

**DEVELOPMENT AND STANDARDIZATION OF SENTENCE TEST IN  
KANNADA LANGUAGE FOR ADULTS**

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**Principal Investigator**

Geetha C, M.Sc. (Audiology)

**Co-Investigator**

Sharath Kumar K. S M.Sc. (Audiology)

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<b>Principal Investigator</b>	Ms. Geetha C Lecturer in Audiology, Department of Audiology All India Institute of Speech and Hearing Mysore– 570 006, Karnataka, India
<b>Co-Investigator:</b>	Mr. Sharath Kumar K. S Research Assistant, Department of Audiology All India Institute of Speech and Hearing Mysore– 570 006, Karnataka, India

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**Contents**

Abstract	5
<b>1. Introduction</b>	6
1.1 Existing sentence tests in Foreign languages	7
1.2 Sentence tests available in Indian languages	9
1.3 Need for the study	10
<b>2. Method</b>	11
2.1 Phase I: Development of Sentence lists in Kannada language	11
2.2 Phase II: Standardization and assessment of list equivalency	18
2.3 Phase III: Assessment of clinical utility	19
<b>3. Results and Discussion</b>	22
3.1 Phase I: Development of Sentence lists in Kannada language	22
3.2 Phase II: Standardization and assessment of list equivalency	23
3.3 Phase III: Assessment of clinical utility	27
3.3.1 Between group comparison	27
3.3.2 Within group comparison	30
<b>4. Summary and Conclusion</b>	35
<b>References</b>	36
<b>Appendix</b>	41

### **Abstract**

**Objective:** The present study aimed to develop and standardize sentence identification test in Kannada language. **Design:** Normative research. **Sample:** 133 participants with normal hearing sensitivity. **Method:** Sentences in Kannada language were selected from various sources. These sentences were evaluated for naturalness, predictability and equivalency on 33 participants. Sentences which were considered natural, low in predictability and equivalent were used to construct 30 lists with 10 sentences each. Standardization of the material and list equivalency were assessed on 100 listeners with normal hearing ability. **Results:** Based on ratings of naturalness and predictability, 564 sentences were considered as natural and low predictable sentences. Of these, 316 sentences were found to be having equal difficulty based on performance-SNR function. These sentences were used for construction of 30 lists. Repeated measures ANOVA and Bonferroni post hoc test revealed List 1, 3, 15, 16 and 30 to be significantly different from at least one of the other lists. After removing these lists, the mean identification score at -5 dB SNR was 54 percent. Clinical utility of the test was also assessed. Individuals with mild, moderate, moderately-severe, and severe degrees of hearing loss were assessed. **Conclusions:** The Kannada sentence identification test consists of 25 equivalent lists, which will be useful for speech intelligibility measures in various applications. The developed sentence material is also sensitive to differences in speech identification abilities across different degrees of hearing loss.

## **CHAPTER 1**

### **INTRODUCTION**

Speech is the most sophisticated form of communication that is quite unique to human. The measurement of speech perception provides useful information in assessing communication difficulties experienced by listeners with hearing loss. The scope of speech perception tests extend even to rehabilitation, targeted particularly for the assessment and monitoring of an individual's speech perception ability before and after fitting of hearing aids or cochlear implants (Mueller, 2001). Further, it aids in choosing appropriate amplification and for counselling (Wilson, Burks & Weakley, 2005; Wilson & McArdle, 2005).

There are a variety of test materials such as nonsense syllables, monosyllables, bisyllables and sentences that can assess speech perception abilities of individuals. Each of them has their own advantages and disadvantages, primarily due to their relation to everyday speech communication, the redundancy aspects, the scoring of responses and test duration (Tyler, 1994). More commonly used speech stimuli are monosyllabic or bisyllabic words and sentences. Carhart (1965) preferred monosyllabic words owing to their non-redundancy and meaningfulness. He also stated that they are not as confusing as nonsense syllables. In addition, as all languages do not have concrete monosyllabic words, bisyllables are preferred and they provide additional cues for intelligibility than monosyllables (Hirsh, 1952). On the other hand, monosyllabic words when presented at constant intensity levels do not truly represent realistic communication. Sentences articulated with natural dynamics have much larger dynamic range when compared to monosyllabic words, thus a more realistic representation of speech communication (Villchur, 1982).

While there exists many meaningful word and nonsense syllable tests, the sentence type of stimuli have the advantage of offering additional insight regarding the individual's performance in more realistic communication scenarios. They are considered to be valid indicators of intelligibility and are a better representation of verbal communication (Tyler, 1994). Further, it is expected that sentence test material will elicit better accuracy and effectiveness in measuring speech reception thresholds, because sentence material result in much steeper

intelligibility function in contrast to tests using single words (Kollmeier & Wesselkamp, 1997). The capacity to manipulate certain patterns like intonation and coarticulation effects on the ongoing speech is severely limited when using single words, especially monosyllables (Killion et al., 2004). Miller, Heise, and Lichten (1951) noted that sentences have face validity as ‘natural’ and ‘meaningful’ stimuli for assessing auditory function.

### ***1.1 Existing sentence tests in foreign languages***

The use of sentence material dates to the 1930s, when Fletcher and Steinberg devised sentence intelligibility lists following the format of simple interrogative or imperative sentences. The sentences never became widely used clinically because of the problems related to familiarity and difficulty of the test material (Hirsh, 1952). One of the first sentence tests to receive widespread clinical acceptance was the *Central* Institute of Deaf (CID) Everyday Sentences Test developed by Silverman and Hirsh (1955). The CID test uses a target-word format, meaning that although the subject must repeat the entire sentence during testing. Scoring is based on correct recognition of key words.

Plomp and Mimpen (1979) developed a sentence test for the Dutch language by first evaluating the intelligibility of all sentences at an intermediate speech level. For the composition of the actual test lists they only employed those sentences that yielded intelligibility close to the average intelligibility of all sentences. Thus, a high homogeneity of the sentences both within each test list and across all test lists was achieved. A similar approach was employed for the hearing-in-noise test (HINT), which was developed at The House Ear Institute and provides a reliable measure of reception threshold for sentences (RTS) in quiet and in background noise (Nilsson, Sullivan, & Soli, 1990; Nilsson, Soli & Sullivan, 1993; Nilsson Soli & Sullivan, 1994). The HINT was designed for testing binaural listening in the sound field allowing for the assessment of amplification.

The HINT consists of 25 equivalent ten-sentence lists and speech spectrum noise. The sentences were revised to remove British idioms, equate sentence length and alter verb tenses. The lists of sentences were normalized for naturalness, difficulty and reliability (Nilsson et al., 1994). The speech stimuli are simple sentences with little contextual information, closely approximating performance intensity slopes for speech intelligibility word lists

(Nilsson, Soli & Sullivan, 1995). The HINT makes use of speech spectrum noise that was generated by spectrally matching the white noise to the long-term average spectrum of the stimulus sentences so that the signal-to-noise ratio is approximately equal at all frequencies. An adaptive method is used for measuring the reception thresholds for sentences in quiet or in noise. The adaptive procedure avoids the ceiling and floor effects associated with most word recognition tests, which are presented at a fixed level (Nilsson, Soli & Sullivan, 1994). There are many other languages such as Danish (Neilsen & Dau, 2009), Mandarin (Wong et al. 2007), Cantonese (Wong & Soli, 2005) in which HINT is available.

Similarly, in German language, a sentence test called “Marburger Satztest” has been developed (Niemeyer, 1967). It consists of ten test lists with ten sentences that are each phonemically balanced. However, the semantic construction is partially unusual and incomplete which has resulted in a relatively poor acceptance of this test in the German language. Moreover, the standardized recording of the sentence test by a schooled speaker is over-articulated and does not reflect an everyday communication situation. The test lists yield approximately the same intelligibility in quiet. However, the equivalence of the test lists and the homogeneity of the sentence intelligibility in noise was not considered when constructing the test.

In German language, another sentence test has been developed by Kollmeier and Wesselkamp (1997). Though this test does not follow the same adaptive procedure used in HINT test, this test also evades the flooring and ceiling effects by providing SNR-50. This test consists of 20 test lists with ten sentences that are each phonemically balanced. The construction of these 20 lists comprised of various steps. The first step was a pilot study to arrive at SNR yielding 50% correct identification of key words of 324 sentences. These 324 sentences were then grouped into six groups, each group having sentences with similar intelligibility based on the results of the pilot study. Speech intelligibility measurements were again carried out on these six groups of sentences and a two-point discrimination function was derived. Based on the derived discrimination function, 20 phonemically balanced sentence lists were then formed from those sentences. Performance-Intensity discrimination functions calculated for these final 20 lists revealed that 50% sentences scores could be obtained at a SNR of -6.1 dB.



This test has been found to have several clinical applications such as assessment of binaural interaction in individuals with normal hearing sensitivity and hearing impairment, assessment of benefits of binaural hearing aids (Peissig & Kollmeier, 1997) and monitoring the progress of the children with cochlear implant after training. From the above it is clear that, over the years, different forms of sentence tests have been developed, keeping in mind the perceptual difficulties of those with hearing loss (Mendel & Danhauer, 1997). In addition, the native language of an individual is another important factor affecting the speech perception of an individual (Delattre, 1964). This necessitates a need for development of speech material in native languages. Hence, administering speech test in the native language of the individual is considered to be ideal.

### ***1.2 Sentence tests available in Indian languages***

India is a multilingual country having several regional languages. In the Indian context, material developed by Rahana and Yathiraj (2007) for Indian English (non native English speakers) is available. They constructed sentences with high predictability and low predictability in English. Each list had 10 sentences, consisting of 5 sentences with high predictability and another 5 sentences with low predictability. They reported a mean list score of around 80% for the Mild-Moderate hearing loss group. Another test material available is a sentence test in Kannada has been developed by Avinash, Meti and Kumar (2010), this has a limited number of sentences which can be used for routinely in clinics, and however, is not a standardized test. Further, this has a limited number of sentences (seven equivalent lists having seven sentences each).

### ***1.3 Need for the study***

It has been reported that the mother tongue of an individual influences his/her perception of speech and that participants consistently had better and optimum discrimination scores in their mother tongue as compared to other languages (Delattre, 1964). Hence, it is important to have speech material in the mother tongue of an individual.

India is a multilingual country with several languages. All India Institute of Speech and Hearing is situated in Karnataka, a state in South India. Kannada is the official language spoken in this state. The Institute renders clinical

services to individuals with communication disorders. The services for individuals with hearing impairment include assessment of hearing sensitivity, fitment of various hearing devices and rehabilitation of individuals with hearing impairment. It is required that a battery of test be administered for assessment, fitting of devices and monitoring the progress of management. Speech identification tests are important tools in the battery in the assessment of hearing and comparing performance of hearing devices and/or settings (Mueller, 2001).

Majority of the service seekers visiting the Institute are speakers of Kannada language. This necessitates development of sentence test in Kannada language for assessment of hearing and hearing device fitment.

Apart from clinical services, research studies also mandate the use of many sentence lists. Primarily, improvements in hearing aid technology have increased the number of hearing aid parameters. Research into the effect of each of the parameter/algorithm requires a large number of sentence lists (Gatehouse, 1992), in order to avoid practice effect. The QuickSIN (Speech in Noise) test in Kannada language developed by Avinash, Meti, and Kumar (2010) included 12 lists with seven sentences each, from a pool of 60 sentences after familiarity rating. The noise used was eight talker speech babble. The lists of the test have been constructed such that each sentence was presented at SNR in the following order: +20 dB, +10 dB, +5 dB, 0 dB, -5 dB and -10 dB, to 30 individual with normal hearing sensitivity. They reported that at -6.17 dB SNR, 50% speech identification scores could be identified and only seven lists were equivalent out of 12 lists. Hence, this test has a limited number of sentence lists (seven equivalent lists having seven sentences each). Further, this test has some sentences occurring more than one time causing a possibility of practice effect. Everyday communication demands listeners to understand speech in varying degrees of noise. It has been proven that listeners with sensorineural hearing loss (SNHL) exhibit greater degree of difficulty in understanding speech than do listeners with normal hearing in the background noise under the similar circumstances (Dubno, Dirks & Morgan, 1984) and, also, speech intelligibility measures are inherently limited by ceiling effects when presented in quiet condition. Hence, the study aims to develop a large set of sentence lists, a maximum of 30 lists, adapting the procedure used by Kollmeier and Wesselkamp (1997) to achieve sentence as well

as list equivalency in the presence of noise and to provide normative for the developed lists. The specific objectives are:

- To develop large set of sentence material in Kannada for adults,
- To standardize the sentence lists, and
- To assess the clinical utility in individuals with hearing loss.

## **CHAPTER 2**

### **METHOD**

The aim of the study was to develop and standardize sentence lists in Kannada language. The study also aimed at assessing the clinical utility of the standardized sentence lists in individuals with different degrees of hearing loss.

The study was carried out in three phases:

**Phase I** - Development of sentence lists in Kannada language

**Phase II** - Standardization of sentence lists and assessment of list equivalency and

**Phase III** – Assessment of clinical utility

#### **2.1 Phase I: Development of sentence lists in Kannada language**

The development of the sentence lists consisted of following steps.

- 2.1.1 Selection of sentences
- 2.1.2 Recording and editing of sentences
- 2.1.3 Determination of global SNR
- 2.1.4 Sentence equivalency
- 2.1.5 Phonetic balancing and list creation

##### ***2.1.1 Selection of the sentences***

Sentences were selected from a large database. The sources were mainly back files of major Kannada newspapers/magazines and day-to-day conversation. The following criteria were used for selection of sentences.

A sentence was chosen if,

- a) the total number of words ranged from four to six
- b) the number of syllables not exceeding fourteen to sixteen
- c) it contained familiar and equally difficult words
- d) it did not contain punctuation characters
- e) it represented conversational speech
- f) it did not contain proverbs, exclamations, proper names, or questions
- g) it was complete (i.e., contained a verb) and was syntactically and grammatically correct, and
- h) it had semantically neutral content.

A total of 700 sentences were selected based on the above mentioned criteria. In each of these sentences, four key words (defined as those words which were deemed to be important for sentence comprehension) were identified by ten adult native speakers of Kannada. Naturalness rating [on a five point rating scale (5 = Natural and 1 = Artificial)] and predictability was then done by the same ten participants. Any sentence that did not receive a mean rating of at least four was removed.

Predictable sentences were defined as those in which the key words could be guessed from a single word or the whole sentence could be inferred from the context. The participants were asked to guess the possible words that could possibly occur when they were presented with the key words. If the number of words guessed were more than two, then, those sentences were considered to be less predictable. Predictability was assessed since sentences with high predictability may elevate intelligibility scores compared to sentences with low predictability (McGarr, 1981; Garcia & Cannito, 1996; Garcia & Dagenais, 1998; Barreto & Ortiz, 2010). Based on all the above ratings, 564 sentences were shortlisted and audio recorded.

## **2.1.2 Recording, editing and noise mixing**

### *2.1.2.1 Recording*

A female speaker (aged 21 years) was selected from a group of three native speakers based on (a speech sample recorded by all the three speakers) their ability to sustain constant vocal effort while maintaining clear articulation and neutral intonation. Recordings were made in a sound treated room using Shure SM48 cardioid dynamic vocal microphone placed in front of the speaker at a distance of around 0.5 m. Each sentence was recorded directly into an individual sound file using Computerized Speech Lab (CSL) software, which also allowed filtering and amplitude monitoring. The waveforms were digitized with a 16 bit A/D converter at a sampling frequency of 44100 Hz.

### *2.1.2.2 Editing*

The digitized waveforms were then edited using Adobe Audition (v 3.0) by eliminating silent intervals at the beginning and at the end of each waveform. Other unwanted sounds, such as breathing noise and lip smacks, were also removed. The mean-squared amplitudes of the signals were equated to 60 dB (relative to one sample unit in a 16-bit digital representation). For calibration purposes, a 1000 Hz tone of 30 second duration was generated at a level equal to the root mean square average intensity of sentences.

### *2.1.2.3 Mixing sentences with noise*

The recorded 564 sentences were concatenated and spectrally analyzed to derive its long-term average speech spectrum (LTASS). The LTASS was then used to design an infinite impulse response (IIR) filter in MATLAB software (v 7.12). White noise was then subjected to the designed IIR filter parameters to obtain a noise with spectral characteristics similar to previously recorded speech sample. Figure 2.1 shows the LTASS of speech and the spectrum of the filtered noise. The 564 sentences were then mixed with the generated spectrally shaped noise at different SNRs. This was achieved using a program written on a MATLAB platform given by Gnanateja and Pavan

(2012). This program calculates the RMS amplitude of the speech and noise signals in 50 millisecond bins and mixes them both in the specified signal-to-noise ratios.

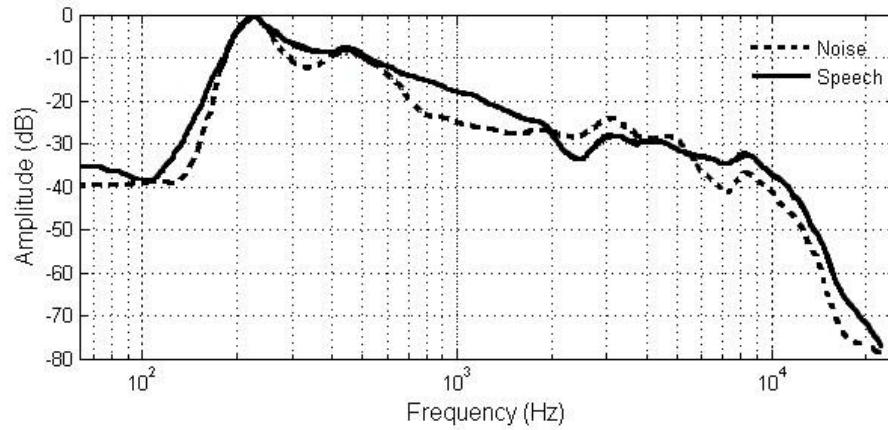


Figure 2.1. LTASS of sentences and spectrally shaped noise.

### 2.1.3 Determination of global SNR

Speech intelligibility measures are inherently limited by the floor and ceiling effects. To overcome these limitations that are associated with tests presented at a fixed level, adaptive procedures are used (Nilsson, Soli & Sullivan, 1993). Adaptive procedure may be utilized to arrive at global SNR. Global SNR was defined as the SNR which yields an average total intelligibility score of 50% (Kollmeier & Wesselkamp, 1997). The important advantage of determining and using global SNR is the minimization of ceiling and floor effects. This SNR was used to get a 50% point in the sigmoid curve and was used to determine sentence equivalency in the pilot study which follows. The following methodology was adopted.

#### 2.1.3.1 Participants

A total of eight native Kannada speaking male and female listeners (four males and four females) participated. Their ages ranged from 18 to 35 years (mean age of 26.2 years, SD = 4.89). All the participants had normal hearing sensitivity and normal middle ear function.

### *2.1.3.2 Procedure*

The participants were seated in a sound treated room. Normal hearing sensitivity was confirmed by routine clinical audiometry. Normal hearing sensitivity was defined as air conduction pure tone thresholds within 15 dB HL across 250 Hz to 8000 Hz and bone conduction thresholds within 15 dB HL across 250 Hz to 4000 Hz. Further, the participants had 'A' type of tympanogram and had ipsilateral and contralateral reflexes at normal levels.

The sentence material was presented monaurally to a randomly chosen ear at the most comfortable level. The sentences were played through a personal computer, connected to a calibrated audiometer. The sentences were delivered through Sennheiser HDA 200 closed dynamic headphones. The headphone was used since it had a good frequency response and offered good comfort.

The sentences were delivered at SNRs ranging from -7 dB SNR to 0 dB SNR at 1 dB SNR intervals. The subjects were instructed to repeat back the sentences as accurately as possible. Listeners practiced with ten randomly selected trial sentences and were provided with feedback regarding their performance before the start of the actual test runs. The words correctly identified by the subjects were marked on a printed response sheet by the experimenter. Each sentence was scored based on the number of correctly identified key words. The words were considered as correct responses for errors such as contractions, spelled out contractions, identifiable mispronounced words, and changes in plurality. The experiments by Giolas & Duffy (1973) and Hinkle (1979) permits such exemptions to scoring procedure. Since each sentence had four key words, the maximum possible score was 4. The responses were noted on printed score sheet. Based on this, an average score for the 564 sentences was then calculated.

The results of the pilot study revealed scores of approximately 75% correct (mean raw score = 2.95) at -3 dB SNR, 50% correct (mean raw score = 2.19) at -5 dB SNR and 30% correct (mean raw score = 1.20) at -7dB SNR. Based on the obtained results, -5 dB SNR was chosen as the global SNR. Hence, for the sentence equivalency



assessment testing was done at -5 dB SNR (global SNR, -3 dB SNR (2 SNRs above the global SNR) and at -7 dB SNR (2 SNRs below the global SNR)

#### **2.1.4 Sentence Equivalency**

To arrive at sentences to be incorporated into lists that are similar to each other, an initial process of sentence equivalency was carried out using the procedure given below. The equivalency was assessed because, even though the sentences had equal RMS amplitudes, their intelligibility exhibited in the presence of spectrally shaped noise would not essentially be equal. Further, the phonemes used, familiarity of words, as well as intonation and intensity variations influence speech perception in noise (Nillson et al., 1994).

##### *2.1.4.1 Participants*

Another group of 15 native Kannada speaking male and female participants were chosen. Their ages ranged from 18 to 48 years with a mean age of 25.8 years (SD = 9.05). All the participants had normal hearing sensitivity.

##### *2.1.4.2 Procedure*

The participants were tested in a sound treated room. Normal hearing sensitivity was confirmed by routine clinical audiometry. Their air conduction pure tone thresholds were within 15 dB HL across 250 Hz to 8000 Hz and bone conduction thresholds within 15 dB HL across 250 Hz to 4000 Hz. Further, the participants had 'A' type of tympanogram and had ipsilateral and contralateral reflexes at normal levels.

Sentence equivalency was assessed at three SNRs, that is at -5 dB SNR (global SNR) and two SNRs on either side of the global SNR at 2 dB SNR intervals. These two SNRs, -3 dB SNR and -7 dB SNR were chosen to obtain the values near the ceiling and floor parts of the sigmoid curve respectively. Stimuli at each SNR were presented to five participants at their most comfortable level. The subjects were asked to repeat back the sentences as accurately as possible and the responses were recorded on a printed sheet. Scoring of the responses were done and assessed for equivalency. The mean values of correctly identified key words at -3, -5 and -7 dB were obtained. The number of correctly identified key words for each sentence was compared with this mean. Sentences with scores above or

below mean were eliminated. Following this process, a total of 316 sentences of equivalent difficulty were shortlisted and included in the final lists. As the aim was to prepare a maximum of 30 lists, a total of 30 sentence lists, with ten sentences each, were prepared such that they were phonemically balanced. The remaining 16 sentences were used as practice items.

### ***Phonetic balancing and list creation***

Phonetic balancing was done to make sure that each list was capable of yielding results representative of the subject's language comprehension ability. The sentences were phonetically balanced based on the frequency of occurrence of the phonemes in Kannada language (Ramakrishna et al., 1961). The sentences were distributed to 30 lists in such a manner that the frequency of occurrence of the phonemes in each list is matched that of the Kannada language as close as possible. After balancing, 25 phonetically balanced lists were thus created, each list containing ten sentences. Five lists were created with 10 sentences each that were not as accurately phonetically balanced as the previous 25 lists were (due to lesser choice of words at the end). However, all the lists included all the phonemes of the language. The remaining 16 sentences were used for familiarization.

## **2.2 Phase II: Standardization and assessment of list equivalency**

The sentence lists were standardized over a group of participants with normal hearing sensitivity, so as to determine the normative performance. Further, evaluation was done to determine the repeatability, and thus the reliability, of the sentence lists measured with different lists.

### ***2.2.1 Participants***

In total, 100 participants with normal hearing were included in this part of the study. The age ranged from 18 to 55 years (with the mean age of 29.4 years, SD = 9.16 years). The participants were seated in a sound treated room. Normal hearing sensitivity was confirmed by routine clinical audiometry. Normal hearing sensitivity was defined as air conduction pure tone thresholds within 15 dB HL across 250 Hz to 8000 Hz and bone conduction thresholds

within 15 dB HL across 250 Hz to 4000 Hz. Further, the participants had 'A' type of tympanogram and had ipsilateral and contralateral reflexes at normal levels.

### **2.2.2 Procedure**

All the sentence lists were administered on 100 normal hearing subjects (this does not include participants studied in the previous sections) at -5 dB SNR (to avoid ceiling effect) at their most comfortable level. The sentences were routed through a personal computer and delivered through Sennheiser HDA 200 closed dynamic headphones via calibrated MA 53 diagnostic audiometer.

The participants were asked to repeat back the sentences they heard. Prior to the actual testing, participants were presented with ten practice sentences that were not present in the final sentence lists. Each sentence was scored based on the number of key words identified and the lists were subjected to appropriate statistical analysis to determine the presence of equivalency.

### **2.3 Phase III: Assessment of clinical utility**

The aim of this part of the study was to assess the clinical utility of the developed sentence lists in individuals with sensorineural hearing loss of varying degrees.

#### **2.3.1 Participants**

Forty individuals with (sensorineural) hearing loss aged between 18 to 70 years (Mean = 28.9 years) and forty individuals with normal hearing aged from 22 to 55 years (Mean = 28.85 years) participated in the study. The degree of hearing loss consisted of mild, moderate, moderately severe and severe categories (based on modified Goodman classification, 1965). Each category consisted of 10 ears. The configuration of loss was restricted to flat type (< 15 dB variation per octave in threshold between 250 Hz to 8000 Hz) and the speech identification scores had to be in agreement with the degree of hearing loss suggesting cochlear hearing loss. All participants had 'A' type of tympanogram and reflexes appropriate to their degree of hearing loss.

### **2.3.2 Procedure**

The participants were tested in a sound treated room with noise levels complying with the ANSI (1999) standards. The sentence lists were presented monaurally at the participants' most comfortable level in quiet condition.

Killion (1997) has evaluated individuals with hearing impairment with SIN test. He reported that even the individuals with mild hearing loss required higher SNR than the normal individuals in the presence of noise, even when the testing is done at higher intensity levels. In the current study, the normative is given at -5 dB SNR which is well below the SNR required even for an individual with 40 dB hearing loss according to the reports of Killion (1997). Further, it has also been reported that individuals with hearing impairment have poorer sentence recognition scores than normal hearing counterparts even if it is presented in quiet condition (Rahana & Yathiraj, 2007). Hence, in the third phase of the study, the sentences were presented without noise. For comparison purposes, a group of normal individuals were also tested in quiet condition. The sentences were routed through a personal computer and delivered through Sennheiser HDA 200 closed dynamic headphones via a calibrated audiometer.

Participants practiced with ten trial sentences and were provided with feedback regarding their performance before the start of the actual test runs. The subjects were instructed to repeat the sentences as accurately as possible. They were also encouraged to guess the sentence if they were unsure of it and were given ample time to respond. The words correctly identified by the subjects were marked on a printed response sheet by the examiner. Each sentence was scored based on the number of key words (25% for each key word) correctly repeated, wherein contractions, spelled out contractions, identifiable mispronounced words, and changes in plurality were counted as correct. The results were tabulated in accordance with the degree of hearing loss and the mean and standard deviations were calculated.

## CHAPTER 3

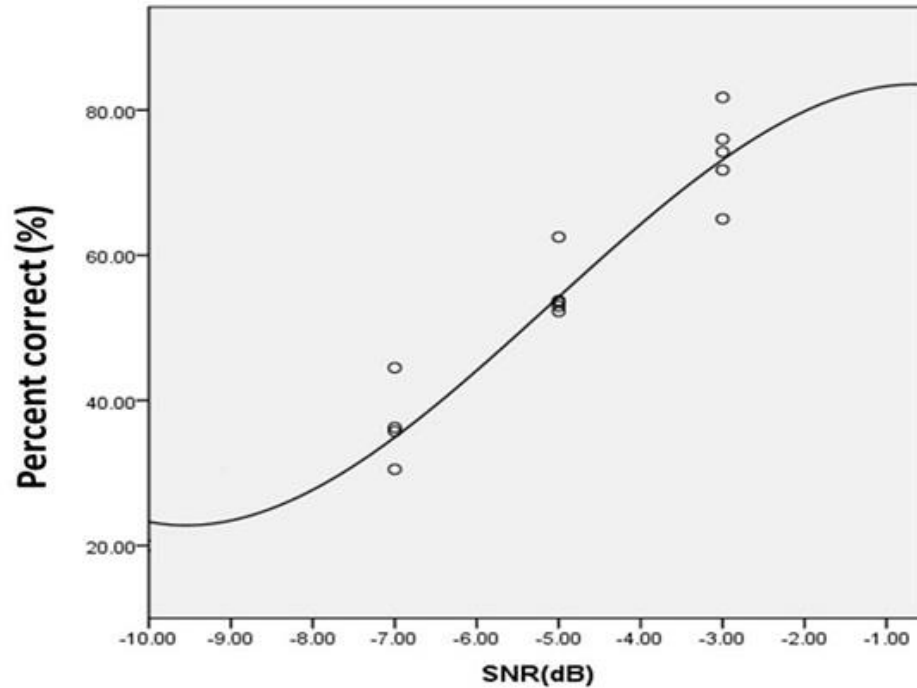
### RESULTS AND DISCUSSION

#### 3.1 Phase I: Development of sentence lists in Kannada language

The first phase of the study focused on the development of the sentence material in Kannada language. This involved selection and determination of naturalness and predictability of 700 sentences, determination of sentence equivalency of 564 shortlisted sentences.

The results of assessment of sentence equivalency revealed scores of approximately 75% correct (mean raw score = 2.95, Range = 0 – 4, SD = 1.2) at -3 dB SNR, 50% correct (mean raw score = 2.19, Range = 0 – 4, SD = 1.13) at -5 dB SNR and 30% correct (mean raw score = 1.20, Range = 0 – 4, SD = 1.39) at -7 dB SNR. A sigmoid function was obtained by plotting the identification scores (averaged for all 564 sentences) against the SNRs. Figure 3.1 illustrates the percentage of correctly identified key words at three SNRs for each individual. The sentences which were too easy (145 nos.) and too difficult (103 nos.) were eliminated. Sentences were considered easy if the average number of correctly identified key words was more than the mean scores obtained at those three SNRs, and the sentences were considered difficult if the average number of correctly identified key words were less than the mean score obtained at those three SNRs. Thus based on this, 316 out of 564 sentences with moderate difficulty were considered for making the sentence lists.

The results of this are in agreement with the results obtained by Kollmiere and Wesselkemp (1997). They had obtained 20% correct scores at -8 dB SNR and 80% correct scores at -4 dB SNR for sentence lists. Hence, the sentences in the present study also had a sigmoid function as reported in the literature.



**Figure 3.1.** Sigmoid function representing mean percent correct keyword identification at -7 dB SNR, -5 dB SNR and -3 dB SNR respectively. Each circle represents each participant.

The aim of the study was to construct 30 lists of 10 sentences each. Hence, only 300 of the 316 sentences were utilized to construct 30 lists, with 10 sentences each. All the 30 sentence lists contained all the speech sounds of the language. Of these, 25 lists could be phonemically balanced, i.e., the frequency of occurrence of speech sounds resembled the frequency of occurrence reported by Ramakrishna et al. (1961). The remaining 16 sentences of 316 sentences, that were not included in the sentence lists, were used for familiarization.

### 3.2 Phase II: Standardization and Assessment of list equivalency

Normative performance was established on 100 participants with normal hearing sensitivity at -5 dB SNR. Table 3.1 gives the mean of number of correctly repeated key word scores and standard deviation (SD) for each of the 30 lists.

Table 3.1

*Mean and SD of number of correctly identified key words for each list in individuals with normal hearing (N = 100)*

	Mean	SD		Mean	SD		Mean	SD
List1	19.79	3.74	List11	21.47	3.47	List21	21.52	3.12
List2	20.69	3.34	List12	20.74	3.50	List22	21.87	3.73
List3	21.20	3.28	List13	20.72	3.29	List23	22.78	3.66
List4	20.72	3.69	List14	21.46	3.72	List24	21.83	3.53
List5	21.64	3.32	List15	21.57	2.30	List25	21.30	3.87
List6	22.18	3.49	List16	21.44	3.39	List26	22.20	3.33
List7	20.75	3.77	List17	21.14	3.49	List27	22.90	3.77
List8	21.61	3.25	List18	22.11	3.24	List28	22.58	3.36
List9	21.40	3.45	List19	22.47	3.04	List29	22.04	3.46
List10	20.44	3.37	List20	21.51	3.54	List30	23.70	3.73

It can be observed from Table 3.1 that the performance was quite uniform across the lists. To determine if the difficulty level across lists was equivalent or not statistically, the difference between the each individual's score for each list and that listener's mean score (scores averaged for all the lists) was calculated. Figure 3.2 presents the mean and SD of these modified scores. Repeated measures ANOVA was carried out on these data to determine if performance across lists varied significantly at the global SNR of -5 dB SNR.

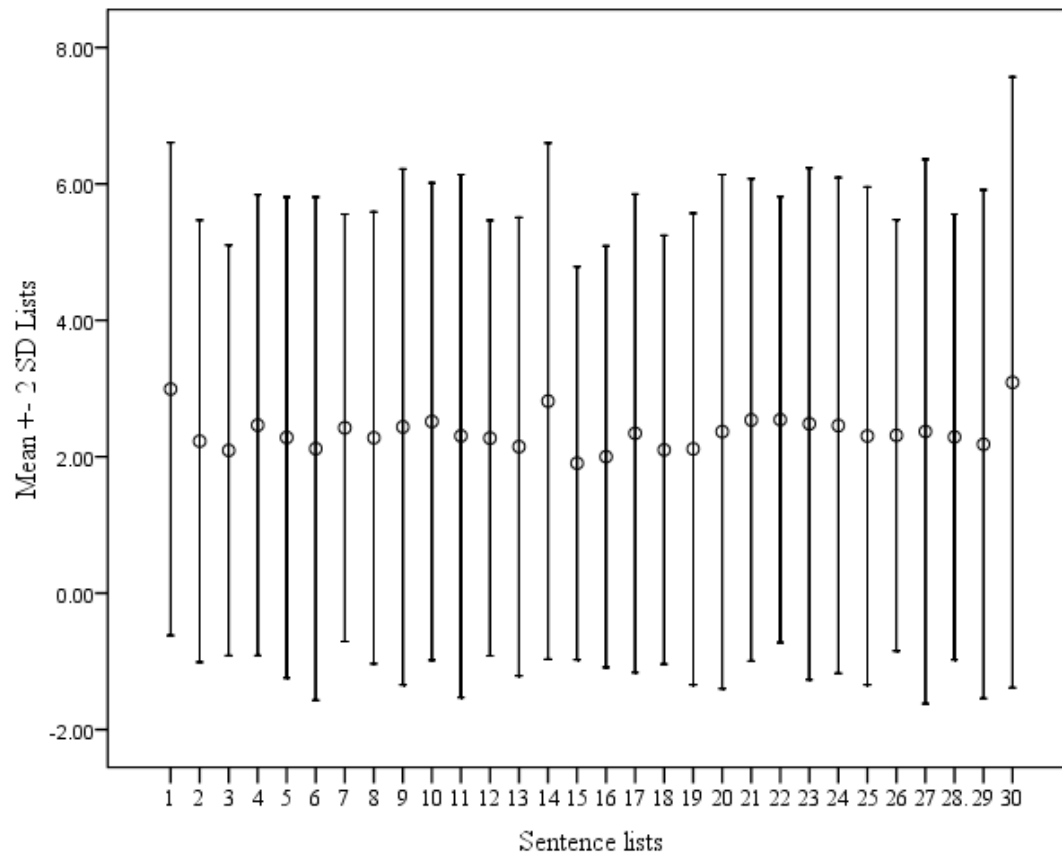


Figure 3.2

Mean difference and SD for 30 lists. Mean difference is the difference between the mean score of each listener and the score obtained by each individual for each list. For each list,  $n = 100$ . Error bars show  $\pm 2$  standard deviation for the mean.

It can be observed, from Figure 3.2, that the deviation from the average mean score for all the lists showed similar values, except for the list 1, 3, 14, 15, 16 and 30. It can also be observed that the SD is higher for the list 30. The repeated measures ANOVA revealed that there was a significant difference in performance across the lists ( $F(27.00, 2.87) = 2.293, p < 0.001$ ) revealing a main effect of lists. Hence, Bonferroni pair-wise comparison was done to analyze which lists differed in scores. The results of this are given in the Table 3.3. The results revealed that the list 1 was significantly different from the lists 3, 15 and 16, and list 30 was significantly different from the lists 15 and 16.

Table 3.2

*Results of pair-wise comparison across lists using Bonferroni post hoc analysis.*

Groups (I)	Groups (J)	Mean Difference (I-J)	Standard Error	Significance
List1	List3	0.899*	.212	.022
	List15	1.087*	.251	.015
	List16	0.992**	.221	.009
List15	List 1	1.087*	.251	.015
	List30	1.185**	.261	.007
List16	List1	0.992**	.221	.009
	List30	1.090*	.258	.023

Note: \* $p < 0.05$ ; \*\* $p < 0.01$

The Figure 3.2 has the mean and SD for all the 30 lists, however, in a different order. That is, the lists 1, 3, 15, 16 and 30 are included at the end. The order of these five lists depended on their mean scores. The lists at and below the reference line are equivalent lists. The equivalent lists are given as List 1 to 25 and the key words are highlighted in the Appendix. The non-equivalent lists are given as practice lists in the appendix.



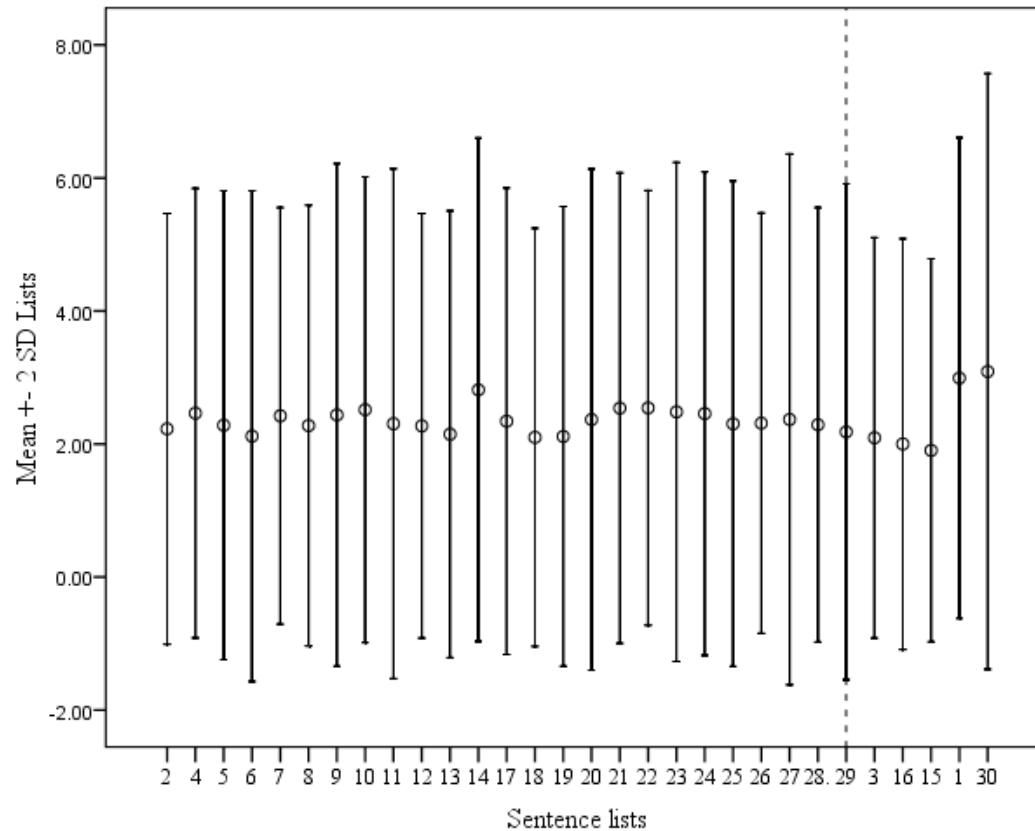


Figure 3.3. Mean difference and SD for 30 lists with revised order. The lists with significantly different scores are given after the reference line. For each list,  $n = 100$ . Error bars show  $\pm 2$  standard deviation for the mean.

After removing Lists 1, 3, 15, 16 and 30, the overall normative performance for the 100 normal hearing subjects had a mean of 21.60 with a range from 20.44 to 22.90. The mean identification score at -5 dB SNR was hence 54%. In English, a score of 48% at -3 dB SNR for CID-Everyday sentences was reported by Rippy, Dancer, and Pittenger (1983). This implies that the latter list was less difficult than the list developed in this study. This difference could be attributed to factors including the number of key words in the list (50 keywords in their study vs. 40 keywords in our study), noise used to mask the speech material (white noise in their study vs. speech noise in the present study) as well as differences between the languages. However, the inter-list equivalency was not present for the CID-Everyday sentences. Kollmeier and Wesselkemp (1997) reported a SNR of -6.1 dB for the 50% scores. Although the results of this study are comparable with that reported by Kollmeier and Wesselkemp, this small difference could be because of the differences in the method. Kollmeier and Wesselkemp have applied weighting

factors depending on the difficulty level of the words to bring homogeneity. They reported that if the weighing factor is removed, there could be variations in the scores up to 4%. In addition, the speech material was recorded by a male talker in their study.

Further, the standard deviation of raw scores, given in Table 1, is lower than that reported by Kollmeier and Wesselkemp. This suggests there is high homogeneity of the sentence lists in the present study even in a difficult condition of -5 dB SNR. In addition, the sigmoid function for sentences used in the lists was derived using the scores at -3, -5 and -7 dB SNRs. The test developed by Kollmeier and Wesselkemp has been found to have clinical applications in assessment, comparing hearing aid benefits and monitoring the progress after the training. Thus, it is speculated that the sentences in the present study could possibly be used in conditions with varying difficulty (in terms of SNR) for different applications such as routine hearing evaluation, hearing device fitment and monitoring progress in the rehabilitation process. The validation of the sentence lists is being carried out for hearing evaluation on clinical population. Further investigations are required to test the other applications of the developed lists.

### **3.3 Phase III - Assessment of clinical utility**

The clinical utility of the developed sentence material was evaluated in 40 individuals with hearing loss and in 40 individuals with normal hearing (a new group). The clinical group consisted of subjects with mild, moderate, moderately-severe and severe sensorineural hearing loss (10 subjects each). Thus, including the normal group, there were a total of five groups.

#### **3.3.1 *Between group comparison***

Table 3.3 gives mean and SD of correctly identified words (averaged for all the lists) for all the five groups. Though data were collected for all the 30 lists in all the groups, comparison are made only for the equivalent 25 lists.

Table 3.3

*Mean and SD of number of words correctly identified by all the groups.*

Groups	Number	Mean Age (years)	Range (years)	SD (years)	Mean (keywords correctly identified/percentage scores)	SD
Normal hearing	40	28.85	18 - 55	8.19	39.44 ( <b>98.61%</b> )	0.15
Mild hearing loss	10	27.00	18 - 38	7.13	39.54 ( <b>98.84%</b> )	0.13
Moderate hearing loss	10	42.00	20 - 60	16.16	36.93 ( <b>92.33%</b> )	1.80
Moderately severe hearing loss	10	41.60	27 - 60	12.96	24.58 ( <b>61.44%</b> )	3.12
Severe hearing Loss	10	45.70	25 - 69	15.74	19.30 ( <b>48.24%</b> )	3.10

The Table 3.3 shows the mean scores (averaged for all the lists) and the SD. It can be observed that the mean value decreases with increasing in degree of hearing loss. However, the scores are comparable between normal and mild group.

Kruskal-Wallis statistical analysis was done to evaluate if the difference in mean is statistically significant. The results revealed that statistically significant difference between groups was present ( $p < 0.01$ ). Hence, pair-wise comparison was made using Mann-Whitney U test. Table 3.4 presents the results of this. The table shows that the difference was significant ( $p < 0.01$ ) between all the groups except between mild hearing loss and normal hearing groups ( $p = 0.63$ ).

Table 3.4

*Results of Mann-Whitney U test*

<b>Groups (I)</b>	<b>Groups (J)</b>	<b>Z</b>	<b>Significance</b>
Mild HL	Moderate HL	3.78 <sup>*</sup>	0.00
	Moderately-severe HL	3.78 <sup>*</sup>	0.00
	Severe HL	3.78 <sup>*</sup>	0.00
	Normal	1.87	0.63
Moderate HL	Mild HL	3.78 <sup>*</sup>	0.00
	Moderately-severe HL	3.78 <sup>*</sup>	0.00
	Severe HL	3.78 <sup>*</sup>	0.00
	Normal	4.87 <sup>*</sup>	0.00
Moderately-severe HL	Mild HL	3.78 <sup>*</sup>	0.00
	Moderate HL	3.78 <sup>*</sup>	0.00
	Severe HL	3.02 <sup>*</sup>	0.00
	Normal	4.87 <sup>*</sup>	0.00
Severe HL	Mild HL	3.78 <sup>*</sup>	0.00
	Moderate HL	3.78 <sup>*</sup>	0.00
	Moderately-severe HL	3.02 <sup>*</sup>	0.00
	Normal	4.87 <sup>*</sup>	0.00
Normal	Mild HL	1.87	0.63
	Moderate HL	4.87 <sup>*</sup>	0.00
	Moderately-severe HL	4.87 <sup>*</sup>	0.00
	Severe HL	4.87 <sup>*</sup>	0.00

Note: \*p&gt;0.01

These results are consistent with the universal fact that as the extent of hearing loss increases, the perceptual difficulties also increase. The most quoted reference for the lower limits of speech identification scores for different degrees of cochlear pathology is Yellin, Jerger and Fifer (1989). They reported lower limits of 68%, 38.5%, 24%, and 11% for Mild, Moderate, Moderately Severe and Severe cochlear pathology respectively. The scores obtained in

this study remain well below the lower limits specified in the present study. The reason for differences could be that the mentioned authors used synthetic sentences which would have considerably increased the difficulty and reduced the scores.

Further, the effects of severe hearing loss on speech identification scores have also been well reported. The drastic decrease in speech identification ability in these individuals may be attributed to the loss of cochlear nonlinearity, decreased frequency selectivity, decreased temporal resolution, increased upward spread of masking and possible presence of dead regions (Moore et al., 2000; Moore, Lynch & Stone, 1992; Plomp, 1994). This could also result in poor speech perception even in quiet (Pekkerinan, Salmivalli & Suonpa, 1990).

In addition, the results reveal that the sentence material is sensitive to differences in speech identification abilities across different degrees of hearing loss. Similar abilities have been demonstrated in well used speech tests like Hearing in Noise Test (HINT) (Nilsson, Soli, & Sullivan, 1993) and CID Everyday sentences list (Rippy, Dancer & Pittenger, 1983). This lends support to the idea of using the developed sentence lists for routine clinical examination as well as for research studies.

### ***3.3.2 Within group comparison***

In order to validate the equivalency of the lists in the hearing impaired population, within group comparison of the scores were made for the four groups of individuals with hearing impairment. Table 3.5 gives the mean and SD of number of correctly identified words for 25 lists for the mild group.

Table 3.5

Mean and SD of number of words repeated correctly for 25 lists by individuals in the mild group ( $N = 10$ ).

	Mean	SD		Mean	SD		Mean	SD
List1	39.80	0.63	List11	39.40	0.70	List21	39.60	0.63
List2	39.40	0.97	List12	39.70	0.48	List22	39.60	0.97
List3	39.70	0.48	List13	39.80	0.42	List23	39.10	0.69
List4	39.50	0.71	List14	39.70	0.48	List24	39.50	0.99
List5	39.70	0.67	List15	39.60	0.84	List25	39.60	0.69
List6	39.80	0.42	List16	39.50	0.85			
List7	39.80	0.42	List17	39.40	0.84			
List8	39.50	0.70	List18	39.30	0.82			
List9	39.50	0.71	List19	39.60	0.70			
List10	39.20	1.03	List20	39.10	1.00			

Table 3.5 shows that the mean and the standard deviation do not vary across the lists. Repeated measures ANOVA was carried out to test this. The results revealed that there is no significant difference  $F(24,216) = 0.802$ ,  $p > 0.05$  between the lists for the scores obtained from the individuals with mild degree of hearing loss.

Table 3.6

*Mean and SD of number of words repeated correctly for 25 lists by individuals in the moderate group (N = 10).*

	Mean	SD		Mean	SD		Mean	SD
List1	37.20	2.70	List11	36.30	2.16	List21	36.20	2.65
List2	36.80	3.29	List12	36.40	2.59	List22	35.80	2.34
List3	38.40	1.50	List13	36.70	3.19	List23	37.00	2.30
List4	37.20	1.93	List14	37.60	2.95	List24	36.90	3.38
List5	37.10	2.33	List15	38.50	1.64	List25	37.50	2.79
List6	35.80	4.10	List16	37.50	1.84			
List7	36.50	3.24	List17	37.10	1.91			
List8	37.10	2.72	List18	37.30	2.40			
List9	36.20	2.25	List19	37.20	2.93			
List10	36.70	2.31	List20	36.30	2.83			

Table 3.7

Mean and SD of number of words repeated correctly for 25 lists by individuals in the moderately-severe group (N = 10).

	Mean	SD		Mean	SD		Mean	SD
List1	20.90	3.75	List11	25.20	4.54	List21	22.20	7.95
List2	23.30	2.40	List12	24.70	5.71	List22	24.80	3.96
List3	25.30	4.00	List13	23.70	3.74	List23	25.40	2.59
List4	25.40	3.86	List14	24.20	4.49	List24	25.90	2.99
List5	23.00	6.81	List15	24.30	4.85	List25	25.60	4.29
List6	25.40	4.11	List16	24.70	4.29			
List7	26.70	4.16	List17	25.00	3.43			
List8	24.20	5.00	List18	25.30	4.92			
List9	24.90	4.60	List19	23.60	4.52			
List10	25.70	4.73	List20	25.00	5.12			



Table 3.8

*Mean and SD of number of words repeated correctly for 25 lists by individuals in the severe group (N = 10)*

	Mean	SD		Mean	SD		Mean	SD
List1	18.10	3.90	List11	20.40	4.69	List21	18.20	3.85
List2	19.10	3.81	List12	19.40	3.23	List22	19.60	4.27
List3	18.60	3.89	List13	18.70	3.30	List23	20.10	3.81
List4	16.90	3.69	List14	19.80	2.74	List24	18.30	3.02
List5	17.70	3.86	List15	19.60	4.16	List25	18.60	4.88
List6	18.70	4.83	List16	19.40	3.13			
List7	21.40	4.35	List17	21.10	4.22			
List8	19.10	3.92	List18	20.20	3.61			
List9	20.80	5.20	List19	19.80	4.56			
List10	19.30	4.90	List20	19.50	3.59			

Table 3.6, 3.7 and 3.8 give the mean and SD of number of correctly identified words for 25 lists for the moderate, moderately-severe and severe groups, respectively. It can be observed that even in these groups, the mean does not vary across the lists. Repeated measures ANOVA also revealed no significant difference for the Moderate group [ $F(24,216) = 1.161$   $p > 0.05$ ], Moderately severe group [ $F(24,216) = 1.347$   $p > 0.05$ ] and severe group [ $F(24,216) = 1.496$ ,  $p > 0.05$ ].

These results suggest that the mean number of correctly identified words do not vary across the lists in any of the four groups, hence, suggesting equivalency across the standardized 25 lists. Any test should aid in comparing a large number of different variables of interest and the results should reflect the actual differences between the conditions. That is, the differences should not be due to the differences in the lists of the tests (Spahr et al., 2011). Hence, from the results, it can be said that the test developed in the present study can aid in comparisons across large

set of test conditions for different degrees of hearing loss in quiet. However, the same needs to be assessed in noise as well.

## **CHAPTER 4**

### **SUMMARY AND CONCLUSION**

The aim of the undertaken project was to develop and standardize a sentence test in Kannada language. In the first stage of the study, 30 lists were developed which had equivalent sentences. In the second stage, the test was standardized by administering on 100 individuals with normal hearing sensitivity, by presenting the lists at -5 dB SNR. After the analysis of results obtained from this large group of normal hearing participants, 25 lists were found to be equivalent.

The standardized lists were administered on hearing impaired individuals of different degrees of hearing loss (mild, moderate, moderately severe and severe). The results revealed that all the 25 lists were equivalent in terms of difficulty and the lists were also sensitive enough to differentiate different degree of hearing loss, by giving lesser scores for individuals with greater degree hearing loss versus individuals with lesser degree of hearing loss.

It can be concluded from the results of the project that these list can be efficiently used as a for measurement of speech intelligibility or SNR-50 measures in various applications such as hearing evaluation in different conditions and it can also be used for evaluating the benefits and effects of hearing aids on speech perception by varying the different features and parameters of hearing device, in adults. Further, the test is also sensitive to the extent of hearing impairment.

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## APPENDIX

Sl No.	SENTENCE LIST 1
1	avanu ṭanna geḷejanige saha:ja ma:dīḍa
2	ra:dzanige prad3gaḷu manavi sallisīḍaru
3	varṣakke ṁmme na:vu kanda:ja ka□□uttē:ve
4	na:vu sada: pariḷudd <sup>h</sup> a ni ṭrannu se:visabe:ku
5	raṭa bisilmalli kelasa ma:duṭṭīḍa:ne
6	makkaḷu sa:la:gi niṭṭu pra:rṭ <sup>h</sup> ane ma:dīḍaru
7	raḷṁḍu se:ṭuveja me:le ṭfalisuṭṭīḍe
8	magu malagīruva:ga haṭṭira hogabe:ḍa
9	u:rīna pakkaḍalli ḍaṭṭava:ḍa araṇ javīḍe
10	avaḷu ga:dzina baḷejannu huḍukuttīḍa:ḷe



Sl No.	SENTENCE LIST 2
1	naḍḍija ḍaḍaḍa me:le mōsaḷe malagittu
2	avanu railmalli kaḍaleka:ji ma:ruttidda
3	hōsa ad <sup>h</sup> ika:riḡe hu: niḍi sva:gaṭisidēvu
4	maḷe ba:raḍa ka:raṇa beḷe na:java:guttide
5	akkana maḍuve u:ṭa b <sup>h</sup> ardzarija:gittu
6	illi a:ḍutturuva magu nanna sne:hiṭanaḍu
7	pa:riva:ṭa be:ṭega:rana baleḡe sikkī bitṭu
8	maguvina dza:ṇmejannu kandu a:ṭfarjava:jiṭu
9	kappu ḍra:kṣi ṭinnalu ṭumba hulija:giḍe
10	naḍḍija ni ru kōneḡe sa:gara se:ruttade

Sl No.	SENTENCE LIST 3
1	appa t̄an̄ḁa ma:v̄ma haṅṅugaḁu huḁja:ḡiv̄e
2	avanu maneḁjali ḁbban̄e   va:sava:ḡidd̄a
3	moḁagaḁa hiṅḁe t̄fan̄ḁranu mar̄eja:ḡidd̄a:n̄e
4	ha:liṁṅḁa sihi t̄ṁisugaḁannu ma:ḁutt̄a:r̄e
5	raiṅara baḁuku iṅḁu kaṣṁakarava:ḡidd̄e
6	avaḁu ḁzaḁeḁe malliḁe hu: muḁḁidd̄a:l̄e
7	ḁa:l̄eḁe ḁṅḁu va:ra rad̄ze niḁala:ḡidd̄e
8	ben̄kiḁa ḁz̄ṁṁe a:ḁuvuḁu apa:ḁaka:r̄i
9	avanu kai gaḁḁja:raḁalli sam̄aja noḁḁḁa
10	na:nu va:rakk̄ṁṁe uguru katt̄ariṁutt̄e:n̄e

SI No.	SENTENCE LIST 4
1	avanu mara haṭṭuva:ga kōmbe murijitu
2	bē:sigejalli nadigaḷu baṭṭi hoḷḷavu
3	sab <sup>h</sup> ejalli t <sup>h</sup> art <sup>h</sup> egaḷu naḍejuttale: iḍe
4	makkaḷa sangi ḷṭa spard <sup>h</sup> e ellarannu: randzisiṭu
5	praṭi va:ra ṭandēge ka:gaḍa barejuttidde
6	habbakke geḷejarannu u:ṭakke karēḍe
7	ammaṇa dzṭe ḍu:rava:ṇijalli ma:ṭana:ḍiḍe
8	a: g <sup>h</sup> aṭane naḍeḍu jaṭama:na kaḷejiṭu
9	ja:la: viḍjart <sup>h</sup> igaḷu prava:sa kaigōḍaru
10	raṭṭanōbba eraḍu eṭṭugaḷannu sa:kiddanu

Sl No.	SENTENCE LIST 5
1	hulija tfarmakke bahaḷa be:ḍike iḍe
2	aḷḷanu ṭṅaḡige sama:d <sup>h</sup> a:na ma:ḍiḍanu
3	avara aḍb <sup>h</sup> uṭa a:ṭa marejuvanṭilla
4	appa ga:ḍi nillisi ṭaraka:ri kṅḍaru
5	pḷi ḷsaru dḷanara gumpannu tfaḍurisiḍaru
6	manejavareḷla ho ḷḡi sṅima: vi ḷkḷisiḍaru
7	maguvu paṭa:ki fabḍ <sup>h</sup> a ke:ḷi ga:bariḡṅḍiṭu
8	juḍḍ <sup>h</sup> a naḍejalu ka:raḷagaḷu halavu
9	gra:maḍa dḷanaṭe ni ḷrillade kanga:la:ḍaru
10	avaḷu kamalaḍa hu:vannu pu:dḷege ṭaḍaḷu

Sl No.	SENTENCE LIST 6
1	hasida bekkondu iljannu hididu tndritu
2	alli dddadandu saro  vara ka:uttide
3	avalu katf <sup>h</sup> e:rigella: siri hantfida u
4	apara:q <sup>h</sup> ige dziva:vaq <sup>h</sup> i fikse vid <sup>h</sup> isidaru
5	aramaneja vaib <sup>h</sup> ava atfjari mu:disitru
6	na:vu hirijarige gaorava kodabe:ku
7	tammanige ga:lipata ha:rivalu ista
8	u:rina dzana kalljarannu sere hididaru
9	ivaru i  ka:le:dzima hosa ad <sup>h</sup> ja:paki
10	ma:vutanu a:negge sna:na ma:dusuttidda:ne

Sl No.	SENTENCE LIST 7
1	avanu nanage anja:ja ma:qalu jatnisiḍa
2	i: ra:tri a:ka:faḍalli tḥandranu ka:ḥalilla
3	avaḷa ḥosa tḥappaliḡalu kaḷeḍu ho ḷiḷḷu
4	sa:ku praḥiḡalu namage sne ḷhiḷḷarante
5	na:vellaru radzeja ḍina u:riḡe ho ḷḍevu
6	nanage ha:siḡe me:le malagalu iḷḷavilla
7	nammu:riḡe lakḷa:nḷara prava:siḡaru baḍaru
8	maḍuve manege ḍe:pa:lanka:ra ma:qala:ḡiḍe
9	ha:vugaḷu kappeḡaḷannu ḷḷḍu baḍukuttave
10	mundza:neḷḷḍa sandzejavareḡe iḍe: kelasa

Sl No.	SENTENCE LIST 8
1	iḷga paṭṛikegaḷannu oduvavaru kaḍime
2	na:vu niḷrannu miṭṭava:gi baḷasabe:ku
3	abḥima:nija kaṇṇu sanṭasaḍiṇḍa ṭumbiṭu
4	ḷa:le biḍuva ve:ḷege appa baṇḍiḍḍaru
5	avanḷbba ṭḷiṭṭarangaḍa prasidḍḥa naṭa
6	kuḍure e:ṭṭi ra:dza juḍḍḥakke hḷaraṇu
7	i: suṇḍarava:ḍa mane nanna magaḷaḍu
8	a: ka:gaḍaḍalli saḥi ma:ḍalu mareṭe
9	appaṭa hasuvina ha:lu ilḷi ḍḷe:juṭṭaḍe
10	adḷḍi makkaḷige kaṭḥegaḷannu hē:ḷuṭṭiḍḍaru

Sl No.	SENTENCE LIST 9
1	makkaḷu muḍḍa:ḍa faliḷjali ma:ṭana:ḍiḍaru
2	nanage ḍvitiḷakra va:hana o ḷḍisalu iṣṭa
3	avara ibbaru: makkaḷu budd <sup>h</sup> ivanṭaru
4	ivanu apa:ra viṣajagaḷannu ṭṭiḍiḍḍa
5	bi ḷḍi na:jigaḷa ha:vaḷi dza:ṣṭija:ḷiḍe
6	ḍo ḷḷiḷu ga:ḷi bisuṭṭiḍḍa kaḍeḷe sa:ḷiṭu
7	lakṣa:ṇṭara ḍzanaru pariḷḷeḷe ha:ḍzara:ḍaru
8	na:vu mane kaḷḷi haṭṭu vaṣagaḷa:ḷiṭu
9	alli na:lku ḍina habbaḍa va:ṭa:vaṇaviṭṭu
10	i: habbaḍalli re:ṣme uḷ upannu ḍharisuṭṭa:re



Sl No.	SENTENCE LIST 10
1	b <sup>h</sup> a:nuva:ra utfiṭa rakṭaḍa:na fībīravīḍe
2	namma mane eḍuru uḍja:navanavīḍe
3	nanna ṭaṇḍe-ṭa:jī katfē:riḡe hogīḍḍa:re
4	pa:t <sup>h</sup> akke se:raḍa haṭṭu praṣṇegaḷu baṇḍavu
5	namma manejallī eraḍu koṇegaḷive
6	gurugaḷu ṭaragaṭṭiḡe ṭaḍava:ḡī baṇḍaru
7	avanu ja:la: ḍmagalīnīḍa ṭuṇṭa huḍuga
8	maḍuvejallī b <sup>h</sup> ardzarija:ḡī u:ṭa ma:ḍīḍe
9	na:nu gurugaḷu he:līḍa puṣṭaka oḍīḍe
10	oṇḍu salaga kabbīma ṭo ṭakke ḍa:līma:ḍīṭu

Sl No.	SENTENCE LIST 11
1	nammu:rina dza:tre baha a sogasa:giruttaḍe
2	avanige ondu o  eja a:lotfane banḍu
3	manṭriga u vidē:fa prava:sa kaigondaru
4	maguvige a:ṭaḍa me:le a:sakti hetṭfu
5	ka:ḍambarijannu eṣṭe: odidaru: mugijaḍu
6	avana bera u apag <sup>a</sup> :ṭaḍalli murijṭu
7	mḍalu na:nu koṭṭa haṇavannu hindirugisu
8	na:ji mariga u noḍalu mudda:giddavu
9	avana ga: i kesarimalli sikkikondṭu
10	nammu:rimalli eraḍu ṭfikka kerega ve

Sl No.	SENTENCE LIST 12
1	viḍja:b <sup>h</sup> ja:sa mugisi viḍe:ḥakke ho ḷḍalu
2	namma maneginṭa nimma mane andava:giḍe
3	nanna ṭangige sihi ṭinḍigalu ṭumba iṣṭa
4	ṭa:ṭa tḥi ḷlavannu ḍa:raḍinḍa hoḷejuttuḍḍa:re
5	bisilḷaḍa ka:raṇa battḥegalu aṇaguttilla
6	na:vu sama:dzakke unnaṭa koḍuge ni ḷ abe:ku
7	avanige sarija:gi o ḷḍalu hē:ḷkoḍu
8	pōli ḷsaru kaḷḷarannu naḷ u ra:ṭri hiḍiḍaru
9	ṭa:ḷakke sarija:gi hēḍḍḍejannu ha:kabe:ku
10	ṭengina maravannu kalpavrukṣa ennutṭa:re

Sl No.	SENTENCE LIST 13
1	ka:dmalli b <sup>h</sup> aja:naka pra:ṇigaḷannu noḍiḍe
2	ḍe:vara ḍarṣanaḍa bajake mḍu iḍe:riṭu
3	su:rja moḍagaḷa hiṇḍe marēja:gidda ḷne
4	ma:rukattejalli hu:vina beḷe hetṭja:gide
5	namma ṭoṭakkinṭa nimma ṭoṭa suṇḍarava:gide
6	hasiḍa simha ka:ḍemmejannu be:ṭeja:ḷ iṭu
7	avara vruṭṭi dzi ḷvanada sa:ḍ <sup>h</sup> ane halava:ru
8	ḍana-karugaḷu maḍa:naḍalli me:juttive
9	sipa:jigaḷu faṭrugalaṇnu guṇḍikki kṇḍaru
10	sada:ka:la eḷarigu suk <sup>h</sup> avannu bjasu

Sl No.	SENTENCE LIST 14
1	bekku battalalli ha:lannu kul ijuttittu
2	niḥnu huḍukuttiruva puṣṭaka allide
3	a: sande:ja nanage sandzeja hōttige ṭalupittu
4	bettaḍa me:lina ḍe:va:laja sundarava:gide
5	na:jigaḷannu sa:kuvuḍu ṇḍu havja:sa
6	appa bilu ku:ḍalige baṇṇa hatṭfuttā:re
7	geḷejarella: se:ri prava:sakke hōraṭaru
8	haḍagu nu:ra:ru dzanarannu hōttu sa:guttide
9	magu malagiruva:ga saḍḍu ma:ḍabe:ḍa
10	mane kattuva kanasu ellarigu: iruttade

Sl No.	SENTENCE LIST 15
1	bɛ:rɛ u:rugaɭɪɳɖa dʒanaru dʒa:ʃrɛgɛ baɳɖaru
2	nanna maneja sutta aɳɖava:ɖa ʃoʃaviɖɛ
3	ʃamma ʃappaɭigaɭaɳnu hoʃraɛ biʃtu baɳɳi
4	pra:ɳi-pakʃigaɭaɳnu himsɪsuvuɖu kru:raʃana
5	makkaɭu nruʃja spard <sup>h</sup> ɛjalli b <sup>h</sup> a:gavahɪsɪɖaru
6	maneja ma:lika ʃɳgaɭa ba:ɖɪgɛ ke:ɭɪɖa
7	ɪɖu sa:vira ru:pa:jigaɭa noʃɳna kaɳʃɛ
8	bahaɭa ɖu:ra oɖuva ʃakʃi avaniɖɪgɛ
9	kaɖalalli ɛʃʃaraɖa aɳgaɭu baruʃʃɪvɛ
10	sɪmma: noɖɪ baruva hoʃʃɪgɛ kaʃʃala:gɪʃtu

Sl No.	SENTENCE LIST 16
1	pakṣigaḷannu no ḷḍalu apa:ra ṭa:ḷme be:ku
2	maḷejinda hōragidda batte ḍḍeja:ḡḡe
3	aranjadalli vipari ḷṭa maḷe surijuttade
4	ra:ṭrija hōṭṭu ṣḷḷegaḷa ka:ṭa hetṣṭja:ḡṭṭide
5	avanu ma:vina marakke kallannu eṣeḍanu
6	ma:navana ḡura:sejinda ka:ḍu nafiṣuttide
7	nanage kelasada naḍuve biḍuve: illa
8	avana ṭandḡe sakkare ka:rk <sup>h</sup> a:neja udjogṛ
9	ninna ne:ṭruṭvadalle: kelasada neḷejaḷi
10	maneja munde va:hanagaḷa oḍa:ṭa dza:ṣṭi

Sl No.	SENTENCE LIST 17
1	raṭṭara beḷeḡe su:kṭa beḷe ḡarakahilla
2	avaḷiḡe viḡe:ḡakke hoguva a:sē iḡe
3	makkaḷu kiṭaki ḡa:dzannu ḡeḡḡu ha:kiḡaru
4	nanage tḡa:pēja me:le malagalu iṣṭa
5	sandze b <sup>h</sup> a:ri maḷe baruva samb <sup>h</sup> avaviḡe
6	b <sup>h</sup> aviṣṡakka:ḡi haṅa ulṭa:ja ma:ḡabe:ku
7	ni ṭnu allinḡa ku:ḡale manēḡe hōraḡu
8	huḡuga puṣṡakaḡa nu:ranē: puṭa ṭṭeḡḡanu
9	ni ṭnu ke:ḷḡa ka:ḡambari ṭṭiṭra: haḷeḡḡḡu
10	la:riḡalli akki mu:ṭeḡaḷannu sa:ḡiṣiḡaru



Sl No.	SENTENCE LIST 18
1	manēja pakkāḍalli gēḷējaru a:duṭṭiḍḍaru
2	na:nu ka:rma tja:lakaniga:gi ka:juṭṭiruṇē
3	avanu viṣṣafrē:ḡḥa a:taga:ranalli ḡbba
4	appa ha:lu ṭaruvuḍannu mareḡu biṭṭaru
5	a: sa:garaḍalli baṇṇa baṇṇaḍa mi ḥnugaḷiṇē
6	nanna ṭa:ji tḡenna:gi rango ḥli biḍiṣuṭṭa:re
7	avanu angaḍijalli kēlasakke sē:riḍa
8	na:ḷē manē kēlasaḍavaru baruvuḍilla
9	hamsagaḷu kōḷaḍalli gumpa:gi idzuṭṭiṇē
10	avaḷu uḍḍava:ḍa dzaḍējannu hoḍiḍḍa:ḷē

Sl No.	SENTENCE LIST 19
1	i: faniva:ra habbakke nammu:riḡe hoḡguve
2	nanage haṇa samajakke sarja:gi baṇṭu
3	nakali noṭugaḷa ha:vali hetftja:guttide
4	gurugaḷannu kaṇḍa makkaḷu ja:nṭara:ḍaru
5	na:nu dza:napaḍa giḡe sparḍhejalli geḍḍe
6	oḍiḍa nanṭara a: puṣṭaka koḍutte:ne
7	ka:ḍmalli b <sup>h</sup> ajankara sarpagaḷu aḍagive
8	avaḷu baḍa manṣṭanaḍalli huṭṭiḍavaḷu
9	avanu saḍḍe ṭaralu ka:ḍiḡe hoṭaṭanu
10	adḷḷija maneja munde ṇḍu ka:luve iḍḍe

Sl No.	SENTENCE LIST 20
1	elēgaḷu uḍuri raṣṭēja mē:le haraḍiḍe
2	na:vu fraḍḍ <sup>h</sup> e vahisi kelasa ma:ḍabe:ku
3	mē:dzima mē:le ka:gaḍa-paṭṭragaḷu ive
4	avara saraḷa naḍaṭṭe ellariḡu: ma:ḍari
5	ellaru: paṭṭisaraḍa maḥaṭva ṭṭṭjabe:ku
6	a: samajaḍalli nanage ḍikkeḷ ṭoḷṭfahilla
7	iḍḍḍu kriḷḍa: pre:migaḷa aḍb <sup>h</sup> uṭa ra:ṣṭra
8	habbaḍalli hoṣa baṭṭe ḍ <sup>h</sup> arisuvuḍu va:ḍike
9	huḍuga bajaḷmalli kuri mē:jisuṭṭiḍḍa
10	maganalli appana saḍḍuḡagaḷu kaḍṭiṭu

Sl No.	SENTENCE LIST 21
1	magu baha a samaja a u nillisalilla
2	marada me:le hakkijondu gu:du ma:dide
3	nanna gelejanobba kannadaka ha:kuttane
4	avalu sankastadalli de:varannu neneda u
5	hudugijaru a:turadinda rasthe da:tidaru
6	hakkga u gu:du kattı mottte iduttave
7	gelejaru ka:rinalli prava:sakke horaataru
8	hasu onagiruva hullannu tinnuttide
9	avanu tjalisuttidda railannu eridanu
10	bi  di na:taka no  dalu dzana se:riddaru

Sl No.	SENTENCE LIST 22
1	dʒanaru kelasakke railmalli hōraʒaru
2	nanage ibbaru aṇṇa-ṭammandīru idḍa:re
3	ka:rmīkaru ṭamma muškara munduvaresīḍaru
4	inḍu ella: angaḍigaḷa ba:ḡilu mutṭṭīḍe
5	nanna geḷeja niḍrejalī ma:ṭa: utṭīḍa
6	amma hōsa pa:ṭrejalī aḍuge ma:ḍīḍaru
7	eṣṭe: ni ru kuḍīḍaru: ḍa:ha ṭi ruṭṭīlla
8	ṇḍu ḷḷeja abʰja:savannu ru:ḍʰisīkōllī
9	na:vu ṭandē ṭa:ji hē:ḷīḍantē naḍejaḷe:ku
10	avanu ka:ḍīmīḍa saode ṭandū ma:ruṭṭīḍa

Sl No.	SENTENCE LIST 23
1	na:lvaru puṭraralli ḡbba viḡe:faḡallidḡa:ne
2	nanna sne:hiṭaru ivatṭu barabahudḡu
3	la:ri tfa:lakaru muṣkara nillisiḡaru
4	a:gasadḡalli kappu moḡagaḡu kavidiḡe
5	sandḡe ve: e hakkigḡu gu:ḡige maraḡuttive
6	ivella namma maneja ka:gada paṭragaḡu
7	kutumba rakṣaṅe ivara moḡala a:ḡjaṅe
8	inḡu namma hoṣa maneja gruhaprave:fa
9	ḡnḡu ḡma arasanḡbba ka:ḡige hoḡḡanu
10	na:niḡa u:ṭa ma:ḡi mugisi baruvḡnu

Sl No.	SENTENCE LIST 24
1	dzanaru tamma netstina sima: no ldiru
2	kastadinda pa:ra:galu be:ga upa:ja ma:du
3	hasida simhavu dzinkejannu be:teja:ditu
4	kaljanu poli sara gundinda tappisikonda
5	emmegalu rastega adava:gi nitive
6	madhara:tri obbane horage ho gabe:da
7	ralu nila:ndalli nilalu dza gavilla
8	amma nenne re:smesi re kharididaru
9	ninaga sikkakelasavannu fraddehinda ma:du
10	badava gudisimalli va:sa ma:duttidda

SI No.	SENTENCE LIST 25
1	amma maguvannu t̃p̃lallı malagııdalu
2	huduga da:rija mad̃hjadallı oduttıddane
3	sasja mattu pra:riyalıge ni ru avajaka
4	ad̃ndu dzagattına suprasıdd̃ha nagara
5	hasıda hulıju manusjanannu konduha:kıtu
6	ni rıma korate nammannu elled̃e ka:duııde
7	huduga t̃andannu kıtakı ga:dzıge hodeđanu
8	marudınadında se:ve pra:ramb̃ha ma:dıde
9	na:nu mundza:ne aıdu gantege oduvenu
10	nanna hal̃eja sne:hıta manege bandanu



Sl No.	PRACTICE LIST 1
1	dʒanaru railinalli ninṭe: praja:ṇisidaru
2	kelasa mugjuvalli onḍu gante kalējitu
3	mara gɪdagaḷigge niru aṭjanṭa avajjaka
4	avanu tʃiladalli ḍʰa:njavannu ṭumbiḍa
5	na:jaka sabʰejalli bʰa:fana ma:duṭṭidḍanu
6	a:neḡinṭa kuḍure ve:gava:gi oduṭṭaḍe
7	avanu kōle ma:di ka:ra:gruhakke hoḍa
8	alliruva janṭra bahaḷa jabdʰa ma:duṭṭide
9	halli dʒanaru pe:tege valase bandaru
10	maḷega:ladiḷalli su:rjana ḍarjana aparu:pa

Sl No.	PRACTICE LIST 2
1	avaḷu mane kelasa mugisi oḍiḍaḷu
2	iḍu nagaraḍa pramuk <sup>h</sup> a rastēgaḷalli oṇḍu
3	avaru godegaḷige bilī baṇṇa hoḍeḍaru
4	sa:garaḍa nirina matta het <sup>t</sup> fa:gu <sup>t</sup> tiḍe
5	makkaḷu sa:mu:hika prar <sup>t</sup> ane ma:diḍaru
6	avanu ellarigimṭa bala:ḷija:ḍa vjakti
7	i ga:ḍeja sa:ra:mfavannu nanage he:ḷu
8	e <sup>t</sup> tiṇa ga:ḍijalli dzanaru dza:ṭrege hoḍaru
9	mane angaḷaḍalli hu:vugaḷu araḷive
10	avaru nivru <sup>t</sup> ta:gi ha <sup>t</sup> tu varfa kaḷejiṭu



Sl No.	PRACTICE LIST 4
1	ava a sara a ana e laru: me fuvant ad du
2	avanu a:duva:ga balaga:l ge pe tta: i tu
3	samu dra dalli na:vu hadagannu kandevu
4	ra ste naduve nadejvu du apa: jaka:ri
5	ra:dza ju dd <sup>h</sup> a dalli so:tu ra:d zjakkehnt rugida
6	ava lu  annage a ge saha: ja ma: dalilla
7	i du prava: siga: ge pri java: da  a: na
8	su:r jo: dajada  ru fja rama jjava:g  kand tu
9	mangavu ha nnu  nnalu ho ntfu ha:kutt de
10	avaru bassiga:g  on du gante ka: daru

