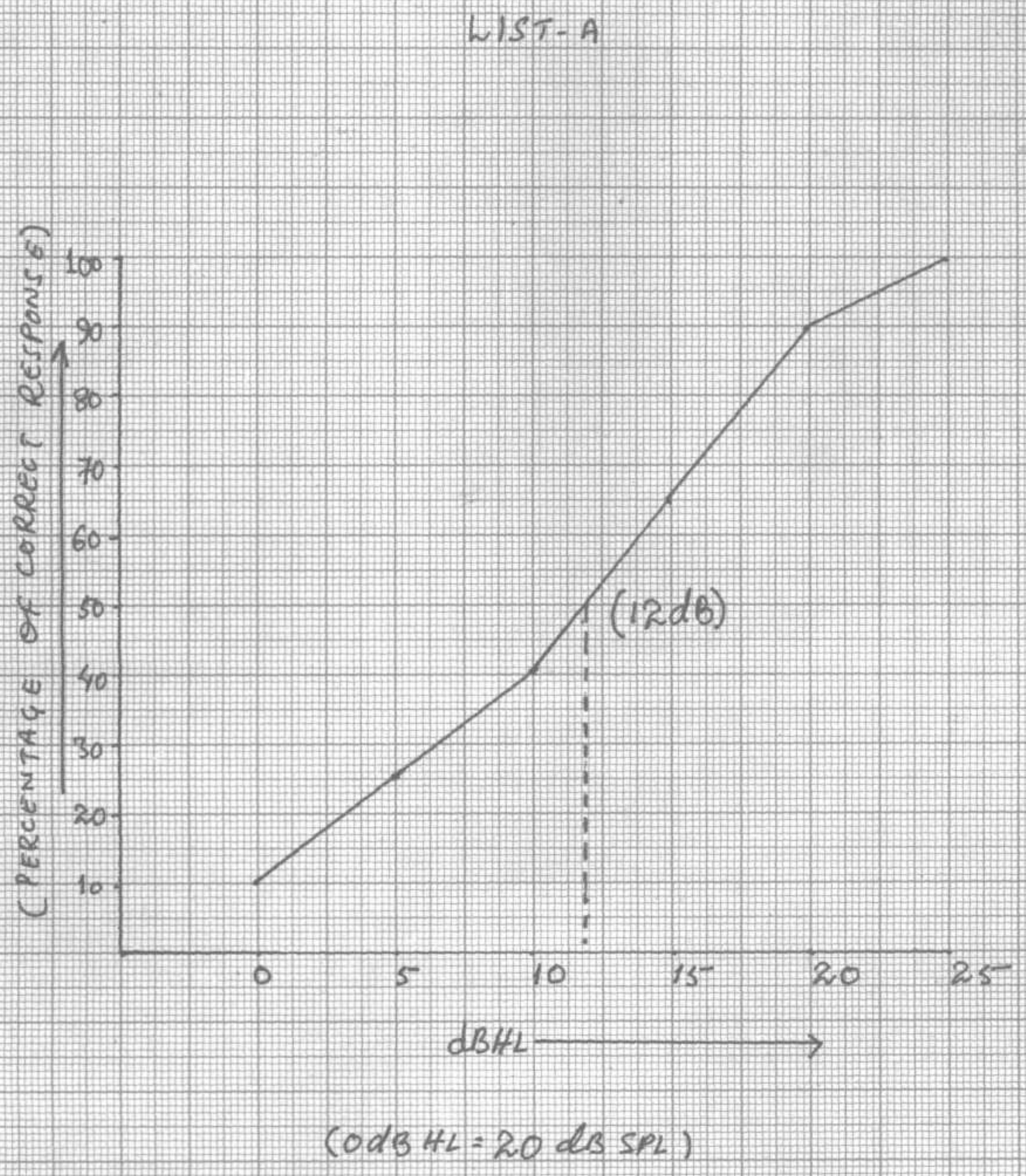


Fig.1: Mean articulation curve for polysyllabic words (List-A)

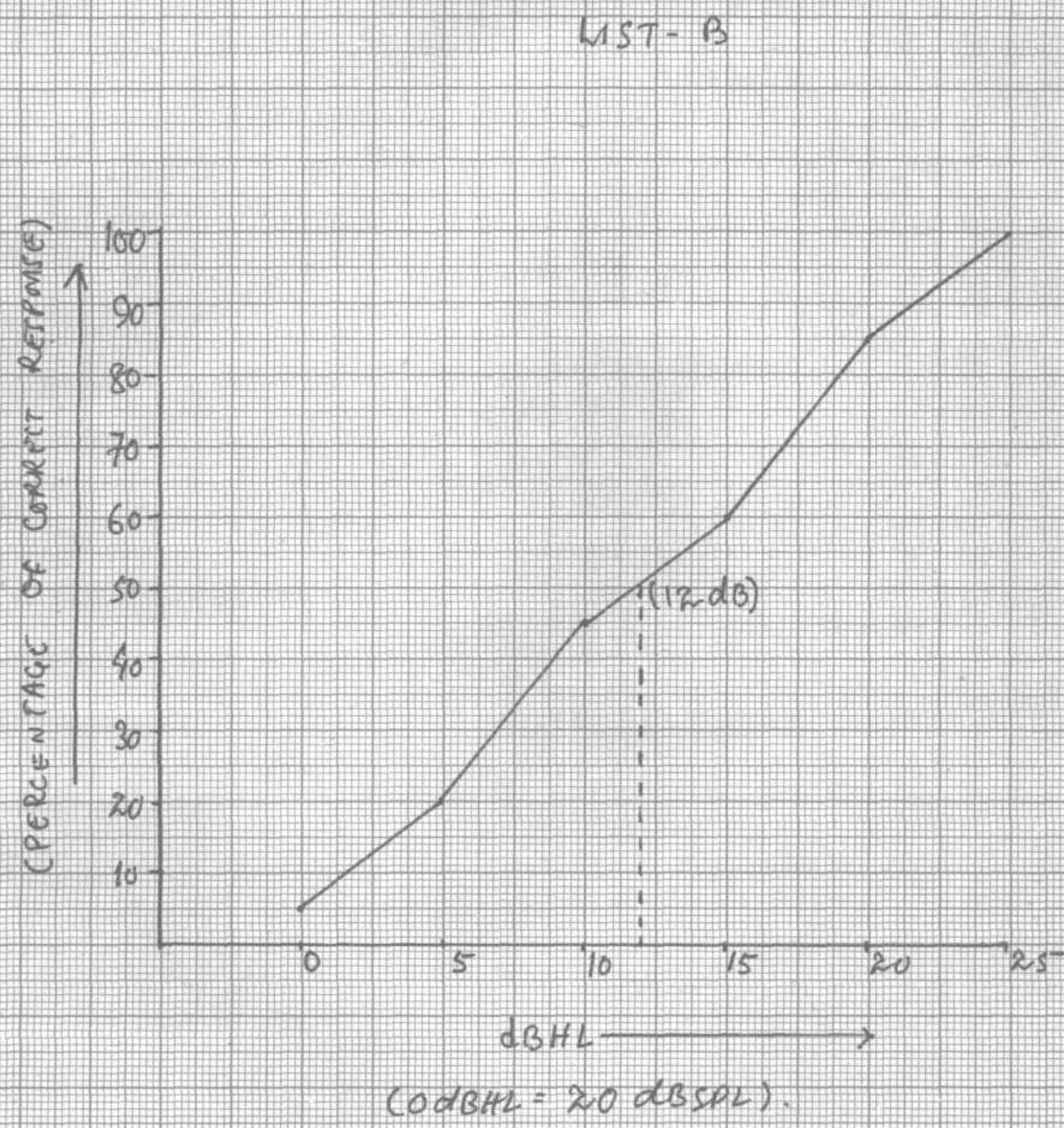


Fig.2: Mean articulation curve for polysyllabic words (List-B).

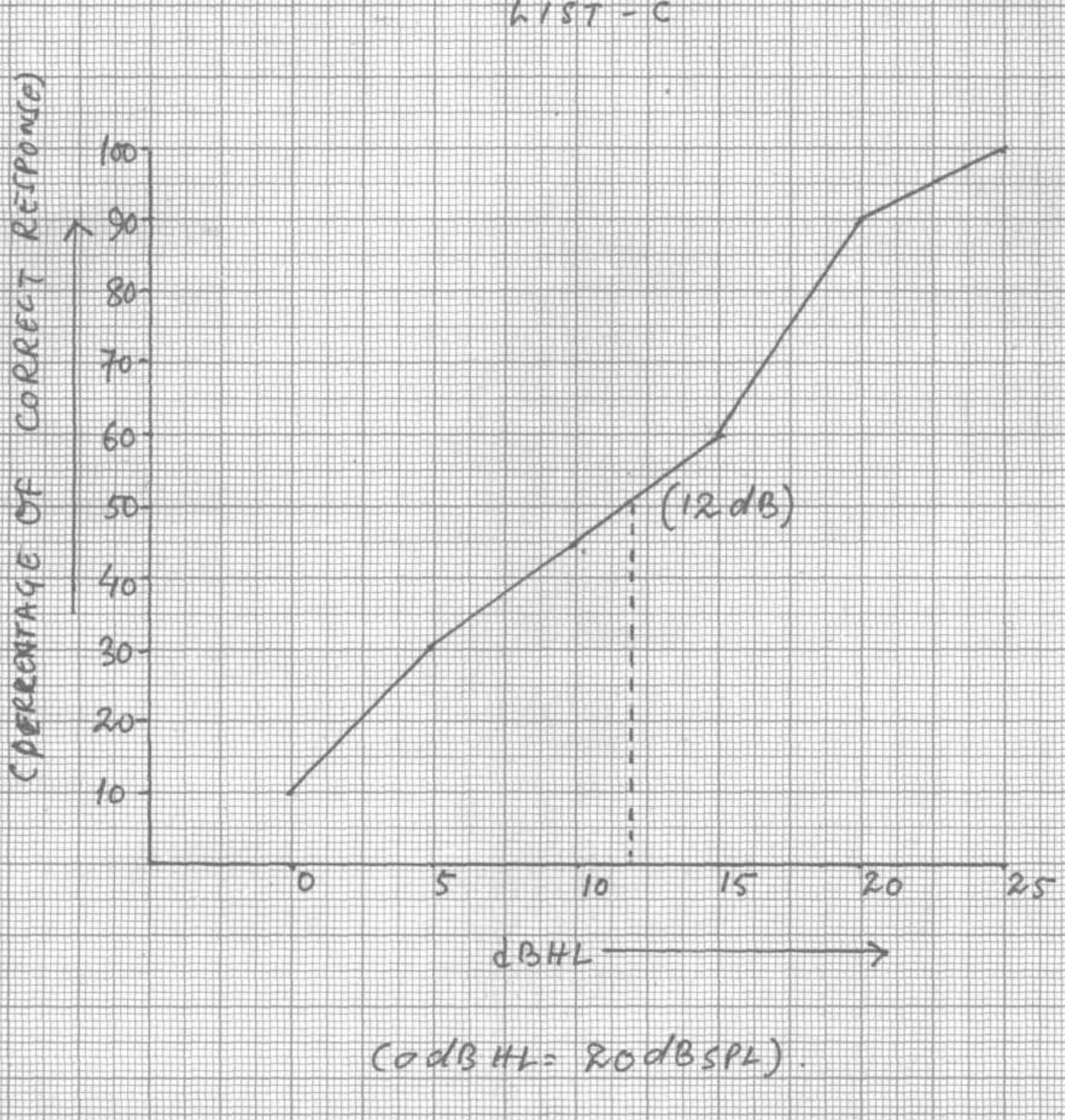


Fig.3: Mean articulation curve for polysyllabic words (List-C).

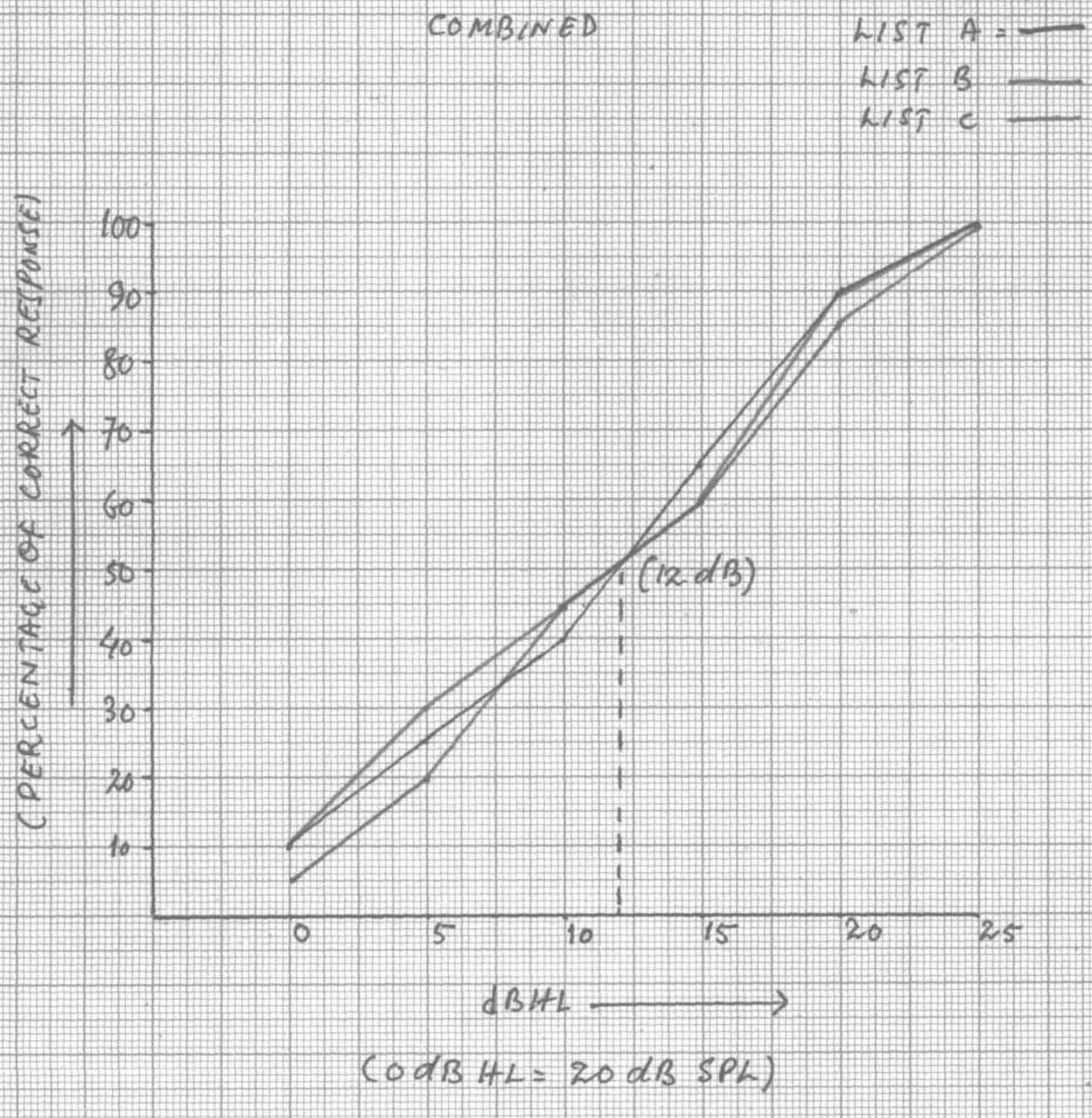


Fig.4: Mean articulation curves of polysyllabic words for List A to List C.

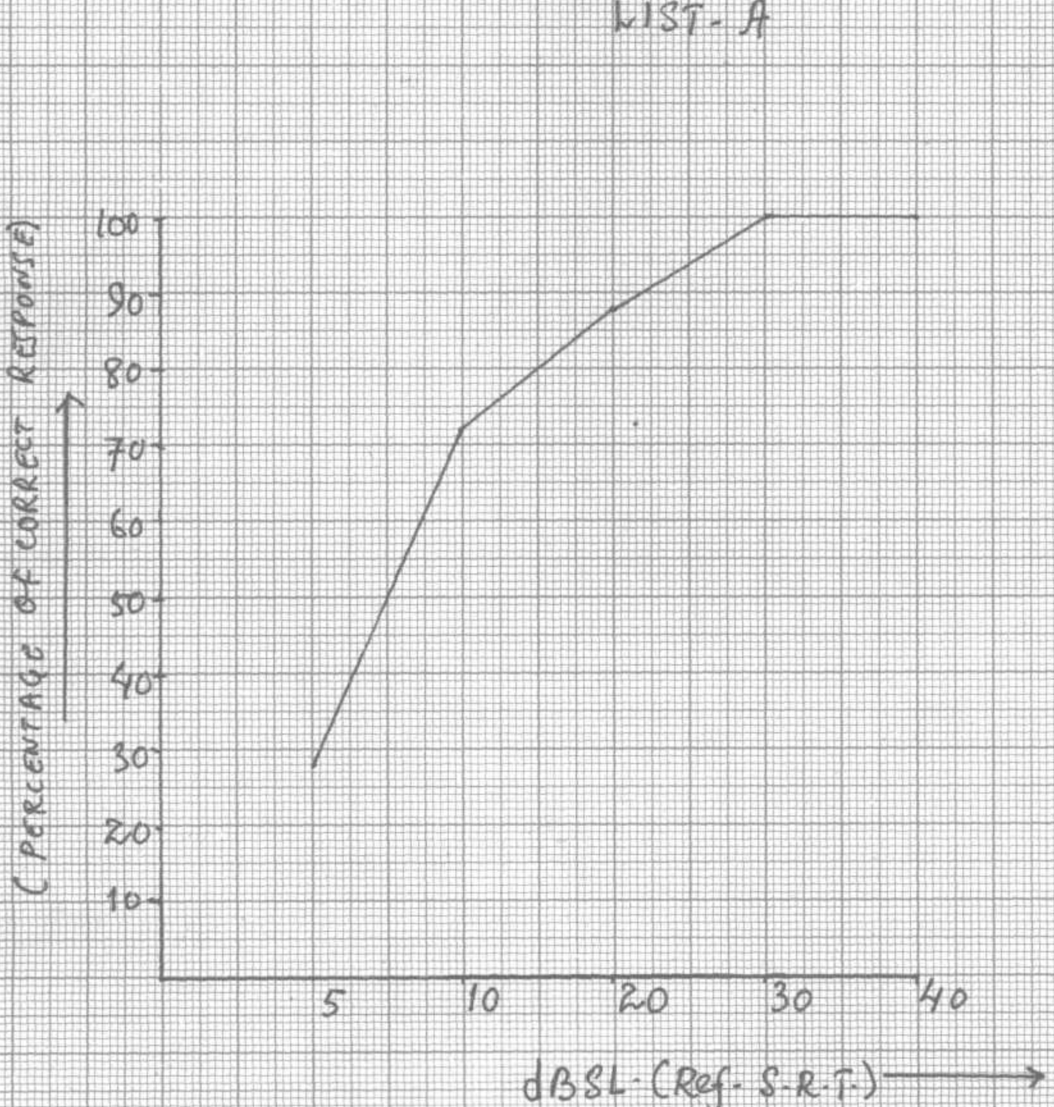


Fig.5: Mean articulation curve for monosyllabic words (List-A).

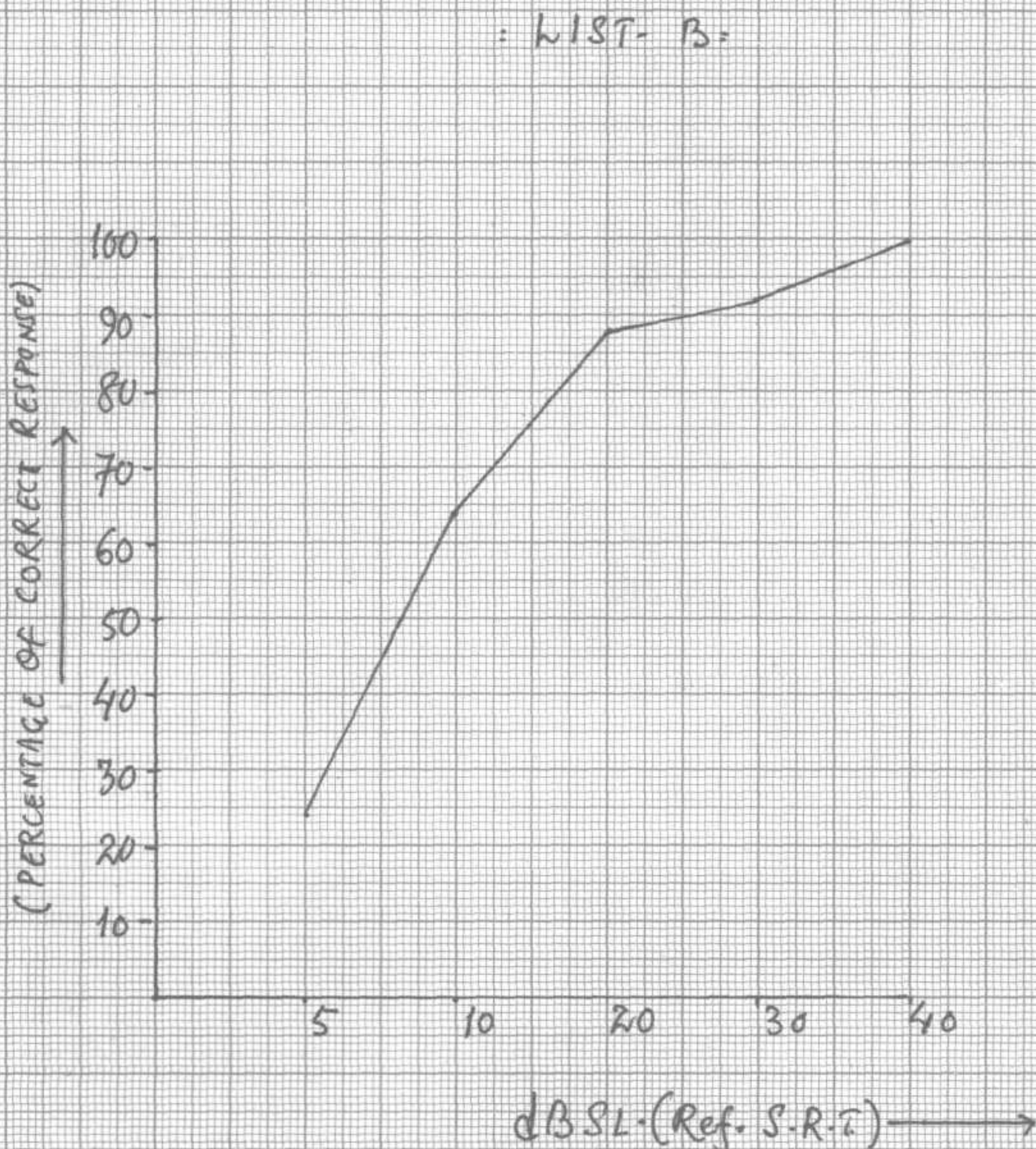


Fig.6: Mean articulation curve for monosyllabic words (List B)

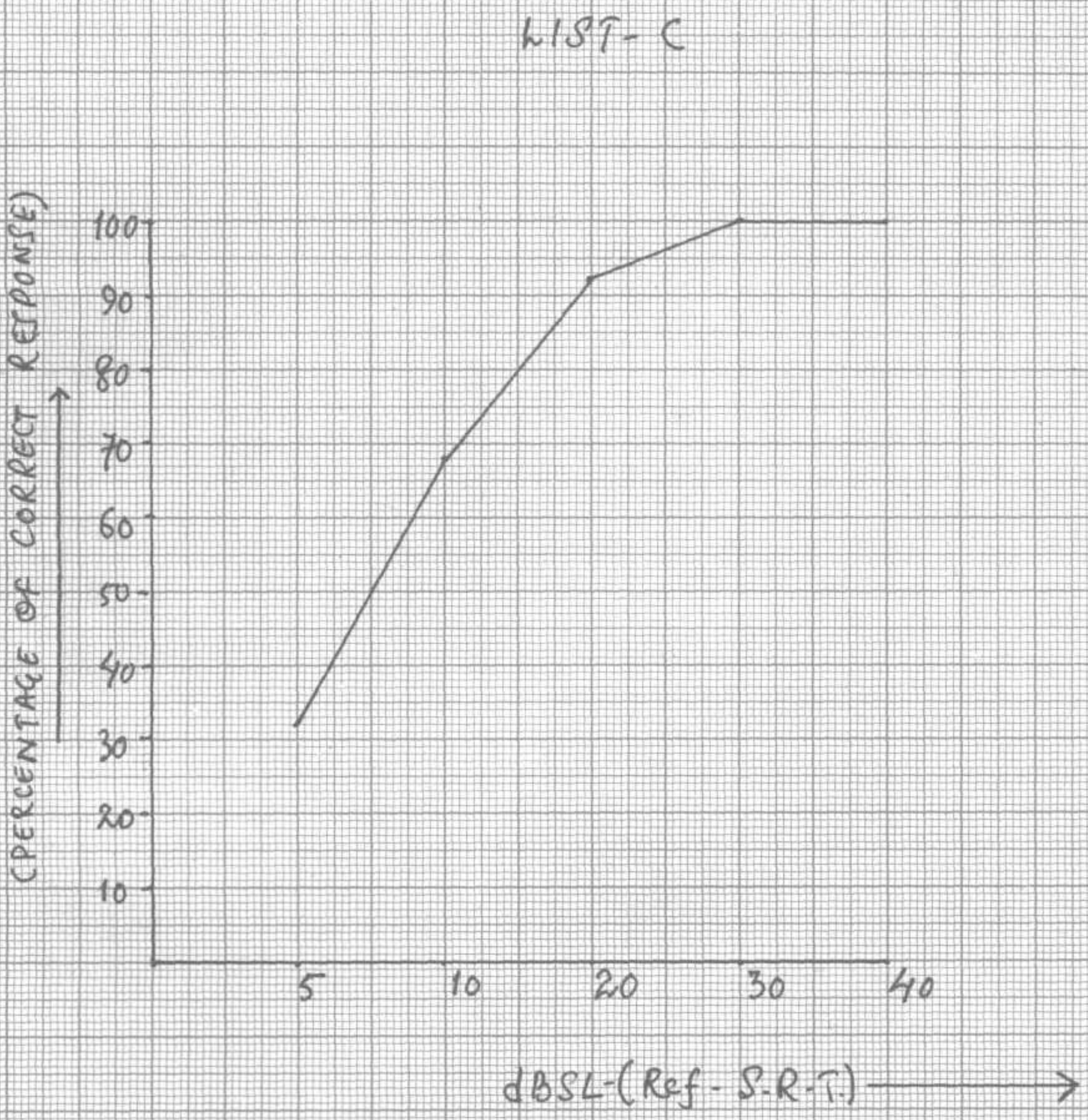


Fig.7: Mean articulation curve for monosyllabic words
(List C)

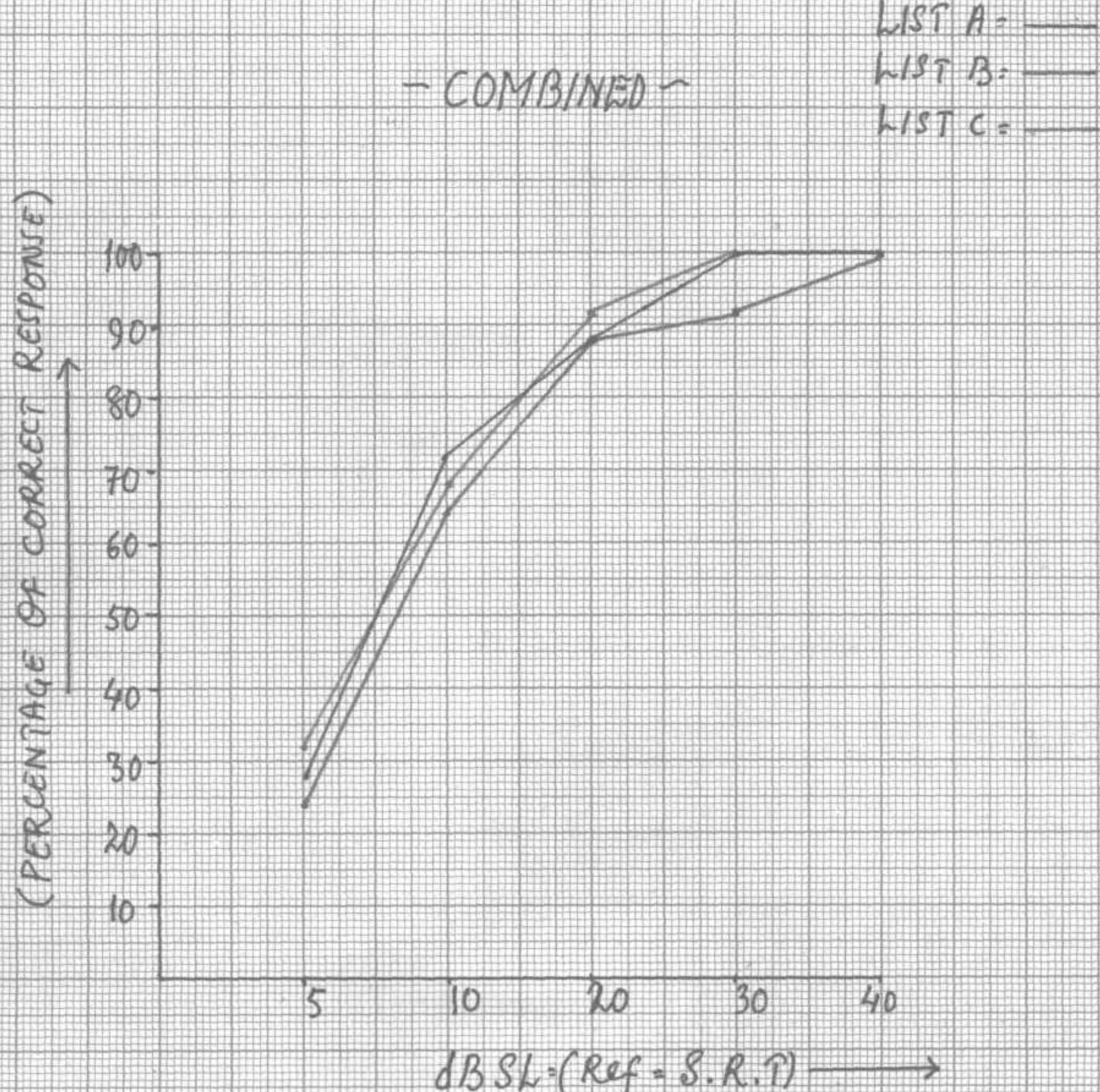


Fig.9: Mean articulation for monosyllabic words for list A to List C

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The objective of the study was to construct and standardize speech material in Bengali language to facilate the speech audiometry procedures (both SRT and speech discrimination testing).

Sixty polysyllables, seventy five monosyllable words, which were rated to be most familiar by fifteen adult Bengalis) were selected for the study.

The polysyllables were divided into three lists (consisting of twenty words) and each list was randomized in six list to oner come practise effect. The level of presentation for the lists were 0, 5, 10, 15, 20 and 25dBHL (Ref.OdB HL = 20dB SPL). The established SRT level were 12 dB (ref. OdB HL = 20dB SPL) which is in close agreement with PTA of 10.16dB.

The monosyllables were too divided into three list and each of the list was further randomized to five list. Each of these randomized list was presented at 5, 10, 20, 30, 40 dB SL (ref.SRT) The established hundred percent score was at 30dB SL for list A and list C. For list B, the established 100% score was achieved at 40dB SL.

The recorded speech materials were fed to the tape input of the audiometer and six subjects were selected for the study. Two of the subjects were presented with one list of polysyllables and one list of monosyllables.

Conclusion:

1. Established difference between SRT and PTA is 1.84dB.
2. Established hundred percent score was achieved at 30dB SL for list A and C and for list B its 40dB SL.

Limitation;

1. The study was limited to only graduate students
2. Limited population tested
3. Reliability with clinical population not tested
4. Only three lists are tested.
5. The words are familiarized with adults and its validity with children is not tested.

Recommendation:

1. Standardization be done with larger population
2. Clinical population should be tested.

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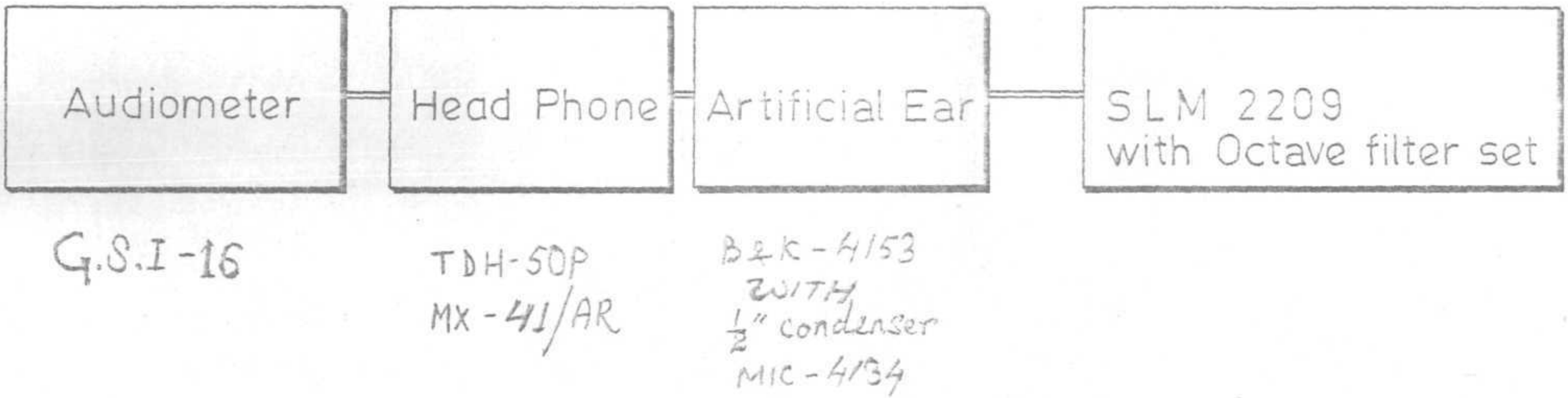
CALIBRATION

The audiometer GSI-16 (Grason-Stadler,INC) was calibrated objectively prior to the collection of data and was periodically checked. The audiometer was calibrated both for frequency and intensity and also for pure tones and speech.

PURE TONE CALIBRATION

Pure tone was calibrated for frequency and intensity for frequency calibration, the out put of the audiometer was given to a frequency limen/counter (Rodart 203), the intensity out put was set to maximum. The tone switch (interrupter switch) was put to continuous position. The difference between the dial reaching on the audiometer and digital display of a given frequency did not exceed permissible limit ($\pm$3Hz) recommended by ANSI 1969. The intensity calibration was done using Artificial ear (B&K 4153) and half inch condenser microphone 4166, which was connected sound level meter 2209 (B&K). (Schematic diagram). The output of the audiometer was kept at 60dB and for each frequency, the difference was maintained at $\pm$3dB (ANSI, 1969).

For calibration of speech output, speech noise was used. The VU meter was so adjusted to give 'O' reading on the dial. The intensity was set to 70dB and the mode of the audiometer switched to speech mode. The tape input of the audiometer was too calibrated with the tape recorder used for the study.


Audiometer
Head Phone
Artificial Ear
SLM 2209
with Octave filter set
G.S.I-16
TDH-50P
MX-41/AR
B&K-4153
WITH
1/2" condenser
MIC-4134

LIST-A	LIST-B	LIST-C
এক	খুন	কাঁচ
কাঠ	ছাপ	ঘাম
খাম	তিল	জাত
গাছ	পাল	তিল
লাল	কূপ	দোষ
ছয়	চোঙ	ভুল
ঝাল	তাস	কর
ঢাল	না	গান
তিন	কাঁধ	জীব
দর	চাপ	ঢোল
ধার	ঢোক	দাম
ফল	রাত	পান
আট	কল	কাজ
কম	ঘি	খুব
কোল	ঠিক	চুন
গাল	দিন	ডাল
মাছ	কাল	দল
চোর	গোল	নাম
জাল	ধূপ	আর
টিন	দান	খাল
তার	আম	চাল
থাক	গম	টক
দিক	জাম	তাপ
নাক	দা	ধান
বাঘ	ভাত	চিল

MONOSYLLABIC WORD LISTS

পথ-ঘাট	সাত দিন	চালডাল
খাল-বিল	লোকসান	ভেদভাব
ঠিক-ঠাক	হালচাল	বদমাশ
চোখ-মুখ	কারবার	জোরদার
হাত-পা	সোমবার	কবিয়াল
নাচ-গান	সাবধান	চোখমুখ
ঘর-দোর	হারজিৎ	মারপিঠ
ডাল-ভাত	বারবার	রাজহাঁস
বর্বর	ঝক্‌ঝক্‌	মাছভাত
টক-ঝাল	সাতপাক	নামধাম
ফল-ফুল	হাটমাঠ	লোকজন
লাল-নীল	ধুমধাম	গোলমাল
ভাই-বোন	ফুটবল	ফেলপাশ
কিল-চড়	রাজপথ	লেনদেন
জাত-পাত	দরবার	ডাকঘর
দর-দাম	রাতদিন	নাককান
ঢাক-ঢোল	চিৎকার	বুধবার
চার-পাঁচ	দানধ্যান	সম্মান
ঝড়-জল	হরদম	গোলগাল
মিট-মাট	জোতদার	লোকদল
LIST-A	LIST-B	LIST-C

POLLYSYLLABIC WORD

LISTS