Modified Early Speech perception Test in Kannada (MESP-K)

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CERTIFICATE

This is to certify that this dissertation entitled *"**Modified Early Speech Perception Test in Kannada"*** is a bonafide work submitted in part fulfillment for degree of Master of Science (Audiology) of the student Registration Number: 15AUD021. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled *"**Modified Early Speech Perception Test in Kannada"*** is the result of my own study under the guidance of Dr. Asha Yathiraj, Professor of Audiology, Department of Audiology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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ABSTRACT

Aim: The aim of the study was to modify the existing early speech perception test for children speaking Kannada (Yathiraj, 2004) and validate the same on young typically developing children as well as children with hearing impairment.

Methods: The 'Modified Early Speech Perception test in Kannada' (MESP-K) was constructed to have two versions, a low verbal version and a standard version. The low verbal version was designed for children aged 2 to 3 years and the standard version for children aged 3 to 5 years. The developed test was validated on 35 typically developing children. The low verbal version of the test was evaluated on 5 children aged 2 to 3 years and the standard version of the test was evaluated on 20 children aged 3 to 5 years. Additionally, the standard version was also evaluated on 15 children aged 3 to 5 years with hearing impairment.

Result: Analyses of the data revealed that in both version of the test, the typically developing children were able to obtain perfect or near perfect scores on the MESP-K with no significant difference between the subtests. On the other hand, the children with hearing impairment, who were tested on the standard version of the test, obtained significant differences across the subtests. Additionally, they performed significantly poorer than the typically developing children on all subtests of the MESP-K.

Conclusion: The Modified Speech Perception test in Kannada (MESP-K) could differentiate the speech perception abilities of typically developing children from that of

children with hearing impairment. Hence, it can be considered a valid test to evaluate young children with hearing impairment.

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CHAPTER 1

INTRODUCTION

The emphasis on providing appropriate listening devices as early as possible for children with deafness, has led to audiologists developing tests that will aid them in selecting these devices. One of the main purposes of prescribing these listening devices at an early age is to enable children with hearing impairment to communicate through speech. Non-speech based tests have not been found to be effective in selecting devices for the purpose of speech perception. A poor correlation has been observed between pure-tone average and speech recognition thresholds in children with profound hearing loss Erber (1974). Hence, the use of speech based tests in selecting listening devices for young children with hearing impairment has been advocated.

Several speech perception tests to assess children young children with hearing impairment have been reported in literature. With the understanding that young children, especially those with high degrees of hearing impairment, would have difficulty in responding to regular speech identification test, tests specific for this target group have been developed. These tests have aimed to assess two components of speech, a temporal component and a spectral component. Thus, speech perception tests for young children with hearing impairment have been developed to evaluate pattern perception as well as word recognition abilities. A few of these tests reported in literature include, 'Monosyllable, Trochee, Spondee' test (Erber & Alencewicz, 1976), 'Discrimination after training' (DAT) test (Thielemeir, 1982), and the 'Auditory number test'(Erber, 1980). Moog and Geers (1990), using ideas from earlier available tests, developed the 'Early speech perception test'

for young children with deafness. This test evaluated pattern perception as well as word identification. This test information was considered useful in categorizing young children with deafness into those who benefited from their existing hearing aids and those who did not. Thus, using the responses of the test, cochlear implants were recommended for children who did not obtain the necessary auditory perceptual skills through their hearing aids.

As Moog and Geers (1990) demonstrated that their 'Early speech perception test' was useful in evaluating children with hearing impairment below the age of 5 years, this test has gained popularity worldwide. The test has been adapted in several languages, including languages in India. A few the tests have developed in India to assess speech perception for young children with profound hearing loss include 'Speech Perception Test for English Speaking Hearing Impaired Indian Preschoolers' (Raashida, 2000), 'A Speech Perception Test for Tamil Speaking Hearing Impaired Children' (Tamilmani, 2002) and 'Early speech perception test Development of Malayalam Speaking Hearing Impaired Children' (Jijo & Yathiraj, 2007-08). In 2004, Yathiraj developed the syllable categorization subsection of ESP in Kannada. However, the test was not validated on children as well as it did not have a low verbal version and all the subsections of the standard version.

1.1 Need for the Study

For early identification of children who are potential candidates for cochlear implant, it is necessary to have a test that assesses the speech perception abilities of children as young as 2 years with limited vocabulary. Responses from such a test will guide audiologists in deciding whether cochlear implants or hearing aids should be recommended. The earlier the decision is made, the better is the speech language development in children with hearing impairment. Since speech test scores are highly influenced by the mother tongue of a child, it

is important to use the speech test in native language of the child (Singh & Black, 1966). Considering the Indian scenario and its diverse linguistic variability, it necessitates speech tests to be developed in major languages of the country. Kannada being one of major south Indian languages, makes it more essential to develop a speech perception test for children with hearing impairment as young as 2 years with limited vocabulary. While a rudimentary test is available in Kannada (Yathiraj, 2004), it has not been formally evaluated. Further, the available test only evaluates syllable categorization but not word identification. Hence, there is a need to formally develop and evaluate speech perception test in Kannada for children as young as 2 years of age.

Aim

The study aimed to modify the existing early speech perception test for children speaking Kannada (Yathiraj, 2004) and validate the same.

Objectives

- To modify the existing early speech perception test for children speaking Kannada (Yathiraj, 2004) by developing a low verbal and standard version of the test.
- Validate the developed material on typically developing children
- Validate the test on children with hearing impairment.
- Evaluate the difference in performance of the children in the different subtests of the test.
- Evaluate the difference in performance between the typically developing children and children with hearing impairment.

Chapter 2

REVIEW OF LITERATURE

The advent of new technologies to enhance listening skills in those with hearing impairment necessitates the use of standard tests to assess speech perception in different age groups. Such tests would help determine the utility of listening devices to decide whether a change in device is called for. Age appropriate speech perception tests are required for all age groups, including young children, as tests for older children or adults cannot be used for young children. With the availability of listening devices for young children, age appropriate speech perception tests are required for them, especially for those with severe to profound hearing loss. The use of such tests are known to help in the deciding whether a young child with hearing impairment can continue to use hearing aids or requires to shift over to cochlear implants.

In literature, several speech perception tests have been described for young children. These tests are available in different languages, including Indian languages. Tests to assess speech perception in young children and studies regarding the outcome of such tests are described below. Focus has been given to speech identification tests that can be used for children with hearing impairment who are below the age of 5 years.

2.1 Speech identification tests for young children with hearing impairment

The *Monosyllable, Trochee, Spondee Tes*t (Erber & Alencewicz, 1976) was developed to test young children aged. The test was evaluated on a large age range of children (3 years to 16 years). The test is reported to have 12 words having 3 monosyllables, 3 trochees and 3 spondees. The test is recommended to be administered using monitored live

voice to test the auditory abilities of children with no speech reading cues. It is designed to assess a child's word identification and stress pattern abilities. Children are required to point to picture cards representing the words, placed in front of them. Word identification was calculated by determining the number of words correctly identified by a child. On the other hand stress pattern perception was calculated based on the ability of a child to identify any word that belongs to a particular stress category (monosyllable, trochee or spondee). Thus, stress pattern was scored correct even if the word that was identified was wrong but belonged to the correct stress category.

Auditory Number Test (Erber, 1980) was designed to assess children aged 3 to 8 years with severe to profound hearing loss to get information regarding perception of spectral and temporal envelop cues. The test consists of picture cards representing 1 to 5 ants. The test requires children to have knowledge of counting numbers till 5. Two different responses are elicited from a child, one assessing spectral perception and the other temporal perception. To assess spectral perception, the child is required to identify a number named by the examiner by pointing to the card containing the number of ants. Temporal perception is assessed by asking the child to point to a card representing the number of repetitions of a number, irrespective of the actual number. A score of 1 is given for each correct response.

The Pediatric Speech Intelligibility Test (Jerger, Lewis, Hawkins, & Jerger, 1980) was developed to assess children aged 3 to 7 years to get information about peripheral and central abilities. The test evaluates monosyllabic word identification and sentences identification in quiet and noise at varying competing intensity levels. The test was used in a longitudinal study by Eisenberg et al. (2006) to evaluate factors that affect spoken language in children using cochlear implants. The 'Pediatric Speech Intelligibility' test was one of the

several tests administered over a period of 1 year at 6 month intervals, in three message-to-competition ratios. The children evaluated with the tests were those who had greater than chance scores in categories 3 and 4 of the Early Speech Perception test developed by Moog and Geers (1990). It was found that improvement was seen in all three message-to-competition ratios, with the scores ranging from 92.8% to 98.5%, 1 year following cochlear implantation.

The Discrimination After Training Test (Thielemeir, 1982) was developed to assess speech perception abilities of very young children with profound hearing loss. The test has been utilized by Thielemeir, Tonokawa, Petersen, and Eisenberg (1985) to evaluate children as young as 2 to 5 years with severe and with profound hearing loss. It has 12 levels that are to be administered using monitored live voice. The test consists of twelve different levels that evaluated the following: Discrimination of long and short sounds administered through audiovisual mode to establish the child understand the task (Level I); Discrimination of long and short sounds presented auditorily (Level II); Nonlinguistic speech sounds discrimination with varying temporal patterns, presented auditorily (Levels III to V); Linguistic speech sounds discrimination with varying temporal patterns presented auditorily (Level VI to VIII) and; Auditory discrimination of spondees in closed-set conditions (Level IX to XII).

Thielemeir et al. (1985) used the 'Discrimination After Training Test' to assess the outcome of cochlear implants in children aged 2 to 10 years They evaluated pre and post-operative speech perception performance of the children, with the post cochlear implantation assessment carried out for five years at intervals of 1 year. It was observed that at the end of 5 years post implantation, 43 out of 59 children were at the level 9 and higher in DAT test indicating progress in speech perception with the use of the device, from detection of some

spectral cues (Level 1) to auditory discrimination of spondees (Level IX).

Glendonald Auditory Screening Procedure (Erber, 1982) was developed to have three parts that include detection of phonemes, identification of words and comprehension of questions. The detection of Phoneme subtest contains vowels and continuant consonants such as nasals, laterals, voiced fricatives and unvoiced fricatives. This subtest requires a child to indicate whether they heard or did not hear the speech sounds by pointing to cards having the words 'YES' and 'NO' written on them. The word identification subtest was designed to assess perception of spectral information and temporal information using four stress patterns (monosyllabic, trochee, spondee, & iambic words). A child is required to point to picture named by an examiner. The sentence comprehension subtest consists of 10 questions that require open-set responses that a child has to answer. The number of times a question is repeated is also recorded. All the three subtests are tested initially through the audiovisual mode. Once a child is able to perform the task in the audiovisual mode, the test is administered in through the auditory mode.

Early Speech Perception Test (ESP) by Moog and Geers (1990) is a test to measure speech perception of young children aged 2 to 5 years having hearing impairment with limited vocabulary. The test was designed to segregate children with profound hearing loss into four different speech perception categories: No pattern perception (Category 1); Pattern perception present (Category 2); Some word identification present (Category 3); and consistent word identification present (Category 4). The test contains 2 versions, a low verbal version meant for 2 to 3 year old children and a standard version meant for children above 3 years. Both the low verbal version and the standard version contain three subtests. The subtests include pattern perception, spondee identification and monosyllable identification.

In all subtests, children are required to point to the item presented. While the low verbal version requires children to point to objects, the standard version requires children to point to pictures.

The pattern perception subtest of the ESP test requires a child to recognize words varying in stress patterns and number of syllables. The low verbal version of the test contains 6 monosyllables, 6 spondees, 2 trochees, and 2 three syllable words, out which four words that are most familiar to the child are selected, one from each word category. The standard version of this subtest contains 3 monosyllables, 3 spondees, 3 trochees and 3 trisyllable words. A score of 1 is awarded for each correct pattern recognition or correct word identification and 0 for an incorrect pattern recognition. Each subtest in ESP is required to be administered thrice for the low verbal version and twice for the standard version making the maximum possible score in this subtest as 12 and 24 respectively. The authors recommend that children, who obtain a score of 8 out of 12 in the low verbal version and 17 out of 24 in the standard version, qualify for the spondee identification subtest to be administered.

The spondee identification subtest of the ESP contains 12 spondees. This subtest requires a child to point to pictures / objects representing the spondees. A score of 8 out of 12 in the low verbal version or 8 or more out of 24 in the standard version is considered as the criteria to administer the monosyllabic subtest of ESP. The monosyllabic subtest contains 6 words in low verbal version and 12 monosyllabic words in standard version. Words in this subtest differ mainly in vowels. A child who scores greater than 13 out of 24 in the low verbal version or 10 out of 12 in the standard version is considered to be able to use spectral information with greater flexibility.

Moog and Geers (1990) claim that the ESP can be used to establish therapeutic goals, measuring training out comes and monitoring effectiveness of listening devices. Establishing of therapeutic goals was done by first determining the perceptual difficulties faced by a child. Goals for training were recommended to be established based on the difficulties faced by the child. The outcomes of training were suggested to be measured by administering the ESP test at regular interval so that the clinician could document changes in speech perception abilities. This was considered to help in monitoring changes due to training, changes of therapeutic goals and decide whether changes in training approaches are required or not. Monitoring the effectiveness of listening devices was recommended by using the test to document changes in speech perception scores with and without the device used by the child. The test was suggested to be used to evaluate the performance of children using cochlear implants, hearing aids or bimodal fitting.

ESP has also been used to determine the long term benefit from devices. A longitudinal study was carried out for 3 years to determine the efficacy of cochlear implants (Nucleus 22), tactile devices (Tactaid) and hearing aids in improvement in speech perception, speech production and language performance in children with profound hearing loss. As a part of the study, speech perception abilities of children using the different devices were compared using 4 different speech identification tests, the easies of them being ESP. It was found that postoperative speech perception scores were better in cochlear implant compared to conventional hearing aid and tactile aid. When ESP was administered 1 year after implantation, improvement was observed in all three subtests of the test, although more improvement was seen in pattern perception subtest. Scores obtained during the third year of the study indicated that those using cochlear implants, showed improvement in the

monosyllable word identification subtests that required children to identify words varying in vowels (Geers & Moog, 1992).

The PLOTT Test was develop by Plant and Westcott (1983) with the aim to get comprehensive information regarding auditory speech perception of children with profound hearing loss. It consists of 9 subtests that evaluated the following: Phoneme detection (Subtest 1); Number patterns identification (Subtest 2); Categorization and word identification (Subtest 3); Identification of long vowels and short vowels varying in F1 frequency (Subtest 4); Identification of long and short vowels varying in duration aspect (Subtest 5); Identification of vowels varying in first two formants (Subtest 6); Discrimination of consonant voicing through identification task (Subtest 7); Perception of consonant manner (Subtest 8); and perception of consonant place (Subtest 9).

The Ling Six Sound Test, developed by Ling (1976) contains six phonemes (/ah/, /ee/,/oo/, /m/, /s/, & /sh/) that have a frequency spectrum that ranges from 250 Hz to 8000 Hz. The test helps in quick assessment of the speech perception abilities of a child. It has been used in hearing aid evaluation of young children.

Ratul and Yathiraj (2011-12) used the 'Ling six sound test' as a screening test, where a recorded version was played at 30 dB HL and children were required to say out the speech sound heard by them. Children were referred for detailed audiological evaluation if they failed to repeat any one or more of the Ling's speech sounds. The referral rate obtained by Ling six sound test was compared with standard screening tests such as tympanometry, acoustic reflexes and Distortion Product Oto-Acoustic Emission. It was found that the Ling six sound test had the highest sensitivity (82%) compared to the other tests.

A few of the speech identification tests developed for young children have been adapted to different languages. These include foreign languages as well as Indian languages. Some of these languages include Mandarin, Italian, Tamil and Malayalam. Information about these adaptations is provided below.

2.2 Adaptation of Speech Identification tests for young children with hearing impairment

Genovese, Orzan, Turrini, Babighian, and Arslan (1995) adapted the ESP test for children speaking Italian language aged 2 to 6ears. The authors mention that necessary modifications were made in the test considering the linguistic variations of the Italian language. Due to the linguistic variations in the two languages, mere translation of the English version to Italian was not done. The vocabulary for the test was selected from words used in children and in pre-school reading material. A simple version was developed for young children and a standard version was developed for older children.

Raashida (2000) adapted the ESP to Indian-English. The test, 'Speech Perception Test for English Speaking Hearing Impaired Indian Preschoolers' was developed for children in the age range of 2 to 5 years. It contains 2 versions, a low verbal version for children between the ages 2 to 3 years. The standard version of the test was developed for children aged 3 to 5 years. Overall, the low verbal version of the test contained 9 monosyllabic, 9 bisyllabic and 3 tri syllabic words, whereas the standard version of the test contained 20 monosyllabic, 14 bisyllabic and 4 trisyllabic words. Both versions have two subtests that measure syllable categorization and word identification.

The low verbal version of the test has three subtests: Syllable categorization subtest

having 3 monosyllabic, 3 bisyllabic and 3 trisyllabic words; Bisyllabic word identification subtest that has 6 bisyllabic words; and monosyllabic word identification subtest with 6 monosyllabic words. Unlike the original version developed by Moog and Geers (1990), the syllable categorization subtest of the low verbal version contains fixed number of stimuli and pictures are recommended to be used instead of objects.

The standard version of the test consists of four subtest: Syllable categorization, bisyllabic word identification subtest, monosyllabic word identification subtest and vowel identification subtest. The syllable categorization subtest consists of 4 monosyllabic, 4 bisyllabic and 4 trisyllabic words. The word identification section of the test consists of three subtests: Bisyllabic word identification subtest (10 bisyllabic words); Monosyllabic word identification subtest (10 monosyllabic words); and vowel identification subtest (6 monosyllabic words). A score of 0.5 is awarded for each correctly identified pattern in the pattern perception subtest and correctly identified word in the word identification subtest. All wrong responses are given a score of 0.

Raashida (2000) also validated the test on 36 children aged 2 to 5 years with severe profound hearing loss. The low verbal version was administered on 16 children aged 2 to 3 years and standard version was administered on 20 children aged 3 to 5 years. In low verbal version, it was found that the mean syllable categorization scores was better (58%) compared to bisyllable word identification (38%) and the monosyllable word identification (30%) subtests. Likewise, the standard version also had a similar pattern with the mean scores being 62% for syllable categorization, 45% for bisyllable identification and 35% for monosyllabic identification.

Tamilmani (2002) developed the 'Speech Perception Test for Tamil Speaking Hearing Impaired Children' ages 3 to 5 years. The test has 4 subtests that include pattern perception, trisyllabic word identification, bisyllabic word identification and monosyllabic word identification. The pattern perception subtest contains 9 words with 3 monosyllabic, 3 bisyllabic and 3 trisyllabic words. The bisyllabic, monosyllabic and trisyllabic word identification subtests contains 8 words in each subtest. The test requires children to point to pictures. A score of 2 is awarded for each correct word identification and 0 for an incorrect word identification. Further, a score of 1 is awarded for a correct response in the pattern perception subtest.

Jijo and Yathiraj (2007-08) developed the 'Early speech perception test in Malayalam' for children speaking the language having hearing impairment. It contains 2 versions, as low verbal version and a standard version for children aged 2 to 3 years and 3 to 5 years respectively. Both versions have two subtests, syllable categorization and word identification. The syllabic categorization subtest of the low verbal version has 2 items and the word identification subtest has 4 bisyllabic and 4 trisyllabic words. Unlike the original version developed by Moog and Geers (1990), the syllable categorization test contains two items (monosyllables with different durations (continuant & non-continuant). The syllabic categorization of the standard version contains 4 monosyllabic, 4 bisyllabic and 4 trisyllabic words. The word identification subtest of standard version has two parts, bisyllabic word identification with 12 bisyllabic words and vowel identification test contained 10 words varying with vowels. In the syllable categorization subtest, a score of 1 is given for each correct pattern identification. For the word identification subtest, a score of 1 is given for each correct word identification and '0' for wrong word identification.

Jijo and Yathiraj (2007-08) validated the test developed to assess 20 children with severe profound hearing loss. The low verbal version was administered on 10 children aged 2 to 3 years and the standard version was administered on 10 children aged 3 to 5 years. It was found that the children with hearing impairment whose aided thresholds were within the speech spectrum were able to perform well. Differences in difficulty level was exhibited with different subtest, where the syllable categorization test was found to be easier compared to word identification subtest and vowel identification subtest. The vowel identification test was the most difficult subtest.

Zheng et al. (2009) developed the Mandarin Early Speech Perception test (MESP) for children aged 2 to 5 years in line with the ESP in English developed by Moog and Geers (1990). They made suitable modification in the test to incorporate the 4 lexical tonality of the language (flat, rising, falling-rising, & falling). The MESP was designed to have 6 categories that included 'Speech sound detection', 'Speech pattern perception' consisting of four speech patterns (monosyllabic words, spondee, trochee & trisyllable) having 3 words in each category. The falling-rising tone was excluded in this category as this tone lead to confusion between monosyllable and bisyllabic words when decision was being made only through temporal variations of the words. Further, the tone of the first and second syllable of Mandarin spondee is the same. The other categories included 'Spondee identification category' that has 12 bisyllabic spondees having equal tone on both syllables; 'Vowel perception category' that has 4 clusters of 3 monosyllabic words, with each clusters having the same consonants and tone but with varying vowels; 'Consonant perception category' consists of four clusters of 3 monosyllabic words having the same tone and vowels with varying consonants; and the 'Tone perception category' consists of 4 pairs of monosyllabic

words having varying tones. A software program was created by Zheng et al. (2009) for automatic administration and scoring of the test.

Zheng et al. (2009) also evaluated the effect of exposed to different dialects Mandarin language on the MESP scores. They evaluated 96 typically developing children aged between 2 to 5 years who were exposed to 2 different dialects of Mandarin (Putonghua & Sichuanhua). The children were divided into three age groups in both dialects (2 to 3, 3 to 4, & 4 to 5 years). The dialect exposure was quantified by using a dialect exposure checklist that was answered by school teachers. It was found that there was no significant difference between the scores obtained for categories 1 to 5 of the test. However, for category 6 (tone perception test), the scores were significantly different between the two dialect groups only for children aged 3 to 4 and 4 to 5 years. Additionally, for this category, age effects were seen indicating that perception of tone contrast develop with increase in age.

Chathurika (2016), using the principles of the 'Glendonald Auditory Screening Procedure (GASP)' and 'Monosyllable, Trochee, Spondee test (MTS)', developed a similar test for Sinhala speaking children that they named 'Kelaniya Monosyllabic trochee polysyllabic test'. The GASP test for Sinhala speaking children included 10 questions and MTP test consisted of 12 words. The developed MTP test was administered on 212 typically developing normal hearing children in the age range 4 to 8 years. Likewise, GASP was administered on 200 children of aged 2 to 8 years. It was found that for the MTP test, all words were correctly identified by 80% of the children except for the word /kesel/ by children in the age range of 2 to 3 years. The GASP test scores were significantly poor for children aged 2 to 3 years and the scores significantly improved with increase in age. Hence, the Kelaniya MTP and GASP test was recommended for children age range of > 3years and

> 5 years respectively.

From the review of literature, it is seen that most of the speech perception test for children assessed both spectral recognition and temporal recognition abilities. A test for young children with hearing impairment that assesses both spectral and temporal recognition is the Early Speech Perception test (Moog & Geers, 1990) . This test has been adapted in different languages due to its usefulness. It is essential to develop such tests that assess spectral recognition and temporal recognition of children in languages where it is not available.

Chapter 2

METHODS

The aim of the present study was to modify the existing 'Early Speech Perception Test in Kannada (Yathiraj, 2004) and to validate the modified test. The study was carried out in three phases using a standard-comparison design. Phase-I involved the development of the 'Modified Early Speech Perception Test in Kannada' (MESP-K); Phase-II dealt with validating the developed test on normal hearing children; and Phase-III involved validating the material on children with hearing impairment.

2.1 Participants

Phase I included 10 children, 5 children aged ≥ 2 to < 3 years and 5 in the aged ≥ 3 to < 4 years. Phase II had 35 children, 15 aged ≥ 2 to < 3 years and 20 aged ≥ 3 to < 5 years. Phase III contained 15 children with hearing impairment in the age range of 3 to 5 years. A purposive sampling technique was used to select the participants.

2.1.1 Participant selection criteria for Phase I and Phase II

The participants selected for Phases I and II of the study were native speakers of Kannada. They had no history of speech, language and hearing difficulties as well as had normal developmental milestones. It was ensured that none of them was ill on the day of testing.

2.1.2 Participant's selection criteria for Phase III

To be included in Phase III of the study, the participants were required to have been diagnosed to have severe-to-profound hearing loss; use hearing aids at least for 1 year; have

aided audiogram within the speech spectrum at least up till 2 kHz; no history of additional disability such as mental challenge, visual impairment or cognitive impairment; and exposure to Kannada from childhood.

2.2.1 Phase-I: Development of the test material

The 'Modified Early Speech Perception Test in Kannada' (MESP-K) was developed in line of the 'Early speech perception test' developed by Moog and Geers (1990). This was done as the earlier developed 'Early Speech Perception Test in Kannada' by Yathiraj contained only a section of the version of the test given by Mood and Geers (1990).

As monosyllabic words are normally not used in Kannada, the test was developed making use of bisyllabic, trisyllabic and polysyllabic words. The words for the test were selected from age appropriate text books, story books, and from parents of children aged below five years. A list of 22 bisyllabic, 9 trisyllabic and 5 polysyllabic words was initially made. From this list, 18 bisyllabic, 6 trisyllabic and 3 polysyllabic words were selected. The selected bisyllabic, trisyllabic and polysyllabic words contained low, mid and high frequency speech sounds. Further, the selected words were classified for use in the low verbal version of the test, meant for children aged 2 to 3 years and for use in the standard version, meant of children aged 3 to 5 years. Categorisation of the words to be used in the low verbal version and the standard version was done with the help of 5 preschool special educators and 5 regular preschool teachers. Additionally, 10 parents (5 for each target age) also rated the familiarity of the words. The teachers and parents were instructed to indicate whether the words shortlisted for the low verbal version of the test were familiar to children in the aged 2 to 3 years and those shortlisted for the standard version were familiar to children of aged 3 to 4 years. Words rated as being familiar by 90% of the teachers and parents were utilised for

the construction of the two versions of the test. Thus, for the low verbal version of the test, 10 words were shortlisted and for the standard version, 34 words were shortlisted. Pictures representing all the words were selected and presented to 5 adults initially to confirm their appropriateness and lack of ambiguity.

The familiarity of the shortlisted words was further confirmed by presenting the pictures of the words to 5 children in the age range of 3 to 5 years. The children were encourage to point to a picture that was named by the examiner. The words were considered to be familiar if they were correctly recognized by 90% of the children. Using the familiar words, the low verbal and the standard version of the 'Modified Early Speech Perception Test in Kannada' were finalised. Each version of the test was designed to have two subtests, one to evaluate syllable categorization and the other to evaluate word identification.

The *low verbal version* had two subtests, the syllable categorization subtest that had 10 words (4 bisyllabic, 4 trisyllabic, & 2 polysyllabic words) and bisyllabic word identification subtest that had 6 bisyllabic words. On the other hand, the *standard version* had three subtests that included syllable categorization, bisyllabic word identification and vowel identification. The syllable categorization subtest consisted of 12 words (4 bisyllabic, 4 trisyllabic, & 4 polysyllabic words). The word identification subtest contained 22 bisyllabic words. Among the bisyllabic words, 12 words were used for testing consonant identification 10 words were used to evaluate vowel identification. The test items for the low verbal and standard versions of the 'Modified Early Speech Perception Test in Kannada' (MESP-K) are provided in Appendix 1.

Audio recording of the developed test was done using a native Kannada female speaker. The recording was done in a sound treated room with a condenser microphone (B-2

PRO), placed 6 inches from the mouth of the speaker. The microphone was connected via an audio interface (MOTU Micro book II) to a computer loaded with Adobe Audition (Version 3). The recording was done using a sampling frequency of 44100 Hz and resolution of 32 bits. The recorded material was normalized such that the average root mean square power of the words varied by not more than +/- 4 dB.

The recorded material was subjected to a goodness test by presenting it to 5 young adults. As the words were clear to the listeners, no further modification was done. A 1 kHz calibration tone having the average root mean square value of the word lists was generated prior to each list.

2.2.2 Phase II: Validation of test on typically developing children

The low verbal and the standard versions of the developed 'Modified Early Speech Perception Test in Kannada' were validated on 15 and 20 typically developing children aged 2 to 3 years and 3 to 5 years, respectively. Prior to evaluating each child, informed consent was obtained from the caregivers of the children, adhering to Ethical Guidlines for Bio-Behavioural Research Involving Human Subjects (2009) of All India Institute of speech and hearing . Each child was made to sit in the sound treated test room at 0^{o} azimuth, one meter away from a loud speaker. Pictures depicting the words were placed on a table, in front of the child. The words were initially evaluated by providing both auditory signals and speech reading (auditory-visual mode). This was done to ensure that the stimuli were familiar to the children. Following this, the stimuli were presented only through the auditory mode twice in a random order at 50 dB HL using a calibrated diagnostic audiometer (Inventis piano). The purpose of presenting the material twice was to overcome the problem of testing with limited number to test items. Live voice presentation was used for presenting the low verbal version

as several of the children did not carry out the task with the recorded material. The standard version was administered using the recorded material that was played on a computer and routed to the sound-field loudspeaker via the calibrated audiometer. The level of the live voice / recorded material was monitored using a VU meter. The children were evaluated using both subtests of the version with which they were tested (syllable categorization & word identification). Initially, syllable categorization was evaluated followed by the word identification subtest.

2.2.3 Phase III: Validation of test on children with hearing impairment

The procedure used to evaluate the children with hearing impairment in Phase III was similar to that used in Phase II. If any child found any of the test items to be unfamiliar, training was provided until he/she was able identify the word correctly through the audio-visual mode. Following this, they were tested similar to the way the typically developed children were tested. Each child, wearing their prescribed binaural digital hearing aids, was instructed to listen to the words heard through the loudspeaker and point to a picture representing the respective word.

2.3 Test Environment

Testing was carried out in a two-room sound-treated suite. The ambient noise level in the sound treated suite was within the acceptable levels specified by American National Standard Institute (1999-R2013)

2.4 Scoring

Scoring was done separately for syllable categorization and for word identification in both versions of the test. For the *syllable categorization subtest* two different types of scores

were calculated, a syllable categorization score and a word identification score. Words identified within a syllable category (bisyllabic, trisyllabic, or polysyllabic words) were given a score of 1 and those not identified within the category were given a score of 0. These scores were given independent of whether the word identification was correct or not. Additionally, words correctly identified in the syllable categorization subtest were given a score of 1 and those incorrectly identified were assigned a score of 0.

Similarly, for the *word identification subtest*, a score of 1 was awarded for each correctly identified word and 0 for every incorrect word identification. Word identification scores were calculated separately for the bisyllabic word identification subtest and the vowel identification subtest.

2.5 Test-retest reliability

Test retest reliability was done on 2 typically developing children in each age group . The children were retested within 2 weeks after the initial testing.

2.6 Analyses

Descriptive and inferential statistics was carried out. Mann-Whitney U test was administered to compare the scores obtained by the typically developing and children with hearing impairment using the standard version of the test. For both low verbal and standard versions of the test, Wilcoxon signed-rank test and Friedman's test were carried out to compare the syllable categorization and the word identification subtest and to compare bisyllabic, trisyllabic and polysyllabic words scores within the syllable categorization test, respectively.

Chapter 4

RESULTS

Statistical analyses of the data obtained from children aged 2 to 3 years and 3 to 5 years, using the newly developed Modified Early Speech Perception Test in Kannada (MESP-K), was performed using the SPSS (version 20). For the former age group, their scores on the low verbal version of the test were analyzed and for the latter age group the data from the standard version were analyzed. Comparison between the responses of the typically developing children and children with hearing impairment as well as comparison between the subtests of the newly developed test were done. A Shapiro-Wilk test revealed that the data were not normally distributed ($p < 0.05$). Hence, the data were analyzed using non-parametric tests.

The results are discussed under the following headings:

Low verbal version of MESP-K

4.1 Comparison of syllable categorization and word identification scores in typically developing children within the syllable categorization subtest (Analysed using Wilcoxon signed rank test)

Standard version of MESP-K

4.2 Comparison of subtests of the standard version of MESP-K (syllable categorization, word identification, & vowel identification) in typically developing children**.**

4.3 Comparison of subtests of the standard version of MESP-K (syllable categorization, word identification, & vowel identification) in children with hearing impairment (Analysed using Friedman's & Wilcoxon signed rank test).

4.3.1 Comparison of bisyllabic, trisyllabic and polysyllabic word identification scores within the syllable categorization subtest for children with hearing impairment (Analysed by using Friedman's test).

4.3.2 Comparison of syllable categorization scores and word identification scores within the syllable categorization subtest (Analysed using Wilcoxon signed rank test).

4.3.3 Comparison of the syllable categorization subtest and the bisyllabic word identification subtest of the standard version of the test on children with hearing impairment (Analysed using Wilcoxon signed rank test).

4.3.4 Comparison of scores of the bisyllabic word identification subtest and vowel identification subtest on children with hearing impairment (Analysed using Wilcoxon signed rank test).

4.4 Comparison between scores of typically developing children with children having hearing impairment for the standard version of the MESP-K test (Analysed using Mann-Whitney U test).

Low verbal version of the MESP-K:

4.1 Comparison of scores of syllable categorization and word identification within the syllable categorization subtest in typically developing children.

The mean, median and standard deviation of the two types of scores (syllable categorization & word identification) obtained from within the syllable categorization subtest of the low verbal version are provided in Table 4.1. From the table it is clear that mean and standard deviation of the two scoring procedures obtained on the 15 children differ only marginally. The analysis between the word subtest and the syllable categorization subtest were not done as the bisyllabic words used in the two subtests were identical.

Table 4.1
Mean scores, percentage scores in parenthesis, median and standard deviation (SD) of the score types of the low verbal version of the MESP-K, within the syllable categorization subtest

Score type	**Maximum possible scores**	**Mean score**	Median	**SD**
Syllable categorization	20	19.93 (99.66%)	20 (100%)	1.29
Word identification	20	19.73 (98.66%)	20 (100%)	2.96

To determine whether the scores of the two scoring procedures of the syllable categorization subtests (syllable categorization & word identification) differed statistically, Wilcoxon signed ranked test was administered. No significant difference was found between the syllable categorization scores and word identification scores ($z = 1.342$, $p = > 0.05$).

Standard Version of MESP-K:

4.2 Comparison of subtests of standard version (syllable categorization, word identification, & vowel identification) in typically developing children.

Table 4.2 provides the mean, median and standard deviation of the scores obtained on the syllable categorization subtest, bisyllabic word identification subtest and vowel identification subtest for 20 typically developing children. It can be seen that all the typically developing children scored 100% for the syllable categorization subtest. Further, for the bisyllabic word identification subtest and the vowel identification subtest, the typically developing children obtained near perfect scores with minimal variation. The mean percentage scores between these two subtests had only marginal variation. As the mean and median scores as well the standard deviation did not vary much, no further inferential statistics was carried out.

Table 4.2

Mean, Median and Standard deviation (SD) for subtests of the standard version MESP-K of typically developing children

Subtests	Maximum possible score	Mean	Median	SD
Syllable categorization total score#	**24**	24 (100%)	24 (100%)	0.00
Bisyllable score	*8*	*8 (100%)*	*8 (100%)*	0.00
Trisyllable score	*8*	*8 (100%)*	*8 (100%)*	0.00
Polysyllable score	*8*	*8 (100%)*	*8 (100%)*	0.00
Bisyllabic words identification	**24**	23.95 (99.7%)	24 (100%)	0.22
Vowel identification	**20**	19.75 (98.75%)	20 (100%)	0.55

Note. # Syllabic categorization subtest total score (24) is a combination of the scores obtained for bisyllabic, trisyllabic and polysyllabic words within the subtest.

4.3 Comparison across the subtests of the standard version of MESP-K (syllable categorization, word identification, & vowel identification) in children with hearing impairment

The mean, median and standard deviation of the scores of the syllable categorization subtest as well as that of the bisyllabic word and vowel identification subtests in children with hearing impairment are depicted in Table 4.3. Additionally, the identification scores of the bisyllabic, trisyllabic and polysyllabic words within the syllable categorization subtest are given. It can be seen that the mean identification scores for the words within the syllable

categorization subtest varied depending on the syllable category. The bisyllabic syllables were identified better than the tri and polysyllabic words. Also, the variability in scores was found to be less for the bisyllabic words compared to the other word categories. Further, the mean score for the vowel identification subtest was poorer, with more variability compared to the other subtests

Table 4.3

Mean, Median and Standard deviation (SD) for subtests of Standard version of the test for children with hearing impairment

Subtests	**Maximum possible score**	**Mean**	**Median**	**SD**
Syllable categorization total score#	**24**	21.40 (89.16%)	22 (91.66 %)	1.59
Bisyllable score	*8*	*7.33 (91.66%)*	*7 (87.5%)*	0.72
Trisyllable score	*8*	*7.20 (90%)*	*7 (87.5%)*	0.94
Polysyllable score	*8*	*7.40 (90%)*	*8 (100%)*	0.91
Word identification total score#	***24***	*19.20 (80%)*	*20 (83.33%)*	2.64
Bisyllable score	8	*6.67 (83.33%)*	*7 (87.5%)*	1.17
Trisyllable score	8	*6.40 (80%)*	*7 (87.5%)*	1.35
Polysyllable score	8	*6.27 (78.37%)*	*6 (75%)*	1.03
Bisyllabic words identification	**24**	17.13 (71.37%)	17 (70.83%)	2.72
Vowel identification	**20**	12.60 (63%)	11 (55%)	3.48

Note. # A combination of the scores obtained for bisyllabic, trisyllabic and polysyllabic words within the syllable categorization subtest

4.3.1 Comparison of bisyllabic, trisyllabic and polysyllabic scores within the syllable categorization subtest test in children with hearing impairment

From the mean, median and standard deviation given in Table 4.3, it is evident that the scores are similar in all three word categories within the syllable categorization subtest. Similarly, the variability in scores across the three categories were similar. To see whether identification of different categories of words (bisyllabic, trisyllabic & polysyllabic words) within the syllable categorization subtest differed statistically, Friedman's test was administered. The results showed that there was no statistically significant difference among them [χ^2 (2) = 1.22, $p > 0.05$].

4.3.2 Comparison of syllable categorization scores and word identification scores within syllable categorization subtest in children with hearing impairment

It can be observed from Table 4.3 that within syllable categorization subtest, the mean and median are poorer for word identification scores than compared to syllable categorization scores. Wilcoxon signed rank test was administered to compare the two scores. It was found that significantly better scores were obtained for syllable categorization compared to word identification, within the syllable categorization subtest ($z = 3.23$, $p < 0.01$).

4.3.3 Comparison of syllable categorization subtest and bisyllabic word identification subtest of standard version of the test for children with hearing impairment.

From the Table 4.3 it is evident that mean scores for syllable categorization subtest is better compared to bisyllabic word identification subtest. Wilcoxon signed rank test indicated

that the scores were significantly better scores in the syllable categorization subtest compared to the word identification subtest scores ($z = 3.39$, $p < 0.01$).

4.3.4 Comparison of scores of the bisyllabic word identification subtest and vowel identification subtest for children with hearing impairment

The mean bisyllabic word identification scores were found to be better compared to vowel identification scores (Table 4.3). This difference in scores was found to be statistically significant on a Wilcoxon signed rank test. Significantly better scores were obtained in the bisyllabic word identification subtest compared to the vowel identification subtest ($z = 2.55$, $p < 0.05$).

4.4 Comparison between scores of the typically developing children and children with hearing impairment for the standard version of the MESP-K test

From Table 4.4 it is evident that mean and median scores for all the subtests of the MESP-K are poorer for children with hearing impairment than the typically developing children. Additionally, the variability in scores was more for the former group compared to the latter group.

Table 4.4

Mean, median and standard deviation (SD) for the subtests of the standard version of the MESP-K Test for typically developing children and children with hearing impairment

Subtest of Standard version	**Maximum Possible Score**	**Typically developing Children (N = 20)**		**Children with hearing impairment (N = 15)**	
		Mean	**SD**	**Mean**	**SD**
Syllable categorization	24	24 (100%)	0.00	21.40 (89.16 %)	1.59
Bisyllabic word identification	24	23.95 (99.7%)	0.22	17.13 (71.38%)	2.72
Vowel identification	20	19.75 (98.75%)	0.55	12.6 (63%)	3.48

Mann-Whitney U test was administered to establish whether the scores obtained by the typically developing and children with hearing impairment in the standard version of the test differed significantly. It was found that in all the subtests, significantly better scores were obtained in by the typically developing children ($p < 0.01$), as can be seen in Figure 1.

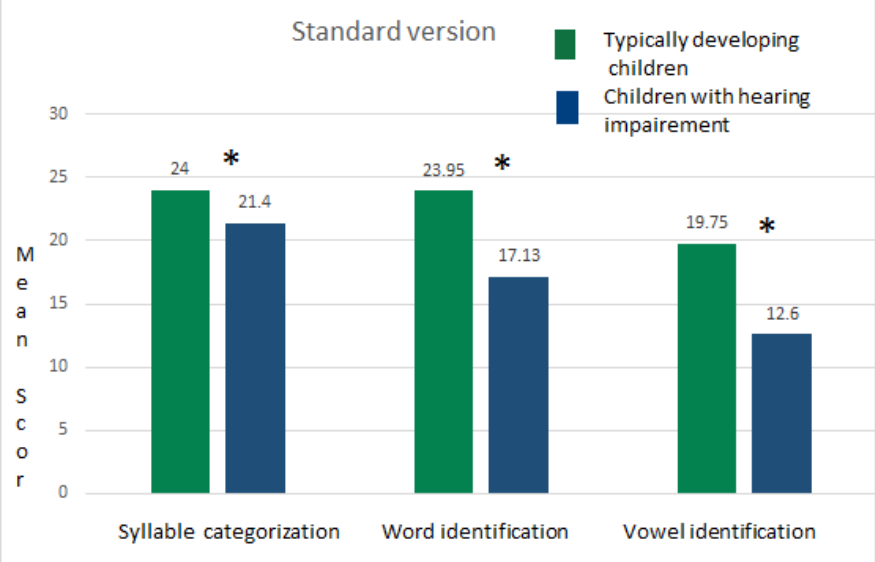

Figure 4.1: Mean percentage scores of the syllable categorization, bisyllabic word identification and vowel identification of typically developing children and children with hearing impairment on the standard version of MESP-K (*Note.* * $p < 0.01$)

Test-Retest Reliability

Test retest reliability was administered on 4 typically developing children, 2 evaluated using the low verbal version of the test and 2 evaluated using the standard version of the test. Cronbach's alpha test indicated that for both versions of the test had a high test-retest reliability ($\alpha > 0.70$).

From the results of the study it can be inferred that in the *low verbal version* of the test, there was no significant difference between syllable categorization scores and word

identification scores within the syllable categorization subtest in the typically developing children. In the *standard version* of the test, there was no significant difference between the scores on the bisyllabic word identification subtest and vowel identification subtest in typically developing children. However, there was a significant difference between the scores of the syllable categorization and bisyllabic word identification subtest. Similarly, significantly better scores were obtained on the bisyllabic word identification subtest compared to the vowel identification subtest. Additionally, significantly better scores were obtained in the typically developing children compared to children with hearing impairment for all the subtests of the standard version of the MESP-K.

Chapter 5

DISCUSSION

The results of the present study are discussed regarding the findings of the low verbal version of MESP-K and the standard version of the test. Information provided for the low verbal version of the test is regarding the performance of typically developing children aged 2 to 3 years. The standard version of the test is discussed with reference to the performance of typically developing children and children with hearing impairment aged 3 to 5 years and a comparison of the performance of the two groups. For both versions of the test, the performance of the participants within and / or across the subtests is discussed.

5.1 Low verbal Version: Comparison of scores of syllable categorization and word identification within the syllable categorization subtest in typically developing children

Within the syllable categorization subsection of the low verbal version of MESP-K, no significant difference was present for the identification of the three different categories of words (bisyllables, trisyllables, & polysyllables). As words familiar to children as young as 2 to 3 years were selected for this version of the test, the typically developing children were able to identify all three word categories equally well.

Similar results were reported by Zheng et al. (2009) on the 'Mandarin Early Speech Perception' test, were their typically developing children were able to identify all the words in the pattern perception and word identification categories of the test. However, they observed that children aged 2 to 3 years could not identify words with variations in tones in the tone perception category of their test.

In the current study, many of the young children tested could do the task when live voice was used but not when recorded material was used. However, Moog and Geers (1990) reported that they were able to administer a recorded version of the test on their participants. Unlike the present study, they validated the recorded low verbal version of ESP on older children aged 4 to 6 years with hearing impairment. In the current study, the low verbal version of the test was administered on much younger children (2 to 3 year old) who found it difficult to carry out the task using recorded material. However, when tested using live voice, these young children were able to carry out the test. Further, as typically developing children aged 2 to 3 years found the recorded task difficult, it is highly likely that children with hearing impairment would also find it difficult. Hence, it is recommended that if the low verbal version of the test is utilized on older children, it is preferable that the recorded version of the test be used. However, it is recommended that if younger children are unable to carry out the task using recorded material, live voice testing may be utilized.

5.2 Standard version: Comparison of subtests of standard version (syllable categorization, word identification, & vowel identification) in typically developing children

In the standard version of the MESP-K, only marginal variations in mean scores were seen across the subtests (syllable categorization, word identification, & vowel identification) in the typically developing children aged 3 to 5 years. This finding is similar to what was observed in the low verbal version of the test. Similar to what was done with the low verbal version of the test, the vocabulary selected for the standard version was chosen from words familiar to children aged 3 to 4 years. AS typically developing children as young as 3 to 5

years obtained near perfect scores, it can be construed that the test can be used effectively on children with hearing impairment, with training if required.

Similar findings have been reported in an earlier study by Moog and Geers (1990) and Zheng et al. (2009). They too obtained near perfect scores for all the children studied by them for the pattern perception and word identification subtest.

5.3 Standard version: Comparison across the subtests of the standard version of MESP-K (syllable categorization, word identification, & vowel identification) in children with hearing impairment

The performance of the children with hearing impairment on subtests of the standard version of the test differed across the tests. Their performance was found to be significantly higher for the syllable categorization subtest (89.16%) compared to word identification subtest (71.38%). Likewise, significantly higher scores were obtained on the bisyllabic word identification subtest (71.38%) than the vowel identification subtest (63%).

It has been noted in the original ESP test by Moog and Geers (1990) and by earlier studies developed in line with the ESP test that pattern perception / syllable categorization scores are better than word identification tasks (Jijo & Yathiraj, 2007-08; Moog & Geers, 1990; Raashida, 2000; Tamilmani, 2002). It is known that suprasegmental cues such as stress patterns are better perceived by individuals with severe to profound hearing loss compared to that of segmental features (Bilger & Wang, 1976; Hack & Erber, 1982; Risberg & Agelfors, 1978; Smith, 1972). While such stress patterns as well as syllable length variations were used in the original ESP developed by Moog and Geers (1990) only the latter variations were used in the newly developed MESP-K. Stress patterns were not used as they do not exist in

Kannada. Hence, the subtest in MESP-K made use of only words varying in syllable length, as done in similar tests developed in India (Jijo & Yathiraj, 2007-08; Moog & Geers, 1990; Raashida, 2000; Tamilmani, 2002). The fact that the children with hearing impairment obtained near perfect scores on the syllable categorization subtest of the current study, indicates that the task can be used usefully in evaluating young children with hearing impairment.

In the present study, poorer scores were obtained in children with hearing impairment for the word subtest compared to the syllable categorization subtest. While the former subtest evaluates spectral perception, the latter subtest evaluates temporal perception. It is known that in individuals with hearing impairment, temporal perception is better that spectral perception (Zeiser & Erber, 1977). This could account for the variations in performance on the two different subtests (syllable categorization & word identification).

The significantly better scores on the bisyllabic word identification subtest compared to the vowel identification subtest, indicates that these two subtests tap different aspects of speech perception in children with hearing impairment. While the word subtest focused on evaluating consonant identification, the vowel subtest, as the name suggests, majorly attempted to evaluate vowel perception. The children with hearing impairment probably found the vowel subtest more difficult, as the words differed in only one or two phonemes that required the children to perceive subtle spectral variations. On the other hand, the stimuli in the bisyllabic word identification subtest differed in more than two phonemes, making the task easy. Due to the greater contrast between the words in the bisyllabic word identification subtest, the children probably performed better.

The results are in consonance with earlier studies (Jijo & Yathiraj, 2007-08; Moog, 1990; Raashida, 2000). As noted by Turner and Henn (1989), individuals with severe to profound hearing loss have poor vowel recognition abilities and larger vowel formant discrimination when compared to normal hearing individuals. This was thought to be due to poor frequency selectivity. However, it is known that poor spectral selectivity should also have resulted in poor scores on a consonant identification test. Hence, it is more likely that the reduced number of cues in the vowel identification rather than just poor frequency selectivity, could have resulted in the children performing poorer on the vowel identification subtest compared to the bisyllabic word identification subtest in the current study.

5.4 Standard version: Comparison of performance between typically developing children and children with hearing impairment for standard version of the test

The findings from the present study revealed that significant better scores were obtained in all the subtests of standard version of the test by typically developing children compared to children with hearing impairment. This confirms that the test is able to assess the perceptual difficulties of young children with hearing impairment. This will enable using the test to make suitable recommendations in terms of the use of listening devices or make judgment about the usefulness of training being provided to young children with hearing impairment.

The poor performance of the children with hearing impairment indicates their difficulty in the perception of spectral as well as temporal cues. Earlier research has confirmed that children with hearing impairment have poor frequency selectivity (Needleman & Crandell, 1995; Turner & Henn, 1989).

Thus, from the findings of present study, it is inferred that the words in MESP-K are suitable for children aged 2 to 5 years in terms of cognitive and language ability. It is also observed that the children with hearing impairment were able to perform above chance level in all the subtests. It is recommended that if words in the test are not in the vocabulary of a child with hearing impairment, the MESP-K test may be administered after training. It is also recommended that as far as possible, the recorded version of the test be used to avoid any adverse influence of a tester's speech production.

Chapter 6

SUMMARY AND CONCLUSION

The availability of technology to enhance listening skills in those with hearing impairment necessitates the use of standard tests to assess speech perception in different age groups. The need to provide appropriate listening devices as early as possible for children with deafness, has led to the development of tests for young children that aid in the selection of these devices. As speech perception tests are advocated to be used in young children and need to be developed in the native language of children, the present study was carried out. The study aimed at adapting the 'Early Speech Perception Test' developed by Moog and Geers (1990) in Kannada. Thus, the 'Modified Early Speech Perception in Kannada' (MESP-K) for children aged 2 to 5 years was developed in the study.

The MESP-K consists of two versions, a low verbal version and a standard version to evaluate children aged between of 2 to 3 years and 3 to 5 years, respectively. Each of these versions consists of two subtests, a syllable categorization subtest and a word identification subtest. The standard version of the test also contains a vowel identification subtest.

The study was carried out in three phases, with Phase I dealing with the development of test material for the MESP-K. In Phase II, the developed material was administered on 35 typically developing children aged between 2 to 5 years. While the low verbal version of MESP-K was administered on 15 children aged 2 to 3 years, the standard version of the test was administered on 20 children aged 3 to 5 years. In Phase III of the study, the MESP-K was validated on 15 children aged 3 to 5 years with severe to profound hearing loss.

The analysis of the data revealed that in the *low verbal version of the test*, no significant difference in word identification was obtained within the syllable categorization subtest in the typically developing children. In the *standard version of the test*, the typically developing children obtained near perfect scores, with minimal variation on all three subtests (syllable categorization, bisyllabic word identification, & vowel identification). On the other hand, the children with hearing impairment obtained significantly better mean percent scores for the syllable categorization subtest compared to the bisyllabic word identification sub test. Further, they obtained significantly better scores on the bisyllabic word identification subtest compared to the vowel identifications subtest. It was also observed that the typically developing children obtained significantly better scores on all three subtests of the standard version of MESP-K than the children with hearing impairment. As the test could differentiate the performance of the typically developing children from those with hearing impairment, the test is considered useful in testing young children with hearing impairment.

Implications of the study

The developed material of Modified Speech Perception Test in Kannada (MESP-K) can be used for the following purpose:

Assessment of speech perception abilities in children aged between 2 to 5 years who are exposure to Kannada. As the test can be carried out following training, it can be administered also on children with limited vocabulary. It can also be administered on older children with delayed developmental milestones and on children with poor attention abilities. The developed test will enable audiologists measure the outcome of devices for young children with hearing impairment using listening devices. Thus, it can be used to assess the outcome of therapy as well pre- and post-cochlear implant speech perception out comes.

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APPENDIX

Appendix - I

Manual

Modified Early Speech Perception Test in Kannada (MESP-K)

Developed in the Department of Audiology,
All India Institute of Speech and Hearing, Mysuru, India

Background information

The Modified Early Speech Perception Test in Kannada (MESP-K) was a developed as a part of a master's dissertation by Priya K. P. under the guidance of Dr. Asha Yathiraj, Professor of Audiology, Department of Audiology, All India Institute of Speech and Hearing, Mysuru, India. The MESP-K is designed to assess speech perception abilities of young children aged 2 to 5 years who are native speakers of Kannada.

Description of MESP-K

The MESP-K consists of two versions, a low verbal version and a standard version. The low verbal version of the test is designed to be administered on children aged 2 to 3 years, whereas the standard version of the test is designed to be administered on children aged 3 to 5 years. The details of the subtests of MESP-K are provided in Table 1.

Table 1. Description of Subtest

MESP-K					
Parameters	**Low verbal version** (2 to 3 years)		**Standard version** (3 to 5 years)		
Subtest	Syllable Categorization	Bisyllable word identification	Syllable Categorization	Bisyllable word identification	Vowel identification
Number of test items	• 10 words (4 bisyllabic, 4 trisyllabic & 2 polysyllabic words)	• 6 bisyllabic words	• 12 words (4 bisyllabic, 4 trisyllabic and 4 polysyllabic words)	• 12 bisyllabic words	• 10 bisyllabic words
Mode of presentation	Live / Recorded	Live / Recorded	Recorded	Recorded	Recorded
Presentation level	50 dB HL	50 dB HL	50 dB HL	50 dB HL	50 dB HL
Maximum possible score	20	12	24	24	20

Although the test can be carried out using live voice, the recorded material is recommended.

Pre-requisites for the administration of the test:

Instrumentation / Materials required

1. A compact disc version of MESP-K is required that contains a calibration tone and the test stimuli with adequate inter-stimulus interval.
2. Calibrated audiometer that has the facility to carry out live voice or recorded material and has a VU meter to monitor the level of the stimuli. To carry out the testing using recorded material, the audiometer should have facility for auxiliary input.
3. Loudspeaker calibrated for 0^{o} azimuth.

Test Environment

The testing should be carried out in an audiometric room having ambient noise levels within the acceptable levels specified by ANSI S3.1-1999 (R2013). The child should be seated one meter away from the loudspeaker and pictures of the subtest should be placed on the table in front of the child. However, young children who are unwilling to be tested within the sound treated facility, the testing may be carried out in quiet room, free from distractions.

Instruction to be given by the tester

The tester should instruct the child as follows: "You will hear words. Point to the picture of the word".

Test procedure: Before testing, the child should be made familiar with the words used in the MESP-K. To ensure that the child knows the words, first the testing has to be done through an audio-visual mode. If the child is able to identify all the words through the audio-visual mode, then the actually testing through auditory modality may be carried out. If required, training should be given for unfamiliar words, until the child is able to identify the word audio-visually. All the stimuli should be presented twice in the auditory modality.

Scoring

The stimuli that were presented audio-visually as well as twice through the auditory modality should be scored. The responses should be scored separately for each subsection and noted in the scoring sheet is provided.

For the *syllable categorization subtest,* a score of '1' should be awarded for each correctly identified word within the syllable category. For example, if the word given was /mane/ and child pointed to picture of / bəssU /, the response is considered correct and a score of '1' is given. A score of '0' should be given if the child points to a picture that is not in syllable category. For example, if the word given was /mane/ and child pointed to picture of / kə̪t̪trI /, the response is considered wrong and a score of '0' is given.

For the *word identification subtest,* a score of '1' should be awarded for each correctly identified picture and '0' for each incorrect word identification.

Modified Early Speech Perception Test in Kannada (MESP-K)

Name: Date:
Age/ Sex: Address:
Language: Hearing Aid Model:

Low verbal version of MESP-K Scoring Sheets

Syllable categorization subtest

Word category	**Stimuli**	**AV**	**A1**	**A2**	**Word Identification Score ↓**
Bisyllabic words	/kəppe/				
	/ka:ge/				
	/kIvI/				
	/ko:t̪I/				AV = /4 A = /8
Trisyllabic words	/kUdUre/				
	/kət̪̪rI/				
	/ba:gIl̪̪U/				
	/bəki:ṭU/				AV = /4 A = /8
Polysyllabic words	/ma:vIn̪ə mərə/				
	/kIt̪̪ṭəḷe hanṇṇU/				AV = /2 A = /4
Syllable categorization Score →		/10	/20		AV = /10 A = /20

Word identification subtest

Stimuli	**AV**	**A1**	**A2**
/kəppe/			
/ka:ge/			
/kIvI/			
/ko:t̪I/			
/ke:kU/			
/kUrI/			
		Total score AV: /6 Total A score: /12	

Modified Early Speech Perception Test in Kannada (MESP-K)

Name: Date:
Age/ Sex: Address:
Language: Hearing Aid Model:

Standard Version of MESP-K Scoring Sheets

Syllable categorization

Word category	**Stimuli**	**AV**	**A1**	**A2**	**Word Identification Score ↓**
Bisyllabic words	/maɳe/				
	/bəssU/				
	/ʈəɻe/				
	/ka:rU/				AV = /4 A = /8
Trisyllabic words	/kəʈʈərI/				
	/kUɖUre/				
	/ba:gIɭU/				
	/bəki:ʈu/				AV = /4 A = /8
Polysyllabic words	/həsIrU bəɳɳə/				
	/gUɻa:bI hUvvU/				
	/ma:vIɳə mərə/				
	/kIʈʈəɭe haɳɳU/				AV = /4 A = /8
Syllable categorization score →		/12	/24		AV = /12 A = /24

Bisyllabic word identification

Stimuli	AV	A1	A2
/bəssU/			
/ka:ge/			
/gənn̪̈e/			
/t̪əẗ̪ẗ̪e/			
/kIvI/			
/mən̪e/			
/mUk^{h}ə/			
/sərə/			
/ʧa:kU/			
/ko:ẗ̪I/			
/a:n̪e/			
/n̪a:jI/			

Total score AV: /12
Total A score: /24

Vowel identification subtest

Stimuli	AV	A1	A2
/kəppe/			
/ka:ge/			
/kIvI/			
/kUrI/			
/ku:gu/			
/kempU/			
/ke:kU/			
/kaI/			
/kombU/			
/ko:t̪I/			

Total score AV: /10

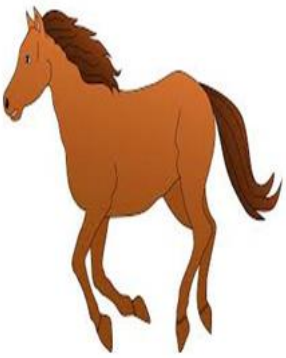
Total A score: /20

Modified Early Speech Perception Test in Kannada
(MESP-K)

TEST MATERIAL

Low verbal Version - Subtest 1

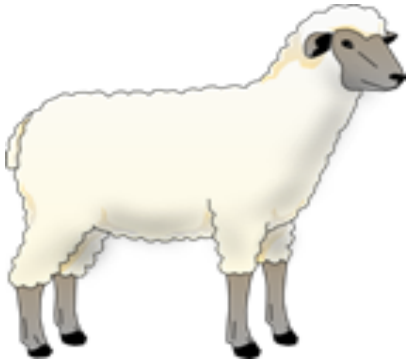
SYLLABLE CATEGORIZATION SUBTEST

x

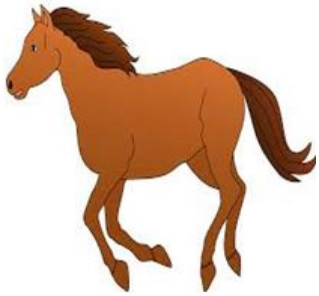
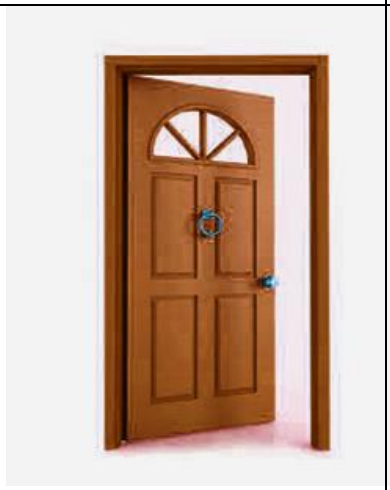
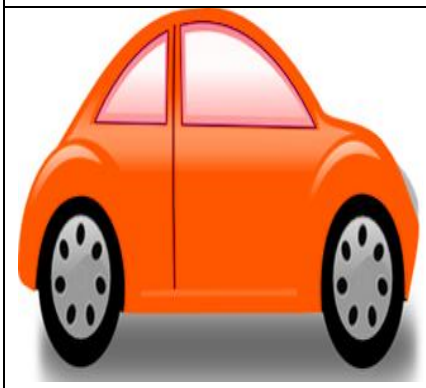
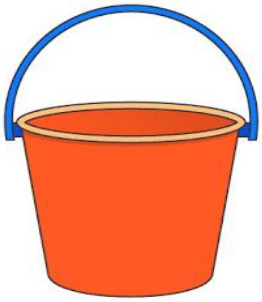
Low Verbal Version - Subtest 2

WORD IDENTIFICATION SUBTEST

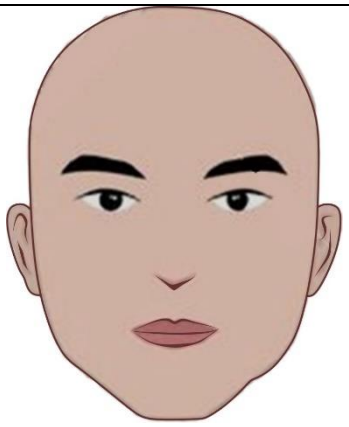
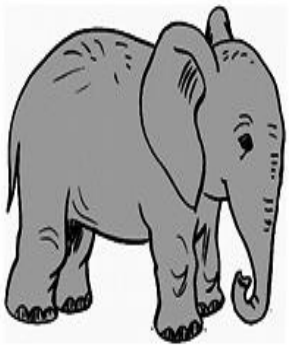
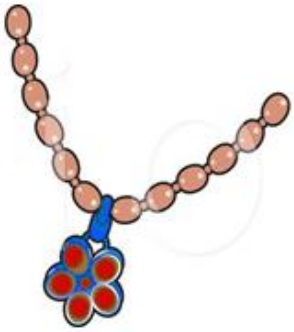
Standard Version - Subtest 2

SYLLABLE CATEGORIZATION SUBTEST

Standard Version - Subtest 2

BISYLLABIC WORD IDENTIFICATION SUBTEST

Standard Version - Subtest 3

VOWEL IDENTIFICATION SUBTEST