SPEECHREADING TEST IN KANNADA

FOR THE ADULTS

Register No. M 9919

An Independent Project submitted as part fulfillment for the first year M.Sc. (Speech and Hearing), Mysore

ALL INDIA INSTITUTE OF SPEECH AND HEARING, MYSORE - 570 006

MAY, 2000

Certificate

This is to certify that this Independent Project entitled SPEECHREADING TEST IN KANNADA FOR THE ADULTS is the bonafide work in part fulfillment for the degree of Master of Science (Speech and Hearing) of the student with Register No.M 9919.

Mysore,
May, 2000

Director
All India Institute of
Speech & Hearing
Mysore - 570 006

Certificate

This is to certify that this Independent Project entitled SPEECHREADING TEST IN KANNADA FOR THE ADULTS has been prepared under my supervision and guidance.

Asha Yathiraj.

Mysore,
May, 2000

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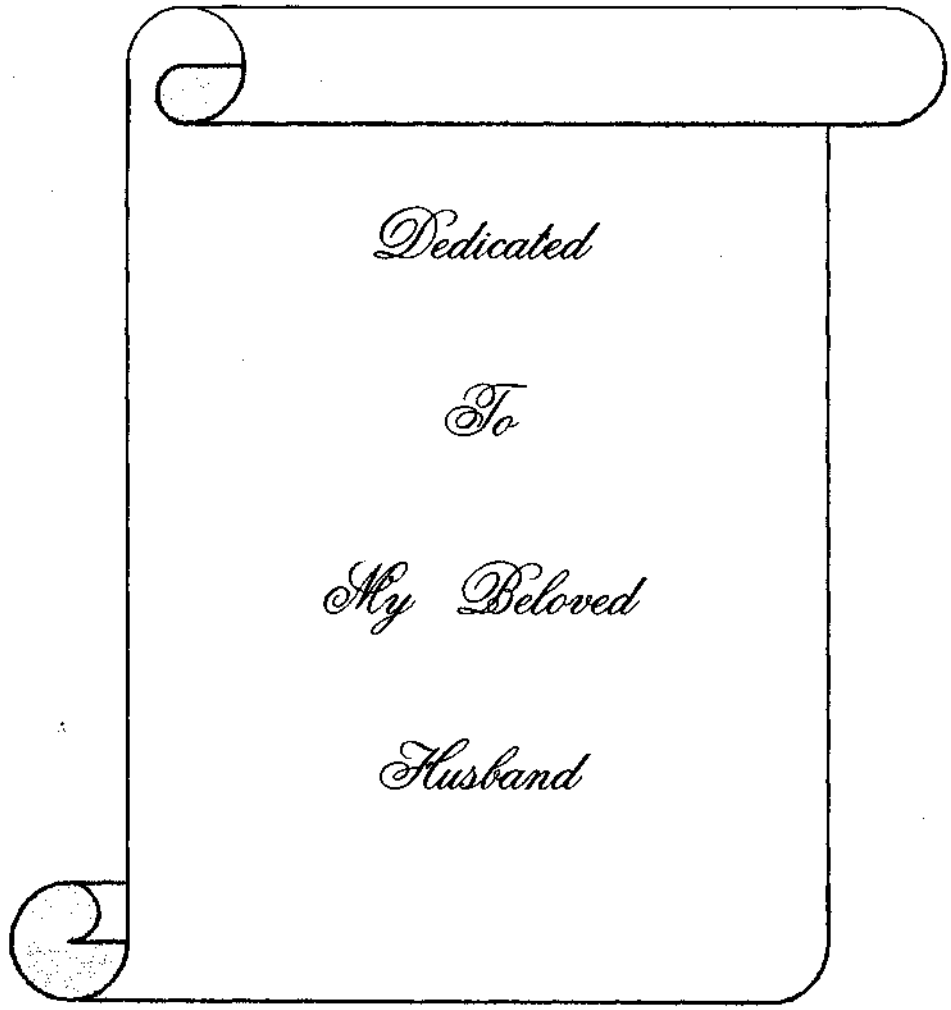
Declaration

This Independent Project entitled SPEECHREADING TEST IN KANNADA FOR THE ADULTS is the result of my own study under the guidance of Dr. Asha Yathiraj, Reader, Department of Audiology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier in any other University for any other Diploma or Degree.

Mysore,
May, 2000

Register No. M 9919


Dedicated
To
My Beloved
Husband

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INTRODUCTION

The act of communication between individuals or groups of individuals is a multifaceted process. At the moment of interaction, it is borne by signals engaging several sense organs and it is based on voice, sign or body language. The emission and reception of signals are physiological processes initiated by central nervous system programmes. Not only the moment of interaction, but also history of each individual, previous interactions and their visions of future are of importance for the form, content and use of message (Lyxell, 1996).

Communication is thus a social and interactive requiring participant to act at times as both receiver and sender of information. Effective communication occurs when individuals accept their responsibility to provide feed back on how the content of message was received either verbally or non-verbally. The responses are made appropriate to person, setting, topic and task of communication (Ewing and Ewing, 1967).

The sense of hearing is a crucial component in communication as it mediates one of the main messenger signals of the spoken language. Population based surveys in Denmark on hearing report on overall of hearing impairment to be 15-20% (>25dB HL) with an increasing prevalence as a function of increasing age, affecting approximately 50%

of the population by age 80 and above (Davis, 1989, 1994; Pederson, 1990, Parving 1997).

In general, genetic factors interact along with exogenous factors such as noise, ototoxic drugs, middle ear infections and ageing result in a higher susceptibility to hearing loss (Sakihara, 1998).

The consequences of hearing deficit after language rules have been learned thoroughly, the individual is not faced with a complete breakdown in auditory communication. The problem of child deaf from birth, is quite different from that of adult who has become deafened after school age or in adult life (Frans, 1992). In adults, the process being primarily cognitive and linguistic in nature, amount of information lost in acoustic signal can be compensated for before communication break down occur (Binnie, 1974).

Aural rehabilitative effort for hearing impairment is to over come the handicap. Helping the individuals to deal their problems must be considered as an integral part of total process of aural rehabilitation (Berger, 1970).

A severe-profound hearing-impaired individual places demands on residual hearing and vision. This increases individual's reliance on

alternative means of communication. Speechreading is one way to compensate for loss of function. It is a multidimensional skill that drawn on a number of information processing subskills (Jeffers and Barley 1971). Speechreading shares features with other forms of communication such as reading and auditory perception (Lyxell, 1989).

The term 'speechreading' movement was coined by Jeffers and Barley (1971) to describe any recognisable visual motor system; pattern usually common to two or more speech sounds. Bodily movement, gesture and facial expression become signals for communicating ideas and information. An additional responsibility is placed on eye as information receiver. Speechreading is possible because of visually observable cues, which are termed as visemes (Fischer1968).

Even in normals, speechreading is used to supplement auditory cues for understanding speech especially in noisy situations, (Hull, 1982). In hearing-impaired individual, speechreading is essential for understanding speech. Visual cues assume a more important place of communication when sensitivity to sound is reduced. Hence, it is important to understand the capabilities of visual system and nature of perceptual and attentional strategies processed by deaf people. Thus, a speech reading test can be administered to assess those capabilities (Davis 1960).

A speechreading test is a specialized educational instrument designed to measure a viewer's ability to understand what a speaker is saying, by concentrating on lip movements and other facial muscles. It provides a means of quantifying an aspect of human behaviour, (O'Neill, and Oyer, 19.61).

There is a great need for a standardized achievement test of speechreading ability for acoustically handicapped children and adults. Up to the 1940's, an individual's speechreading ability was judged subjectively by teachers and others. Later, researches constructed speechreading measures which were either filmed or face to face. Filmed speechreading are recorded with clarity and quality. The control, constancy of speaker, lighting, image size, angle and rate of presentation are significant benefits provided by filmed versions. Live voice presentation has frequently been employed because of desire of more flexibility, control of testing of more life like situation, (O'Neill, and Oyer, 1961).

A battery of tests has been suggested to assess speechreading ability. According to Silverman and Kricos (1990) it should consist of a number of subtests, including a measure of consonant recognition, word discrimination, identification of everyday sentences and comprehension of connected speech. However, speechreading is

difficult, as it is only possible to detect a small proportion of message visually. All extra information that enhances and increases the relatively sparse stimulus information should at least theoretically, be beneficial for speechreader. This assumption has proven valid when tactile support (Lyxell et al., 1993) and contextual information (Smith and Kitchen, 1972; Samuelson, 1993) have been presented together with speechreading tasks.

Aim of the study:

The aim of the present study is to:

1. Construct test material to assess speechreading ability in Kannada speaking hearing-impaired adults with acquired loss.
2. Administer the test material on normal subjects to assess whether the three forms developed are equal.
3. Administer the test on hearing impaired subjects to note whether the test is able to assess individuals having varying abilities to speech read.

Need for speechreading test material in Kannada

To date no such test material has been developed in Kannada for hearing impaired individuals.

- Speechreading ability cannot be predicted from reading level or school achievement, chronological age, age of onset of deafness or grade placement (Utley, 1946). Thus, reliable and valid speechreading measure is useful in assessing ability to speechread.

- Tests of speechreading need not only be instruments that measure the skill of speechreader, they can also indicate the visual intelligibility of individual speakers.

- Further tests can also point out persons who can speechread easily from those who find it difficult.

- Since India is a multilingual country, development of tests in various languages is necessary.

- Speechreading also aims at developing one's ability to understand language and to acquire knowledge of large vocabulary.

- It will serve as a guide for speech and hearing professionals to assess visual perceptual ability before and after training. Ultimately aims at effective communication.

REVIEW OF LITERATURE

There is an idealized relationship between contributions of vision and audition for speech reception. Particularly in noisy environment a normal hearing individual calls upon his speechreading abilities. A hearing impaired individual quite often also has to speechread. As the hearing impairment becomes more severe, it can be seen that vision gradually emerges as the lead receptive sense, while audition becomes less value (Berger, 1978).

There is a great need to develop a standardized speechreading test for acoustically handicapped children and adults. Such a test should provide answers to major questions as the following:
(Utley, 1946)

1) To what extent are the skills of word, sentence and story recognition interrelated as shown by coefficient of correlation?
2) What is the internal reliability of each part as shown by interform correlations?
3) What degree of validity does this test have, in terms of representing everyday life, comparing teachers rating to test scores?
4) What are the correlation of scores with language function, chronological age, age of onset of deafness?
5) What is the best criterion to be used as basis for standardization of a test of lipreading ability?

The selection of a representative sample of oral language, commonly used by individuals in all parts of the country, is undoubtedly difficult (Utley, 1946). The primary goal in preparing a speechreading test is to produce a test which yields reliable results, avoids floor and ceiling effects and differentiates well between speechreaders.
(Bench et al., 1994)

One major obstacle to establish a relation between different characteristics of an individual and his ability to read speech is the lack of a quantitative measure of speechreading ability. There have been various attempts to devise tests (Simmons, 1959).

In 1928, Day, Fusfeld and Pintner created a series of tests given in face to face situation but the variability of speaking situations and among speakers contributed to low reliability. The advent of motion pictures led to both test material and speaker to be held constant from trial to trial. How well can you read lips? (Utley 1946), Mason's visual hearing test developed for children at Ohio State University, Lowell's first test of Lipreading developed at the John Tracy Clinic, Morkovin and Moore's speechreading Tests (1936) were subsequently used to test speechreading ability (Nitchie, 1950). Likewise, several other tests on speechreading have been developed. These include , Costello test of speechreading (Costello, 1957), Cavender test of lipreading ability (1949), Craig lipreading inventory by Craig (1964), Semidiagnostic test by Hutton et al, (1959); A film test of lipreading by Taffe (1957); Barley-

CID speechreading test by Barley (1971); Children's speechreading test by Butt 8B Chreist (1968); Diagnostic test of speechreading test by Myklebust and Neyhus (1970); CID Everyday speech-sentences by Davis and Silverman (1978) and Lipreading screening test by Binnie et al., (1976).

There are several factors that influence speechreading tests. They may be classified as,

(1) MATERIAL VARIABLES:

(i) Syllables
(ii) Words
(iii) Sentences
(iv) Connected discourse

(2) TEST PROCEDURE VARIABLES:

(i) The Environmental variables
- Distance
- Lighting
- Viewing angle
- Distractions.

(ii) The speaker variables
- Image of the speaker
- Selection of the speaker
- Rate of the speech
- Sex of the speaker.

(iii) The speechreader variables
- Intelligence
- Behavioural pattern
- Educational background
- Synthetic and analytic ability of speechreader
- Non-verbal visual perception
- Rhythm and pitch
- Visual skills
- Age
- Hearing loss
- Sex.

(1) MATERIAL VARIABLES:

Speechreading ability varies depending upon the type of test material used. Syllables, words, phrases, sentences, stories and connected discourse are the materials that can be used to assess speechreading. Careful examination of the effects of types of speech stimuli used in tests is greatly needed, since there is an unclear understanding of their validity. Speechreading differences based upon the effect of diversity of test materials used may be clouding many research findings (O'Neill and Oyer, 1961).

The perceptual information for a visual signal forces the speechreader to take advantage of other sources of information like lexical, syntactic, semantic, prosodic or contextual to interpret the message (Lyxell and Ronnberg, 1991). Few speechreading tests incorporated individual words as the stimuli, the most commonly used tests, particularly for adults, have consisted of lists of everyday sentences. These tests have typically used vocabulary that is comparable to a third grade reading level, enabling their use with older children and adults. Familiar, everyday language was used and sentence length varied from two to approximately ten words. The lists of unrelated sentences are probably the most common way to measure speechreading, but this does not mimic the typical conversation in which one sentence logically follows another (Silverman and Kricos, 1990).

(i) *Syllables:*

Use of phones, syllables to assess speechreading is open to question, since people do not respond just to this type of stimulus material in their everyday communication. However, it seems that establishment of basic performance levels for place of articulation cues is an important first step as part of a full complement of speechreading assessment (Binnie et al., 1976). Hence he developed speechreading test that incorporated only syllables. The test was named "Lipreading screening test".

Confusions in speechreading of initial consonant clusters were investigated by Franks and Kimble (1972) in the age range of 18-35 years. The results indicated that consonant clusters were highly confused in speechreading, since they were incorrectly perceived 89% of the time. The clusters were seen most frequently as single consonants followed in frequency by identification as other consonant combinations. The visible movements associated with production of the sounds are frequently very similar, and as a consequence are easily confused. Hence, they suggested to provide emphasis on discrimination and identification of consonant clusters progressive in difficulty. Here the need to increase contextual cues is also very important.

Benguerel (1982) investigated the ability of speechreaders to use visual information alone to identify phonemes in varying contexts in the age range of 22-31 years. Results revealed that performance was perfect

for /p/, /f/, /w/, /o/ and /u/. But speechreading performance depended on context for *ft/*, /k/, /t / /t /, /s/, /i/ and /ae/. The features labial, rounded and alveolar/palatal place of articulation were found to transmit more information to speechreaders than did feature continuant. Variability in articulatory parameters resulting from coarticulatory effects appeared to increase overall speechreading difficulty.

Woodward and Barber (1960) developed a speechreading test to establish the relationship of the visually perceived symbols to the underling linguistic system. The test materials were mono-syllables/nonsense words, consonants and identical pairs. The results of the study reveal that out of 24 initial consonants tested, only four visually contrastive units were available for the speechreader. Vowel speecreading movements are less visible than those for the consonant sounds (Jeffers & Barley, 1971).

Nitchie, (1950) strongly emphasized that isolated syllables were not enough to develop and foster speechreading skills. Recognising problem of discrimination among homophenes, lack of redundancy in visemes, he stressed the ability to synthesize and grasp meaning from contextual clues. The testing involving isolated syllables presumably have a lower face validity (Berger, 1972).

(ii) *Word level:*

Several tests of speechreading incorporated word level utterances. They are visual hearing test by Mason (1961), Costello test of speechreading by Costello (1957) and Semidiagnostic test by Hutton (1959).

Many researchers have investigated speechreading of words: (Numbers and Hudgins, 1954; Prall, 1957; Darke, 1957; Van Uden, 1960 and Ross et al.,1972). They have examined speechreading performance in auditory, visual and auditory visual skills and found better scores in both combined conditions. Nitchie (1913) states that about 50% of the words in English language are homophenous.

Roback (1961) determined the ability of subjects to identify homophenous words correctly. Results of a multiple choice test procedure indicated that homophenous words were not produced exactly like on the lips since subjects were able to select them correctly more frequently than would be expected by chance alone.

In contrary to above, Jeffers and Berley, 1971 reported that major problem confronting in a speechreader is that there is not a single consonant sound that has a characteristic lip or jaw movement of its own and can be recognised on the basis on audition alone. Adding a phoneme to a syllable altered the relative identification of the syllable. Two and three phonemes in a word produced about same speechreading

scores, but lengthier words produced lower scores (Cartwright and Dandridge, 1971). In contrast, Kazanas and Susan (1972) noted that mean correct scores were 28% for the spondee and 17% for the PB word. The higher scores obtained for the spondees could be due to the linguistic cue available in them.

Lyxell and Ronnberg (1989) noted that word discrimination contributes significantly to efficient speechreading performance. However, the nature of relationship depends on particular aspect of word discrimination being tested whether short term memory component involved or not. The results clearly supported the existence of relationship between skilled performance on a word discrimination test and a sentence based speechreading.

A summary on literature about isolated words suggest that, lengthier the word (> two to three phonemes) more difficult is the speechreading task and there are equivocal studies regarding identification of homophenous words. However, spondees are easier to speechread than monosyllables.

(iii) *Sentences:*

A relationship exists between visual feature extraction ability and speechreading of more complex speechreading stimuli, such as sentences or short stories. Visual feature extraction ability has typically

been operationalized as decoding or assessing the meaning of visual pattern (Lyxell and Ronnberg, 1989).

Speechreading tests which included only sentence level utterances are Cavender test of lipreading ability (Cavender, 1949); Film test of lipreading (Taaffe and Wong, 1957); Barley-CID sentences (Barley, 1971); CID everyday speech sentences (David & Silverman, 1978); Lip reading test (Day & Fusfeld, 1928) and the Keaster film test of lipreading (Keaster, 1949).

Tests of speech understanding are often required in evaluations of schemes of aural rehabilitation. A battery of such tests is likely to include a test of sentence perception in order to measure the ability of parse connected speech into constituent words (Foster et al., 1993). Tests of sentence perception need to include many trials if they are to be reliable (Green, 1987).

A speechreading test that included questions as a test material was Butt's children speechreading test (Butt and Chriest, 1968). This test was intended for young children who were yet to learn to read. The child indicates comprehension through motor action. It consisted of two portions, Test A - an informal checklist for children below three years, Test B for children 3 years and above. The total items included were seventy. The coefficient of reliability was found to be 0.95 significant at 0.001 level.

Griggs (1972) determined the extent to which key word identification was dependent upon the familiarity of the sentence in traditional and declarative sentences. The subjects correctly identified 54% of the key words in the traditional sentences, 37% of the key words in the declarative sentences. Lloyd (1964) evaluated the relationship between sentence familiarity and sentence speechreading difficulty. The test material used was 60 sentences from, "Filmed test of speechreading' (Taaffe, 1957). A correlation of r=0.31 was found between difficulty and familiarity of each sentence. This was interpreted as significant and weak relationship.

A group of sentences was developed at CID to represent "Everyday American Speech'. They consisted total of one hundred sentences. Their content was related to everyday colloquial speech and had high face validity. High correlations were found between the both forms of Barley CID every day sentences test and Utely sentence test, Form A.

Numbers and Hudgins (1948) reported that sentences were easier to speechread than words in deaf children. Wong and Taaffe (1958) noted that the first few words in a sentence usually were easier for normal hearing adults to speechread than were the last few.

A study of Erber and McMahan (1976) contradicts the findings of Numbers and Hudgins (1948) and Wong and Taaffe (1958). They studied twenty monosyllabic nouns presented in isolation and in three

different positions in sentences to fifteen profoundly deaf children to determine effect of context on word intelligibility through speechreading. Isolated words were more intelligible (80%) than words in sentences (46%). Animate nouns were more intelligible (70%) than inanimate nouns (33%) when used in initial position in sentences. The results suggest that some perception difficulties of deaf children could be diagnosed through speechreading tests which are scored on the basis of correctness of 'Key words' in sentences. It is likely that placement of words within the test of other words creates 'segmentation' problem for the speechreader. Coarticulation effects may make it difficult for the speechreader to specify word boundaries. Subjects apparently anticipated the occurrence of animate nouns in initial positions.

A study by Ronnberg et al (1995) investigated potential relations among three Variables; (a) audiovisual speech signal - low frequency supplemented speechreading as opposed to pure speechreading, (b) typical/atypical sentences, (c) presence/absence of additional context. All the three variables revealed significant main effects, but no interactions observed. Typical sentences were perceived easier than atypical sentences as they require more predictable and therefore demands less maintenance of information in working memory. Accessing less typical knowledge may demand another kind of less global, more analytical, access to phonological representations that is beyond the information given by low frequency information. Decoding ability and information processing speed are most important for the

population as a whole, especially for the old speechreader, and are generalisable to different speechreading conditions (Ronnberg, 1990). Verbal inference making/guessing in especially crucial when the context is poor. As an indirect back up system, the individual's working memory capacity is important when processing demands are high or extreme speechreading skill has developed (Ronnberg, 1993).

In summary, sentences are easier to speechread than isolated words due to availability of situational cues. It also depends on the guessing and working memory capacity of the speechreader.

Combination of types of test material:

It has been suggested by Kricons and Silverman (1990) to assess speechreading ability using battery of tests. It should include a measure of consonant recognition, word discrimination, identification of everyday sentences and comprehension of connected speech.

Most of the speechreading tests incorporated both word and sentence level utterances. They were: How well do you read lips (Utley, 1946); Costello test of speecreading (Costello, 1957); Craig lipreading inventory (Craig, 1969); Diagnostic test of speechreading (Myklebust and Neighus (1970) and Filmed speechreading test by Heider and Heider 1940).

The importance of using isolated statements is quite obvious because they serve as a large part of normal language experience (Utley, 1946). Thorndike's list of most frequently used words served as the basis for the selection of words. A list of 100 words was compiled by extracting every tenth word from the first 1000 most frequently used words. The Utley's test was made up of ten trial statements, fifty common expressions, twnety idiomatic statements, 100 words and story test. Results reveal that, the skills of word, sentence and story recognition are interrelated. The relationships are high enough to indicate that there is a great deal of overlapping among various skills. Yet, the combined skills do not represent a single unitary ability. Word, sentence and story recognition should be measured separately for diagnostic purposes. The internal reliability of "How well can you read lips?" (Utley, 1946) was 0.92 for sentence test, 0.79 for word test and 0.943 for the entire test. The validity of the test is established by its logical derivation as a representative work sample from everyday life and by the high reliability, resulting from interrelationships of the best material.

Three types of speech materials were presented by Brannon (1961) for visual identification to subjects. It included Utley's lipreading sentence test, Form A; fifty selected PB words and ten selected spondee words. The PB words were selected on the basis of six categories of visibility related to the phonetic composition of the words. Five spondee words were chosen which contained phonetic elements of low visibility

and five containing of high visibility. Comparing different types of material, the following were the major outcomes:

(a) The subjects approximately identified 50% of words in Utley sentence test, Form A.,

(b) Identified a mean % of approximately 35% of fifty selected PB words. Words containing consonantal elements of greater visibility were more easily identified.

Speechreading tests which consisted of syllables, words and sentences were - Lipreading test (Conklin, 1917; Lipreading test (Kelly, 1955); Lipreading achievement test (Reid, 1947) and Costello test of speechreading (Costello, 1957). Speechreading tests which incorporated word, sentence and story as a test material were, How well can you read lips? (Utley, 1946), Lipreading achievement test (Ried, 1947).

Several experts suggest using a battery of tests to evaluate speechreading. The battery should include combinations of syllable tests, word tests, sentence tests including stories.

Connected discourse:

Speech Tracking by DeFilippo and Scott (1978) is a test that evaluates a speechreader's ability to perceive connected discourse. It is a potentially useful and sensitive index of communication efficiency measured in words transmitted per minute. It acts as a basis for evaluating speechreading performance although there are several

important methodological problems in using it as a speechreading test (Gagre, et al., 1995). This technique, typically involved a story, chapter or a magazine article, presented by tester and speechreader is asked to shadow, word by word. When errors occur in material's repetition, the talker and receiver employ various strategies to resolve the blockage in order to obtain correct verbatim response. All the words were eventually transmitted through speechreading and none were missed. This approach is self paced, enables adjustment of difficulty of the material and employs meaningful speech.

Franks and Kimble (1976) suggested that introduction of penalty points yielded an additional measure of fluency. The automatic timing and monitoring of penalty points combined with carefully prepared large points enabled the speaker to concentrate on the task and to build up a good relationship with individual subjects.

Green (1987) investigated the effect of three levels of text complexity upon continuous discourse tracking in normal listeners who tracked speechreading alone and along with auditory presented voice pitch. Text complexity affected continuous discourse tracking under both speechreading conditions. Tracking rates decreased as the level of text complexity increased. The improvement in tracking rate with the addition to voice pitch information was found to be invariant over changes in text complexity when expressed as a simple difference between the two tracking rates.

An advantage of connected discourse is that it is related to everyday colloquial speech where the speechreader's familiarity can be tested. But one of the disadvantage could be that the test is time consuming, as the tester has to wait until 100% accuracy is achieved.

Another drawback of tracking was that it provides practice with written language. Also, both young and old speechreaders required special considerations in the tracking task (Kricos and Lesner, 1985).

No. of lists:

Ideally, tests should include many lists of different sentences. Reliability can then be achieved by presenting several lists in each condition, without exhausting the stock of lists. The lists must be of equal difficulty if scores obtained in different conditions of program of rehabilitation are to be compared (Foster, et al., 1993).

Procedures for compiling lists of equal difficulty have been described (Plomp and Mimpsen, 1979; Xazanas and Susan, 1972; Macheod and Summerfield, 1990). They selected sentences which represented conversational speech, short enough, easy to repeat, not redundant and not confusing. In total, 170 sentences were constructed avoiding words consisting of more than three syllables. The sentences were administered and those considered as to be easiest and most difficult were eliminated. Randomized ten lists were further processed by

computer program, to determine the phoneme frequencies for each list, to select the phoneme with largest spread in frequency of occurrence over the lists, and to take a sentence with a high frequency of that phoneme from the list with the highest frequency and interchange it with a sentence of low frequency of a phoneme from the list with lowest frequency. By repeating this procedure again and again extreme frequencies of occurrence of phonemes in particular lists could be reduced substantially. This was basically done to improve reliability of testing speech reception threshold for sentences by Plomp and Mimpsen (1979). The procedure are labourious to get a large number of equivalent lists. An alternative is to constrain the range of vocabulary and syntax in lists in order to compile a large number of lists of approximately equal difficulty and then to compute corrections that can be used post hoc in order to take account of any remaining differences in difficulty between lists (Foster et al., 1993).

The relative difficulty of the different lists is unlikely to vary with the age of subjects. Thus, the procedures for correcting for differences in difficulty between lists are likely to apply to all adult subjects (Foster et al., 1993). However, several studies of learning have shown that older subjects acquire information more slowly than younger subjects (Sharp, 1972). Thus, the rate of learning that underlies the improvement with score over lists might be reduced in older subjects.

The choice of the number of lists to present in a condition depends on the size of effect that one considers it to be of material importance to demonstrate (Foster et al., 1993). However, they recommended at least two lists of equal difficulty.

The research findings mention that, for a reliable test at least two to three equivalent tests is absolutely necessary to rule out familiarity and practice effects.

TEST PROCEDURE VARIABLES:

WE ENVIRONMENTAL VARIABLES;

There are some environmental factors that positively or negatively affect understanding of speechreading.

Since the speechreading must function in an assortment of locations, not always predictable or easily altered, it follows that the environment cannot usually be modified for optimum understanding by the speechreader. However, home and school environments can be modified to take advantage of those factors that might enhance the probable success with speechreading (Berger, 1972).

The environmental variables are;

1) Distance
2) Lighting
3) Viewing angle
4) Distractions

1) *Distance:*

Most of the research studies on effects of distance on speechreading recommend distances varying from four to eight feet (O'Neill, 1954; Prall, 1957; Hutton, 1959 and Evans, 1960).

Berger (1970) compared speechreading performance at 2 ft, 12 ft, 18 ft 8 & 24 ft and found no significant differences. But from a distance of 24 ft, elderly subject had difficulty probably due to lessened visual acuity. Speechreading from very close distance, less than 2 feet is contraindicated (Markides, 1977). Erber (1971) reported the effects of distance on visual reception of speech in profoundly deaf. Speechreading at 5 ft was 75% correct and at 100ft, it was 11% correct. In another year supplementary study Erber (1972) he found identification of vowels was less affected by distance than that of consonants.

Larry (1991) compared speechreading performances in three visual distance 6 ft, 12 ft & 18 ft. There was an overall decrease in lip-reading performance with increasing distance from 6 ft to 18 ft. The combination of speechreading and tactile aid apparently enabled subjects to improve their speechreading of sentences at increased distances. Therefore it can be speculated that testing would logically be most meaningful if done at distance most representative of typical daily conversational situations, i.e., between five to ten feet.

2) *Lighting*

Lighting on the speaker's face is an important factor in speechreading. A light source low and in front of speaker has been

found to produce better scores than normal lighting condition (Jackson et al., 1976). The effects of illumination visual reception of speech by profoundly deaf children was investigated by Erber (1974). The result showed, within 0 to 45° range of horizontal viewing angles, illumination conditions which shadowed the speaker's oral cavity (overhead lighting) lowered the mean speechreading performance 3-12% below that which was obtained for 0 or +45° angles of light incidence. With the frontal illumination of the speaker, a large reduction in facial luminance (from 30 to 0.03 footlamberts) produced only a 13% decrement in visual intelligibility. Under conditions of high background brightness, however, a reduction in facial luminance from 30 to 3 footlamberts produced a mean decrement of 41%. He suggests that the teachers should face the window as they speak and by compressing the pattern of pupils' desks so that all children can observe their teacher from favourable angles.

Berger (1972) noted that individuals familiar with the message content produced slightly diminishing scores as the intensity of the room illumination decreased from thirty foot candles to one-half foot candle.

Owens and Blazek (1985) in their filmed speechreading test had lighting condition provided by an umbrella light (Lowell Totalight) system consisting of intense lights placed in front of talker. The

reflected light from the umbrella provided a clear, bright picture of talker's face. The talker's face and portion of shoulder was reflected in visual recognition task of viewers during the recording procedure. While testing, subject was tested in a quiet room lights dimmed and no light reflecting off the 12 inches from diagonal television monitor. Kricos and Lesner (1985) determined effect of talker differences in speechreading performance. In their study, the lighting condition used were two reflector hoods with 150 watts incandescent bulbs to supplement normal room illumination.

Various studies on lighting suggest an angle of illumination to be 0-45° intensity to be 30 foot candles. A high background brightness will reduce speechreading ability.

3) ***Viewing angle***

Larr (1959) compared speechreading of normal adults at different angles, front view (0°), 45° angle and profile view (90°). The 45° viewing angle produced slightly better speechreading scores than the other two angles. Highest speechreading scores were reported from a 45° angle and lowest scores at 90° (Blair, 1972). Bruewar and Plomp (1986) found a significant difference in speechreading scores at 0° and lowest at 45° angle. Erber (1974) found best visual recognition scores for 0 to 45° horizontal observation angles. Mean scores were 14

to 22% lower when the angle was increased to 90°. For viewing angles within the range of 0 to 45°, the smaller the distance between the speaker and speechreader, the greater was the visual intelligibility. Minor variations in vertical viewing angle (-30 to +30°) had little effect on speechreading performance.

Most of the studies reveal 0°-45° is more visible and to be the best viewing angle between the speakers and the speechreader.

4) *Distractions*

A distraction is a psychological factor. But if the distracting stimuli is at a high enough level, it may become a physical factor. Distraction can be either visual or auditory:

a) *Visual distractions*

Markides (1977) suggested that visual distracters influence speechreading. Among the visual distractors reported by speechreaders were movement of hands in the area of face and exaggerated lip movements (Berger 1972). A positive and significant relationship was found between purposeful hand movements by the speaker and speehreading scores (Keil, 1968). It is difficult to speechread a person wearing dark glasses because part of the face is hidden. A male having a beard or moustache, female wearing long dangling earrings will also be difficult because of the distractions. The pipe or cigar in mouth

hinder speechreading performance by reducing lip mobility (PetKoveak 1961).

From the above studies, it can be presumed that visual distractions contribute reducing speechreading ability. In daily life the visual distractions are more predictable and may have a greater negative effect on speechreading. It is necessary to maintain visual attention for a considerable period of time during speechreading.

b) ***Auditory distractions***

It would be difficult to determine effect of auditory distractions on speechreading with hearing impaired population. Background masking noise has been employed in a number of experiments using normal hearing subjects (Erber,1972; O'Neill, 1954; Sumbly and Pollack, 1954). The auditory distractions significantly and adversely influenced speechreading scores even in trained subjects (Leonnard, 1962). The experimenter employed white noise, speech and background music each presented at 80 dB SPL. The only significant difference among the three noise distractions was between white noise and music and this difference may reflect a practice or learning effect. The intermittent noise had more distraction than continuous noise, since the subjects would be expected to adjust to continuous noise more easily (Berger, 1972).

For a given S/N ratio the combined auditory visual performance is typically better than is the recognition through listening alone. The information would be used to establish S/N criteria for auditory or auditory visual perception of speech in noisy areas where communication must occur, for e.g., in industrial and educational areas.

Pettit (1963) compared effects of speechreading performance in noisy and quiet conditions. The noise was at 90 dB level and the test materials used were monosyllabic words. Results indicated poorer speechreading scores in noise than when in quiet. Binnie, Montgomery and Jackson (1974) showed that even when broadband masking (-12dB S/N) eliminated all but voicing and nasality features, normally hearing subjects recognised consonants through auditory visual perception considerably better (83%) than when merely listened (34%). This increase was attributed to speechreading of the place of articulation information that was masked by the noise.

To conclude, various studies on auditory distractions signifies decrease in speechreading performance among normal subjects. In case of hearing impaired, contribution of auditory distractions may not be practical enough, because of impairment in audition.

The environmental variables contribute significantly in speechreading ability of the individual. Adequate lighting, a distance of 5-8 ft between the speechreader and the speaker, viewing angle of 0°-45°, auditory and visual distractions should be controlled prior to testing. These factors if modified or manipulated will enhance the success of speechreading.

THE SPEAKER VARIABLES

Speechreader needs to converse with many persons, some of whom will be strangers. He cannot expect each speaker to modify their speech behaviour to facilitate visual understanding.

The speaker variables are;

- Image of the speaker
- Selection of the speaker
- Rate of the speech
- Sex of the speaker

1) Image of the speaker:

How much of the speaker is in view is an important variable in speechreading, especially if the test is a filmed one. Reid's (1947) test film showed upper part of the shoulders and lower three fourth's of the speaker's face. Most other test items have used a head and shoulders view of the speaker (Arnold and Kopsel (1995). A waist up view has been used in several test films. Conklin (1917) presented a videotaped sentences test wherein the key word was shown in a close up view of the mouth following a larger image of speaker saying entire sentence. It has been found that more of a speaker visible, easier he is to be speechread (Stone, 1928). Larr (1959) compared speechreading scores obtained when subjects were shown four images of speaker, upper torso, head and neck, head only and lip only. Optimum image seemed to be head and neck, with lips only being most difficult.

Greenberg and Bode (1968) examined consonant identifications as seen full face or only lips down to upper laryngeal area. Significant differences in favour of full image was found. It is probable that smaller image of speaker merely rules out or minimizes useful clues and makes the task more difficult.

Preminger (1998) used digital video technology to effectively mask the facial aspect. The visual masking involved entire mouth, mouth and upper part of face and mouth and lower part of the face. Results showed masking of tongue and teeth had little effect on viseme recognition. When entire mouth was masked, participants identified consonant visemes with 70% or greater accuracy in |a| and /)/ vowel contexts than |u|. When mouth and upper part of the face were masked, performance was poor, but information was available to identify the consonant viseme |f|. When mouth and lower part of face were masked, viseme recognition was quite poor, but information was available to discriminate the consonant viseme |p| from other consonant visemes. Visibility of tongue and teeth was important only in discriminating |t| from |k| in |u| context.

Most of important information available on the face was located at level of lips and mouth especially, chin and sides of the cheek. This

effect of vowel context on speechreading ability has shown by Benguerel (1982); Erber (1974); Owens and Blazek (1985).

Researchers suggest that the speaker should be positioned so at least the head and shoulders are clearly observable to the speechreader. The articulators of the speaker should be clearly visible to enhance speech reading.

Selection of the speaker:

Some persons are much easier to speechread than others. Therefore, to test a speechreading task speakers of varying degrees of nonverbal expressions should be included. Speakers should represent race, dialect, sex and age in proportion to the frequency of their occurrence in the overall population of a country. These factors should then be represented in proportion to the frequency of their occurrence in the population for which the test is built. Great care must be exercised in making random selection of speakers within the racial, dialectal, age and sex categories set up. (O'Neill and Oyer 1961).

In a study by Kricons and Lasner (1985) it was noted that use of different talkers significantly affect the speechreading performance of hearing impaired teenagers. Oyer and Frankmann (1975) concluded that a natural speaking style appears to facilitate speechreading. A

study of Stone (1928) suggested that normal rather than tight lip mobility and smiing facial expression affected better speechreading scores. But these differences were not statistically significant. A speechreader stated that an expressionless face, immobile lips and grimaces inhibit speechreading proficiency (Woodward and Barber 1960).

Exaggerated speech was not found to be significantly easier than non-exaggerated speech (Van Uden, 1960). In a study by Berger et al. (1972) scores gradually and significantly deteriorated as lip thickness of the speaker increased. He also noted black speechreaders were able to speechread black speakers best and white speechreaders speechread white speakers best. The speaker with thick lips is difficult to speechread because of reduced lip mobility and that a person can speechread a speaker of his own race better because of more practice in communication within the race (Berger, 1972). "Most preferred" speaker was easier to speechread than "least preferred" speaker (Woodward and Blakely, 1953).

Speechreaders often state that for best understanding of speech the speechreader need not know only the language and dialect of the speaker, but also his other speech habits. Knowing the personality of a person is said to make it easier to understand him (Petkovsek, 1961).

There are reports that relatives and close friends are easier to speechread than persons who are more distantly known (Berger, 1972). Trask (1917) suggested that speechreading proficiency could be judged on the basis of person's success in speechreading ranging in relationship from a close relative to a causal acquaintance.

A study by Kricos and Lesner (1982) conclude that viseme categories do vary across talkers and are related to ease with which talkers can be speechread. This may be accounted for the fact that individuals differ not only in precision with which they produce sounds but also in manner in which they form the sounds (Jeffers and Barley, 1971).

Bench et al. (1994) carried out a study to select several talkers from a pool of potential talkers, to avoid adventitiously choosing a markedly atypical single talker. This was done to assess speechreading as a general skill rather than as talker specific and to select talkers who were acceptable to speechreaders, relatively easy to speechread and comparable with their speechreadability. Totally sixteen talkers out of which four talkers involved in the study were young man, young woman, older man and older woman. The result suggested that younger women were easiest to speechread.

The talkers chosen for a speechreading test based on words or sentence will significantly affect the test results. The choice of talker for speechreading tests had generally been rather arbitrary and the talkers have not been well characterised. Speechreading should be assessed as a generalised skill and not as talker specific (Plant 1980), as it does not reflect the spedchreader's need.

A study by Lyxell et al. (1995) noted the role of facial expression in speechreading. It was assessed by three different tests; sentence based speechreading, word-decoding and word discrimination. The results revealed that no general improvement as a function of expression was obtained across all the tests, which could be due to information carried by expressions is not integrated together with verbal information.

The advantage of facial expressions restricted to speechreading tasks with a relatively low level of linguistic complexity, i.e., word decoding and word discrimination. There is no interaction between skill and type of expression for more complex tasks i.e., sentences. There is verbal priority in speechreading such that additional information is processed when speechreading task allows for such processing (Lyxell et al., 1995).

Facial expression cany a broad spectrum of information. They inform about individual's age, sex, mood, feelings, or intentions (Taafee and Wong, 1957). The role of facial expressions in speechreading is to strengthen the relatively weak stimulus signal and thereby to increase possibility for speech understanding (Lyxell et al., 1996).

Numerous studies suggested speaker differences. The speechreader is more dependent on the speaker, hence more the number of speakers he can speechread easier for him to communicate in day to day life. A natural style of speaking leads to better speechreading scores.

Rate of speech

A normal speech rate (120 words per minute) is said to be faster than the "optimum" for speechreading purposes (Nitchie, 1950). Sumby and Pollack (1954) reports, that in normal speech, articulator movements averages to twelve per/sec but eye can see only nine or ten.

In was found that a filmed test projected at sixteen frames per second was easier to speechread than twenty-four frames per second, about two third of normal speed produced best speechreading scores, with no significant difference (Frisina, 1963).

In contrary to above studies, there was no significant differences were found among viewing speeds between speechreading proficiency groups (Byers and Liebermann, 1959; Blair, 1972). Speechreader is not hampered by slower than average speech rate's and their accompanying exaggerated lip movements (Berger, 1972). In general, a profound loss depends on eyes for 80-100 percent of received information. The rate of speechreading instruction varies with and is limited by extent of the loss and proficiency of the speechreader.

Summerizing the above studies, there are equivocal results regarding rate of speech influencing speechreading proficiency. Most of the studies show that the speed of focussing is less compared to articulatory movements, hence a slightly slower than average rate could enhance speechreading performance.

Sex *of the speaker:*

Women are easier to speechread than men because of the use of lipstick draws attention to their mouth and also because they use freer facial expression and more gesture (Petkovsek, 1961).

It is sometimes also mentioned that males with moustaches, beards, pipes in their mouth are difficult to speechread. These seem to be more a matter of distractions than sex differences as such (Berger,

1972). Ross, et al. (1972) found that female speakers produce significant differences in terms of greater rate and intensity of movement on the surface of the face during the production of selected homophenous words than males.

In a questionnaire sent to hearing impaired adults, male and female respondents were in general agreement about the ease of speechreading males, but the male respondents indicated that females were not easy to speechread more often than did female respondents (Berger and Popelka, 1971). Shepherd and Markides (1972) found no significant differences in speechreading scores produced by the sex of the speaker.

Thus from the above studies it can be concluded that there are equivocal studies regarding sex of the speaker affecting speechreading. Individuals may not feel comfortable with opposite sex to perform a speechreading task, as constant visual concentration is required. Rather than the sex difference, visual distractions like moustache, earrings etc., may contribute in reduction of ability.

The articulatory precision of speaker, the rate, cooperation, visibility of speaker, amount of lip movement, speaker familiarity and sex of the speaker are the critical variables important in understanding

them. It is important to study the factors that contribute to readily understanding and qualities that make it difficult in the speaker.

THE SPEECHREADER VARIABLES

Understanding the factors related to the speechreader is particularly important as they affect speechreading proficiency. It is crucial that these variables be controlled, when constructing a speechreading test.

Further, with better understanding of those speechreading factors, most important in the development of the speechreader, we may be able to develop simpler and quicker, indirect methods for modifying habits and behaviour.

The speechreader variables are

-Intelligence
-Behavioural pattern
-Educational background
-Synthetic and analytic ability
-Non-verbal visual perception
-Rhythm and Pitch
-Visual skills
-Age
-Hearing loss
-Sex.

1) Intelligence

Pintner (1929) tested face-to-face speeechreading in deaf students and found no correlation between speechreading scores and scores on Pintner non-language mental set. A study by O'Neill and Davidson (1956), using Ohio state psychological examination, reported no correlation between speechreading skills and intelligence.

The Weschler scale was administered on 24 hard of hearing subjects and no significant correlation was found between IQ and spechreading skills (Nakano, 1960).

Heider and Heider (1940) developed a film test and tested students of dark school, they found no significant relation between school achievements and speechreading proficiency.

IQ tests requires analytic reasoning ability, but speechreading is a synthetic process, hence a close relationship between the two will not be present. However, where IQ test includes a number of verbal subtests, it should correlate better with speechreading performance (Jeffers,1967).

Most of the studies indicate no significant correlation between intelligence and speechreading, except a study by Craig (1964) and

Evans (1965). They found small but significant correlation between intelligence and speechreading scores.

Behavioural pattern

Nitchie (1913) considered speechreading as speech thinking. He suggested four types of speech thinking, (1) Visual (2) Acoustic (3) Speech motor (4) Script motor. Persons with visual thinking were best suited for speechreading and those of acoustic type found speechreadng difficult.

There are experts who found a correlation between behavioural abilities and speechreading. Wong and Taaffe (1958) reported general ability, personal relation and emotional stability were important personality aspiration in speechreading. Aptitudes such as reasoning, identical fluency, spontaneity, flexibility and fluency were considered important for speechreading.

Griggs (1972) reported that good speechreaders had a more positive attitude towards themselves than poor speechreaders. He also felt that speechreaders got fatigue due to concentrative visual attention and therefore they should learn to relax when having to speechread. Markides (1977) considered motivation to be very important in speechreading task. Psychological factors like attention, attitude and

motivation definitely influenced speechreading ability (Markides, 1977). Speechreading requires more attention and better motivation than audition, since only unidirectional visual cues form the speaker can be used for understanding (Berger, 1972).

Milesky (1960) stated "Motivation/drive cannot be tested, although this perhaps is one of the most important factor in speechreading ability. Falconer and Meffer (1970) found that good speechreaders made more guesses than poor speechreaders. They considered decreased reaction times on a visual motor task as indicative of high motivation and found good speechreaders had lower reaction times.

It is sometimes claimed that adolescent deaf become poorly motivated in their academic work and have a low aspiration level which results in reduced speechreading performance (Berger 1972). Good speechreaders were more introverted, less neurotic, well adjusted on E.P.I, scale (Falconer and Mefferd, 1970). It has been suggested that the speechreader must be alert without being tense (Bunger, 1952).

In contrary to above studies, a few experts noted no relationship between behavioural pattern and speechreading task. O'Neill and Davidson (1956) found no significant correlation between aspiration

level and speechreading skill in a population of congenitally deaf subjects. Similarly, Worthington (1950) found no significant correlation between behaviour patterns or degree of adjustment and speechreading ability. There was no significant correlation between speechreading and aspiration for both the deaf and normal hearing subjects (O'Neill and Davidson, 1956). In a test that required the maintenance of visual attention over an extended period of time, a non-significant difference was found between good and poor speechreaders. They become fatigued from concentrated visual attention required for the task (Frisina, 1963).

Though majority of the studies emphasize on positive mental attitude, high aspiration level, motivation and flexibility in good speechreader, there are a few contradictory studies too.

Educational background

It is important to consider speechreading from the standpoint of educational placement and other factors related to schooling.

Pintner (1929) found that day school students scored higher in speech intelligibility and speechreading than did residential school students. Day school students had better hearing sensitivity and a later onset of deafness than did residential students. Length of training or

schooling and grade placement may be important variables in speechreading. A high correlation was obtained by Kazanas and Susan (1972). But a low correlation was reported by (Reid, 1947, Jackson, et al., 1976). Larr (1959) found small, significant relationship between speechreading scores and educational achievement test. Educational achievement, grade placement and number of years in school would seem to be interdependent. Their relative importance to speechreading performance is not clear from evidence, but reported correlations are moderately high for the most part.

Rather than the kind of educational program the child attends, it is probably the amount of training the child gets to practice speech reading, that would affect the speechreading scores.

Thus the kind of educational set-up a person attends may affect the scores, he/she may obtain on a speechreading test.

Synthesis and analytic ability of speechreader

Synthesis seems to be related to closure, which is ability to perceive an incomplete figure/movement as a whole. Synthetically oriented person lets his mind fill in the portions of the overall message that he does not clearly see. He makes use of greater linguistic cues when visual cues are in sufficient for meaning.

The analytic person, presumably sees every position of articulators in detail and therefore cannot speechread readily. Conversational speech moves too rapidly and hence analytic speechreader may be inefficient (Erber, 1969). Evans (1960) was the first one to relate analysis and synthesis in speechreading. He compared ranking of adult speechreaders with their ranking on a sentence completion task. The resulting correlation was 0.65. On the basis of a similar test, Binnie (1974) concluded that synthetic ability should be dominant for successful speechreading. Jackson, et al. (1972) modified letter prediction test by giving the subjects a key word within a sentence and then requiring the prediction of the letters of remaining words. This was done to assess synthetic ability. The correlation between the score for this test and a speechreading test score (r=0.42) was not statistically significant.

Green and Green (1984) reported a weak but statistically significant relationship (r=0.39) between speechreading and the completion of printed sentences distorted by the omission of every third letter.

Internal speech constitutes an especially appropriate coding strategy when short term memory and reading tasks were considered (Baddelay, 1986. 1990; Delson and Prather, 1974; Wagner and Targensen, 1987). It is a mental representation of sound used for

various purposes (Rayner and Pollatsck, 1989). Even normal individuals make use of some form of inner speech.

Majority of the tests of speechreading are based on synthetic ability (Utley's test of speechreading (1946); Diagnostic test of speechreading by Myklebust and Neyhus (1971). One of the tests that relates to analytic ability is speechtracking method by Di Flippo and Scott (1978).

Lyxell and Ronnberg, (1994) noted that one of the primary consequences of acquired deafness is that representative aspects of internal speech deteriorate over time, whereas mechanical aspects remain relatively intact. Inter-correlation between accuracy level in direct testing and speechreading performance also suggest that speehreading ability declines. Working memory is necessary prerequisite for speechreading. It implies that some individuals with low working memory capacity are less apt for speechreading, but it does not preclude rehabilitation efforts. There is also tendency that working memory capacity is more critical when the messages to the speechread are increasing in length (Lidestam et al., 1999).

Lyxell and Ronnberg (1986) indicated that skilled guessing in terms of sentence completion task performance proved to be critical for

longer sentences to be speechread. Skilled guessing as measured by a word completion task proved to be critical for speechreading situations where a low level of contextual information was offered. The results of his study suggest that speechreading and guessing skill are related to each other, and that different types of guessing tests predict different aspects of the speechreading process. Speechreading in terms of guessing is not a unitary task. Hence, it should not be possible to make predictions from the results of the single guessing test to enable speechreading process.

In summary, attempts were made by most of the investigators to relate synthetic and analytic ability. They conclude perhaps synthetic ability is related to the willingness to guess, good knowledge of linguistic rules, keen sense of observation of situational and other clues. It also seems possible that at the initial stages of speechreading analysis is employed and but with progress in speechreading skills synthesis becomes more important.

Non-verbal visual perception

Hieder (1940) found 'integrated type' of child (good speechreader) usually sorted geometric forms by colour, while the more 'rigid and analytical' child (poor speechreader) were more apt to sort the forms by shape of the form itself. A significant correlation (r=0.48) *between a* visual recognition of designs test and a filmed speechreading test was

found by Evans (1964). Costello (1957) reported nonsignificant correlations between knox cube test, which is test for memory of movement and speechreading performance with hearing impaired children. But, she found significant relationship between speechreading skill and ability to arrange picture sequences depicting social situations. Poor speechreaders more frequently repeated incorrect choices for nonverbal concept and required most time to make choices before attaining the concept (Taaffe and Wong, 1957).

Thus it can be concluded that speechreading is a skill heavily dependent upon the rapid perception of quickly changing movements.

Rhythm and Pitch:

Speechreading test do not mention that stress patterns for words of more than one syllable may supply visual cues, but it can be inferred that visual recognition of rhythmic patterns in phrases and sentences is possible (Ewing and Ewing, 1967).

The normal hearing subjects reported that the task was difficult, and they were unable to explain how they arrived at their decision. The responses made by subjects for both two syllable and three syllable words suggested that stress patterns were identified more often than by chance (Berger, 1972). Speechreaders appear to be able to determine

terminal pitch contour of sentences on better than a chance basis (Fischer, 1961).

A few studies report that rhythm and pitch changes can be judged through speechreading. However, most tests of speechreading, do not assess this aspect.

Visual skills

O'Neill (1951) and O'Neill and Davidson (1956) did not find a significant relation between visual skills and speechreading. Several tests of visual-motor co-ordination were used, included tests of block design, object assembly and digit symbol from Weschler-Bullevu adult intelligence scale. Results indicated significant correlation between scores for digit symbol and speechreading. However, no such correlation was found between block design, object assembly and speechreading. This seems to indicate the speechreading may involve not the recognition of verbal elements but recognition of configuration/form of patterns.

Sharp (1972) found good speechreaders significantly superior to poor speechreaders on tests of visual closure, movement closure and short term memory. Evans (1960, 1965) and Berger (1972) agree that anyone with vision sufficient to see difference in movements and

position of the articulators of the speaker, can speechread. 20/40 seems to be sufficient in most conversational situation (Markides, 1977).

In case of normal hearing, visual memory for complex shapes significantly correlated with speechreading. For the hearing impaired, reading ability was significantly correlated with speechreading, but for the bilingual deaf the correlation was not significant (Arnold and Kopsel, 1995). They noted that it would be useful to learn more of the relationship between word recognition, and the use of syntactic and pragmatic knowledge in reading on one hand with equivalent speechreading skills.

Shepherd et al, (1972) found significant product moment correlation ranging form 0.09 to 0.91 between a selected peak latency in average visual electro-encephalic responses and speechreading scores in twenty adults with normal hearing and vision.

The studies indicate that there exists a relation between speechreading and visual motor skills which include block design, object assembly and digit symbol. However, studies regarding reading abilities and speechreading skills are equivocal.

Age of the speechreader

Evans (1965) reported rapid increase in speechreading scores between ages of six and eleven years and then a plateau is reached. According to Farrinand (1959) speechreading ability improved from second to third decade of life and then it declined. He found that speechreading scores of person over 60 years were about half those achieved by 30-35 years old people.

But Conklin (1917) did not find deterioration of speechreading scores with age. Similarly, Hieder and Hieder, 1940; Utley, 1946, and Reid, 1947 reported a very low and insignificant correlation between age and speechreading performance. A number of studies have examined the effect of chronological age on speechreading performance (Ewertsen and Birk-Nielspn, 1971; Smith and Kitchen, 1972; Delson and Prather, 1974). Common to the results of these studies is a decline in speech reading performance with increasing age (Lyxell and Ronnberg, 1989).

Deterioration in speechreading scores for an aged person may be due to lack of motivation and reduced vision.

Hearing loss and speechreading

Speechreading ability and degree of hearing loss and age of onset have been compared. Heider and Heider (1940) found speechreading and hearing loss correlated favouring the child with better hearing.

This could be probably due to better vocabulary, high motivation found in children.

Petrovek (1961) in an autobiographical report claimed that a totally deaf person found it easier to learn speechreading than a person with good hearing because the latter tend to concentrate on listening at the expense of speechreading.

Bunger (1952) conducted a large study and reported that normally hearing persons scored higher in speechreading than did deaf people. Here a normal hearing individual shares an equal capacity to speechread with the hearing impaired individual.

Speechreading ability was investigated by Tillberg et al, (1995) among hearing aid users with different time of onset and different degree of hearing loss. Audio-visual and visual only performance was assessed. One group had hearing impairment early in life and the other later in life. There was no significant difference on audio-visual test between the groups, however early onset group performed significantly better on visual only test. Hence, it was concluded that the visual information constituted the dominant coding strategy for the early onset group. An interpretation chiefly in terms of early onset may be most

appropriate, since dB loss variations as such are not related to speechreading skill.

Erber (1972) demonstrated that the magnitude of visual contribution, defined as the difference between audio-visual and auditory only scores, increases as the auditory channel was progressively impaired. In case of audio-visual testing, it is most likely that most of the information in pitch, intensity and time variation is available to subjects with severe hearing loss who use hearing aids and to those with the moderate hearing loss who do not use hearing aids (Tillberg et al., 1995).

Studies relating speechreading and hearing level are equivocal in nature. But, majority emphasizing on hearing impaired benefit greater than normals as they have to depend more upon visual reception of speech.

Sex of the speechreader.

Females are generally superior to males in linguistic skills. Most of the researchers (Mc Eachun and Aushford, 1958; Brannon, 1961; Graig, 1969'; Evan, 1965) found females scored high in speechreading than males but the difference were not statistically significant. Costello (1957) and Frisina (1963) reported significant difference in speechreading ability in favour of females.

Berger (1972) sent a questionnaire to hearing impaired persons sixteen years and older. He reported, males considered groups of two to three persons as a more difficult situation in which to speechread than did females. It might be that hearing impaired males are less often in small group conversations than are females and rather, are in one to one communication more often and watch television more than do females.

A number a studies support females having greater speechreading ability than males. This may be probably due to their higher linguistic skills.

Responses

The response criteria would depend upon the type of speechreading test considered. Speechreaders can indicate their response by writing, repeating after the speaker, pointing or by selecting if a multiple choice pattern is given. Two type of response mode are:-

1) Open set response
2) Closed set response (Rintelman, 1976)

1) *Open set response* - Speechreader can independently answer where there is no choice given (free choice). He can guess whatever he gets the utterance as.

b) They must be important to meaning of the sentence.

c) They must have approximately the same visibility as the rest of the sentence.

Erber (1974) developed a response matrix to determine test results. Range of response tasks were detection, discrimination, recognition and comprehension, they tend to increase in difficulty. At each level of task complexity is considered to be a prerequisite for success at the next higher level. This will broadly describe the subjects current level of speechreading performance and test results might suggest where to begin and what sort of materials to use.

Schoepflin and Levitt (1991) evaluated the method of continuous discourse tracking in terms of the strategies used by talker and types of responses elicited from the listener. Talker utterances were classified into four categories:

1) Complete repetition
2) Partial repetition
3) Repetition with change in emphasis
4) A combined strategy using two or more correction strategies.

Speechreaders responses were classified into three categories.

1) Correct repetition of intended utterance
2) Partial correct repetition
3) Totally incorrect repetition.

-The speechreaders showed small, best statistically significant differences in their response patterns.

The response thus would depend for the test constructed, complexity of items, whether cues given or not and the age of the speechreader. In case of children, where who does not have enough vocabulary response is elicited by appropriate motor action (Butt-Children's speechreading test). Kind of responses depend on whether an open set or a closed set. Greater variability would be seen in open set whereas, in closed set variability found is less.

Scoring

Test constructor should decide upon scoring procedure before selecting items for the test. There could be a difference in the stimuli selected if the scores were based upon correct identification of sounds, syllables and word than if they were based upon meanings. Specific numeral values should be assigned to the items that are employed so that performance of the persons tested can be mathematically presented (Berger, 1972). Dillion and Chang (1995) gave two ways to represent the test scores, qualitative and quantitative scoring.

1) *Quantitative scoring.*

Items can be scored as proportion of words or phonemes correct. Phoneme scoring will always lead to a higher score than word scoring, because words cannot be correct unless all its phonemes are correct. The disadvantage of phoneme scoring is that it places additional demands on the concentration of tester. Boothroyd (1968) reported phoneme scoring to be 20-30% higher from the whole word scoring. Thus, phoneme scoring reduces the influence of language function and inter-list difference.

Another scoring method is keyword in a sentence. This response task requires the subject to follow an instruction or answer a question. Then subjects' action are judged as either right or wrong. When a material consists of sentences with several key words per sentence, scoring become difficult for the tester unless subject perceived nearly everything correctly. Utley (1946) scored sentences in two ways, by correct idea i.e., if the content was perceived with reasonable accurancy and by the number of words correctly recorded. The resulting correlations was 0.98 and 0.97 between the two methods of scoring. The results indicated that sentences could be corrected according to number of correct words recorded which in more objective method.

According to Utley (1946), percentage of correct score for sentences and interpretation of type of speechreader is given below:

(%) Number of sentences correct		Interpretation
90-100%	-	Excellent
78-87%	-	Good
52-74%	-	Average
Below 49%	-	Poor

The written responses to the sentences were scored by both the loose and tight keyword methods in a study by Foster (1993). Loose methods requires only the root of the keyword to be reported correctly. Other details, such as inflexion or precise word ending need not be correct. Tight method required the response to be identical to the stimulus word. Scoring using loose method produced slightly but significantly higher scores then tight method.

A variation to counting items occurs in connected discourse tracking (De Filippo and Scott, 1978). In this, the talker presents and represents words and phrases until the listener is able to repeat them correctly. Here, the number of words per minute, rather than proportion of words correct is scored.

2 Qualitative scoring:

Here the raw scores are represented in terms of percentage. The percentage of speech units correct is the most appropriate way to express the result. Whenever the purpose is to find comparisons under some specified condition, qualitative scoring can be used (Dillion and Ching, 1995).

Both qualitative and quantitative scoring is absolutely necessary in a standardized test. Scoring the keywords is more practical, as speechreader need to know the concept of transmitted message rather than analysing every articulatory movement. Hence, in most of speechreading tests the correct word is scored. Converting raw scores into percentiles allows for standard comparison across test items and tests.

The scoring of a speechreader could also be descriptive. Simmons (1959) described the levels of ability in speechreading and a rating scale was created, w*hich is* given below.

Good Does not often miss what is said, speechreads without hesitation, follows shift of topic, can follow direct and indirect conversation, can speechread profiles and fullface, can speechread variety of speakers, needs no special distinctness on part of speaker.

Average. Sometimes hesitates and requires a filling in, eventually gets what is said either through repetition or regarding without an extreme breaking down of what was said, speechreads some people better than others, has some difficulty in following change in topic, has some difficulty with individual conversation, has some ease with speech if it is distinct, requires a simplification of language on part of speaker.

Poor- requires frequent repetition, requires written clues, has only limited range of topic, cannot follow even when speech is rewarded, cannot pick up speech from context, needs to have lip movements exaggerated, needs slow rate and simple language.

The above rating scale would aid in differentiating a type of speechreader. A combined assessment, from a rating scale and the test scores would probably yield a reliable diagnosis.

From the review of literature, it can be noted that there are several variables that affect speechreading. While constructing a speechreading test it is essential that these variables are considered. The choice of material would depend on the purpose of the test. The environmental variables should be kept constant no matter whether a film test is constructed or it is a live test. The choice of the correct speaker is important. Further, the results of the test are depended on the speechreader variables, and the way the responses are obtained. Prior to the construction of the test, the way in which the responses are elicited and scored, should be determined. Careful consideration to all the variables should be given, while constructing a speechreading test.

METHODOLOGY

The aim of the present study was to construct a speechreading test for Kannada speaking acquired hearing impaired adults (above the age of 18 years).

It was proposed that the test should have three equivalent forms, i.e., Form A, Form B and Form C. Each form would have the following subtests;

1) Word subtest
2) Two word phrases
3) Three word sentences
4) Connected discourse

This study was conducted in three phases;

Phase 1—> Construction of the test material

Phase 2 —> Administration of the test material on normal hearing subjects.

Phase 3 —>Administration of the test material on hearing impaired adults with varying ability to speechread.

Phase 1 — Construction of the test material:

This phase was conducted to obtain material for the three forms of the test, each of which had the following subtests;

1) Word level
2) Two word phrases
3) Three word utterances
4) Connected discourse

1) Word level:

The words were chosen from a Kannada dictionary, Kannada newspapers and magazines. The words selected were familiar, simple, meaningful and had vocabulary appropriate to adults. The words that did not vary in spoken and written form were selected.

Each list consisted of phonemes that were selected based on the frequency of occurrence in Kannada language (Ramakrishna, 1962). Each of the forms A, B & C had 50 syllables. In this subtest, homophenous words were avoided. Total number of words in Form A, B & C were 22, 21 & 21 respectively (Table 1).

2) Two word phrases:

This subtest consisted of two word phrases chosen from newspaper and magazines. Vocabulary selected were familiar, commonly used and semantically reasonable. Frequency of

occurrence of each phoneme in this subtest was constant in all the three forms A, B & C. The total number of phrases in all the three forms were twenty-one. The total number of syllables were 44, 44 and 47 syllables is Form A, B 8B C respectively (Table 1).

3) Three word sentences:

These sentences had a mean length of utterance of three words. Selection of words had criteria as mentioned in two word utterances. The frequency of occurrence of each phoneme was equal in all the three forms A, B & C. Each of the form had six sentences. The total number of syllables were 51, 51 8B 52 in case of Form A, B 8B C respectively (Table 1).

4) Connected discourse:

General topics that were of common interest to most adults were selected. The dialect spoken in and around Mysore was used. The mean length of utterance of the sentences ranged form 3-6 words. This subtest consisted of 50 words in each of the Form A, B and C. The frequency of occurrence of phoneme remained constant in all the three forms (Table 1).

Table 1: Number of test items in Form A, B and C

SI. No	Sub items	Form A			FormB			FormC		
		Syll.	Wd.	Sen.	Syll.	Wd.	Sen.	Syll.	Wd.	Sen.
1.	Word	50	22	—	50	21	—	50	21	—
2.	2 word phrases	44	14	7	44	14	7	44	14	7
3.	3 Word sentences	51	18	6	51	18	6	52	18	6
4.	Connected discourse	172	50	10	169	50	10	175	50	10

Syll. - Syllables, Wd. = Word, Sen. = Sentence.

The constructed test material was then subjected to familiarity. Three speech and hearing professionals and three non speech and hearing professionals who were fluent in Kannada were instructed to check the material for grammatic correction and familiarity. Items that were not familiar were deleted and substituted with words/phrases/sentences that were considered familiar. The substituted items consisted of the same target phonemes. Equality of forms in terms of phonemes and complexity was maintained ever after correction. (Appendix-1).

Phase II — Administration of the Kannada speechreading test material on normal hearing subjects.

This was done to determine whether the three forms were equal and could be used as alternate form to test speechreading ability.

Subjects:

30 subjects were evaluated to assess equality of scores across the three forms. The subjects met the following criteria ;

- They were native speakers of Kannada or fluent speakers of Kannada, form Mysore District.
- They were within the age range of 18-45 years.
- They had normal hearing, speech and intelligence.
- They had good vision or corrected to near normal vision.

Testing Environment:

- The testing room was quiet and free from distraction.
- It was well lit and with the light falling on the speaker's face.

Test Procedure:

- The subject was seated comfortably at a distance of 5-6 ft, facing the speaker.
- The tester used a normal rate of speech, rhythm and no voicing.
- Exaggeration of lip and jaw movements were avoided.
- Each subject was tested in two sessions. The duration of each session was 45 minutes. This was done to avoid fatigue.
- Each subject was tested with all the three forms which were randomly selected.

Instructions:

Prior to carrying out the test, the following instruction was given;

"I will be saying a few words/ sentences with no voice. You have to watch my face carefully and try to understand the utterance. Please repeat the word aloud. Even if you understand part of the message, guess whatever was said'.

Two practice items were presented prior to commencement of each of the subtests.

Scoring

Verbatim transcription of subject's responses for each of the subtests across three forms were done. The responses were scored as given in Table-2.

Table-2: Scorings for the responses

SI No.	Response	Score
1	Correct repetition of the utterance	1 point
2	Correct repetition after second presentation of the utterance	½ point
3	Incorrect response even after second presentation	0 point

Scoring was done separately for each of the subtests. At word level, every correct phoneme was given a score of "one". In sentences and connected discourse subtests, every correct word was given a

score of 'one'. Table 3 indicates scoring for each of the subtests for all the three forms.

Table 3: Scoring for the subtests in form A, B & C.

SI No.	Subtests	Items scored	Raw score	% score
1.	Word	Phonemes	50	100
2.	Two word phrases	Word	14	100
3.	Three word sentences	Word	18	100
4.	Connected discourse	Word	50	100

$$\% \text{ score} = \frac{\text{actual score}}{\text{raw score}} \times 100$$

As the raw score in each of subtests were unequal, they were converted into percentage scores.

Statistical analysis:

Raw scores obtained from 30 subjects for test items were subjected to statistical analysis.

Phase HI ~ Administration of the Kannada speechreading test material on hearing impaired.

The Kannada speechreading test was administered on the hearing impaired to differentiate a good speechreader from a poor speechreader. Ten hearing impaired subjects, five males and five females were included for the study.

Criteria of subject selection was as follows ;

- They had severe to profound acquired hearing loss
- They were within the age range of 18-55 years
- They had Kannada as their mother tongue or were able to converse in Kannada fluently, using a dialect spoken in and around Mysore.
- They had normal vision or corrected to near normal vision.
- They had normal intelligence and no other associated handicap except for hearing loss.

To assess whether a person is good or poor speechreader a scale regarding speechreading abilities was used. Following this, the speechreading test was administered.

I. Assessment of self perceived speechreading ability:

Development of questionnaire:

A questionnaire in Kannada was developed to assess speechreading abilities of the subject. The questionnaire had six questions which assessed identification of speech movements by observing the speaker's face, eyesight, motivation and their ability to synthesize the transmitted message. The questions were based on the review of literature regarding the various aspects that differentiate a good speechreader from a poor speechreader (Trask,

1917; Simmons, 1959; Tiffany and Kates, 1962; Sartoni, 1965). (Appendix 2a).

A similar questionnaire was developed for the family members. This was done to assess the family member's views regarding the speechreading ability of the hearing impaired individual.
(Appendix 2b).

Scoring

The ratings of the subjects and their family member was given the following scores; 'usually' was given a score of Two, 'sometimes' a score of One and 'Never' a score of Zero (Appendix 3a). The total score obtained form each subject and their family member was calculated. The maximum score for each of the questionnaire was twelve.

Each question had to be rated on a three point scale, i.e., Usually, Sometimes and Never. Each of the rating points were defined as, Usually', 'Sometimes' and 'Never'. Each of the rating points were defined as, Usually' indicated 75-100% of the time, likewise 'Sometimes' and 'Never' indicated that the speechreader could perform 25-75% and < 25% of the time respectively.

Administeration of questionnaire

The subjects and their close family member were instructed to read each question carefully and rate it on a three point scale. If the subjects were unable to read, instructions were given orally and the questions were also read out to them. The hearing impaired subjects wore on their prescribed hearing aids while the questionnaire was administered.

The questionnaire was administered in a quiet, well lit room, free from distractions. Each question had to be rated on a three point scale. The subjects had to answer all the questions.

Scoring:

Scoring was done as mentioned earlier.

II. Administeration of speechreading test in Kannada on hearing impaired subjects.

Test Procedure:

The testing condition and procedure were similar to that used with normals, except that the hearing aids worn by the subjects were switched off. The test was administered only when subject followed the instruction and were able to repeat the practice items. If required, sufficient cues like repeating and written instructions were also given.

Scoring

The responses were scored as done in phase II.

Statistical analysis:

The raw scores obtained for questionnaire, average test score and subtests were subjected to statistical analysis.

RESULTS AND DISCUSSION

The objective of the present study was to construct a speechreading test for Kannada speaking hearing impaired adults having three equal forms with each form having the following four subtests.

1) Word sub test
2) Two word phrases
3) Three word sentences
4) Connected discourse.

To study the above, the data was subjected to the following statistical procedures.(SPSS)

a) The correlation using the Spearman's coefficient correlation was done to check the equality of three forms, i.e., Form A, B and C. This was done for each of the four subtests (Word subtest, Two word phrases, Three word sentences and Connected discourse).

b) The correlation between the four subtests was done USING Spearman's coefficient correlation.

c) To check whether the test differentiated a good speechreader from a poor speechreader, the speechreading scores obtained on hearing impaired subjects was correlated with that of the two questionnaire administered.

a) Equality of Forms A, B and C

The equality of the three forms were evaluated by administering the developed Kannada speechreading test to normal subjects. This was done to assess whether the three Forms A, B and C can be used alternatively to test speechreading ability. The equality was determined for the four subtests,

1) Word subtest
2) Two word phrases
3) Three word sentences
4) Connected discourse.

1) Word subtest:

The mean for the "word level subtest" found in Form A, Form B and Form C were 23, 24 and 22 respectively. This shows that the means hardly differed from each other (Table 1). The difference in terms of variability as measured by standard deviation across the forms were also less. This implies that, the constructed test had similar means and standard deviation for all the three forms in 'word subtest'. The range of scores for all the three forms were also similar. Table 2 represents the correlation across the three forms.

Table la: Mean, Standard Deviation and Range in word sub-test.

Forms	Mean	S.D.	Range
Form A	23.0	4.6	21-30
Form B	24.7	4.0	20-30
Form C	22.3	4.6	19 -32

Table 2: Correlation and its level of significance in word sub test.

Between Forms	t	Correlation	Significance
Form A Vs. B	2.0	0.51	0.01
Form B Vs. C	2.7	0.56	0.01
Form C Vs. A	1.8	0.57	0.01

The results indicated position correlation which was significant at the 0.01 level.

From the above statistics it can be seen that all the three forms of 'word subtest' are equal.

Two word phrases:

Form A, B, and C had a mean score of 9, 7 and 8 respectively for the "two word phrases" (Table 3). The mean scores of the three forms differ just by one point, which implies the average score to be more or less similar. The variability as measured by the SD and range, across the Forms were also similar.

Table 3: Mean, S.D. and Range for the three Forms in two word phrases:

Forms	Mean	S.D.	Range
Form A	9	2.3	5 - 1 4
Form B	7	2.3	4 - 1 1
Form C	8	2.2	4 - 1 2

As with the word subtests, the "two word phrases" also had a positive correlation at 0.01 level of significance (Table 4).

Table 4: Correlation and its level of significance of two word phrases on comparing three forms.

Between Forms	t	Correlation	Significance
Form A Vs. B	1.4	0.68	0.01
Form B Vs. C	1.5	0.65	0.01
Form C Vs. A	2.0	0.70	0.01

The results prove that all the "two word phrases" represented in Form A, B and C are equal and can be used alternatively to measure speechreading ability.

Three word sentences:

For the "three word sentences", the mean scores in Form A, B and C were 14, 12 and 10 respectively. Mean, standard deviation and range for the three forms are shown in Table 5. Table 6 represents correlation and its significant level for the three forms in three word sentences.

Table 5: Mean, standard deviation and range in three word sentences:

Forms	Mean	S.D.	Range
Form A	14	2.2	10-18
Form B	12	1.9	9-16
Form C	10	1.8	6-17

Table 6: Correlation and its level of significant in three word sentences.

Between Forms	t	Correlation	Significance
Form A Vs. B	2.0	0.60	0.02
Form B Vs. C	1.4	0.60	0.01
Form C Vs. A	1.3	0.70	0.01

Form A had the highest mean score, followed by Form B and Form C. The mean scores differed from each other only by two points. The three forms had similar standard deviations. Form C had the widest range, while Form B had the least.

The results indicate positive correlation between the forms which was significant at either at 0.01 and 0.02 levels. The correlation

between Form A and B are significant at 0.01 level, while the correlation between Forms B and C and Forms C and A were significant at 0.01 level. This implies that, even for Three word sentence' sub test Form A, B and C can be used alternatively to test speechreading ability.

Connected Discourse:

Form A, B and C had a mean score of 21, 25 and 28 respectively for connected discourse subtests. Table 7 represents mean, standard deviation and range for all three forms for the "connected discourse" subtest.

Table 7: Mean, Standard Deviation and Range in connected discourse:

Forms	Mean	S.D.	Range
Form A	23	**3.3**	14-30
Form B	25	**3.8**	15-34
Form C	27	4.0	21-35

Once again, the mean and variability was considerably less. The correlation and its significance is depicted in Table 8.

Table 8: Correlation and level of significance for connected discourse:

Between Forms	**t**	Correlation	Significance
Form A Vs. B	1.3	0.56	0.01
Form B Vs. C	1.3	0.57	0.01
Form C Vs. A	1.9	0.56	0.01

The results indicate high positive correlation at 0.01 level of significance. Hence, equality across the three forms was maintained even in terms of connected discourse.

Overall results indicate that all the four subtests are equal in difficulty. The care taken regarding familiarity, visibility and linguistic balancing during the construction of the test has led to equality of three forms. Alternate forms that yield same result is absolutely necessary for an ideal test (O'Neill and Oyer, 1951). It can be administered in order to control effects of memory that intrude when a subject is tested several times.

b) **Comparison between the four subtests:**

The average score of each of the subtest was calculated, (Table 9) using the following formula.

a) Average score for word level $= \frac{\text{Form A + B + C}}{3}$

b) Average score for two word phrases $= \frac{\text{Form A + B + C}}{3}$

c) Average score for three word sentences $= \frac{\text{Form A + B + C}}{3}$

d) Average score for connected discourse $= \frac{\text{Form A + B + C}}{3}$

Table 9: Comparison of average score between subtests in normal subjects:

Subtests	Average score in percentage for Form A, B & C
Word subtest	46%
2 Word phrases	50%
3 Word sentences	67%
Connected discourse	50%

Highest average score was obtained for "three word sentences" when compared to the other subtests.

This indicates that the normal subjects could speechread sentences better than words and connected discourse. As the mean length of utterance was only three words, it was easier for the subjects. The demand on visual attention was less and transmitted message had contextual cues. Even if the subjects was not certain of one word, they could guess the Whole message. Speechreading is not a simple combination of elements or parts, but requires guessing and mental filling in as well (Jeffers and Barley, 1971).

Two word phrases and connected discourse had the same percentage of average scores. This implies that both subtests was not as easier as sentences. Connected discourse had a mean length of utterance of 3-6 words. Sentences that are longer are known to be more difficult than shorter sentences. As the length of the sentence increases, the demand on visual attention and memory would probably also increase.

This has been found by Graig (1961), who reported that there was a definite decline in speechreading scores as the length of the sentences increased. Also, a word was harder to understand when placed in a long sentence than when placed in a shorter sentence. Numbers and Hudgins (1948) also reported that in case of hearing impaired children sentences were easier to speechread than words. When words were presented in sentences, the scores increased from about 32% to 50%. It was felt that context offered by the sentence was the reason for the increase in percentage (Keaster, 1949).

Supporting above, even in the present study, the "word subtest" score increased remarkably from 46% to 67% in "three word sentence" subtest. The scores for speechreading words in context showed a significant improvement over those in isolation in Spanish language (Sarrail, 1952). Even in a Japanese study, it was concluded that speechreading test of connected discourse was too difficult to test (Sato, 1964).

Correlation of the four subtests across the three forms were found (Table 10). No significance was obtained for the correlated score across the subtests.

Table 10 : Summarizes the relationship among individual subtests considered in the study.

SI. No.	Between Subtests	CORRELATION		
		FORM A	FORM B	FORM C
1	Word subtest Vs. Two word phrases	0.44	0.39	0.36
2	Word subtest Vs. Three word sentences	0.21	0.19	0.28
3	Word subtest Vs Connected discourse	0.12	0.23	0.30
4	Two word Vs. Three word sentences	0.56	0.45	0.58
5	Two word Vs. Connected discourse	0.23	0.31	0.36
6	Three word Vs. **Connected Discourse**	0.27	0.28	0.3

*Scores not significant at 0.01 level.

Here the results indicate that there is no correlation between the individual subtest in each of the Form. Ability to speechread cannot be predicted just by administering one of the subtest. For diagnostic purposes, all the subtests, word level, Two word phrases, Three word sentences and Connected discourse should be administered.

In contrary to the above, Utley (1946), developed a speechreading test in which the subtests correlated. The relationships were high enough and indicated a great deal of overlapping among the various skills. But he also reported, *y[et]> combined skills do not represent a single unitary ability. Thus, word, sentence and story recognition should be measured separately'.

c) **Correlations between the test scores and the two questionnaires:**

Results of the two questionnaire:

Two questionnaires were administered, one to the hearing-impaired subject himself/herself and another to their close family member. Based on the raw scores of questionnaire, type of speechreader was determined (Appendix 3b).

Correlation between the raw scores of both the questionnaires, as rated by the subject and their close family member was found to have a high positive correlation of 0.86 at 0.01 level of significance. This shows that the hearing impaired subject and their closest family member were able to judge the speechreading ability of the former equally well.

Among the 10 hearing impaired subjects, two were poor, six were average and two were considered as good speechreaders. They were categorised as poor, average and good speechreaders based on scores in the questionnaire (Appendix 2a and 2 b).

Results of the speechreading test:

The administration of the test on the hearing impaired subjects obtained a mean score of 50% at word level, 57% at two word utterances, 72% at three word utterances and 64% for connected discourse (Table 11). Results indicate three word utterances to be

speechread better compared to other subtests. This was similar to what was found in normal hearing subjects.

Table 11: Mean, Standard Deviation and Range in the test scores in hearing impaired subjects:

Subtests	% Score	S.D.	Range
Word subtest	50	9.7	1 -8
Two Word Phrases	57	3.1	1-9
Three word Sentence	72	4.1	1 -9
Connected discourse	64	4.0	1 -8

Average scores for the type of speechreader is tabulated in Table 12.

Table 12 : Average scores of normal hearing, good, average and poor speech reader

Average scores of subtests	Hearing Impaired			
	Normal N = 30	Good N = 2	Average N = 6	Poor N = 2
Average score of Word subtest	49%	76%	48%	19%
Average score of Two word phrases	66%	81%	60%	24%
Average score of Three word sentences	71%	87%	62%	27%
Average score of Connected discourse	56%	86%	44%	28%

From the table, it can be concluded that, the normal subjects had average scores similar to that of average type of speechreader among hearing impaired.

The type of speechreader was intepreted also based on the test raw scores (Table 13).

Table 13: Percentage scores that differentiate the type of speechreader.

Percentage Score	Types of Speechreader
71 - 100%	Good
31-70%	Average
0 - 30%	Poor

Comparison of questionnaire with speechreading test:

Table 14 shows the correlation between the raw scores of questionnaire and subtest scores.

Table 14: Scores of correlation between questionnaire and subtests.

Questionnaire Vs. Subtests	**t**	Correlation	Significant
Word level	1.18	0.94	0.01
Two word phrases	1.9	0.85	0.01
Three word sentences	2.9	0.80	0.09
Connected discourse	0.9	0.86	0.001

The results indicate scores of questionnaire highly correlated with each subtest and was significant at the 0.01 level. Hence, by administering any one of the subtest along with questionnaire would help in deciding whether the individual is a poor, average or good speechreader.

In conclusion, the present study can be summarized as follows:

1) The Kannada speechreading test consists of three lists of equivalent forms to assess speechreading ability.
2) The speechreading test can be assessed at four levels, Word level, Two word phrases, Three word sentences and Connected discourse. All the four subtests have to be administered since speechreading ability at one level cannot be predicted by another level.
3) The speechreading score was better at Three word sentences compared to other subtests.

4) The speechreading test can differentiate a good speechreader from a poor speechreader along with the questionnaire.

SUMMARY AND CONCLUSION

Speecreading is a mental activity by which the speech of other people can be understood when the words can be seen but not heard (Irene Ewing, 1941). As the hearing impairment becomes more severe, vision gradually emerges as the lead receptive sense, while audition becomes of less value (Berger, 1972). Hence, the area of speechreading is important in aural rehabilitation. The speechreading proficiency can be evaluated by various tests that have been developed over the decades.

Several investigators have developed speechreading tests consisting of syllables, words, sentences, connected discourses and stories (Utely, 1946; Costello, 1952; Cavender, 1949; Lowell, 1957, Reid, 1947 and Kelly, 1955). Speechreading tests can be used to measure the basic speechreading ability of an individual. They can be employed to measure the effects of speechreading training program and also aid in proper placement of individuals within a training program. Tests can sort out the acoustically handicapped individuals as excellent, average and poor speechreaders. In addition, tests need not only be instruments that measure the skill of speechreader; they can also determine the visual intelligibility of individual speakers (Berger, 1972).

Till date, no speechreading test has been developed in Kannada for hearing impaired adults. Since India is a multilingual country, development of tests in various languages is necessary.

The aim of the present study was to develop a Kannada speechreading test for adults having three equal Forms. Each form consisted of four subtests, i.e., Word subtest, Two word phrases, Three word sentences and Connected discourse. All the three forms were equal in terms of difficulty, visibility, familiarity and phonemically balanced. Further, the study also aimed to check whether the test could differentiate a good speechreader from a poor one.

The test was administered on thirty normal hearing subjects to check whether the three forms were equal in assessing speechreading ability. The constructed test material was administered in a face-to-face situation with no voicing. This was done in a quiet, well-lit room, free from distractions. The normal subjects had to speechread the tester and repeat the signals. Verbatim transcription of responses was done. The "word subtest" was scored in terms of 'phonemes' while the other subtests, "two word phrases", "three word sentences" and "connected discourse" were scored in terms of correct "word' recognised. The data thus collected was subjected to statistical analysis.

The results indicated that all the three Forms A, B and C had high correlation across the four subtests. This shows that the three Forms A, B and C can be used alternatively to test speechreading ability. When subtests (i.e., Vord', two word phrase', three word sentence' and 'connected discourse") were compared, there was no correlation between any of them. Hence, all the subtests of each Form should be administered to measure the individual's speechreading ability for various linguistic aspects.

Additionally, the test was administered on hearing impaired subjects to check whether the test differentiates a good speech-reader from a poor speechreader. The speechreading ability of the hearing impaired was assessed based on the two questionnaires developed. One was administered to the hearing impaired individual and the another to their close family member. The questionnaire consisted of six questions regarding various aspects of speechreading, which were rated on a three point scale. These questions helped to classify the speech readers as good, average or poor.

The scores obtained on the speechreading test correlated with that of the scores obtained on the questionnaires which differentiated good, average and poor speechreaders. This indicates that the developed speechreading test could also make the similar distinction.

The following conclusions can be made from the present study:

1) The test developed can be administered to Kannada speaking hearing impaired adults in the age range of 18-75 years.
2) The test material can be administered to individuals whose language ability is normal.
3) The three Forms A, B and C were found to be equivalent across the four subtests ('word', two word phrases', three word sentences' and 'connected discourse'). Hence, any of the three forms can be used alternatively to avoid effects of familiarity, memory and practice. Hence the three equivalent Forms can be used to monitor progress of an speechreading training program or to assess the effectiveness of training.
4) Speechreading ability for three word sentences' were better compared to 'word' and 'connected discourse' subtest.
5) There was no correlation between the subtests of each of the forms A, B and C. Hence to evaluate the total ability of a person to speechread, all the subtests should be administered.
6) The speechreading test could differentiate a good, average and poor speechreaders.
7) The developed test material can be administered on hearing impaired individuals who either use or do not use hearing aids.

RECOMMENDATIONS FOR FURTHER RESEARCH:

Using the test material developed in the present study, the following research studies can be carried out:

1) A similar procedure can be adopted to develop a speechreading test in other Indian languages.

2) The test can be tried on post-lingually hearing-impaired children to assess speechreading ability.

3) The test can be used to compare speechreading ability in the presence of auditory and visual distractions.

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APPENDIX -1

WORD SUBTEST

Practice Items

1) ಪೆನ್ನು

2) ಕನ್ನಡ

	FORM 1	FORM 2	FORM 3
1. ಪ	ಪಟ್ಟಿ	ಪದ	ಪಕ್ಕ
2. ಬ	ಬಸ್ಸು	ಬಾವುಟ	ಬುದ್ಧಿ
3. ಮ	ಮರ	ಮತ್ತು	ಮನೆ
	ವಿಮಾನ	ಮನಸ್ಸು	ಸಮಯ
4. ವ	ವಿಮಾನ	ವಿದೇಶ,	ಇವತ್ತು
	ವಾರ	ವೀಣೆ	ವಕೀಲ
	ವಯಸ್ಸು	ಬಾವುಟ	ವಿಷ
	ತಾವರೆ		
5. ತ	ತಾಯಿ	ತಾವರೆ	ಇವತ್ತು
	ಉತ್ತರ	ತಾರೀಖು	ಗೊತ್ತಿಲ್ಲ
	ಕತ್ತರಿ	ತೀರ	ಕತ್ತು
	ತಾತ	ಹತ್ತು	ತಕ್ಕಡಿ
		ಮತ್ತು	
6. ದ	ದಿನ	ಪದ	ಬುದ್ಧಿ
	ದೋಣಿ	ವಿದೇಶ	ದೊಡ್ಡದು
	ದಾರಿ	ಸುಂದರ	ದಾನ
	ಗಾದೆ	ಕಾಗದ	ಕುದುರೆ
	ದೇಶ	ಇದ್ದಾರೆ	
7. ಟ	ಪಟ್ಟಿ	ಬಾವುಟ	ರೊಟ್ಟಿ
8. ಡ	ಕಾಡು	ನೋಡು	ತಕ್ಕಡಿ
			ದೊಡ್ಡದು
9. ನ	ವಿಮಾನ	ಮನಸ್ಸು	ಮನೆ
	ದಿನ	ವೀಣೆ	ದಾನ
	ದೋಣಿ	ನೋಡು	ನೀರು

	ಕಾರಣ	ನೀಲಿ	
	ನಗು	ಚಿನ್ನ	
	ನಾಲಿಗೆ	ಜನ	
10. ಲ	ಲಾರಿ	ನೀಲಿ	ವಕೀಲ
	ನಾಲಿಗೆ	ಕೆಲಸ	ಗೊತ್ತಿಲ್ಲ
	ಲಂಚ		ಅಳಿಲು
			ಗಾಳಿ
11. ರ	ಮರ	ಸುಂದರ	ರೊಟ್ಟಿ
	ವಾರ	ಜನರು	ಗೆರೆ
	ಉತ್ತರ	ರೋಗ	ಗೆರೆ
	ಕತ್ತರಿ	ಕಾರು	ಜಾರು
	ದಾರಿ	ಇದ್ದಾರೆ	ರುಚಿ
	ಲಾರಿ	ತಾರೀಖು	ರಸ
	ಕಾರಣ	ತೀರ	ನೀರು
			ಕುದುರೆ
12. ಸ	ಬಸ್ಸು	ಮನಸ್ಸು	ಸಮಯ
	ವಯಸ್ಸು	ಸುಂದರ	ರಸ
		ಕೆಲಸ	
13. ಚ	ಲಂಚ	ಚಿನ್ನ	ರುಚಿ
14. ಜ	ಜಾಗ	ಜನರು	ಜಾರು
15. ಶ	ದೇಶ	ವಿದೇಶ	ವಿಷ
16. ಕ	ಕಾರಣ	ತಾರೀಖು	ವಕೀಲ
	ಕತ್ತರಿ	ಕಾರು	ಕತ್ತು
	ಕೊಡು	ಕಾಗೆ	ತಕ್ಕಡಿ
		ಕಾಗದ	ಕುದುರೆ
17. ಗ	ಗಾದೆ	ರೋಗ	ಗೊತ್ತಿಲ್ಲ
	ನಗು	ಕಾಗೆ	ಗೆರೆ
	ನಾಲಿಗೆ	ಕಾಗದ	ಗಾಳಿ
	ಜಾಗ	ಗಾಯ	

Note : Underlined words indicates repetition.

TWO WORD PHRASES

Practice Items

1) ನನಗೆ ಬೇಡ

2) ನಾನು ಹೋಗುತ್ತೇನೆ

Form 1	Form 2	Form 3
1. ಬಾಗಿಲು ಮುಚ್ಚಿದರು	1. ಜನರು ನಿಂತರು	1. ಪೆನ್ನಲ್ಲಿ ಬರೆದೆನು.
2. ಹುಡುಗ ಬರುತ್ತಾನೆ	2. ರೈಲು ಉದ್ದವಿದೆ	2. ತಾತ ಮಲಗಿದರು
3. ಮಗು ಜಾರಿತು	3. ಉಪದೇಶ ಮಾಡಿದರು	3. ಲೆಕ್ಕ ಸುಲಭವಿದೆ
4. ಪಾಪು ಅಳುತ್ತಿದೆ	4. ಚಾಕು ಹರಿತವಿದೆ	4. ಮಕ್ಕಳು ಓದಿದರು
5. ನಾವು ನೋಡಿದೆವು	5. ಬಟ್ಟೆ ಸುಟ್ಟಿದೆ	5. ತೋಟ ಚೆನ್ನಾಗಿದೆ
6. ಶಾಲೆಗೆ ಹೊರಟರು	6. ಮನೆ ನೋಡಿದೆನು	6. ನೆಲ ಜಾರಿತು
7. ಕೋಳಿ ಸಿಗಲಿಲ್ಲ	7. ಔಷಧಿ ತಂದರು	7. ಅವಕಾಶ ಒದಗಿದೆ

THREE WORD SENTENCES

Practice Items/

1) ಎಲ್ಲರೂ ಆಟ ಆಡಿದರು

2) ಅಪ್ಪ ಊರಿಗೆ ಹೋದರು

Form 1	Form 2	Form 3
1. ಹಸು ಹಾಲು ಕೊಡುತ್ತದೆ	1. ಇಲ್ಲಿ ನೀರು ಬರುತ್ತದೆ	1. ಇಲ್ಲಿ ದೀಪ ಉರಿಯುತ್ತಿದೆ
2. ಮನೆ ತುಂಬಾ ದೂರವಿದೆ	2. ನಮ್ಮ ದೇಶ ಭಾರತ	2. ಗೊಂಬೆ ಚಾಪೆಯ ಮೇಲಿದೆ
3. ನಾನು ಬಸ್ಸಿನಲ್ಲಿ ಹೋದೆನು	3. ಹುಡುಗ ಇವತ್ತು ಬಂದನು	3. ಸಕ್ಕರೆ ಡಬ್ಬಿಯಲ್ಲಿ ಇದೆ
4. ಕೆಂಪು ಗುಲಾಬಿ ಅರಳಿದೆ	4. ಕರಡಿ ಜೇನನ್ನು ತಿಂದಿತು	4. ನಾಟಕ ಬೇಗ ಮುಗಿಯಿತು
5. ಅವರು ಊಟ ಮಾಡಿದರು	5. ಕಪ್ಪು ಟೋಪಿ ಮೇಲಿದೆ	5. ವಿಮಾನ ಬಂದು ನಿಂತಿದೆ
6. ಇವತ್ತು ಶಾಲೆಗೆ ರಜೆ	6. ಚಿನ್ನದ ಸರ ಹಾಕಿದ್ದಾರೆ	6. ಶಿವನ ಪೂಜೆ ಮಾಡಿದರು

CONNECTED DISCOURSE

FORM 1

ಮಾರ್ಕೆಟ್

ನಾನು ಮಾರ್ಕೆಟ್‌ಗೆ ಹೋಗಿದ್ದೆನು. ನನ್ನ ವಾಹನವನ್ನು ಹೊರಗಡೆ ನಿಲ್ಲಿಸಿದೆನು. ತರಕಾರಿ, ಹಣ್ಣು ಮತ್ತು ಹೂಗಳು ತಾಜಾವಾಗಿ ಕಾಣುತ್ತಿತ್ತು. ಮಾರ್ಕೆಟ್ ಜನರಿಂದ ತುಂಬಿತ್ತು. ಅಲ್ಲಿ ಓಡಾಡಲು ತುಂಬಾ ಕಷ್ಟವಾಯಿತು. ಅಲ್ಲಿ ಹಬ್ಬದ ವಾತಾವರಣ ಎದ್ದು ಕಾಣುತ್ತಿತ್ತು. ಹಬ್ಬದ ಪ್ರಯುಕ್ತ ಪದಾರ್ಥಗಳ ಬೆಲೆ ಜಾಸ್ತಿಯಾಗಿತ್ತು. ಆ ಬೆಲೆಗಳನ್ನು ಕೇಳಿ ತುಂಬಾ ಆಶ್ಚರ್ಯವಾಯಿತು. ಸ್ವಲ್ಪ ಕಡಿಮೆ ಬೆಲೆಗೆ ಕೇಳಿದೆನು. ಕೆಲವು ವ್ಯಾಪಾರಿಗಳು ಒಪ್ಪಲಿಲ್ಲ. ಆದರೂ ಚರ್ಚಿಸಿ ಪದಾರ್ಥಗಳನ್ನು ತೆಗೆದುಕೊಂಡೆನು. ಕೊನೆಗೆ ಅಲ್ಲಿಂದ ಹೊರಗೆ ಬಂದೆನು.

Form 2

ಪ್ರಯಾಣ

ಪ್ರತಿದಿನ ನಾನು ಆಫೀಸಿಗೆ ಹೋಗುತ್ತೇನೆ. ನಾನು ಯಾವಾಗಲೂ ಬಸ್ಸಿನಲ್ಲಿ ಪ್ರಯಾಣಿಸುತ್ತೇನೆ. ಬಸ್ಸಿನ ದರವು ಬೇರೆ ವಾಹನಗಳಿಗಿಂತ ಕಡಿಮೆ. ಆದರೆ ತುಂಬಾ ಹೊತ್ತು ಕಾಯಬೇಕು. ಆದ್ದರಿಂದ ಮನೆಯನ್ನು ಬೇಗ ಬಿಡುತ್ತೇನೆ. ಆಫೀಸಿಗೆ ಹೋಗಲು ಎರಡು ರುಪಾಯಿ ಟಿಕೆಟನ್ನು ಪಡೆಯುತ್ತೇನೆ. ಬಸ್ಸು ಕೆಲವು ಸಲ ಜನರಿಂದ ತುಂಬಿರುತ್ತದೆ. ಒಂದೊಂದು ಸಲ ನಿಲ್ಲಲು ಸ್ಥಳ ಇರುವುದಿಲ್ಲ. ಬಸ್ಸು ತುಂಬಾ ಕಡೆ ನಿಲ್ಲುತ್ತದೆ. ಬೇಗ ಹೋಗಬೇಕಾದರೆ ಆಟೋದಲ್ಲಿ ಹೋಗುತ್ತೇನೆ. ಬಸ್ಸಿನ ಪ್ರಯಾಣದಿಂದ ತುಂಬಾ ಆಯಾಸ ಆಗುತ್ತದೆ.

Form 3

ಆಸ್ಪತ್ರೆ

ನಮ್ಮ ಮನೆ ಹತ್ತಿರ ಸರ್ಕಾರಿ ಆಸ್ಪತ್ರೆ ಇದೆ. ಆಸ್ಪತ್ರೆಯನ್ನು ಯಾವಾಗಲೂ ತೆಗೆದಿರುತ್ತಾರೆ. ಆಸ್ಪತ್ರೆಯ ಕಟ್ಟಡ ದೊಡ್ಡದಾಗಿದೆ. ಅಲ್ಲಿ ಹೊರರೋಗ ಮತ್ತು ಒಳರೋಗಿಗಳೆಂಬ ವಿಭಾಗಗಳಿವೆ. ಗಂಡಸರು ಮತ್ತು ಹೆಂಗಸರಿಗೆ ಪ್ರತ್ಯೇಕ ವಾರ್ಡ್‌ಗಳು ಇವೆ. ಅಲ್ಲಿ ಉಚಿತ ತಪಾಸಣೆಯನ್ನು ಮಾಡುತ್ತಾರೆ. ಕೆಳ ಮತ್ತು ಮಧ್ಯಮ ವರ್ಗದ ಜನರು ಜಾಸ್ತಿ ಬರುತ್ತಾರೆ. ವೈದ್ಯರು ರೋಗಿಗಳಿಗೆ ತಕ್ಷಣ ಪರೀಕ್ಷೆ ಮಾಡುತ್ತಾರೆ. ಅಲ್ಲಿ ಎಲ್ಲಾ ಖಾಯಿಲೆಗೂ ಚಿಕಿತ್ಸೆಯನ್ನು ನೀಡುತ್ತಾರೆ. ಅಲ್ಲಿಯ ನೌಕರರಿಗೆ ಸರ್ಕಾರ ಸಂಬಳ ಕೊಡುತ್ತದೆ

APPENDIX - 2A

ಪ್ರಶ್ನಾವಳಿ - ಕಿವಿ ತೊಂದರೆ ಇರುವವರಿಗೆ

ಸೂಚನೆ : ನಿಮ್ಮ ಮಾತಿನ ಚಲನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ಹಾಗೆ ಕೆಲವು ಪ್ರಶ್ನೆಗಳನ್ನು ಕೊಡಲಾಗಿದೆ. ದಯವಿಟ್ಟು ಎಲ್ಲಾ ಪ್ರಶ್ನೆಗಳನ್ನು ಸರಿಯಾಗಿ ಉತ್ತರಿಸಿ. ಈ ಪ್ರಶ್ನೆಗಳಿಗೆ ನಿಮ್ಮ ಉತ್ತರವು ಶೇಕಡ 75-100% ಸರಿ ಅನಿಸಿದರೆ 'ಯಾವಾಗಲೂ' ಕೆಳಗೆ (✓) ಹಾಕಿ, ಶೇಕಡ 25-75% ಸರಿ ಅನಿಸಿದರೆ 'ಕೆಲವೊಮ್ಮೆ' ಕೆಳಗೆ (✓) ಹಾಕಿ ಮತ್ತು ಶೇಕಡ <25% ಸರಿ ಅನಿಸಿದರೆ 'ಯಾವಾಗಲೂ ಇಲ್ಲ' ಕೆಳಗೆ (✓) ಹಾಕಿ.

ಹೆಸರು : ವಯಸ್ಸು : ಲಿಂಗ :

QUESTIONS	RATING SCALE		
	ಯಾವಾಗಲೂ (75-100%)	ಕೆಲವೊಮ್ಮೆ (25-75%)	ಯಾವಾಗಲೂ ಇಲ್ಲ (<25%)
1. ಮಾತನಾಡುವವರ ಮುಖವನ್ನು ನೋಡಿ ಮಾತಿನ ಚಲನೆಯನ್ನು ಸರಿಯಾಗಿ ಗುರುತಿಸಬಲ್ಲಿರಾ ?			
2. ನಿಮ್ಮ ಮನೆಮಂದಿಯವರ ಮುಖವನ್ನು ನೋಡಿ ನೀವು ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೀರೆಂದು ಅವರಿಗೆ ಗೊತ್ತಿದ್ದೀಯಾ?			
3. ನಿಮಗೆ ಕಣ್ಣು ಚೆನ್ನಾಗಿ ಕಾಣಿಸುತ್ತದಾ ?			
4. ಮೂರರಿಂದ ನಾಲ್ಕು ಶಬ್ದವಿರುವ ವಾಕ್ಯವನ್ನು ಬರೀ ಮುಖವನ್ನು ನೋಡಿ ಗುರುತಿಸಬಲ್ಲಿರಾ ?			
5. ನಿಮಗೆ ಮೊದಲನೇ ಬಾರಿ ಅರ್ಥವಾಗದಿದ್ದರೆ, ಮತ್ತೊಮ್ಮೆ ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ಪ್ರಯತ್ನಿಸುತ್ತೀರಾ ?			
6. ಮಾತಾಡುವಾಗ ಕೆಲವು ಶಬ್ದಗಳು ಗೊತ್ತಾಗದಿದ್ದರೆ ನೀವು ಊಹಿಸಬಲ್ಲಿರಾ ? (ಮುಖವನ್ನು ನೋಡಿ ಮಾತು ಅರ್ಥಮಾಡಿಕೊಳ್ಳುತ್ತಿದ್ದಾಗ)			
7. ನೀವು ಕನ್ನಡಕ ಹಾಕಿಕೊಂಡು ಚೆನ್ನಾಗಿ ನೋಡಬಲ್ಲಿರಾ ?			

APPENDIX - 2B

ಪ್ರಶ್ನಾವಳಿ-ಮನೆಮಂದಿಯವರಿಗೆ

ಇಲ್ಲಿ ಮಾತಿನ ಚಲನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ಹಾಗೆ ಕೆಲವು ಪ್ರಶ್ನೆಗಳನ್ನು ಕೊಡಲಾಗಿದೆ. ಶ್ರವಣದೋಷವುಳ್ಳ ನಿಮ್ಮ ಸಂಬಂಧಿಕರು ಮಾತಿನ ಚಲನೆಯನ್ನು ಎಷ್ಟು ಅಳವಡಿಸುತ್ತಾರೆಂದು ದಯವಿಟ್ಟು ತಿಳಿಸಿ. ಈ ಪ್ರಶ್ನೆಗಳಿಗೆ ನಿಮ್ಮ ಉತ್ತರವು ಶೇಕಡ 75-100% ಸರಿ ಅನಿಸಿದರೆ 'ಯಾವಾಗಲೂ' ಕೆಳಗೆ (✓) ಹಾಕಿ, ಶೇಕಡ 25-75% ಸರಿ ಅನಿಸಿದರೆ 'ಕೆಲವೊಮ್ಮೆ' ಕೆಳಗೆ (✓) ಹಾಕಿ ಮತ್ತು ಶೇಕಡ <25% ಸರಿ ಅನಿಸಿದರೆ 'ಯಾವಾಗಲೂ ಇಲ್ಲ' ಕೆಳಗೆ (✓) ಹಾಕಿ.

ಕೇಸ್ ಹೆಸರು :　　ವಯಸ್ಸು :　　ಶ್ರವಣದೋಷವುಳ್ಳವರ
ಲಿಂಗ :　　ಜೊತೆ ಸಂಬಂಧ :

QUESTIONS	RATING SCALE		
	ಯಾವಾಗಲೂ (75-100%)	ಕೆಲವೊಮ್ಮೆ (25-75%)	ಯಾವಾಗಲೂ ಇಲ್ಲ (<25%)
1. ಅವರು ನಿಮ್ಮ ಮುಖವನ್ನು ನೋಡಿ ಮಾತಿನ ಚಲನೆಯನ್ನು ಗುರುತಿಸುತ್ತಾರಾ ?			
2. ಅವರು ನಿಮ್ಮ ಮುಖವನ್ನು ನೋಡಿ ಮಾತನ್ನು ಅರ್ಥಮಾಡಿಕೊಳ್ಳುತ್ತಾರಾ ?			
3. ಅವರು ಸುಮಾರು 3-5 ಶಬ್ದವಿರುವಂತಹ ವಾಕ್ಯವನ್ನು ಮುಖವನ್ನು ನೋಡಿ ಅರ್ಥಮಾಡಿಕೊಳ್ಳುತ್ತಾರಾ ?			
4. ಅವರಿಗೆ ಮೊದಲನೇ ಬಾರಿ ಅರ್ಥವಾಗದಿದ್ದರೆ, ಇನ್ನೊಂದು ಸಲ ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ಪ್ರಯತ್ನಿಸುತ್ತಾರಾ?			
5. ಅವರು ಮುಖವನ್ನು ನೋಡಿ ಮಾತನಾಡುವಾಗ ಕೆಲವು ಶಬ್ದಗಳು ಗೊತ್ತಾಗದಿದ್ದರೆ ಊಹಿಸುತ್ತಾರಾ ?			

APPENDIX-3a

SCORING FOR THE RATING SCALES IN QUESTIONNAIRE

SI. No.	Rating Scale	% of rating	Score
1	Usually	75-100%	2
2	Sometimes	25-75%	1
3	Never	0-25%	0

APPENDIX-3b

RAW SCORES FOR THE TYPE OF SPEECH READER

SI. No.	Raw Score		Type of Speech reader
	Self evaluation	Evaluation by family member	
1	9-12	9-12	Good
2	5-8	5-8	Average
3	0-4	0-4	Poor