UPDATING MATERIAL FOR SPEECH AUDIOMETRY- A REVIEW

Register No. M 9816

Independent project submitted in part fulfillment for the first year M. Sc, Speech and Hearing to the university of Mysore

All India Institute of Speech and Hearing
Mysore, India.
May, 1999

DEDICATED

To my dear *Amma* and *Nanna*

CERTIFICATE

This is to certify that the Independent Project entitled "*UPDATING* MATERIALS FOR SPEECH AUDIOMETRY - A REVIEW" is the bonafide work in partial fulfillment for the first year M. Sc (Speech & Hearing) of the student with register No. M 9816.

Mysore, India
May 1999

Director
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CERTIFICATE

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This is to certify that the Independent Project entitled **"UPDATING *MATERIAL FOR SPEECH AUDIOMETRY - A REVIEW* "** has been prepared under my supervision and guidance.

Mysore, India
May 1999

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DECLARATION

This Independent project is the result of my own study undertaken under the guidance of **Dr. Rajalakshmi .K,** Lecturer, **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.

Mysore, India
May 1999 . **Register No. M9816**

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INTRODUCTION

What is speech Audiometry ?

Speech Audiometry is an important element in the battery of audiometric tests. It has come into existence because of some inherent disadvantages in puretone audiometry. An audiometer is calibrated in dB HL for speech It should be capable of presenting speech materials by monitored live voice tape or disc recording.

Threshold tests measured in speech audiometry include measurement of patients thresholds for speech recognition threshold (SRT), speech detection threshold (SDT), most comfortable loudness level (MCL), range of comfortable loudness (RCL or DR) and word recognition scores (WRS).

Speech threshold may be of two kinds, the speech detection threshold (SDT) and speech recognition threshold (SRT).

Speech Reception Threshold (SRT)

Speech Reception Threshold is the lowest level at which a person correctly recognizes the speech stimuli 50% of the time. Usually recognition is indicated by repetition of the speech stimulus item. Terms other than SRT include spondee threshold and speech reception threshold. These two have been used synonymously with speech recognition threshold. It is an important tool serving many clinical purposes such as

(a) Penniting the evaluation of the well documented relation between Speech and puretone sensitivity thereby providing a check on the validity of the puretone thresholds essential for speech recognition (Carhart 1952 ; Chaiklin and Ventry 1964).

(b) Providing a reference intensity level for suprathreshold speech recognition testing (ASHA 1979, Wilson and Margolis 1983).

(c) Providing an estimate of the hearing sensitivity in the speech frequency range in difficult-to-test patient (example cannot be conditioned to respond to puretone stimuli (ASHA 1988, Wilson and Margolis 1983).

(d) Assessing amplification performance and monitoring progress in aural rehabilitation / habilitation (ASHA 1979; 1988; Wilson and Margolis 1983).

Speech Detection Threshold (SDT)

The speech detection threshold (SDT) is the lowest hearing threshold level at which a person correctly detects the presence of speech stimulus 50% of the time. The term "Speech Awareness Threshold" (SAT) has been used synonymously with SDT. SDT is preferred to SAT because the nature of the listener's task is more precisely specified with the former than the latter term.

Uses of Speech Audiometry

Speech audiometry helps in earlier detection of slight Losses, otherwise overlooked and provides better documentation of initial or slight gains after therapy (Carhart 1965).

! - Helps in a better assessment of differences among hearing aids.

- Helps in better diagnosis in cases of high frequency loss and non-organic loss.

- To determine the patients ability to perform at suprathreshold levels.

- To determine patients social adequacy index.

- The SRT scores provide information regarding the communicative handicap imposed by the hearing loss. Assist in the selection of appropriate amplification and serve as one of the basis in developing an organized aural habilitation program.

- Through use of speech audiometry diagnosis can be made regarding the type of hearing disorder and the general site of pathology. It is in addition an aid in verifying the reliability of puretone test results.

- Both in children and adults various thresholds can be identified using speech audiometry.

Aim of the Study

- To compile speech materials used in speech audiometry in different language of the world.

- To develop a profile for the Indian population (Adults and Children).

Materials for speech audiometry may include connected speech two syllable (spondaic) words, monosyllabic words, sentences. The growth in the general acceptance and use of speech audiometry is accompanied by need for standardization so that the test results of one clinic can be compared with those of another clinic.

The present study aims at reviewing the literature available with respect to the materials used in speech audiometry in different languages. This study comprises of a review of available literature from.1980. .to.1998

It is also aimed (at the end of the study) whether it is possible to develop profiles for Indian population with the existing materials. An attempt is made to include studies which have used monosyllabic words to sentences (connected discourse).

REVIEW OF LITERATURE

History and Development of Speech Audiometry

Specially designed speech recognition tests have been in regular use for just over 50 years. However speech was used as test material for hearing assessment as far back as two centuries ago when Fraund and Pereire in the middle of the eighteenth century and Itard at the beginning of the nineteenth century used speech to evaluate the effects of auditory training on their patients speech perceptual abilities (Urbantschitsch 1895).

It is true that these early attempts in the measurement of hearing for speech have very little in common with what we now refer to as speech tests of hearing. They did however stimulate discussion especially among otologists towards the end of the nineteenth century (Gruber 1891). This debate was also facilitated by a series of timely scientific inventions that had considerable influence on the development of speech audiometry. In 1876, Alexander Graham Bell invented a transducer that converted sound energy to electrical energy and vice versa. In 1877, Thomas Edison patented the phonograph which was later on suggested for use in the measurement for speech (Bryant 1904).

It is of interest to note that in 1874 Wolf had suggested that human voice was the "most perfect conceivable measure of hearing". He constructed a table of intensity values for the various sounds of the German language. The intensity rather than being expressed in decibels were expressed in paces or distance from the speaking source. The major testing materials were consonants syllables and words. Later in 1890, Wolf

recorded words on an Edison wax cylinder. He was able to present the words to the patient through adjustable tubing which permitted control of the intensity of recorded materials (O Neil and Oyer, 1966).

- Development of SRT Test Materials

Fletcher and Steinberg (1929) and their colleagues at Bell Telephone Laboratories assessed the efficiency of speech transmission through communication systems such as the telephone. Fletcher and his colleagues referred to the speech recognition score as the articulation score. They measured the articulation scores as a function of intensity level using consonant vowel (CV) or consonant Vowel Consonant (CVC), monosyllables. The plot of these data was considered the articulation function.

Hudgins, Hawkins Karlin and Stevens (1947) developed phonographic recordings at the Harvard Psychoacoustic Laboratories of two spondaic words lists, each list containing 42 spondees. These test the PAL Auditory Test No.9 were used clinically for measuring the patients speech threshold.

During World War II considerable effect was expended in the development of articulation testing methods for the evaluation of various types of military communications equipment. Certain test developed at the psycho-Acoustic Laboratory Harvard University were applicable to the clinical evaluation of hearing.

Psycho- Acoustic Laboratory (PAL) Auditory Tests No.9 and No.12 for measuring the threshold of intelligibility for spondaic words and for sentences respectively were made available on phonograph records for clinical use first for military

rehabilitation centers and then for more general use. These two recorded tests permitted a quick and reliable measure of the threshold of intelligibility it's related clinical measure the hearing loss for speech (Hudgins 1947; Hirsh 1947). The speech stimuli available as test materials range from very simple to very complex items. At one extreme of the stimulus dimension are the phonemes syllables and words all of which are widely used in evaluative measures (Erber 1977). These brief stimuli are preferred because (1) many can be presented within a short amount of time (2) they are easily scored with a right or wrong criterion (3) they can easily be presented within a set closed format (4) numerous examiner explain a child's perceptual confusion. The main drawback of such simple stimuli is that they do not form the typical content of everyday speech communication.

At the other extreme of the stimulus dimension are phrases, sentences and connected speech all of which are very desirable as test materials because they represent the stimuli that hearing impaired child normally encounters in daily conversation. The main difficulty using such speech materials is that the scoring of large language units, such as sentences may not be an easy task.

Criteria for the Test Construction and Administering it

a) Type of the Speech Material used in speech discrimination test ranges from nonsense syllables to sentences. Nonsense syllables have been found to be rather abstract causing considerable confusion to the subjects (carhart 1965). One such test is one constructed by Mayadevi (1974). One advantage of nonsense syllables is that they facilitate the measurements in cases where intelligibility score is high (Pederson 1970).

Several tests have been developed for the adult population. One of the early ones that was developed at Psycho-Acoustic Laboratories (PAL) Harvard where series of tests were constructed and underwent numerous revisions. These were the revised monosyllable word lists. Egan (1984) from a core vocabulary of 1200 words, 24 lists of 50 words each were produced.

Monosyllables provide this desirable factor, since they are sufficiently unpredictable. In addition they serve as an easy task for the listener because of contextual cues. By using monosyllable words it is possible to construct word lists that are highly familiar as well as phonetically balanced.

Polysyllabic words have been found to yield higher intelligibility than monosyllabic ones under the same conditions this is due to the fact that they afford more cues for discrimination than do monosyllabic words. Some of sentence tests include the CID sentences lists.

b) Phonetic Balance: A test that is phonetically balanced should contain the elements of that particular language in approximately the same proportion as they occur in that language. It is essential that each list of a discrimination test should not exclude those sounds that occur more frequently in that language.

c) Full list vs. half list, There is controversy as to whether utilizing a half list is likely to affect the speech discrimination scores. Main point of argument has been as to whether saving time is a more important factor or maintaining the phonetically balanced list is more vital.

Factars Related to the Test Materials

The test material consists of speech stimuli (items) whether items should be described in phonetic terms is uncertain. Initially phonemic aspects and subsequently the ramification of the acoustic realization of the material are considered. An item is a response evoking stimulus typically a syllable word or sentence. Quite apart from whether one considers the item to be linguistic element or one of its many acoustic images, the term item is used in a somewhat ambiguous way in the literature of speech tests. In fact it may refer to at least four different concepts as suggested.

1) **ELEMENT OF INTEREST** (or independent variable) For instance we might be interested in the effect of varying a phoneme. But nevertheless present words (containing the phoneme) to the listener.

2) **STIMULUS ELEMENT** If for instance the elements of interest are words they will occasionally be inserted in sentences (called carrier sentences) whereby the physical stimulus becomes a sentence rather than a word.

3) **RESPONSE ELEMENT** Although frequently the listener is asked to repeat or identify the stimulus as heard, certain experiments will call for other types of response. The example mentioned above might for instance require the listener to respond only the inserted word not the whole sentence.

4) **SCORING ELEMENT** Even when the response is in the form of a sentence one may opt to score certain key words only rather than the whole sentence where these distinctions are of minor importance, the word item is used.

Items may be construed as the fundamental unit of speech tests just as an isolated tone burst is the fundamental unit in puretone audiometry. But just as presenting a puretone once will not yield as statistically satisfactory result. One is forced to present a speech test item again and again until the statistical variation on the compounded score is reasonably low. Unfortunately repeated presentation of a speech item is not a viable method, because memory effects will render the result meaningless. The alternative commonly employed is to select a number of different items, all within the speech material to be considered, and present each item of this subset once. If all items are equal with respect to the relevant properties the subset (list) will yield a compound result (score) equivalent to that which would have been obtained if single item could have been used again and again (Lyregaard 1973).

A list is thus the set of items necessary to obtain a stable score for the conditions imposed (eg. Speech level, masking noise). In this respect it is akin to the set of puretone stimuli necessary to obtain an estimate of threshold at a given frequency. Because one may want to compare score for different imposed conditions several lists may be needed all with exactly the same properties. Thus irrespective of the particular set of conditions scores obtained from any of the lists should be equal save for random fluctuations. In summary the list concept is based on

1. Statistical stability of scores (implying that items must be repeated or set of items presented).

2. Human memory (implying that items in the list must be different).

3. Interchangeability of list (implying that lists must have equal relevant properties in all test conditions).

For some purpose these fundamental requirements are supplemented by others, for example that the speech material should be representative of everyday speech given a frame of items and lists as described above a strategy for filling in the frame (i.e., selecting the items) is needed. This problem divided into two

- From which population should the items be samples?

- Which method of sampling should be employed?

While developing a test of speech perception the researcher should take into serious consideration the response elicitation modality. It depends on numerous factors such as age group, literacy disability of the subjects. There are four basic types of responses that contribute to perception of conversational speech. They are detection, discrimination, recognition and comprehension (Hirsh 1966; Boothroyd, et al., 1971).

Detection is the ability to respond differently to the presence and absence of a speech stimuli. It may result in child orienting to the speaker in order to acquire more speech information from him (Hirsh 1966).

Discrimination refers to the ability to perceive similarities and differences among two or more speech stimuli. This important skill allows the child to discover that different words phrases have different acoustic qualities visible characteristics intensities or duration's. For eg. The child may be asked "Do these words seem to be the same or different: feather/father? " (Hirsh 1966).

Recognition is the ability to produce a speech stimulus by naming or identifying it in some way, a child's recognition response may take the form of pointing writing or repeating the speech that was presented. Recognition is the most common form of response employed in clinical evaluation (Hirsh 1966).

Comprehension is the ability to understand the meaning of a speech stimulus usually by reference to knowledge of language. To indicate comprehension a child's response must be qualitatively different from the stimulus that was presented but must be closely associated with it in some way. That is the child cannot simply repeat the stimulus but must demonstrate that he understands by responding, usually to a question or instruction (Hirsh 1966).

It is interesting to note that various terminologies have been used to describe the speech discrimination tests viz., articulation testing intelligibility testing speech discrimination tests, speech identification tests, speech recognition tests speech perception tests. However, the currently accepted term is "test of speech perception" as it most closely explains the nature of the test as well as the task for the subject (Penrod 1983).

Factors to be considered while developing a Test of Speech Perception

While developing a "test of Speech perception" the researcher must take several factors into consideration. The target population for which the test is being developed the language in which the test is to be constructed, type of speech material to be used as stimuli transmission of the stimuli presentation levels; choice of response modality statistical analysis are to be devised before developing the test.

Target Population

Materials for speech audiometry should be selected in such a way that it should be within the linguistic abilities of the subjects. In this context a basic dichotomy separates the materials developed so far adults vs children.

CRITERIA FOR DEVELOPMENT OF DIFFERENT SPEECH TESTS

Selection of Speech Material

The type of material to be used would be one of the following, or a combination thereof:

Syllables

Words (mono, Bi or polysyllabic)

Sentences

These categories are not mutually exclusive and there may be difficulties in defining their boundaries. It is of importance to bear in mind that the material to be selected is spoken rather than written. The differences between written and spoken English can be rather large particularly in its more colloquial forms. The syntactic structures proper to written English are often distorted in the spoken language, where prosodic features in part perform the role of syntax.

Selection of speech test material entails consideration of the following factors:

Redundancies

Phonemes are the least, sentences are the most redundant type of item. The less choice among alternatives given the more redundant are the items. This is reflected in the shape of the intelligibility curves for different types of items (Lehmann 1962)[i]; suggesting that the higher the redundancy the fewer the acoustic cues needed to recognize the stimulus. A test using sentences will therefore partly measure hearing deficiency at the peripheral level and partly combination of linguistic competence and general cerebral function.

Scoring of Responses

Responses to phonemes and to some extent syllables are difficult to score in the absence of phonemic transcription system familiar to the average patient. At the other end of the scale sentences are equally difficult to score because a correct response would be one showing that the sentence was understood even though not repeated verbatim, minor errors in adverbs, prepositions etc, being irrelevant. Attempts have been made to do this in Immediate Appreciation tests (Richards 1973) and more oblique scoring methods have been devised in telephonemetry based on the time required for a complete information transfer to be accomplished eg. the reproduction by the listener of geometrical designs (Richards 1973).

Familiarity of Material

The question of phonemic balance has little bearing on the actual test but is possibly important for the interpretation of results. The familiarity of speech material is important for both test and interpretation. In order to quantify the familiarity of a word the assumption is often made that it is equivalent to the frequency with which a person has been exposed to the word and that this in turn is approximated by the frequency of occurrence of words as found in a corpus of word material sampled so as to ensure good coverage of written or spoken materials.

The work of Black (1952) Howes (1957) Pollack et al., (1959) Owens (1961) and Savin (1963) indicate that uncommon words have a lower intelligibility than common words everything else being equal. The size of the effect in terms of shift of SRT from common to uncommon words is estimated at 15 dB (Howes 1957). If however subjects are acquainted with the words before or during the experiments no word frequency effects is found (Pollack et al., 1959). In the studies cited the measured word frequency effect has been somewhat compounded by intervening factors. Thus there is a correlation between word length and word frequency effect likewise phonetic similarities between correct and alternative response are of importance.

In practice most speech tests have to a greater or lesser extent allowed for the word frequency effect. Normally very uncommon words are excluded from the test material and sometimes the very common words are also omitted. In the testing of communication equipment it is common practice to familiarize the listeners with the test material prior to the start of the experiment. Tests based on a forced choice methodology

are insensitive to the word frequency effect. Although familiarity (or at least frequency - of- occurrence) of the test words clearly has an effect on intelligibility that in itself is no impediment to diagnostic speech audiometry provided the effect is equal for all whom English second language) will however tend to exhibit deviant frequency-of-occurrence effects leading to depressed intelligibility scores that have no relation to their auditory capacity and therefore confounding the diagnostic test. The difficulty is largely remedied if lists are composed of fairly common words only.

SRT Testing with Cold Running Speech

When connected speech is used to measure the SRT patients are instructed to indicate the level at which the speech is so soft that they can barely follow what is being said sometimes this involves using a verbal or hand signal or allowing the patient to control the hearing level using a verbal audiometry. The level of the speech may be raised and lowered in steps of 2 or 5 dB depending on the preferences of the audiologist. Several measurements should be taken to ensure accuracy.

SRT Testing with Spondaic Words

The SRT is usually as the lowest hearing level of which 50% criterion is invoked. Also many methods used for SRT measurement in the past were rather vague suggesting that the level should be raised and lowered but not giving a precise methodology.

For some reason most SRTs had been obtained in 1 or 2 dB steps until Chaiklin and Ventry (1964) proved that for clinical purposes 5 dB steps are just as accurate using 5

dB steps up the procedure makes decisions regarding threshold easier without sacrificing the equality of test results.

Tillman and Jerger (1959) showed that familiarizing the patient with the list of spondaic test words lowers the SRT by 4 to 5 dB. Conn, Dancer and Ventry (1975) found that only 15 of the original words from the 36 spondees in CID. Auditory Test W-l could be used without prior familiarization altering test results. Other studies (eg. Frank and Mcphillips 1976) have shown that fewer than half of the original words are similar with respect to the intensity required for intelligibility.

Practice with SRT procedure lowers the response interpreted as threshold by a very small amount, although guessing may lower that level more than 4 dB, at least for people with normal hearing. Burke and Nerbonne (1978) suggest that the guess factor should be controlled during SRT tests by asking the patient not to guess and thereby improving the agreement between the SRT and the PTA. Because no data have surfaced that reveal the effects of guessing on patients to increase attentiveness of the test stimuli. It is considered advisable whenever possible to give the patient list of the words before the test begins together with printed instructions for the entire test procedure.

Until the work of Chaiklin and Ventry (1964) most descriptions of the measurement of the speech recognition threshold were rather vague. Clinicians and students had been advised simply to use up-down method in search of threshold. Chaiklin and Olsen (1973) refined the SRT test methodology into a series of steps that led to the use of formula for deciding on SRT, thereby taking the arbitrary decision out of the clinicians hands. The practicality of the Tillman-Olsen method was tested by Wilson,

Morgon and Dirks (1973), modified the Tillman-Olsen method that it could be used without prior knowledge of the puretone results, thereby increasing its objectivity as an independent measurement of hearing.

ASHA (1988) has revised its guidelines for determining the SRT. There has been evidence that audiologists were not using the guidelines advanced earlier (ASHA, 1979) probably because of the time consuming nature of the recommended procedure (Martin, Armstrong and Champlin; 1993). The new ASHA guidelines are based on the findings of several studies (Beattie, Forrester and Ruby, 1987; Huff and Nerbonne, 1982; Martin and Stauffer, 1984; Wilson, Morgon and Dirks, 1973).

The ASHA (1988) method for determining SRT involves the following steps (1) familiarizing the listener with the spondaic words in the word list to be used (2) ensuring that the vocabulary is familiar (3) establishing that each word can be recognized auditorily (4) ascertaining that the patients response can be understood by the clinician. These goals the can be accomplished by allowing the patient to listen to the words as presented through the speech audiometer. Words that present any difficulty should be eliminated from the list.

SPEECH MATERIAL FOR TESTING CHILDREN

While developing materials for children, one has to consider the limited vocabulary and linguistic competence.

Various materials have been devised specifically for use with young children. Some of these are commercially available in recorded form, and normative data are

provided. Other tests consist simply of printed lists which may be administered by monitored live voice or by self-recorded presentations. The available stimuli consist of monosyllabic words (Haskins, 1949; Siegenthaler and Haspiel, 1966; Ross and Lerman, 1970; Goldman et al., 1970; Katz Elliot, 1978). Sentences (Weber and Redell, 1976; Jerger et al., 1980), numbers (Erber, 1980) and environmental sounds (Finitzo-Hieber et al., 1980). Both open (no options given) and closed set (forced choice) response formats are employed, and the response mode may be verbal or psychomotor (pointing).

The selection of materials depends on the linguistic sophistication of the subjects. In general, with increased language development, there is a wider variety of applicable materials. A factor which must be considered when selecting materials for children is whether the patient has intelligible speech since its presence will permit the use of an open set response format and allow for more precise assessment (Penrod,1990).

Watson (1953), had constructed discrimination tests using monosyllabic words taken from the vocabulary of five year old children. It was found to be useful for children with impaired hearing.

Watson, Murray, Reed, Keaster (1947); Sortini and Flake (1953); Siegenthaler, Pearson and Lezak (1954); Ross and Lerman (1970); Katz and Elliot (1978) constructed speech tests for young children in which the child had to point to a picture or an object after hearing the stimulus word.

A review of speech identification tests shows that the attempts at modification can be divided into categories. One was to modify the testing procedures to make them more appropriate for children. As many hearing impaired children cannot repeat spondees or

monosyllabic words, tasks using non-verbal responses, i.e., picture pointing, have been developed. A second attempt involved a modification of the test stimuli.

Nonredundancy is a desirable factor while testing discrimination presence of redundant material would make available to the patient clues which may obscure his discriminating disability to a considerable degree.

Speech Tests of Hearing for Children

According to Watson (1957) the major criteria for valid speech recognition tests for children are the following :

a) They should be constructed to monosyllables.

b) The words should be within the vocabulary range of the child.

c) The lists should be phonetically balanced.

d) The lists should be equal in difficulty.

e) The responses required must not involve a skill which will cause the subject any difficulty.

The use of monosyllabic words, preferably of the consonant-vowel-consonant type is recommended because contextual clues are relatively absent with such materials. He also found that nonsense syllables make too difficult a test for children.

Speech Recognition Tests for Children Used in the USA

Hudgins (1949) introduced a test, consisting of four monosyllabic word lists based on familiar words as the Phonetically Balanced Familiar (PBF) lists. A similar test was also developed by Haskins in (1949). It consisted of four lists, fifty words in each list, and was called the Phonetically Balanced Kindergarten 50's (PBK-50's) test for young children below the age of 6 years.

Ross and Lerman (1970) developed Word Intelligibility by Picture Identification (WIPI) test, suitable for 3-6 years olds and consists of 4 lists of monosyllabic words arranged into twenty five plates with each plate having a 6 picture matrix.

A similar test was also developed by Katz and Elliott in 1978. Their test referred to as the Northwestern University-Children's Perception of Speech (NU-CHIPS) test was specially designed for very young (3 year old) children. Test consists of four monosyllabic word lists with fifty items in each list.

Ling (1978) recommended the use of isolate sounds as stimulus materials for evaluating the hearing potential of very deaf children referred as the Five sound Test using three vowels /u / / a / and / i / and two consonants / s / and /J/.

Erber (1974, 1977, 1980) developed a series of tests the most widely known as (ANT). This was a simple test specially designed for children with severe to profound hearing loss. This test is known as the Auditory Numbers Test (ANT). It requires that the child can count from 1 to 5 and is suitable for age range of 3 to 8 years.

Finitzo - Hieber and his associates (1980) developed a non-linguistic test for very young children around 3 years old. Their test is based on 30 environmental sounds (plus one Practice item) and is referred to as the Sound Effects Recognition Test (SERT). The 30 environmental sounds are divided into 3 lists with each test consisting of 10 items represented on 4 picture matrix plates.

Speecb Recognition Tests for Children used in United Kingdom

One of the first workers to develop a speech recognition test specially designed for children in the UK was D.C. Kendall (1953, 1954) working in the University of Manchester underTrofessor Ewing.

1. The Kendall Toy Test (KT Test)

The KT Test was intended for very young children (3 to 5 years old) who has developed a moderated vocabulary. It consists of 3 lists, each list containing 10 monosyllabic words which are represented by small toy replicas. Each word list contains a range of the most common vowels, diphthongs and consonants.

2. The Manchester Junior (MJ) Lists

The Manchester Junior test was specially designed for hearing-impaired children from about the age of six and upwards. It consists of 4 word lists with 25 monosyllables in each list. Each list is scrambled once thus giving a total of eight 25 word lists.

3. The Manchester Picture (MP) Vocabulary Test

The MP test was multiple choice test developed for hearing -impaired children of six years and over who because of their handicap were unable to take part in an open set type of speech recognition test.

It consists of 6 lists of twenty monosyllables each. The test is configured in the form of three sets of twenty cards each. The lists are not phonemically balanced but the words in each list are carefully chosen to give as wide a selection as possible of the phonemes from the English.language.

4. The Manchester Sentence (MS) Test

The Manchester Sentence Test was developed to ascertain the speech recognition abilities of hearing-impaired children when presented with connected speech. It consists of five lists often sentences each. The sentences consist of familiar statements, commands and questions and they reflect a linguistic level within the abilities of hearing-impaired children of 10 years and over.

5. The AB Isophonemic Word Lists

The test was developed by Arthur Boothroyd in 1968. This test consists of fifteen ten word lists with each list containing the same thirty phonemes, ten vowels and twenty consonants. The monosyllabic words used in constructing the test were of the consonant-nucleus-consonant (CNC) type.

6. The BKB Sentence Lists

The test was developed by (Bench, Koval and Bamford, 1979). The construction of this test was based on the responses of hearing impaired children in the age range 8-15 years. It consists of 21 lists of 16 sentences. Each list contains 50 Stimulus words. A simplified version of this test referred to as the picture Related BKB Sentence Lists for Children (BKB-PR). This version consisted of 11 lists of 16 sentences with 50 stimulus words in each list.

7. Reed Screening Hearing Test

The Reed Hearing Test (Reed 1959) consists of a set of cards, each one containing four pictures. The pictures each depict a single object which on one card have a common vowel eg. mouse, house owl, cow but with differing consonants. There are eight cards in all. Reed revised the test and it was published by the Royal National Institute for the Deaf in 1970 as the RNID Hearing Test Cards.

Recognizing the need for testing the word recognition abilities of small children who are either or unable unwilling to respond in the fashion of adults, Ross and Lerman (1970) developed the word Intelligibility by picture Identification (WIPI) test. The child is presented with a card that contains six pictures. Four of the six picture are possibilities as the stimulus word on a given test and then other two words on each card (which are never tested) act as foils to decrease the probability of a correct guess. Twenty five such cards are assembled in a spiral binder, children indicate which picture corresponds to the word they believe they have heard. This procedure is useful in working with children whose discrimination for speech cannot otherwise by evaluated, provided that the

stimulus words are within the children's vocabularies. Incorrect identification of words simply because they are not known is common with children under three and one-half years of age (Sanderson-Leepa and Rintlemann, 1976). This test had been modified for use in sentence tests (Bench, Kovall, and Bamford 1979; Weber and Reddell, 1976). The WIPI test just described is available commercially. The Northwestern University Children's Perception of Speech (NU-CHIPS) test (Elliot and Katz, 1980) is similar to the WIPI. Each child is presented with a series of four picture sets, including 65 items with 50 words scored on the test. The use of this procedure appears to be gaining in popularity.

Perceptual factors for consonants contained in the non-sense syllable test, were evaluated from normal hearing and hearing-impaired children's errors. One group consists of 30 normal hearing children between 6.0 - 12.8 years of age, the other group consists of 7 hearing impaired children between 8.0 - 14.8 years. The subjects provided verbal responses to list A of the no-sense syllable test which was presented to 25, 35, 45, and 55 dB SL, regarding each subjects reception threshold. Responses were phonetically transcribed, pooled across SL, converted to conclusion matrices and submitted to symmetric individual differences scaling consonants are analyzed for pre and intervocalic positions. Results revealed that features differed across subject group and consonant positions. Salient features related to place of articulation, voicing, nasality, sonorancy and sibilancy. (Danhauer, Abdala, Johnson and Asp, 1986).

A previous paper described the development of the prototype of a semi-automated, sensitive and accurate version of the Mc. Cormick Toy Discrimination Test. In this report they describe a further development of the hardware and demonstrate that

results obtained from the automated test provide a basis for estimating the mean elevation of puretone threshold in the child's better ear. The correlation between speech and puretone results is high. The average of the better ear puretone thresholds at 0.5,1 and 4 kHz can be predicated from the word discrimination threshold obtained with the toy test with a 95% confidence interval of +/-11 dB (Palmer, Shepherd and Marshall, 1991).

Twenty one hearing impaired subjects participated in the present study designed to investigate two question. First, whether the ability to discriminate isolated words is related to sentence based speech reading. Second, whether older adults (52 to 75 years) could as in listening tasks, benefit relatively more than younger adults (31 to 50 years) when extra contextual information is offered in the speech reading task. The results demonstrated that word discrimination contributes significantly to efficient speech reading performance. However, the nature of the relationship is dependent on the particular aspect of the word discrimination being tested : that is, one aspect of the word discrimination test was tried to one specific speech reading condition only, Whereas another aspect facilitated performance in all kinds of speech reading conditions. For both age groups it was found that contextual information had an equally facilitative effect. The results were discussed with respect of the role played by contextual information in visual speech perception compared to other related areas (listening and reading tasks) (Lyxell and Ronnberg, 1991).

Type of Stimulus Material

Various stimuli have been used for speech identification testing, viz. Nonsense syllables, environmental sounds, monosyllabic words and sentences.

a) Nonsense Syllable

The use of nonsense syllables in the study of intelligibility represented an analytic approach in which the interest is focussed on the intelligibility or repeatability of specific phonetic element. The advantage of using nonsense syllables lies in the fact that they are devoid of meaning and hence their intelligibility is in no way dependent upon the vocabulary of the listener. Furthermore, the nonsense syllables are non-redundant, a property essential for a test of speech discrimination (Carhart, 1965). Also it is easier to construct lists of comparable difficulty using nonsense syllables than by using meaningful material (Egan, 1948).

On the other hand, nonsense syllables have the disadvantage of being unfamiliar to the listener. They are often abstract and are they very confusing to the listener (Carhart, 1965). They need special training to be read out in the intended way.

It has been found in practice by Lafon (1966) that nonsense syllables are by no means easy to use because the subject has an unconscious tendency to look for a meaning in the sound presented to him and to reproduce it as a known term.

Edgerton and Danhauer (1979) developed a Nonsense Syllable Test (NST) which consisted of 25 items of CVCV stimuli. The materials were constructed from non-meaningful stimuli.

Danhauer et al., (1984) assessed the monoaural performance of seven girls (8.8-14.8 years) with mild to moderate hearing loss and found NST to be useful in assessing children's phoneme perception.

Butts et al., (1987) compared the errors on the NST to puretone thresholds of 109 subjects with normal hearing or sensorineural hearing loss. Excellent predictive relations were found between total NST errors and weighted puretone averages for slight to marked sensorineural hearing loss.

Dubno et al., (1982) reported that, subjects with steeply sloping audiometric configuration showed consistently poor performance than those with flat hearing loss. NST was found to be sensitive to high frequency sensorial hearing loss. The above studies reveal that the NST has been fond to be useful for evaluating both adults and children. However, she used with children, it requires some modifications, viz., monitored live voice presentation and familiarization of items. This test is better suited for older children as against younger ones.

Nonsense-Syllable Lists

Edgerton and Danhauer (1979) developed 2 lists of 25 nonsense syllables each. Each item contains a two syllable produced by a consonant followed by a vowel (CVCV). Carhart (1965) originally suggested that nonsense words are too abstract and difficult for many patients and to discriminate and this is sometimes true of the CVCV test. It does have the advantage that each phoneme can be scored individually, eliminating the obvious errors in the all or none scoring used in PB word tests. The advantage of such testing has also been supported by further research (Doyle, Danhauer and Edgerton, 1980).

Speech sound discrimination stimuli were obtained for two speech sound contrasts (ba vs da and ba vs ga) for infant and adult subjects. The stimuli were computer

generated synthetic tokens. An adaptive threshold procedure was used with the visual reinforcement infant speech discrimination procedure for the infant subjects. Adults were tested using the same apparatus and threshold tracking protocol as the infant. There was a 28 dB difference in threshold for discrimination of /ba/ vs/ da/ and /ba/ vs/ ga/ between the infants and the adults. The differences reveal that to reach a criterion level of performance on a simple speech perception task, infants require much greater stimulus intensity than do adults. This had implication of or our understanding of normal auditory development, for our nation of hearing impairment in infants and for the role of intensity in research studies of infant speech perception (Nozza, et al., 1991).

Both meaningful (sense) and meaningless (nonsense) syllables of the consonant vowel consonant type (CVC syllables) and shortsentences consisting of 8 or 9 syllables were presented in quiet and in noise to 20 young subjects with normal hearing and to three groups of 20 subjects each with presbycusis, with Meniere's disease and with noise induced hearing loss. All meterial were uttered by a female speaker. The masking noise consisted of continuos noise shaped in accordance with the LTAS of the speaker. For each individual, the level of the noise was chosen half way between the SRT for sentences in quite, the SRT for whole sentence correct scores (Sentence SRT) corresponded closely to the SRT for phoneme scores with sense CVC syllables in quiet (CVC phoneme SRT). Averaged across all groups of subjects, sentence SRT in quiet and sentence SRT in noise within 1.8 dB, from CVC phoneme SRT in noise. The prediction error for sentence SRT in quiet using the PTA average of 0.5, 1 and 2 kHz was 6.0 dB, for sentence SRT in noise using the PTA of 2 and 4 kHz, it was 2.1 dB. In view

of the smaller measurement error, a direct measurement of sentence SRT in noise is advisable (Bosman and Smoorenburg, 1995).

Logatomes are nonsense syllables used for analyzing the confusion of phonemes by hearing-impaired listeners. They can provide a precise differentiation of phonemic confusion, which may be useful in the exact adjustment of programmable hearing aids. In this study, two list of Logatomes with 108 three sound combinations with a structure of consonant vowel consonant (CVC) ad vowel consonant vowel (VCV) were recorded on a compact disk. Twenty normally hearing adults and 28 patients with a sensori-neural hearing loss were tested at a comfortable listening level of about 25+/-5 dB above the mean audiometric thresholds at 0,5,1 and 2 kHz index of reduction of speech perception was calculated. A significant relationship between reduction of logatome perception and puretone audiometric thresholds at 1, 2, 3, and 4 kHz was demonstrated. Moreover, it was possible to distinguish difference between different groups of hearing-impairment. The logatome test helps to analyze specific effects that hearing loss can give on the recognition of acoustic speech signals. The logatome test may become a valuable addition to speech audiometric tests with further standardization (Welge-Lussen et al., 1997).

In the study with respect to speech recognition performance of 50 subjects aged 63-80 years was measured for a wide range of material among them even non-sense syllable were used (Humes et al., 1994).

b) Monosyllabic words

Monosyllabic words are less analytic units of speech and are more easily repeated than nonsense syllables. Therefore, many researchers have preferred to use monosyllabic words. Carhart (1965) recommends the use of phonetically monosyllabic word lists. He wrote : "A test of discrimination for speech as opposed to a threshold test must consist of relatively non-redundant items otherwise, the multiplicity of clues available to the patient will obscure many of his inabilities to differentiate consonants and vowels accurately" (Carhart, 1965, P. 253).

Monosyllable words are sufficiently unpredictable for clinical subjects so those individual speech elements must be perceived relatively independently. On the other hand, "they are not as confusing a nonsense syllables, which are so abstract that they baffle many subjects" (Carhart, 1965, P. 253).

By using monosyllabic words it is possible to construct a word list that is highly familiar, as well as phonetically balanced. Moreover, they can be easily manipulate to represent colloquial speech (Giolas, 1975). They enable articulation function (Boothroyd, 1968). Tobias (1964) stated that, "— monosyllabic words are useful in that they are a specific form of speech because they are a good representation of everyday conversational speech". Some of the commonly used monosyllabic word lists are the PAL PB-50 (Egan, 1948): CID W-22 (Hirsh, et al., 1952): NU-4 and 6 (Tillman et al, 1963: Tillman and Carhart, 1966).

A number of monosyllabic word lists have been developed for the pediatric population. The popular ones being those developed by Haskins (1949), Fairbanks

(1958), Siegenthaler and Haspiel (1966), Ross and Lerman (1970), Goldman et al., (1970), Katz and Elliott (1978). Thus, it is evident from the review that, the use of monosyllabic words is popular when constructing speech identification tests for children.

Testing of Monosyllables with a Closed-Response set

The closed-set paradigm for word recognition testing followed the development of a rhyme test by Fairbanks(1958). House et al., (1965) developed the modified Rhyme Test, in which the patients are supplied with six rhyming words from which they select the one they think they have heard. Fifty sets of items are presented to the patient, along with a noise in the test ear. Half of the word sets vary only on the initial phoneme and the other half differ in the final phoneme. Variation of the rhyme test has been proposed by kreul et al., (1968).

A 100 item multiple choice test for consonant identification labelled the California Consonant Test (CCT) was developed expressly for use with hearing-impaired patients. A computer-assisted analysis was obtained for the test responses of 550 patients with sensorineural hearing loss. The test seems highly sensitive to configuration of high the loss, but the correlation with degree of loss, especially in the instance of flat configurations, is somewhat low (-0.40). Test re-test correlation is 0.96. A correlation of 0.35 with a W-22 list indicates that the two tests are measuring different aspects of speech reception. In addition to its usefulness in identifying consonant confusion for rehabilitation purposes, the California consonant Test (CCT) may prove helpful in ranking hearing aids. For the latter purpose who 50-item subforms, Designed for equivalence have been under observation for possible use when time is a critical factor.

Repetitions of the 100 item list offer greater stability, however CCT was given fewer than two formats. In one the original CCT multiple choice answer forms (lists 1 and 2) published for commercial use by Auditec of St. Louis were used. Subjects were required to check their responses on the multiple choice answer form that provided as a closed set or forced choice procedure. For eg. the answer form provided the following choices for the test item "GAZE", "GAVE", "GAME", "GAGE". In the other condition, a new format for administrations was devised. The CCT was modified to resemble a traditional open-set speech discrimination test (Owens and Schubert 1977).

A test designed to be sensitive to the discrimination problems of patients with high frequency hearing losses is the California Consonant Test (Owens and Schubert, 1977) one hundred monosyllabic words are arranged in two scrabbling to produce two test lists. The subject, selecting from four possibilities, marks a score sheet next to the word that has been discriminated, whereas, normal hearing individuals obtain high scores on this test, patients with high frequency hearing losses show some difficulty. The increased difficulty found in the California Consonant Test was compared to that of the NU-6 lists for patients with high frequency hearing losses by Schwartz and Surr (1979).

The Auditec recordings of the CID W-22 monosyllables were used to generate test and retest intelligibility function on normally hearing listeners and subjects with mild-to-moderate sensorineural hearing loss. The normally hearing subjects were tested with 50 words list at spells ranging from 15 to 50 dB. Lists of 25 words were used with the hearing-impaired group. The functions were analyzed to assess the reliability of threshold (50% slope(20% -80% points) and maximum intelligibility (PBMax). The 50% point was obtained at 28 dB SPL. for the normally hearing listeners and at a sensation

level of 12 dB were spondaic thresholds for the hearing impaired group. Very stable monosyllabic thresholds were found, because 95% of the test retest values were within 6 dB for both subject groups. Slopes of 4.9% per dB and 2.7% per dB were obtained for the normally hearing and hearing-impaired groups, respectively. Fair reliability was observed, 95% per dB for the normally hearing subjects and +/ - 1.9% per dB for the normally hearing subjects and +/-1.1% per dB for the hearing-impaired group. Although Igroup slopes provide useful information associated with individual differences in speech recognition performance among the elderly, accounting for 70-75% of the total variance in speech recognition performance. Speech recognition performance is the measure of auditory processing and cognitive function accounting for little or no additional variance (Beattie and Michael, 1985).

Sixty children aged 3, 5, and 7 years were tested using a simple up-down adaptive speech threshold procedure. The test stimuli were familiar monosyllabic words presented as a closed set with a picture pointing response. The result indicate that monosyllabic adaptive speech test (MAST) procedures can be used reliably with children as young as 3 years of age. 30 of the children also received a different randomization of the same speech stimuli presented at a constant level, equal to their MAST threshold. The results confirmed the accuracy of the MAST estimates of the children's 50% speech threshold. Further support for the validity of the MAST threshold procedure with young children was obtained using a group of 10 children with conductive hearing loss. Their results show a significant correlation between the MAST threshold and puretone loss. The date also indicated significant improvement, in MAST thresholds over the three age

groups investigated. These developmental changes are discussedin terms of frequency effect.

The speech stimuli used were from the NU-CHIPs test (Eliot and Katz, 1980) which met the criterion of being within the receptive vocabulary of 3 years old children. The NU-CHIPS is a monosyllabic word list, consisting of 50 words, which uses a four alternative picture pointing response (Mackie and Dermody, 1986).

Speech recognition threshold was measured unquiet and in noise for normal hearing subjects and subjects with high frequency region of importance for each of two sets of speech materials-spondees and monosyllables. With changes in frequency response the stimulus delivery system, SRT was sifted differentially for spondees and monosyllables. The speech reliability, and apparent sensitivity of the SRT in quiet and noise to frequency response characteristics make it a potentially useful tool for hearing aid evaluation of speech materials appropriate to both the hearing loss configuration and the frequency response of amplification are chosen (Van Tasell & Yanz et al., 1987).

Cantonese is a common Chinese dialect spoken by the citizens in Hongkong. It is difficult to construct a material for speech audiometry in the Chinese language in view of three facts (1) All words are monosyllabic (2) The language is tonal (3) There are many homophones. Kam (1982) based on FAAF test using 120 monosyllabic words developed 4 lists of 30 words which were imposed by Cantonese. Since well documented Cantonese speech audiometry is not available, , an attempt was made in the pilot study to construct short word list which was equivalent phonemic distribution (Lau and So, 1988).

The pattern of Performance differed between young and elderly normally hearing adults on a closed vs open set discrimination task. The California consonant test was administered at 32 dB SL to young and 20 elderly normally hearing subjects under two children's one which required subjects to mark their response on a multiple choice answer form and a second which required subjects form. The only significant difference occurred within the young group between conditions (closed set, openset). The young groups speech discrimination was significantly better in the closed set conditions than in the openset condition . No other differences were significant. The results question the concept of phonemic regression as a concomitant of aging (Alice et al., 1988).

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A New Danish speech material (Dantale) for clinical and experimental speech audiometry is digitally recorded on compact disc(CD). The speech material is designed to meet present audiological requirements at Danish hearing centers. One channel of the CD contains the speech signals and the other a masking noise. The CD also contains

various calibration signals recorded on both channels at the end of the CD. The speech material compromises.

1) Digit triplets for the measurement of speech reception threshold (SRT).

2) Lists of monosyllabic words for the measurement of discrimination score (DS) for adults, children and small children. The word lists for the adults are equalized with regard to important phonetic and "visual" elements and the word lists for the children consist of minimal pairs.

3) Continuous speech for the measurement of the most comfortable loudness level (MCL), assessment of hearing aid fitting and the like. The masking noise is an amplitude-modulated speech shaped noise signal, which is designed to simulate a 4-person speech babble in order to assess both the frequency selectivity and the temporal resolution. The speech material is described and the long- term power spectra and modulation spectra are given.

In 1984, the Danish Medical Audiological Society (DMAS) established a working group with the present authors as members. The purpose was to initiate the design and production of the new Danish speech material. It was used for diagnostic, purposes, for evaluation of hearing aid used for diagnostic purposes, for evaluation of hearing aid fitting and for estimation of hearing handicap in medicolegal cases. The test material allows for speech intelligibility tests, monosyllabic word lists, digit triplets, running speech masking noise and calibration signals. (Elberling et al., 1989).

The speech material is named Dantale and recordings made on compact disc (CD). The materials used for clinical trials at the Danish audiological centers :

Speech Material

Dantale fulfills all existing requirement for speech audiometer at Danish hearing centers. The meant that the materials should incorporate speech signals, especially designed to meet the different demands and preferably compatible with materials in current use. The material includes.

1) Word lists for adults .
2) Word lists for children ,
3) Word lists for small children .
4) Digit triplets ,
5) Running speech .
6) Masking noise .
7) Calibration signals .

Summary and conclusion: DANTALE material covers the present demands for speech audiometry in Denmark eg. SRT measured by means of monosyllabic digit triplets and discrimination scores (DS) measured by means of monosyllabic words. It provides the following:

1) Significant lower distortion .greater DR and higher stability than available Litherto;

2) Easy / quick access to and identification of different parts of the material.

3) Calibration signals available for both daily set up check and technical measurements.

4) Word lists equalized with regard to important phonetic and "visual" elements.

5) Lists with minimal pairs ("child" word lists) which are useful to study phonetic confusion.

6) A possibility to measure speech discrimination in competing background noise. The masking noise is designed to assess both frequency selectivity and temporal resolution and is therefore effective even for small hearing handicaps.

7) Running Speech which for instance can be used to measure most comfortable loudness level (MCL) and to check results of hearing aid fitting.

Speech recognition has been measured in a group of elderly (age range 55-70years) subjects with normal hearing. The results from this group were compared with the results from a young, normal hearing group (age 19-36 years). The two groups were matched as regards education, occupation and dialect. The test material used was four alternative closed response speech test composed of monosyllabic words. Each word was presented in a carrier sentence and masked by a speech spectrum shaped modulated background noise. No significant difference was found between the speech recognition in the two groups (Poulsen and Keidser, 1991).

The effects of signal presentation level and word duration on time gated isolated monosyllabic word recognition performance was examined. Measures of listener

confidence, word identification, isolation point (IP), confidence at IP and acceptance point were obtained from normal hearing listeners subjects were presented with non time gated and time gated speech stimuli at 40 dB SPL (N = 21). The resulting performance measures were compared with previously reported results obtained using an 80 dB SPL presentation level. The speech stimuli consisted of 60 sec, time gated isolated monosyllabic words developed from a prerecorded 50 item list (Auditec NU-6) comparisons were drawn between presentation levels word durations, and time gated and non-time gated presentation conditions. Poorer accuracy and longer isolation points were observed at the lower signal presentation level. Monosyllabic word duration was a significant factor in on line recognition performance, regardless of presentation level (Craig and Kim, 1992).

The speech recognition performance of 50 subjects aged 63 to 83 years were measured for a wide range of materials (nonsense syllables, monosyllabic words, sentences) and listening conditions (presentation level of 70 and 90 dB SPL) both in quiet and in a noise background). In addition to complete audiologic evaluations, measures of audiotory processing (the Test of Basic Auditory Capabilities (TBAC), Watson, 1987) and cognitive function (Wechsler Adult Intelligence Scale Revised (WAIS-R) and WMS-R, Wechsler 1981, 1987) were obtained from all subjects. Principal component analyses were applied to each of the three sets of measures (speech-recognition, audi rtory and cognitive) prior to examine associations among the sets using canonical analyses. Two principal components captured most of the systematic variation in performance sample by the set of 20 speech recognition measures. Hearing loss emerged as the single largest factor associated with individual differences in speech recognition performance among

the elderly, accounting for 70-75% of the total variance in speech recognition performance, with the measures of audiotory processing and cognitive function accounting for little or no additional variance (Humes et al., 1994).

c) Disyllabic Words

Disyllabic words have been more popular as stimuli for speech reception threshold than for discrimination testing because of the redundant cues they provide. They are less analytic than the monosyllabic words and provide additional cues for intelligibility. In order to repeat a monosyllabic word correctly one must hear each of the phonetic elements. A word of two syllables, however can be basis of phonetic elements but also on the stress pattern (Hirsh, 1952).

Disyllabic words have been found to yield higher intelligibility than monosyllabic words under the same conditions. But it does not give an accurate measure of a person's speech intelligibility as there is greater amount of redundancy present in these stimuli (Penrod, 1990).

The use of disyllabic words in speech discrimination tests have been mainly due to language restriction i.e., in some language adequate number of concrete monosyllabic words are not available. Comstock and Martin (1984) developed a picture pointing speech discrimination test which can be efficiently administered by English speaking clinicians to Spanish children. The test consisted of four lists of 25 disyllabic words.

Mathew .P (1996) developed a similar material in Malayalam for children, which consisted of two test forms. Each form included the same 50 picturable disyllabic words in different randomization.

Rout .A (1996) developed a material titled perception of monosyllabic words in Indian children which consisted of one full test half list in English for children, which , consisted of two test forms. Each included the same 50 picturable monosyllabic words in random order.

Componential analysis of items comprising the speech sound pattern discrimination test (SSPDT). The SSPDT, developed by Bochner et al., (1986) uses a closed set sentence discrimination task to assess the auditory speech processing skill of severely and profoundly hearing impaired individuals. A set of components reflecting differences in the phonetic and task related characteristics of the test stimuli was developed, and the contributions of the components to discrimination task difficulty were evaluated using liner regression methodology. Discrimination task difficulty indices were transformation of percent correct scores, resulting from fit of the SSPDT data to the Rasch measurement model. Three of the hypothesized components (one spectral one temporal and one task related) entered and stepwise regression solution. These components have an intrinsic role in the construct validity of the instrument. The structure of the discrimination task, however, is more complex than might be suspected, because 'same' or matching test stimuli showed advantages in case of discriminability compared with their different or non matching counter parts. The study findings will facilitate development of an enlarged item bank, and aid in the interpretation of test scores(Bochner et al., 1992).

An adaptable Finnish language "Speech in Noise" test was developed using a personal computer equipped with a sound card. Each of the 1000 test items stored as a separate digitized waveform file on the hard disk of a personal computer consisted of disyllabic words on one stereo track and synchronized speech noise on the other. Because only a few randomly selected words are presented in this test for SRTN (speech recognition threshold in noise or S/N ratio corresponding to 50% recognition) the selection and equalization of test material was considered to be crucial to the achievement of reproducible results in short time. Equalization of the test items (word plus noise) in accordance with degree of difficult, by adapting the noise signal to the properties of the corresponding word, and selection of 510 of the initial 1000 recordings with the smallest SDS were described. The effect of this procedure on then test retest reliability of testing SRTN is evaluated. Despite contrary expectations, the procedure appears to have no effect on the reliability of speech Reception Threshold in noise (SD from 1,5 to 1.7 dB) Laitakari(1996).

d) Speech Sound

High frequency emphasis lists

Gardner (1971) developed two lists with 25 words on each word carrying a value of 4%. The test used with these lists is designed to measure the speech discrimination of patients with high frequency hearing losses, who are known to have special difficulties in understanding speech. Each of the words contains the vowel *HI* (as in kick) and is preceded and followed by a voiceless consonant. Gardner suggested that the test is more

useful if a woman with high-pitched voice. A similar approach to high frequency word lists was taken by Pascoe (1975).

To determine whether the pattern of performance differed between young and elderly normally hearing adults on a closed vs. open set discrimination task. The California consonant test was administered at 32 dB SL to young and 20 elderly normally hearing subjects under two children's one which required subjects to mark their response on a multiple choice answer form, and second which required subjects form. The only significant difference occurred within the young group between conditions (closed set openset). The young groups speech discrimination was significantly better in the closed set condition than in the openset conditions. No other differences were significant. The results question the concept of phonemic regression as concomitant of aging (Alice et al., 1988).

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Phonetically balanced word lists have many applications, including the field of audiometric testing, as equivalent test material, an experiment designed to assess the effects of digitizing parameters on speech intelligibility has shown following detached analysis, that the lists show degree of non equivalence. The reasons for these were explored and questions asked about the fundamental principles involved in describing speech forms, other approaches were discussed (James et al., 1991).

The Componential analysis of items comprising the speech sound pattern discrimination test (SSPDT). The SSPDT developed by Bochner et al., (1986) used a closed set sentence discrimination task to assess the closed set sentences discrimination task to assess the auditory speech processing skill of severely and profoundly hearing impaired individuals. A set of components reflecting differences in the phonetic and task related characteristics of the test stimuli were developed, and the contributions of the components to discrimination task difficulty were evaluated using liner regression methodology. Discrimination task difficulty indices were transformations of percent correct scores, resulting from fit of the SSPDT data to the Rasch measurement model. Three of the hypothesized components (one spectral, one temporal and one task related) entered and stepwise regression solution. These components have an intrinsic role in the construct validity of the instrument. The structure of the discrimination task, however, is more complex than might be suspected, because same of matching test stimuli showed advantages in case of discriminability compared with their different or non-matching counter parts. The study findings will facilitate development of an enlarged item bank, and aid in the interpretation of test scores (Bochner et al., 1992)

e) Phonetically Balanced Word Lists

Original attempts at word recognition testing (Egan,1984) involved compiling lists of words that are phonetically balanced (PB), that is words that contain all the phonetic elements of connected English discourse in their normal proportion to one another. Egan's work at the PsychoAcoustic Laboratories at Harvard University resulted in 20 lists of 50 Words each. When these word lists are used today a weight of 2% per word is allowed. The word recognition score is determined by counting the number of correctly identified words out of 50 and multiplying this number by 2 percent.

Hirsh and others (1952) eliminated most of Egan's original 1000 phonetically balanced words and were left with a total of 200 words, of which 180 were derived from Egan's list. These 200 words were divided into four lists of 50 words each, with each list scrambled into six sublists. The resultant PB word lists known as CID Auditory Test W-22, are commercially available.

Ross and Huntington (1962) found some slight differences among the W-22 word lists in terms of discrimination scores, but the magnitude of the differences among lists is small enough that they may be used interchangeably in clinical practice.

Because many of the words in adult PB word lists are unfamiliar to children, Haskins (1949) developed four lists of 50 words, all within the vocabularies of small children. The test may be presented by type or by monitored live voice, and it is scored in the same way as PB words when adults or older children are tested. 3 PBK (Kindergarten) word lists are also included.

Characteristics of the range of intensities yielding PBMax and of the threshold for monosyllabic words (PBT) were investigated in 110 elderly subjects with mild to moderate sensorineural hearing loss. Word recognition functions were generated using the auditec recordings of the CIDW-22 words with 50 words per level. The results indicated that (a) the range of intensities yielding PBMax was appropriate 33 dB at a level corresponding to 12% below PBMax (b) The PBMax range decreased as the magnitude of hearing loss increased (c) Testing at the loudness discomfort level was likely to provide a more accurate estimation of PBMax testing at most comfortable listening level (d) word recognition scores should be obtained at minimum of two intensities in order to estimate PBMax (e) the PBT in dB SL re, the spondaic threshold increased as the steepness of the audiologram increased, and (f) the PBT should not be considered unusual unless it exceeds the predicated value by about 14 dB (Beattie and Zipp, 1990).

Results of speech recognition tests with competing sound obtained by the use of standard audiometric equipment will suffer from considerable systematic errors because . of normal calibration variability. To avoid this and to keep the reliability high not only in investigating situations but also in clinical practice, it was highly recommended that test materials be used with speech and noise mixed in the recording. Considering this, a test material was developed consisting of six Swedish PB word lists and speech weighted noise pre-mixed with a fixed speech to noise ration and recorded on compact disc. This materials was investigated for list equality and normative recognition data were obtained. The material was found to be reliable and suitable for clinical use (Magnusson, 1995).

"The CD 'Svensk Talaudiometri" (the common Swedish speech test material) includes 12 phonemically balanced monosyllabic 50 word lists with carrier phrases, originally constructed by Liden (1954). In 1966 these lists were revised and new recordings were made.

f) Consonant - Nucleus Consonant Word Lists

The phonetic construction of the English language is such that there is no way truly balance a list of words phonetically, especially a relatively short list because of the almost infinite number of variations that can be made on each phoneme (allophones) as it is j uxtaposed with other phonemes.

Lehiste and Peterson (1959) prepared ten 50 word lists that were phonemically balanced, a concept they judged to be more realistic than phonetic balancing. Each monosyllabic word contained a consonant, followed by a vowel or diphthong followed by another consonant. CNC words were scored the same way as the original PB word lists. Later CNC lists were revised (Lehiste and Peterson, 1962) by removing proper names, rare words and the like. Duffy (1983) suggested scoring each of the three phonemes correctly identified, rather than using the correct or incorrect approach, in order to give patients credit for all the sounds they had discriminated.

Tillman, Carhart and Wilber (1963) took 95 words from the CNC lists (Lehiste and Peterson, 1959) and added 5 of there own, thereby generating two lists of 100 words each. Tillman and Carhart (1966) later developed four lists of 50 words each (Northwestern University Test No.6) which they found to have high inter test reliability. Each of the four tests was scrambled into four randomization's. Auditory test NU-6

remains very popular and is commercially available. It is important to remember, however that patients response to this test, as to other speech discrimination tests, may change on the basis of a number of variables, not the least of them being differences among the talkers who make the recordings. This problem is increased when the test is performed in the presence of background noise (Frank and Craig, 1984).

Word recognition functions for auditec recordings of the CID W-22 stimuli in multitalker noise were obtained using subjects with normal hearing and with mild to moderate sensorineural hearing loss. In the first experiment word recognition functions were generated by varying the signal to noise ratio (S/N), whereas in the second experiment, a constant S/N was used and stimulus intensity was varied. The split half reliability of word recognition scores for the normal hearing and hearing impaired groups revealed variability that agreed closely with predictions based on the simple binomial distribution. Therefore the binomial model appears appropriates for estimating the variability of word recognition scores whether they are obtained in quiet or in a competing background noise. The reliability for threshold (50% point) revealed good stability. The slope of the recognition function was steeper for normal listeners than for the hearing impaired subjects. Word recognition testing in noise can provide in sight into the problems imposed by hearing loss, particularly when evaluating patients with mild hearing loss who exhibit no difficulties with conventional tests. Clinicians should employ a sufficient number of stimuli so that test is adequately sensitive to differences among listening conditions (Beattie, 1989).

For New Danish Speech material, which consists of eight word lists, normative speech recognition curves are presented and the equivalence of the different lists was

examined. The normative curves were obtained in quiet and noise using three scoring methods, based 25,75 and 80 scoring units respectively. Significant subjects variations were found with respect to all three scoring methods due to different ways of processing the perceived sounds. Based on the test retest significant difference, the two alternative scoring methods of 75 and 80 scoring units were found to be slightly more reliable than the usual word lists. This was accepted in quiet presented in noise, the difference between the list was significant due to a different distribution of words with an initial "S" in the word lists, and a significant difference in the spectra of the speech and the noise in the higher frequencies (Keidser, 1993).

Both meaningful (sense) and meaningless (nonsense) syllables of the consonant vowel consonant type (CVC syllables) and short sentences consisting of 8 or 9 syllables were presented in quiet, and in noise to 20 young subjects with normal hearing, and to three groups of 20 subjects each with presbycusis, with Menier's disease and with noise induced hearing loss. All materials were uttered by a female speaker. The masking noise consisted of continuous noise shaped in accordance with the LTAS of the speaker. For each individual the level of the noise was chosen half way between the SRT for sentences in quiet, the SRT for whole sentence correct scores (sentence SRT) corresponded closely to the SRT for phoneme scores with sense CVC syllables in quiet (CVC phoneme SRT). Averaged across all groups of subjects, sentences SRT in quiet and could be predicated within 4.2 dB from CVC phoneme SRT in quiet and sentence SRT in noise with in 1.8dB from CVC phoneme SRT in noise. The prediction error for sentences SRT in quiet using the PTA average of 0.5,1 and 2 kHz was 6.0 dB for sentence SRT in noise using the PTA

of 2 and 4 kHz it was 2.1 dB. In view of the smaller measurement error, a direct measurement of sentence SRT in noise is advisable (Bosman and Smoorenburg, 1995).

Half List vs Full List

There has been considerable controversy as to whether utilizing a half list is likely to affect the speech discrimination scores. In an effort to reduce clinical testing time to aid patient fatigue, it has become common practice for many audiologists to use only half of a 50 item speech discrimination test (Penrod,1983).

This procedure has come under scrutiny of a number of researchers using variety of subjects. Investigations were carried out for PAL PB-50 (Resnick, 1962; Shutts et al., 1964; Burke et al., 1965), CID W-22 (Elpem, 1961; Deutsch and Kruger, 1971; Margolis and Millin,1971; Jirsa et al., 1975; Penrod, 1980) NU-6 Schumaier and Rintelmann, 1974; Schwartz et al., 1977 ; Beattie, et al., 1978) and PBK- 50 (Manning et al., 1975).

Presently no consensus exists regarding the clinical use of half list testing. Some authors have advocated its use while others have advised against it and some have recommended its use but with certain cautions.

Considerable savings of time can be realized with the half list procedure but not without risks. There are two concerns : (1) whether the results are valid and (2) whether they are reliable. Thornton and Raffin (1988) point out the trade off between measurement error and sample size. As sample size was reduced, variability in scores increased, and the farther the score from 100% or 0% the less confidence one can have in the specific value. However, Elpem (1961) pointed out that a 25 word test was as

effective as a 50 item list, based on his analysis of W-22. Competent (1962) obtained similar results on the PB-50 lists" Employing only 25 words was considered to save time.

Katz and Elliot (1980) reported that half list NU-CHIPS test is equally reliable as compared to full list across all four test forms.

Tobias (1964) opined that phonetic balance was not essential factor in a "useful diagnostic test". Thus a half list was considered as informative as a full list.

Grubb (1967) contradicted the findings of Elpem (1961), Campanelli (1962) and Tobias (1964) and reported that the two half lists may not be equally difficult or equally easy. Also, the list would no longer be phonetically balanced.

Martin (1975) favors the administration of the full list by stating the full list takes no more than five minutes to administer, which is not a considerably long duration.

From the above review, it is evident that research very in their opinion regarding whether a half lists is a useful as a full list. Their findings may varied due to the difference in the test used by them. A half list may be used only if the two halves have equal representation of phonemes and difficulty of the test items.

g) Spondees

Cold running speech - A form of continuous discourse may be used to determine the SRT by modifying instructions to the patient and altering response criteria. Today most SRTs are obtained with the use the spondaic words, often called spondees. A spondee is a word with two syllables, both pronounced with equal stress and effort. In

setting up their list of spondees, Hirsh et al., (1952) reduced the list of 84 words originated by Hudgins et al., (1947) to 36 words to increase their homogeneity of audibility and familiarity. Although spondees do not occur in spoken English, it is possible by altering stress slightly, to force such common words as baseball, hot dog and tooth brush to conform to the spondaic configuration, whether the spondees are spoken into the microphone or introduced by tape or disk both syllables of the word should peak at zero VU.

Recognition thresholds for spondaic words were obtained in normal listeners under conditions of varying set size. Six sets of spondees were derived from the 36 word corpus of a Northwestern University recording of CID W-l Spondaic words.

One of these sets represented the full list of 36 spondees, Whereas the remaining five were comprised of 27, 18,9,6 and 3 spondees selected to be homogenous in level and slope characteristics. Results revealed a systematic and reliable effect wherein mean threshold decreased from 19.1 dB SPL to 12.2 dB SPL as set size was reduced from 36 to 3 spondees. The data was consistent with past research on human information processing in that spondee recognition threshold increased linearity with the number of bits per stimulus (Punch and Howard 1985).

Speech recognition threshold was measured in quiet and in noise for normal hearing subjects and with high frequency region of importance for each of two sets of speech materials spondees and monosyllables. With changes in frequency response of the stimulus delivery system, SRT shifted differentially for spondees and monosyllables. The speed reliability and apparent sensitivity of the SRT in quiet and noise to frequency

response characteristics make it a potentially useful tool for hearing aid evaluation if speech materials appropriate to both the hearing loss configuration and the frequency response of amplification were chosen (Van Tasell & Yanz, 1987).

The Department of Veterans Affairs have produced a compact disc of speech audiometry materials. The compact disc, which is available commercially includes the W-l spondaic words recorded by a female speaker. Two experiments were conducted. The purposes of experiment 1 was to obtain normative detection and recognition data on the female recordings of the spondaic words and to compare the detection and recognition functions for the female speaker with detection and recognition functions for the original male speaker version of the W-l words. No significant differences were found between the recognition functions for each speaker. The recognition functions for both speakers were displaced to higher sound pressure levels by 8 dB above the detection functions. Clinically, the two versions of the W-l spondaic words should produce equivalent result. In experiment 2, slopes of the individual spondaic word recognition functions for the female speaker were obtained from two listeners and were discussed in terms of interstimulus, intertrial and intersubject variability (Cambron et al., 1991).

In the determination of the speech reception threshold (SRT) spondaic words were assumed to be homogenous with respect to intelligibility assumption using word thresholds as the sole criterion not an adequate basis for specifying the equality of intelligibility. In the present study the recorded spondaic words (Tillman recordings) were analyzed in an attempt to create a more homogenous set of spondaic words. The recorded spondaic words were digitized and the RMS level and duration of each syllable and word were calculated. None of the RMS or duration measures were correlated with

word thresholds, so no attempt was made to equate level or duration. They recommended that small sets of "equally intelligible" spondaic words not to be used for clinical testing because set size is a strong factor in determining threshold for spondees (Meyer and Bilger 1997; Punch and Howard, 1985; Bilger et al, (1998).

h) Sentences

The use of single words and especially single syllable words, imposes severe limitations on the capacity to manipulate a crucial parameter of ongoing speech its changing pattern over time. In order to add this dimension to speech audiometry, it is necessary to develop materials to based on relatively longer samples of speech than words. Furthermore, the relation between word lists and used in the measurement of intelligibility and the continuous flow of words encountered in conversation is not clear. Sentences are considered to be more valid indicators of intelligibility.

Sentences were used by the Bell Telephone Laboratories (Fletcher and Steinberg, 1929) in their early work. These early lists consisted of interrogative sentences that were not to be repeated by the subject but to be answered. These lists were not found so useful for the clinician, because of the test demand not only that the subjects hear the words of the sentence, but also that he provide answers to some fairly difficult questions. Simpler lists of sentences were constructed for the adults at the Psychoacoustic Laboratory by Hudgins et al., (Auditory Test No. 12). The questions were relatively simple and could be answered by a single word. This feature makes them when a written test for use in group testing is desired.

Berger (1969) developed the Kent state University (KSU) speech discrimination test for the adult population. It employed five key words within a series of sentences. The test consists of 150 sentences. Each sentence contained a key word, which is so chosen that four other words could also be used in its place, pertaining the meaningfulness of the sentence. The subject chooses one of these five sentences, which he thinks, he had heard. The test had eight equal forms with thirteen sentences in each form which were arranged in an order of progressive difficulty (Berger, 1969).

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

Jerger et al, (1980) published the Pediatric Speech Intelligibility test (PST) which used both word and competing message sentence material. Two groups of sentences, i.e., for low and high receptive language ability for children were used. Bench,Koval and Bamford (1979) developed the BKB sentences list in U.K. it consisted of 21 lists of 16 sentences (not more than severe syllables in each sentence). Each list contains 50 stimulus words. The scoring was achieved by calculating the percentage of key words repeated correctly.

Speaks and Jerger (1965) introduced the synthetic sentence identification test (SSI) for adults. The test materials were not real sentences in that, they did not make any sense but they were in a sentence format. The words used to formulate the synthetic sentence were selected following specific syntactic rules. The SSI used closed set format.

Kalikow et al., (1977) developed an openset responses sentence test called the Speech Perception in Noise (SPIN) test for adults. It comprised of eight sets of fifty sentences. Half of the sentences contain items with high predictability and half contain items with low predictability based on contextual, syntactic and prosodic cues. The background noise was a 12 talker speech babble.

In summary, sentences have been used as stimuli to test speech intelligibility. They are more representatives of the conversational speech. But majorities of the sentence tests are developed for the adult population.

Testing Word Recognition with Sentences

Jerger, Speaks and Trammell (1968) objected to the use of single words as a discrimination test on the basis that single words to not provide enough information regarding the time domain of speech. Normal connected speech is constantly changing patterns over time, thus necessitating the use of a longer sample than single words can provide for a realistic test. Jerger, Speaks and Trammell also interacted the problems inherent in testing with an open message set. Other criticisms of sentences tests include the effects of memory and learning, familiarity with the items as a result of reputation, and the methods of scoring. Much of the opposition to sentence tests is that their structure enables a listener who is good guessero make more meaning of a sentence than does another patient with similar speech recognition abilities.

A number of different sentence test have been devised to measure speech recognition. One of the first was the Central Institute for the Deaf (CID). Everyday

sentence Test (Silverman and Hirsh, 1955), which was revised several times but never demonstrated the reliability necessary for a word recognition test.

Kalikow, Stevens and Elliot (1977) developed a test made up of eight lists of 50 sentences each; only the last word in each sentence was the test item, resulting in 200 test words. The test item was recorded on one channel of a two channel tape, and voice babble was recorded on the second channel. In this way the twp hearing level dials of a speech audiometer can control the ratio of the intensities of the two signals. This procedure called Speech Perception in Noise (SPIN) Test, had undergone, considerable modification (Bilger et al., 1984). Schum and Mathews (1992) reported an interesting effect. A significant percentage of the elderly hearing impaired patients they tested did not use contextual cues as effectively on the SPIN as did their younger counterparts.

Forty were hearing impaired young adults were tested with a newly developed instrument designed to assess auditory speech processing skill. Analysis indicated that the resulting test data could be characterized in terms of the Rasch model for person measurement. Evidence of the scale's empirical validity also was obtained. The instrument use a closed set sentence discrimination task, and appeared to be useful over a fairly wide range of hearing losses(Bochner et al., 1986).

A group of 15 patients with complaints of having difficulties in understanding speech, especially in noisy surroundings in-spite of (nearly) normal puretone audiograms, were subjected to battery of speech audiometry tests. The results showed that these subjects had statistically significantly higher speech reception threshold (SRT) for sentences in noise than a reference group of 10 normal hearing subjects. This difference

was most clear for a fluctuating masking noise. In conditions with much reverberation, the patients also proved to be handicapped more than the control group. Binaural hearing gain was equal for both groups. The pathogenesis of the speech hearing loss, was not known but assessment of the SRT in noise proved to be a valuable asset in objectifying these patients complaints (Middelweerd et al., 1990).

The speech recognition performance of 50 subjects aged 63 to 83 years were measured for a wide range of materials (nonsense syllables, monosyllabic words, sentences) and listening conditions (Presentation levels of 70 and 90 dB SPL) both in quiet and in a noise background). In addition to complete audiologic evaluations measures of auditory processing (the Test of Basic Auditory Capabilities (TBAC), Watson, 1987) and cognitive function (Wechsler Adult Intelligence Scale Revised (WAIS-R) and WMS-R, Wechsler, 1981, 1987) were obtained from all subjects. Principal component analyses were applied to each sets using canonical analyses. Two principal components captured most of the systematic variation in performance sampled by the set of 20 speech recognition measures. Hearing loss emerged as the single largest factor associated with individual differences in speech recognition performance among the elderly, accounting for 70-75% of the total variance in speech recognition performance, with the measures of auditory processing and cognitive function accounting for little or no additional variance (Humes et al., 1994).

Modification of Materials

Cold-running speech - A form of continuous discourse may be used to determine the SRT modifying instructions to the patient and altering response criteria. Today most

SRTs are obtained with the use of spondaic words, often called spondees. A spondee is a word with two syllables both pronounced with equal stress and effort. In setting up their list of spondees, Hirsh et al., (1952) reduced the list of 84 words originated by Hudgins et al, (1947) to 36 words to increase their homogeneity of audibility and familiarity. Although spondees do not occur in spoken English, it is possible by altering stress slightly to force such common words as baseball, hot dog, and tooth brush to conform to the spondaic configuration whether the spondees are spoken into the microphone or introduced by tape or disk both syllables of the word should peak at zero VU.

Egan (1948) further modified the well known PAL PB - 50 lists. The PB lists were devised to meet the following criteria. Monosyllabic words, equal average difficulty, range of difficulty and phonetic composition of each list as well as representative of English speech, using words in common usage.

The PAL PB - 50 list has some limitations. The researchers at the CID worked on to revise the original PAL test to overcome the limitations. This modified list became CAD auditory test W-22. The criteria for vocabulary of the revised lists were that all words be of one syllable, that none appear on more than one list, that all words be familiar and that the phonetic composition of each list be representative of English. The vocabulary consisted of 120 words selected from the original 1000 words of the PAL PB-50 lists and 80 additional words.

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Connected Speech test (CST)

Cox, Alexander and Gilmore, 1987, Cox et al., 1988. The most recent version of the test contains several practice passages and 48 test passages of continuous discourse, each approximately, 50 seconds in length. On the second channel of and stereo recording was a babble of six simultaneous speakers, which was played to the same ear and thus served as competition for the test sentence. Each passage contains 25 key words, which are used for scoring 5 words at each of five levels of difficulty in a given passage in its entirely intelligibility scores. The CST appears to meet many of Intelligibility and validity not found in other the criteria for reliability and validity not found in other sentence tests and thus holds promise as a diagnostic tool.

Testing word Recognition with Half lists

A number of researchers (Elpern, 1961; Lynn, 1962; Resnick, 1962) have suggested that time can be saved in word recognition testing by limiting the test lists to 25 words, using one half of each list with a weight of 4% per word. Opposition to this procedure (Grubb,1963) was based on the following arguments (1) that one half of a list may produce fewer audible sounds than the other half, (2) that there may be some real

differences in difficulty of discrimination between the two halves of a list, but primarily (3) that splitting the lists causes them to lose their phonetic balance. Tobias (1964) pointed out that phonetic balancing is unnecessary in a "useful diagnostic test" and that half lists do measure the same thing as full lists. The studies of Schwartz, Bess and Larson (1977) and of Edgerston, Klodd, and Beattie (1978) have suggested that the use of half lists is not advisable. Thornton and Raffin (1978) showed half lists to be as reliable as the full 50 word lists. Martin, Armstrong and Champlin (1993) found that most audiologists prefer to test with 25 word lists.

It has been demonstrated that very good or very poor word recognition scores may be found by using as few as 10 words (Hosford - Dunn, Runge and Montgomery, 1983; Rose, Schreurs and Miller, 1979) if the word list is rank - ordered. It is probably advisable, when testing with monosyllables to use all 50 words. When time is a factor, and a patient has achieved a high score on the first 25 words (i.e., has missed no more than 2 words) the second half of the list may be eliminated was this high score is consistent with other audiometric data such as type and amount of hearing loss present.

Sixty children aged 3, 5 and 7 years were tested using a simply up down adaptive speech threshold procedure. The test stimuli were familiar monosyllabic words presented as a closed set with a picture pointing response. The results indicate that Monosyllabic Adaptive Speech Test (MAST) procedures can be used reliably with children as young as 3 years of age. 30 of the children also had received a different randomization of the same speech stimuli presented at a constant level, equal to their MAST threshold. The results confirmed the accuracy of the MAST estimate of the children's 50% speech threshold. Further support for the validity of using a group of 10 children with conductive hearing

loss. Their results show a significant correlation between the MAST threshold and puretone loss. The data also indicated significant improvement in MAST thresholds over the three age groups investigated. These developmental changes are discussed in terms of frequency effect. The speech stimuli used were from the NU-CHIPS test (Elliot and Katz, 1980) which met the criterion of being within the receptive vocabulary of 3 years old children. The NU-CHIPS was a monosyllabic word list, consisted of 50 words, which used a four alternative picture pointing response (Mackie and Dermody, 1986).

Forty were hearing impaired young adults were tested with a newly developed instrument designed to assess auditory speech processing skill. Analysis indicated that the resulting test data could be characterized in terms of the Rash model for person measurement. Evidence of the scale's empirical validity also was obtained. The instrument used a closed set sentence discrimination task, and appeared to be useful over a fairly widerange of hearing losses (Bochner et al., 1986).

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In the study, the speech - recognition performance of 50 subjects aged 63 to 83 years was measured for a wide range of materials (nonsense syllables, monosyllabic words, sentences) and listening conditions (PL of 70 and 90 dB SPL) both in quiet and in a noise background). In addition to complete audiologic evaluations, measures of auditory processing (the Test of Basic Auditory Capabilities (TBAC), Watson, 1987) and cognitive function (Wechsler Adult intelligence Scale Revised (WAIS-R) and WMS-R, Wechsler, 1981,1987) were obtained from all subjects. Principal measures (Speech-recognition, auditory and cognitive) prior to examining associations among the sets using canonical analyses. Two principal components captured most of the systematic variation in performance sample by the set of 20 speech recognition measures. Hearing loss emerged as the in speech recognition performance among the elderly, accounting for 70-75% of the total variance in speech recognition performance, with the measures of auditory processing and cognitive function accounting for little or no additional variance (Humes et al., 1994).

Speech Materials for CAD

Dichotic Tests

- Digits - different digits, presented in competition.

  Words (CVCs - Spondees) - Monosyllabic or bisyllaic words presented in competition.

- Nonsense sentence vs. Discourse - nonsense competing against continuous disease.

- Real sentences vs. Real sentences.

- Consonant vowels (CVs) - different CV pairs in competition.

Digits: Different pairs of numbers are presented simultaneously to two ear.

Eg - The numbers five and nine may be presented to the subject's right ear at the same time the numbers two and eight are presented to the left ear. The subject is asked to repeat all of the numbers heard, if possible, using any strategy of his choice. A perfect response would be to repeat all four numbers.

Staggered Spondic Word Test (SSW) - Katz (1962, 1968) for use with both adults and children. Two spondaic words partially overlap. The second syllable of the first spondee word. Which originates in the opposite ear. The subject was simply asked to repeat the spondee words presented to the two ears.

	Non-competing	Competing	Non-competing
RE	out	side	
LE		in	law

Much of the information about this test (available from Auditech of St. Lois) concern its use as a diagnostic measure for assessing central lesions in adults (Brunt, 1978). It has also modified form with children.

Synthetic Sentence Identification Contralateral Competing message

SSI-ICM (Jerger and Jerger 1974,1975) is a test of brainstem integrity that has comprised of nonsense sentence stimuli. These are presented at progressively difficult sentence to competition rations. SSI -ICM is not an appropriate test for CAD population,

because the correct item from randomly ordered lists of ten nonsense sentences were to be found out by children who are learning disabled for vision or reading. Jerger (1981) has reported successful use of the SSI-ICM with children.

Real Sentences : A dichotic test using actual sentences was developed by willeford in 1968 and validated initially on adults with cortical lesions (Lynn and Gilroy 1975,1976, 1977). The test protocol w,ith dichotic competing sentences is to present different sentences that are for eg. "I read that in the newspaper" versus "The man on the radio said it".

Ipsilateal - Contralateral Competing Sentence Test

Another natural- sentence test. IC-CS is based on certain limitations of other tests and to provide a comprehensive task paradigm. The IC-CS is based on certain features of the SSI concept, except that it avoids requiring the subject to read. It uses real sentences as both stimulus and competition items, and it is not a closed set procedure. The test consists of five sets of ten - sentence pairs. One - sentence in each pair spoken by female voice the other by a male voice.

Consonant Vowel Test

The test protocol involves presenting a CV, such as / ba/ on one ear while a different CV, Such as / da / is presented to the other ear. There are six CV stimulus items (Pa-ba-ta-da-ga-ka) that occur in all possible combinations and arranged in 30 paired items per test list. The subject is requested to repeat what is heard in both ears. A CV test had also been formed for children 5-13 years of age. Lynn and Gilroy (1977) note that

for most patients with brain tumors it is found that the dichotic CV test is very difficult and so only excellent hearing levels and minimal neurological deficit cases are selected for this test.

Egan (1948) further modified these lists and the well known PAL PB-50 lists were developed. The PB lists were devised to meet the following criteria. Monosyllabic , words, Equal average difficulty, Range of difficulty and phonetic composition of each list as well as representative of English speech, using words in common usage.

The PAL PB-50 list had some limitations. The researchers at the CID worked on to revise the original PAL tests to overcome the limitations. This modified list become CAD auditory test W-22. The criteria for vocabulary of the revised lists were that all words be of one syllable, that none appear on more than one list, that all words be familiar and that the phonetic composition of each list be representative of the English. The vocabulary consisted of 120 words selected from the original 1000 words of the PAL PB-50 list and 80 additional words.

Apart from the above word lists, lots of other lists have been developed for testing the adult population. Lehiste and Peterson (1959) developed CNC word lists.

In creating the NU Auditory Test NO.4, Tillman et al, (1963) developed from these words a list of 95 words, plus some additional words. A total of 16 test lists were developed from this original work; included them is the NU Auditory Test No.6 (Tillman and Carhart, 1966).

Two of the more widely used discrimination tests are the Rhyme Test developed by Fairbanks (1958) and the Modified Rhyme Test developed by House et al., (1965).

Specialized test lists for different frequency regions were prepared by Glaser (1974) to assist in hearing aid selection. An abbreviated test for screening purposes was prepared by Rose (1974). In addition to these there are specific types of sentences, multiple choice tests and CAD test lists.

Thirty patients were tested with four dichotic speech tests before and after temporal lobectomy for control of infactable seizures. Ipsilateral ear scores improved on all tests post operatively, these improved scores reached statistical significance for the staggered spondaic word test and for consonant vowel syllables. This result, combined with a nonsignificant decrease for contralateral ear scores, with post operative increase in the Ipsilateral minus contralateral ear difference scores, similar to previous literature. Pre-operative tests for a larger group of patients showed significantly poorer performance than for normal subjects for all four tests. Total correct scores used as a measure of overall auditory processing capacity, were impaired for these patients, but unchanged or slightly improved after surgery (collard, et al., 1986).

The clinical validity of four different low- redundant speech tests was calculated using four groups of 53 patients with retrocochlear or central auditory lesions. The speech tests used were : interrupted speech (7 or 10 interruptions) time compressed speech and filtered speech. A comparison between patients and age matched normal hearing control showed that the patients had significantly lower speech recognition score. The best sensitivity ratings of the tests were between 47% and 80%, the highest in

patients with cerebello Pontine angle tumors and temporal lobe lesions and the lowest in vascular brainstem lesions. The speech and tests with the highest sensitivity were 7 interruptions and time compressed speech (Karlsson and Rosenhall, 1995).

Speech Material for Geriatric Population

The speech recognition performance of 50 subjects aged 63 to 83 years was measured for a wide range of materials (nonsense syllables, monosyllabic words, sentences) and listening conditions (PL of 70 and 90 dB SPL) both in quiet and in a noise background). In addition to complete audiologic evaluations, measures of auditory processing (the Test of Basic Audiotory capabilities (TBAC), Watson, 1987) and cognitive function (Wechsler Adult Intelligence scale Revised (WAIS-R) and WMS-R Wechsler, 1981, 1987) were obtained from all subjects. Principal component analyses were applied to each of the three sets of measures (Speech-recognition, auditory and cognitive) prior to examining associations among the sets using canonical analyses. Two principal components captured most of the systematic variation in performance sampled by the set of 20 speech recognition measures. Hearing loss emerged as the single largest factor associated with individual difference in speech recognition performance among the elderly, accounting for 70-75% of the total variance in speech recognition performance, with the measures of audiotory processing and cognitive function accounting for little or no additional variance (Humes et al., 1994).

Speech recognition had been measured in a group of elderly (age range 55-70 years) subjects with normal hearing . The results from this group were compared with the results, from a young, normal hearing group (age 19-36 years). The two groups were

matched as regards education, occupation and dialect. The test material used was a fair alternative closed response speech test composed of monosyllabic words. Each word was presented in a carrier sentence and masked by a speech spectrum shaped modulated background noise. No significant difference was found between the speech recognition in the two groups (Poulsen and Keidser, 1991).

To determine whether the pattern of performance differed between young and elderly normally hearing adults on a closed vs open set discrimination task. The California consonant test was administered at 32 dB SL to young and 20 elderly normally hearing subjects under two children's one which required subjects to mark their response on a multiple choice answer form, and a second which required subjects to provide a one word written response on a blank answer form. The only significant difference occurred within then young group between conditions (closed set, openset). The young groups discrimination was significantly better in the closed set condition than in the openset condition. No other differences were significant. The results question the concept of phonemic regression as a concomitant of aging (Alice et al., 1988).

The revised Speech Perception in Noise (SPIN) test and the Dichotic Sentence Identification (DSI) test have been used to help evaluate speech recognition capabilities in elderly people. By evaluating the test retest reliability of these measures of 17 subjects aged 63-82 years. The DSI and revised SPIN tests were administered at 65, 75 and 85 dB SPL, with a total of three presentation at each level. Reliability was assessed using a repeated measures analysis of variance and 95% critical differences for each test. Results raise serious questions about the use of these tests for diagnostic determinations or assessment of speech recognition ability in elderly people (Cokely et al., 1992).

The following are some of the speech test materials used to in the UK which are potentially available for measurement of speech processing using English (not American) speakers.

1) Speech- In-Quiet-Arthur Boothroyd word lists (Boothroyd, 1968) Fifteen lists of 10 consonant vowel consonant words isophonemically constructed. Normally scored as phonemes correct out of 30 AB (S) recordings have standard British Southern Pronunciation using a male speaker. Tapes containing the 12 most equally difficult AB(S) lists may be purchased from the Institute of sound and Vibration Research, University of Southampton.

2. BKB Sentence List for children - Twenty one lists of 16 sentences each list, containing a total of 50 key words to be scored. Restricted to vocabulary of partially hearing children (Bench and Bamford, 1979). Recorded by Female speaker with Southern English accent. Tapes available from Audiology Unit, Royal Berkshire **Hospital, Reading Berks.**

3. Speech—In-noise - Sentence Identification in Noise (SIIN) based on BKB recordings against modulated noise. Noise has somelong term spectrums as speech and is modulated with the same amplitude envelope. Tapes available through Institute of Hearing Research, University of Nottingham. Two example sentences from the sentence identification in noise test (SIIN) follow. Scoring is based on key words which are in capitals. Based on BKB word lists.

The BATH TOWEL was WET

The MATCHES LIE ON the SHELF

4. Four Alternative Auditory Feature (FAAF) test four alternative forced choice test on a vocabulary of 80 consonant vowel consonant words in 20 sets of four, composed like rhyme test on the binary feature principle (FAAF) follow:

BAD BAG BAT BACK

GAB DAB TAB CAB

5. Two Alternative picture pointing - Tests described by Haggard, wood and Carroll (1984). Recording of 48 consonant vowel consonant words against a background of Steady speech spectrum shaped noise, by a female speaker with a North Midlands regional accent using vocabulary of 24 minimal pairs, each pair differing only in the initial phoneme. 48 words allowed forced choice picture pointing response suitable for use with 5 year old children. Scored as percent words correct. Materials available by arrangement with Institute of Hearing Research, University of Nottingham,

6. Audio-Visual-Tests - Four Alternative Diability And Speech Reading Test (FADAST) Similar in principle to the FAAF test, but recorded on Sony U-matic video cassette and displaying head and shoulders of speaker. No carrier phrase is incorporated, but visible cues warm of on set of words. Four alternative responses also displayed as caption and differ in vowel as well as either initial or final consonant.

2 examples, From (FADAST) follow :

HEEL SEAL HAIL SAIL

SUCK SUNG SACK SANG

The German path to standardization in speech Audiometry :

A comprehensive concept of standardization in the field of speech audiometry had therefore, been elaborated in Germany from 1968 to 1977.

List of Numerals and Monosyllabic Nouns

As early as 1961, as a first step, word lists for hearing tests using speech were laid down, in the German standard DIN 45621 based on research work of Hahlbrock (1957). These lists comprise 10 groups each containing ten Polysyllabic numerals, and 20 phonetically balanced groups, each containing twenty monosyllabic nouns. Examples of both tests are

Numerals

Group **1** : 98[1], 22, 54, 19, 86, 71, 35, 47, 80, 63.

Monosyllabic nouns

Group 1 Ring spalt Farm Hang Geist Zahl Hund Bach Hoh Larm Durst Teig Prinz Aas Schreck Nu*B* - wolf Braut Kern Stich.

'Pronounced 'acht - und-neun-zig' with uniform pitch.

The numerals are easy to understand if the level is high enough to detect at least the vowels contained in them.

List of Sentences

A short- meaningful sentences developed by Niemeyer (1967) was standardized in Germany (DIN 45621-2). This test comprises 10 phonetically balanced groups, each containing ten sentences of four to six words. Each group thus consists of fifty words. .

An eg.

Group 1 :

1. Geld allein macht nicht gllicklich.
2. Bose Menschen Verdienen ihre Strafe.
3. Mittwoch Kommt uns Besuchpassend.
4. Ich bin nicht nap geworden.
5. Uns're Eltern tanzen Wiener walzer.
6. Lärmt nicht, Jungs, vater Schreibt.
7. Were weiβdort genau Beascheild?
8. Er geht links, sie rechts.
9. Leider ist dies Haus teuea.
10. Dienstag wieder frish gebrannte Mandeln.

Word lists for intelligibility Testing in Paediatric Audiology

Special word lists, Which are in use for testing the hearing of children have recently been standardized in the German standard DIN 45621-3. The alternative tests were specified. Test A compiled by Biesalski et al., (1974) 4-8 years old. Test B developed by chilla et al., (1976) 3-6 years old children.

The Scandinavian approach to speech Audiometry

For the determination of SRT the most common test material is bisyllabic word, spondees. However monosyllabic words and three digit combinations were also used.

In Sweden three lists of spondees were available, each containing 24 words.

- The test lists used today were originally developed by Liden in his 1954 dissertation.

- In 1965 a revision was made by the department of Technical Audiology, Karolinska Institute in Stockholm when a number of words were discarded as being too difficult semantically for hearing-impaired listeners.

- In Norway bisyllabic test materials is available in the form of twelve test list of thirty word each, developed by Quist Hanssen.

- At Denmark in the early 1950s, test lists were produced, which contained both one and two syllable words. Between 1970 and 1980 test lists were produced based solely on monosyllabic test words.

- Finnish is a language which contains only a few monosyllabic words. Thus, the test material that Jauhiainen developed for speech audiometry (1974) were six each

containing 25 test words preceded by a carried phrase was based solely on bisyllabic words.

- For the determination of maximum discrimination score, monosyllabic test words were used is all Scandinavian countries except Finland, since Finnish lacks such words in sufficient number.,

- In Sweden twelve lists were available, originating from Liden (1954) each with 50 test words preceded by a carrier phrase. Each list is phonetically balanced.

- In Norway fifteen lists of 35 monosyllabic words each are available presented without carrier phrase spondees are used to a lesser limit, by Norwegian speech audiometry which emphasizes the use of monosyllabic test words.

Speech Audiometry in Rehabilitation Programmes

- Hagerman (1982) had produced a new speech test material that might prove to be valuable with regard to hearing aid evaluation. It contains 12 lists each list made up often five word sentences. Each sentence contains one name, one verb, one digit, one adjective and one substantive.

eg, 'Gustav took eighteen black boxes'. Each list has different combinations and is fairly good phonetic balance. Material as it is based on 50 words occurs in all lists only in different order.

- In Denmark considerable interest has been devoted to audiovisual speech perception with regard to hearing aid performance and degree of hearing handicap. In the

HELEN test (Ewertsen, 1973; Ludvigsen, 1974) the test material is based on sentences.

Distortion Speech Tests

In 1977 Margareta Korean - Bengtsen in her dissertation had applied a number of different distortions on her test material, consisting of sentences of 4-8 words each with four key words which were formulated as questions, each to be answered by one single word.

Eg. Which animal is biggest, a cat or Lion? to be correctly answered by the single word 'Lion'.

No standardized test material for children seems to exist in any Nordic country so far. In Sweden, taped test list are commercially available, consisting of three digit combinations and very simple mono and bisyllabic test words. The Danish Project of Producing New Standardized Test Material for speech Audiometry also involves four test lists for children, each with 25 monosyllabic test words.

Speech Audiometry in Australia

Speech audiometry and Australian English usage - Australian English has a basic similarity to English as spoken as in the United Kingdom, but increasingly reflects North American English Usage, besides containing some expressions, phrases and word usage's which are essentially Australian (eg. 'Milk bar' very roughly equivalent to the American 'drug Store' or the English 'corner shop'). Standard Australian English is very similar to standard English as regards grammar, but a minority of words (especially nouns or noun

phrases and some verbs) as used in English may have a somewhat different meaning in Australia (Bench and Doyle, 1979.)

Word and Phoneme Tests and their usage

Most commonly used test (especially as an initial speech audiometry test) is the Boothroyd word Lists (Boothroyd, 1968) other tests include the Kendall Toy (Kendall, 1956), the word Intelligibility by picture Identification (WIPI) test (Ross and Lerman, 1970) the Modified Rhyme Test (House et al., 1965), the CAL -PBM lists (Australian Clark, 1981), the HRRC Rhyme Test (Eisenberg et al., 1977) Various non-sense syllable tests, the PLOTT Test (Australian : Plant, 1984,b) and the Auditory Numbers Test (ANT) (Erber, 1980). PLOTT Test developed by Plant his colleagues in Sydney, it consists of nine subtests for phoneme detection; number patterns; monosyllable, trochee, spondee and polysyllable distinctions; a picture vocabulary test; vowel length discrimination vowel discrimination initial voiced and voiceless stop consonant discrimination and discrimination; and discrimination of place of articulation for consonants. The PLOTT test shows considerable help to decide whether a hearing-impaired person can perceive spectral information, or onlytime and intensity cues. Many children with hearing losses greater than 100 dB (ISO) were found by plant that children could distinguish between a number of vowel consonant contrasts.

Upfold and Smither (1981) have outlined the use of the CVN nonsense syllable test (Levitt and Resnik, 1978), the Modified Rhyme Test, the Norton HRRC Rhyme Test, the Monosyllable, trochee, Spondee Test (Erber and Alencewicz, 1976) and the SPIN test

(adapted for Australian speech characteristics) in a systematic hearing fitting Protocol designed for use by NAL.

CAL-PBMS and the Clark lists designed for Australian usage was not used because the CAL-PBM lists consisted of twelve lists each of 25 monosyllables, designed to be phonemically balanced across lists and to reflect common occurrence in Australian speech. Grant (1980) concluded that the CAL-PBM lists could not be considered to be phonemically balanced. Because 34% of the phonemes correlated well, 44% did not correlate well with a sample of Australian speech.

Clark's word lists is derived from the Northwestern University Auditory Test No.6, but designed for Australian English . It consists of (I) monosyllabic CVC word structure (ii) Exact interlist phonological balance (iii) Minimal intralist phonotactic redundancy; (iv) high lexical familiarity; and phonological distribution generally compatible with that for monosyllabic words in Australian English. Clark lists are reported to be too few, and each list is too long, for regular clinical use.

Sentence Tests

SPIN Test (Kalikow, et al., 1977), the minimal auditory capabilities (MAC) test battery (Owens et al., 1980) is used in some centers (Blarney et al., 1985).

The only set of sentence lists designed for use in Australia was developed by Tonnison (1977) Bench and Doyle, had prepared a set of BKB (Bench and Bamford, Loc, cit.) sentence lists for hearing impaired children. Tonnison's lists reflect the central Institute of the Deaf (Davis and Silverman, 1970). Every day sentences it consists of nine

lists, each containing ten sentences or common phrases and 50 key words. These sentences are appropriate for older children and adults rather than the hearing impaired child.

Arabic Test lists

Arabic word lists by Ashoor and Prochzka (1982, 1985) for testing hearing of adults and children speech in Saudi Arabic, again with modern Standard Arabic. For adults this material comprises 6 lists 20 PB nouns and for children 8 lists of 10PB mono and disyllabic nouns. Onsa in 1984 at Manchester University developed the first speech test material in standard Sudanese Arabic, the dialect of central Sudan, for use in local audiology clinics. Several 20PB word lists and ten 10 word lists were produced using monosyllabic words.

Other African languages

Muyanga (1974) at London University worked on the development of speech audiometric material for zaire, reported that the great majority of Zairian languages are Bantu languages - of the four official vernacular languages Lingala, Swahili, Ciluba and Kikongo. Twelve PB lists of 25 Lingala disyllabic words and 14 similar lists of Ciluba word were produced.

STUDIES DONE IN INDIA

In (1970) Abrol, developed spondee and phonetically balanced word lists in Hindi, it however had a lot of drawbacks like it did not include practice effect and SRT levels were not mentioned.

Kapuri(1971) developed speech test materials in Tamil, Telugu and Malayalam (34 spondee in Malayalam). Bisyllabic words were used for both SRT 30 PB word list as very few monosyllables were available.

De (1973) developed spondee and PB word list in Hindi but it was restricted only to Hindi, speaking population.

Dayalan (1976) developed PB word list in Tamil language (4 lists of twenty five words each) eg. so:da, sundal, toṭṭil. (Appendix provided)

Rajashekar (1976) developed bisyllabic words in two lists of twenty words each for adults Eg. Kallu Mannu, tai-ṭaṇḍe, aṇḍa –čaṇḍa. (Appendix provided)

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

Mallikarjuna (1974) developed spondees and monosyllabic word lists in Gujarthi language. (Appendix provided)

In 1985 Tanuja developed speech material in Manipuri language in monosyllabic words of 4 lists with 25 words each. (Appendix provided)

Debashish Ghosh (1988) developed monosyllabic word lists (A,B,C) 25 each in number. (Appendix provided).

Speech audiometry in India was started in 1966. By 1971 in the Rehabilitation Unit in Audiology and Speech Pathology at the All India Institute of Medical Science, New Delhi, had Prepared PB monosyllabic and spondee word lists in the Hindi local

dialect. De sa followed in 1973 by Publishing further PB word lists for speech audiometry in Hindi. Kapur (1971) referred to lists in Malayalam, Tamil and Telugu.

Research was done on Adaptation of speech Test Material in English to Indian conditions* by Nikam (1968). She combined the words from W-22 and children's spondee list and administered to seventy two undergraduates in Myosre for familiarity ratings. Out of eighty words, forty five words were rated as very familiar by seventy percent of the subjects. These words were intended to be used with those cases with minimum of high school education.

Abrol's (1971) study on the development of spondee and phonetically balanced word lists in Hindi was one of the early advances in India with regard to speech audiometry. His study was based on the frequency analysis of the speech components and familiarity. Yet it faced some drawbacks as

1) it did not include practice effect;
2) SRT level not mentioned, and
3) Articulation curves were not given.

Kapur (1971) developed Hearing and speech Test material in Tamil, Telugu and Malayalam. In the construction of these tests excepting for the nature of materials used their method of selection, methodology was similar for all three languages. In Malayalam languages disyllabic words were used for both SRT and PB word lists as very few monosyllables words were available in the language. (Appendix privided.).

In Tamil language though he succeeded in collecting the familiar monosyllables, the list failed to represent all the sounds which do occur in Tamil language and are used

and distinctive feature in the perception of speech in today's Tamil (Somasundaram, 1973).

Some of the limitations of Kapur's (1971) study were that

1. Practice effect was not taken care of
2. SRT level was not mentioned
3. Disyllables were used in place of monosyllable (for Malayalam)

I

An attempt has been made by Swamalatha (1972) to standardize spondee and PB word list in English on Indian population. However this test is meant only for literates. Appendix Provided)

Nagaraja (1973) developed a synthetic speech identification test in kannada language.

Later De (1973) developed spondee and PB word list in Hindi and claimed that it could be used all over India. But this test cannot be administered to non-Hindi speaking population owing to unfamiliarity and language barrier. Also the test validity was not determined.

An attempt was made by Mayadevi (1979) to construct a speech discrimination test which could be used with the speakers of all Indian languages. (Appendix provided).

Dayalan (1976) developed PB word list in Tamil language. The list yielded similar results like any other valid test of discrimination.

Rajashekhar (1976) developed a picture SRT test for adults and children in kannada. The articulation function for this word list extended over 30 dB. Hence words were not considered homogeneous.

An attempt was made by Malini (1981) to standardize NU Auditory Test NO. 6 on English speaking Indian population. The population she tested was limited to those subjects to who are proficient in English language. -

Hemalatha (1981) developed a SRT test in kannada for children, picturable polysyllabic words were used as stimuli. The children tested were in the range of 3-5 years and the mean SRT was found to be 11 dB HL. The test was standardized only on school children so its validity with other group of children has to be established. (Appendix Provided)

Asha (1983) studied effect of word familiarity on speech discrimination scores and found that words that were highly familiar were correctly discriminated more frequently than those which were less familiar and listener familiarity of the test words " had no influence on their discrimination scores, when words were presented at different intensity levels.

Mallikarjuna (1984) developed spondee and monosyllabic word list in Gujarathi language.

Rangamani (1984) constructed bisyllabic word list in English from the common vocabulary of Indian English and standardized to different language groups. She claims that this test could be used with people from different language background and also those who have no formal education in English. But the study was restricted only to kannada and Tamil languages.

Tanuzadevi (1985) did a study for development and standardization of speech test materials in Manipuri language. Her study consists of 80 polysyllabic words and 100

monosyllabic words. Four lists were developed for each type of words, polysyllabic word lists contained 20 items each and monosyllabic word lists contained 24 items each.

TEST MATERIALS DEVELOPED IN INDIA

		Nature of Material	No. of tests / forms/items	
1	Kapur(1971)	i) Spondees in Tamil ii) Spondees in Malayalam	i) Forty four in Tamil ii) Thirty four in Malayalam	
2	Swarnalatha (1972)	i) Phonetically balanced Monosyllables in English ii) Spondees in English PAL PB lists and the	i) Two lists of twenty five monosyllables each for adults ii) Two lists of twenty five monosyllables each for children iii) Two lists of twenty five spondees each.	The spondees were derived from PAC lists and the monosyllables from CID W -22 list.
3	De(1973)	Phonetically balanced monosyllables in Hindi	Six lists of fifty monosyllables each	
4	Nagaraju (1973)	Synthetic sentence in Kannada		
5	Mayadevi (1974)	Monosyllables	Six scramblings of a list of twenty items	Consonants common to most Indian language were included. Each of these is followed by vowel lal
6	Dayalan Samuel (1976)	Phonetically balanced monosyllables in Tamil	Four lists of twenty five words each	
7	Rajashekar (1976)	Bisyllabic words	i) Two lists of twenty words each for adults ii) One list of 15 words for children	
8	Hemalatha .R (1981)	Polysyllabic words	One list of twenty words	

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i

Kannada Spondee Word list-Rajashekar (1976)

	Gloss		Gloss
1. ಮರ-ಗಿಡ	mara-giḍa.	21. ದಾನ-ಧರ್ಮ	ḍa:na-d'arma
2. ಕಲ್ಲು-ಮಣ್ಣು	kallu-maṇṇu.	22. ಕೆಲಸ-ಕಾರ್ಯ	kelasa-karya
3. ತಾಯಿ-ತಂದೆ	ṭa:i-ṭaṇḍe.	23. ಕನಸು-ನನಸು.	kanasu-nanasu
4. ಗಂಟು-ಮೂಟೆ	gantu-mu:ṭe.	24. ಪಕ್ಷಿ-ಪಕ್ಷಿ	pakṣi-pakṣi
5. ಅಂದ-ಚಂದ	aṇḍa-čaṇḍa.	25. ಬಂಧು-ಬಳಗ	baṇḍʰu-baḷaga.
6. ಅತ್ತ-ಇತ್ತ	aṭṭa-iṭṭa.		
7. ಸುತ್ತ-ಮುತ್ತ	sutta-mutta		
8. ಮನೆ-ಮಠ	mane-matʰa		
9. ಹೊಲ-ಗದ್ದೆ	hola-gaḍḍe.		
10. ಬೆಟ್ಟ-ಗುಡ್ಡ	beṭṭa-guḍḍa		
11. ನಡೆ-ನುಡಿ	naḍe-nuḍi		
12. ಈಗ-ಆಗ	i:ga-a:ga.		
3. ನಮ್ಮ-ನಿಮ್ಮ	namma-nimma		
4. ಬೇಳೆ-ಕಾಳು	be:le-ka:ḷu.		
5. ಅಲ್ಲಿ-ಇಲ್ಲಿ	alli-illi.		
6. ಗೆಜ್ಜೆ-ಪೂಜೆ	gedʒdʒe-puːdʒe.		
7 ಮೀನೆ-ಮೇಷ	mi:na-meiʃa.		
8. ಕಷ್ಟ-ಸುಖ	kaṣṭa-sukʰa.		
7. ಆಸ್ತಿ-ಪಾಸ್ತಿ.	a:sṭi-pa:sṭi		
2. ಗುರು-ಶಿಷ್ಯ.	guru-ʃiʃya.		

Kannada Monosyllables - Mayadevi (1976)

I.			II.		
1.	ಮ	ma	1.	ಚ	tʃa
2.	ತ	t̪a	2.	ದ	d̪a
3.	ಸ	sa	3.	ನ	na
4.	ಚ	tʃa	4.	ಕ	ka
5.	ಡ	ḍa	5.	ಬ	ba
6.	ತ	t̪a	6.	ರ	ra
7.	ರ	ra	7.	ಗ	ga
8.	ಣ	ṇa	8.	ಪ	pa
9.	ಪ	pa	9.	ಮ	ma
10.	ವ	va	10.	ವ	va
11.	ನ	na	11.	ಡ	ḍa
12.	ಜ	dʒa	12.	ತ	t̪a
13.	ಕ	ka	13.	ನ	na
14.	ಲ	la	14.	ಳ	ḷa
15.	ಹ	ha	15.	ಜ	dʒa
16.	ಳ	ḷa	16.	ಸ	sa
17.	ಗ	ga	17.	ತ	t̪a
18.	ದ	d̪a	18.	ಶ	ʃa
19.	ಜ	ja	19.	ಜ	dʒa
20.	ಶ	ʃa	20.	ಲ	la

TELUGU SPONDEE WORD LIST- Padmaja (1976)

		Gloss
1.	వజ్రం	wajram
2.	జీతం	ji:tam
3.	విషం	visam.
4.	ఆత్మ	a:tma
5.	బలం	balam.
6.	సుఖం	sukham
7	మందు	mandu
8	బల్ల	balla
9	డొంక	donga.
10	ధైర్య	dha:rya.
11.	దీపం	di:pam.
12.	గుండె	gunḍe.
13.	పండు	pandu.
14.	లక్ష	Lakṣa.
15.	సింహం	simham.
16.	చర్మం	Čarmam
17.	సిస్స	si:sa.
18.	కత్తి	katti.
19.	గిన్నె	ginne.
20.	పద్యం	padyam.
21.	ఒంటె	onṭe.
22.	కన్ను	kaṇṇu.
23	కప్ప	kappa.
24.	అందం	andam.
25.	తల	tala.

		Gloss
1.	గుంపు	gumpu.
2.	ఒళ్ళు	oḷḷu.
3.	మళ్ళె	maḷḷe.
4.	నక్క	nakka.
5.	రాట్నం	Raṭnam
6.	తెల్ల	tella.
7.	ఒక	oka.
8.	వంద	vanda.
9.	కొత్త	kotta.
10.	ముడి	muḍi.
11.	రాత్రి	Ra:tri.
12.	ప్రేమ	pre:ma.
13.	కోటి	ko:ti.
14.	అన్నం	annam.
15.	మైనం	mainam.
16.	పులి	puli.
17.	చలి	čali.
18.	కష్టం	kaṣṭam.
19.	గంట	ganta.
20.	మొగ్గ	mogga.
21.	గుడి	guḍi.
22.	కుర్చి	kurči.
23.	ముద్దు	muddu.
24.	తొంభై	tombʰai
25.	వెండి	Veṇḍi.

PB WORD LIST IN TAMIL- Dayalam Samnel (1976)

கோல்	koːl
சேய்	saːi
நேர்	neːr
கண்	kaɳ
தூள்	t̪uːɭ
பொன்	poɳ
தயிர்	taːir
பேய்	peːj
நாள்	naːl
பெண்	peɳ
மீன்	miːn
சேல்	seːl
நாய்	naːj
மண்	maɳ
போர்	poːr
தேன்	t̪eːn
சோல்	soːl
வாள்	vaːɭ
நீர்	niːr
தோள்	t̪oːl
யார்	yaːr
காய்	kaːi
கால்	kaːl
மயர்	majar
தாய்	t̪aːj
கார்	kaːr
மான்	maːn
ஞாண்	ɟaːn
கேள்	keːɭ
பார்	paːr
காய்	kaːj
தூண்	t̪uːn
கல்	kaɭ
கேள்	keːɭ
நான்	naːn
புல்	puɭ
பாய்	paːj
நூல்	noːl
கான்	kaːn
நோய்	noːj
கொல்	kol
மோர்	moːr
நெய்	neːj
வில்	vil
நார்	naːr
பால்	paːl
போய்	poːi
நில்	nil
வாய்	vaːj
சார்	saːr

SPONDEE WORD LIST IN TAMIL- Dayalan Samnel (1976)

சோடா	so:ḍa	20. பந்து	panḍu
1. லட்டு	Laḍḍu	21. எலி	eli
2. செம்பு	sembu	22. வைக்கோல்	vaikko:l
4. சுண்டல்	suṇḍal	23. இட்லி	iḍli
5. தொட்டில்	ṯoṭṭil	24. கொடி	koḍi
6. கப்பல்	kappal	25. நாய்வால்	naivaːl
7. மான்தோல்	maːnḍoːl	26. சுவர்	suvar
8. கிளி	kiḷi	27. மாங்காய்	maŋgai
9. பந்தல்	paṉḍal	28. நெற்றி	netri
10. தேனி	ṯeːni	29. பூனை	poːnai
11. அணில்	aṇil	30. தொந்தி	ṯonḍi
12. போண்டா	boːṇḍaː	31. ஜன்னல்	dzannal
13. மெத்தை	meṯṯai	32. மயில்	majil
14. பட்டம்	vaṭṭam	33. தாழ்ப்பாள்	ṯaːlppaː
15. சிக்காய்	siːkkaj	34. யானை	jaːnai
16. ரோஜா	roːdzaː	35. தயிர்	ṯajir
17. வண்டி	vaṇḍi	36. இணை	oːṇaːn
18. நகம்	naːkam	37 முயல்	mujal
19. போர்வை	poːrvai	38. கூஜா	koːdza

Malayalam PB word List.

1. പട്ട	paṭṭa	16. തിന്നു	tinnu
2. തൈവം	daivam	17. മല്ലി	malli
3. ചിപ്പു	ci:pu	18. ചേട്ടൻ	ceṭṭan
4. പശ	paśa	19. പണ്ടു	pandu
5. മുറ്റം	cuṭṭum	20. മുണ്ട	muṇḍa
6. പള്ളി	palli	21. പകൽ	pagal
7. മുണ്ടു	cuṇḍu	22. തെറ്റു	teṭṭu
8. തന്നു	taṉṉu	23. മുറ്റം	muṭṭam
9. മുട്ട	muṭṭa	24. ചിന്ത	ciṭṭa
10. പുള്ളു	pullu	25. അപ്പൻ	appan
11. തങ്കം	taṅkam	26. മുഞ്ഞ	muṉja
12. ചന്ത	canda	27. റോസ	rosa
13. മഞ്ഞ	maṉja	28. മുഖം	mukham
14. അഞ്ചു	aṉca	29. രസം	rasam
15. പേന	pena	30. മഞ്ഞ	maṉja

Malayalam Spondee word list

1. കാക്ക	kakka	20. പണ്	pata
2. വസ്ത്രം	vasthram	21. കിട്ടി	kiṭṭi
3. നെറ്റി	neṯṯi	22. സിംഹം	simham
4. പൈസ	paysa	23. ഈച്ച	eeca
5. എട്ട്	eṭṭu	24. മദ്ധ്യാഹ്നം	madhyana
6. കട്ടിൽ	kaṭṭil	25. കപ്പൽ	kappal
7. അഗ്നി	agni	26. പച്ച	paca
8. ലജ്ജ	leja	27. രാത്രി	ratri
9. സന്ധി	sanji	28. തട്ട്	taṭṭu
10. കൈപ്പ്	kaypu	29. കഷ്ടം	kaṣtam
11. പാട്ട്	pattu	30. ചക്ക	cakka
12. അപ്പോൾ	appol	31. പുച്ച	pu:ca
13. താങ്കൾ	tankol	32. മുത്ത്	muthu
14. സന്ധ്യ	sandhya	33. ബന്ധം	bandham
15. പട്ട	paṭṭa	34. പട്ടി	paṯṯi
16. എത്ര	etra	35. നേർച്ച	nerca
17. പക്ഷി	pakši		
18. സാമ്പാർ	sambar		
19. ചേച്ചി	chechi		

PHONETICALLY BALANCED MONOSYLLABIC WORDS IN GUJARATI LANGUAGE

By MALLIKARJUNA.

Based on Egan's (1948) three point criterion, 150 monosyllabic I Gujarati words are selected from Shukla's (1975) 'The Gujarati Vocabulary of Students of Standard I fc V in SURAT District. A study, and three lists of 50 PB words each are formed. The speech discrimination scores are obtained at various sensational levels above the SRT for Spondee Words in Gujarati; and the findings are on par with that of HIRSH et al (1952) on Auditory test W-22, and Samuel (1978) on Tamil PB list. The three PB lists are matched, and can be used as a valid test for speech discrimination for Gujarati Speaking population.

LIST 1		LIST 2		UST 3	
ફૂળ	વન	પક્ષ	લોટ	શોખ	મોજ
મધ	મગ	માલ	ઢેલ	શ્વાસ	મત
વાત	ઢોલ	બસ	દેવ	લોભ	પીઠ
ચીજ	સિંહ	છાત્ર	આમ	વાર	પાપ
પાન	ગામ	સાત	ખાસ	બૂટ	દર
પૂલ	ઊંઘ	સાંઠ	બીક	તીર	સીમ
દાવ	દંડ	આઠ	ભાઈ	નંગ	રોજ
કેમ	આગ	કોફ્ત	નોટ	પેટ	મેશ
ખુશ	ભાત	રીત	ભૂંડ	કામ	રંગ
સોળ	માર	હાર	એક	દુઃખ	વર
શાલ	ભીડ	કાન	મોર	ભેટ	હળ
ગાય	જીપ	દાન	જીભ	ખસ	કપ
લાભ	બેન	જળ	મન	ભાવ	બાઈ
દેશ	કાપ	સાપ	ધન	ગીત	સાંજ
ધૂળ	ફોન	તેજ	પાંચ	છોડ	એમ
જેમ	હંસ	બાગ	પાક	નાક	વાલ
લાન	પાળ	રોજ	વાળ	પર	કાલ
જોઈ	નખ	સીંગ	લૂમ	હાથ	નખ
પગ	કેક	ઘર	ખૂબ	આંખ	જોર
દસ	લાલ	નામ	સંપ	રસ	જેલ
બેલ	રાગ	પેન	દુઃખ	આજ	ટોર
માન	ખાંડ	ભેળ	માંસ	વાઘ	ખેલ
દાંત	ફૂલ	નાડ	ગામ	ભૂખ	જુઈ
ઘી	આપ	નેશ	શાક	પીપ	દાળ
[illegible]	તાર	ચાર	વડ	ફોઈ	જાન

SPONDEE WORDS IN GUJARATI. LANGUAGE

By MALLIKARJUNA

A list of 60 Spondee Words in Gujarati Language is prepared and the articulation as. a function of intensity is determined. A positive correlation of 0.73 and significant at 0.01 level is established with spondee list in English for Indian population (as standardised by Swarnalatha, 1972). This list is found to be valid test and can be used to establish the SRT in Gujarati Language.

LIST 1

સાયકલ	બરાબર	જેમતમ	ગીતકાર	બાંયછોડ
ફુટબોલ	ચગડોળ	જાયફળ	વયધટ	ચગડોળ
જાનવર	વરસાદ	પરવળ	નોટબુક	સરકાર
ધરકામ	દરરોજ	લગભગ	ધનવાન	આપઘાત
તલવાર	હારબંધ	શૂરવીર	જાણકાર	કુદરત

LIST 2

દૂરબીન	મફલર	બુશકોટ	હાથપગ	દૂધપાક
દોડધામ	માનપાન	ઉપવાસ	કોપરેલ	હારજીત
ઝટપટ	જોરદાર	સુખદુઃખ	આસપાસ	લૂંટમાર
વનરાજ	દફતર	ફરસાણ	આવકાર	મોરપીછ
એકમત	ગુજરાત	સીંગતેલ	આમતેમ	જામફળ

PB WORD LISTS IN HINDI
(Standardised and used in ENT Dept, AIEVIS, N. Delhi Since 1968-69)

1-अब	26-देर	51-आग	76-दोष
2-आज	27-धूप	52-आप	77-धूल
3-इस	28-ताल	53-उस	78-नाक
4-ऊन	29-आग	54-और	79-नोट
5-कम	30-पाल	55-कब	80-पाप
6-काम	31-पेट	56-काम	81-प्यास
7-कौन	32-फल	57-क्या	82-फूल
8-खाट	33-बस्	58-जाल	83-बात
9-खुद	34-बीस	59-खुश	84-बोझ
10-गाल	35-मार	60-गीत	85-भीड़
11-घाव	36-भूल	61-घास	86-भेंट
12-चाल	37-मन	62-चोर	87-पाल
13-छत	38-मोल	63-छेद	88-मुँह
14-अब	39-मेज	64-जान	89-मोड़
15-जिस	40-यह	65-जेब	90-याद
16-जोष	41-रस	66-ज्वार	91-रात
17-झट	42-रेल	67-झूठ	92-रोज
18-टाल	43-लाज	68-ठीक	93-लाल
19-ठीक	44-लूट	69-ठेल	94-लेट
20-डाल	45-वह	70-डाक	95-वोट
21-ढंग	46-शाप	71-ढेर	96-शोर
22-तार	47-सच	72-तीन	97-सब
23-तेल	48-साथ	73-तेल	98-साफ
24-दस	49-सेव	74-दाम	99-सेर
25-दिन	50-हम	75-दूध	100-हाथ

SPONDEE WORD LISTS IN HINDI

(Standardized and used in ENT Dept, AIIMS, N. Delhi Since 1968-69)

तालिका-1

1-घर-बार
2-छान-बीन
3-देख-रेख
4-टाल-टूल
5-डाक-घर
6-फल-फूल
7-धूप-छाँह
8-नाक-कान
9-हाथ-मुँह
10-माँ-बाप
11-काम-धाम
12-दौड़-धूप
13-ऊंच-नीच
14-भेद-भाव
15-हेर-फेर
16-गोल-माल
17-चाल-ढ़ाल
18-मार-पीट
19-पाल-पोस
20-शोर-गुल
21-भूख-प्यास
22-झूठ-सच
23-चुप-चाप
24-होन-हार
25-राज-घाट
26-मेल-जोल
27-हार-जीत
28-चीर-फाड़
29-खान-दान
30-बात-चीत
31-छेड-छाड़
32-आस-पास
33-जात-पांत
34-रोक-थाम
35-माप-तोल
36-खान-पान
37-घास-फूँस
38-जब-तब

तालिका-2

1-भाग-दौड़
2-जी-जान
3-भीड़-भाड़
4-खेल-कूद
5-सुख-दुख
6-लोक-लाज
7-आज-कल
8-दस-बीस
9-दिन-रात
10-नोंक-झोंक
11-भूल-चूक
12-हाल-चाल
13-सांठ-गांठ
14-जोड़-तोड
15-ठीक-ठाक
16-सुन-सान
17-साव-धान
18-दाँव-पेंच
19-नाच-गान
20-आन-बान
21-जोर-दार
22-डोल-डौल
23-रंग-ढंग
24-शान-दार
25-आर-पार
26-झट-पट
27-चाप-लूस
28-सोम-वार
29-धूम-धाम
30-खींच-तान
31-लेन-देन
32-हाँथ-पांव
33-रोक-टोक
34-देन-दार
35-चार-पांच
36-सूझ-बूझ
37-बोल-चाल
38-याद-गार

Phonetically Balanced Monosyllabic Word lists in Tamil

	List I	List II	List III	List IV
1.	நாள் nāḷ	கார் kār	பீர் bīr	கால் kāl
2.	யான் yān	பென் pen	ஜான் jān	போர் pōr
3.	தம் dam	நாய் nāy	சார் sār	வாய் vāy
4.	மின் min	ஜோர் jōr	கொய் koy	பால் pāl
5.	சுர் sur	வெல் vel	மென் men	வீழ் vīḻ
6.	சீர் sīr	வின் vīn	டின் ṭin	பஸ் bas
7.	முள் muḷ	பஸ் bas	யாழ் yāḻ	சாய் sāy
8.	மேய் mēy	பீர் bīr	கோல் kol	சேர் sēr
9.	வாழ் vāḻ	பேய் pēy	நோய் nōy	சார் cār
10.	வேல் vēl	மாய் māy	தாய் tāy	றால் hāl
11.	ஜில் jil	யாஸ் yās	பாய் pāy	பன் ban
12.	நான் nān	நர் nar	நொய் noy	நேர் nēr
13.	நார் nār	தம் dam	பொன் pon	தேய் tēy
14.	பீர் bīr	மேல் mēl	மின் mīn	கோல் gol
15.	பஸ் bas	மெய் mey	றால் hāl	யார் yār
16.	பொய் poy	சொல் sol	வார் vār	கொல் kol
17.	தேய் dēy	சல் sal	தெய் dey	நில் nil
18.	டின் ṭin	தேய் dēy	தம் dam	நோர் nōr
19.	தோல் tōl	டின் ṭin	வர் var	மான் mān

20.	சூல் sūl	சில் sīl	மொய் moy	கெய் dēy
21.	கால் hāl	சால் hāl	சேய் sēy	செய் jey
22.	கோல் gōl	கோல் gōl	பஸ் bas	மண் maṇ
23.	கூழ் kūḻ	தேன் tēn	கோல் gōl	டம் dam
24.	கூர் kūr	கண் kaṇ	நால் nāl	நெய் ney
25.	பொய் poy	கை kay	நெய் ney	டின் tin

Tamil Spondee Word List*

1.	சோடா	sōḍa	23.	எலி	eli
2.	லட்டு	laḍḍu	24.	வைக்கோல்	vaikkōl
3.	தேம்பு	sembu	25.	இட்லி	iṭli
4.	சுண்டல்	suṇḍal	26.	பத்து	pattu
5.	கப்பல்	kappal	27.	தோசை	dōsai
6.	தொட்டில்	toṭṭil	28.	கொடி	koḍi
7.	மாண்டோல்	māṇḍol	29.	நாய்கால்	nāyvāl
8.	கிளி	kiḷi	30.	சுவர்	suvar
9.	பந்தல்	paṇḍal	31.	மாங்காய்	māṅgāy
10.	தேனி	tēṇi	32.	நெற்றி	neṭri
11.	அணில்	aṇil	33.	பூனை	pūṇai
12.	போண்டா	boṇḍa	34.	தொந்தி	toṇḍi
13.	மொட்டை	moṭṭai	35.	ஜன்னல்	jaṇṇal
14.	வட்டம்	vaṭṭam	36.	மயில்	mayil
15.	சீக்காய்	sīkkay	37.	தோப்பான்	tāppāl
16.	ரோஜா	rōjā	38.	சட்டை	saṭṭai
17.	வண்டி	vaṇḍi	39.	யானை	yāṇai
18.	தெரு	teru	40.	தயிர்	tayir
19.	மோஜை	mōjai	41.	ஓணான்	ōṇan
20.	நகம்	nagam	42.	முயல்	muyal
21.	போர்வை	pōrvai	43.	துணி	tuṇi
22.	பண்டு	paṇḍu	44.	கூஜா	kūja

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*Y.P. Kapur, "Needs of the Speech and Hearing Handicapped in India," (Vellore: Christian Medical College and Hospital, 1971)

English Spondee Word Lists for Indians prepared by Swarnalatha.

	List I		List II
1.	sunset	1.	therefore
2.	playground	2.	toothbrush
3.	workshop	3.	backbone
4.	birthday	4.	blackout
5.	outside	5.	schoolboy
6.	starlight	6.	grandson
7.	whitewash	7.	airplane
8.	blackboard	3.	railroad
9.	housework	9.	platform
10.	although	10.	eyobrow
11.	farewell	11.	woodwork
12.	daybreak	12.	headlight
13,	mushroom	13.	midway
14.	northwest	14.	beehive
I5.	playmate	15.	pancake
16.	doorstop	16.	cowboy
17.	earthquake	17.	watchword
13.	lifeboat	18.	padlock
19.	sundown	19.	shipwreck
20.	stairway	20.	eardrum

.*K.C. Swarnalatha, "The Development and Standardization of Speech Tost Material in English for Indians", (Unpublished Master's Dissertstion, University of Mysore, 1972) App. C, P. 86.

21 armchair	21. coughdrop
22. hardware	22. yardstick
23. outlaw	23. cupcake
24. cargo	24. cookbook
25. doormat	25. horseshoe

English PB word Lists for Indians prepared by Swarnalatha.

	List I		List II
1.	ran		yard
2.	tan	2.	hunt
3.	what	3.	lie
4.	kite	4.	there
5.	start	5.	earn
6.	does	6.	you
7.	her	7.	chair
3.	give	3.	send
9.	near	9.	true
10.	poor	10.	than
11.	with	11.	him
12.	young	12.	skin
23.	leave	23.	fire
14.	fate	14.	flat
15.	two	15.	well
16.	bill	16.	king
17.	oil	17.	book
13.	than	13.	may
19*	deaf	19.	dull
20.	arm	20.	got

21 hand

22. though

23. year

24. move

25. my

21. Show

22. rat

23. man

24. when

25. else

Kannada-Polysyllabic Words- Hemalatha.R (1981)

1. pennū - pensil
2. āṭā - ūṭā
3. gali - paṭā
4. ∫rtū - pentū
5. ili - bekku
6. tate - lotā
7. ānne - mēri
8. koli - motte
9. bilū - bāṇe
10. buguri - ḍarā
11. aṇṇa - tammā
12. koti - mari
13. kitle - haṇṇū
14. kurchi - tebal
15. onḍu - erḍu
16. nalli - nīru
17. hasu - karū
18. cappli - buḍs
19. gaḍḍa - mise
20. laḍu - unḍe

LIST-A	LIST-B	LIST-C
এক	খুন	কাঁচ
কাঠ	ছাপ	ঘাস
খাম	তিল	জাত
গাছ	পাল	তিল
লাল	কূপ	দোষ
ছয়	চোঙ	ভুল
ঝাল	তাস	কর
ঢাল	না	গান
তিন	কাঁধ	জীব
দূর	চাপ	ঢোল
ধার	ঢোক	দাস
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	থাল
তার	আম	চাল
থাক	গম	টিক
দিক	জাম	তাপ
নাক	দা	ধান
বাঘ	ভাত	ঢিল

BENGALI MONOSYLLABIC WORD LISTS

BENGALI POLLYSYLLABIC WORD LISTS

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

Manipuri

(Monosyllabic word lists) - Tanuza devi (1985)

List A

[illegible]

List B

[illegible]

List C

[illegible]

List D

[illegible]

(Polysyllabic word lists)

List A

[illegible]

List B

[illegible]

List C

[illegible]

List D

[illegible]