PROJECT REPORT

SENTENCE LISTS IN MALAYALAM AND TELUGU

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Abstract

Objective: The aim of the study was to develop a test material in Malayalam and Telugu for assessing sentence recognition threshold in noise. *Design:* The study was conducted in two phases. First phase involved three experiments 1) collection and recording of sentence material in the languages 2) assessment of sentence perception at five signal-to-noise ratios (SNRs) 3) formulation of 20 equal intelligibility lists with 10 sentences each in Malayalam and Telugu using numerical optimization procedure. In the second phase, SNRs for 50% correct sentence score were estimated using adaptive procedure on subjects with normal hearing. The developed lists were also administered on clinical population (only for Malayalam). *Study Sample: A t*otal of 102 native speakers of Malayalam (of which 38 speakers participated for development of sentences, 30 in list equivalency check and 34 individuals with hearing loss for utility check in clinical population) and only 68 native speakers of Telugu (of which 38 speakers participated for development of sentences and 30 in list equivalency check) participated in the study. The difference in the number of participants among two languages was lack of availability of participants with Telugu as native language and meeting the subjection selection criteria. *Results:* 12 optimized lists in Malayalam and 14 optimized lists in Telugu were formulated. Lists were found to be of equal difficulty in normal-hearing listeners in both the languages and also with individuals with hearing loss in Malayalam. The average SNR_{50} (the signal-to-noise ratio for a 50% sentence score) was -4.28 dB with a standard deviation of 0.30 dB in Malayalam. Whereas, in Telugu it is -2.57 with a standard deviation of 1.20 dB. The clinical utility of the Malayalam test material was assessed on individuals with hearing loss ranging between mild and moderately severe degrees of hearing loss (PTA_1 <60). *Conclusions:* The

developed test provides a valid and reliable means of measuring sentence recognition thresholds in noise for native speakers of Malayalam and Telugu.

Chapter I

Introduction

Speech audiometry provides systematic information concerning not only one's sensitivity to speech stimuli but also the abilities of understanding speech at supra threshold levels. The initial roots of speech audiometry were found to be the work conducted at Bell Labs in 1920s and 1930s for efficiency measures of communication systems. Over several decades since then, at present speech audiometry has become a fundamental tool in regular clinical audiological assessment as it is used diagnostically to examine speech processing abilities processed at various levels of the auditory system. Along with a close depiction of subject's ability to utilize his hearing in ways that are closer to everyday experience (Mendel & Danhauer, 1997), the results from speech audiometry would add some kind of validity to the basic pure tone test procedure. In addition to the assessment of difficulties in communication, speech audiometry has also been found to be useful in finding out the type and degree of hearing loss, a hearing aid selection, identifying functional hearing loss and the site of lesion. Speech audiometry has also been found to take less time than pure-tone audiometry (Kutz, Mullin, & Campbell, 2010).

Various speech audiometric tests include Speech Awareness Threshold (SAT), Speech Recognition Threshold (SRT) and Speech Identification Score (SIS). SAT is also known as Speech-Detection Threshold (SDT), which is a measure of lowest level at which speech can be detected at least half of the time (Hain & Garner, 2012). During the SAT, the patient is instructed to indicate whether he /she is hearing the sound or not. Speech materials usually used to determine this measurement are certain standardized words or phrases. This is merely an awareness test and therefore

irrespective of type of stimulus used, it does not provide information regarding a person's ability to understand speech.

The objective of SRT is to obtain the lowest level at which speech can be identified/ understood by the subject at least half of the time. As SRT measures involve understanding abilities, the selection of test materials for SRT is crucial for ensuring valid clinical practice. Presently SRT can be measured using speech stimuli such as nonsense syllables, monosyllables, spondees, sentences etc. Most often nonsense syllables have been reported to be the most difficult to recognize (Mc. Ardle & Hnath-Chisolm, 2009), as they have minimal semantic content. However, SRT measures through non sense syllables reveal very little information about the auditory disability and handicap that an individual experiences in everyday life (Gatehouse & Robinson, 1997).

Monosyllabic words have also been used for the assessment of speech recognition. However, Giolas and Epstein (1963) stated that monosyllables provide diagnostic but not prognostic values, as it does not approximate on how an individual understands conversational speech. Cox, Alexander and Gilmore (1987) reported no relationship between the monosyllable recognition threshold and hearing aid benefits. These results were attributed to lack of lexical, semantic, syntactic redundancies, and dynamic cues in monosyllables.

Other stimulus such as Spondee words (bi-syllabic words with equal stress on each syllable) have been reported to be used frequently in the clinical setting to measure SRTs because they are faster and easier to administer (Carhart, 1965). They have highest homogeneity of audibility (Egan, 1948) and were well correlated and used to confirm results on pure tone audiogram (Scourfield, 2011). However,

spondees are less representative of natural language communication than sentences and also spondees spoken as isolated utterance (or) in carrier phrases may not represent the normal spectral weighting, level fluctuations, intonations, pauses and other aspects associated with conversational speech. Moreover, the limited number of spondees together with the risk of familiarization and learning effects associated with randomization and reuse of the same items prevents measurements and comparison of performance in multiple experimental or clinical conditions.

Furthermore, word tests are not suited for more advanced testing and fitting of hearing aids, since some of hearing aid features such as compression and the noise reduction algorithm do not take full effect with isolated single words (Nilsson, Soli, & Sullivan, 1994). These limitations underscore the need for sentence length test materials that can be used to measure SRTs (Nilsson, et al., 1994).

Thus sentences will be more advantageous than other stimuli, as they provide information regarding the time domain of everyday speech and can approximate contextual characteristics of conversational speech (Jerger, Speaks & Trammell, 1968). The initial traces of sentence material used for speech recognition came from development of Central Institute for the Deaf (CID) every day sentence list by Silverman and Hirsh (1955). Brinkmann and Richter (1997) stated that the sentences provide additional information on the ability of participants to understand speech in daily life and have proved to be a useful tool, especially for the selection of a suitable amplification device. Additionally, the discrimination function (often referred as performance intensity curve) for sentence material has been reported to be steeper than for shorter speech segments and thus provide a very accurate measurement of a speech recognition threshold (Bosman & Smoorenburg, 1995; Kollmeier &

Wesselkamp, 1997). Speech in noise tests are commonly used to quantify Cochlear Implant benefit and also differential diagnosis of several auditory processing disorders.

In spite of these advantages of sentences, clinically the possibility to re-test with sentence stimuli for SRT measures on the same subject is highly limited as the material is highly syntactically loaded. Additionally extrinsic redundancy cues such as acoustic and contextual cues further limit the use of sentence material for regular clinical use. These characteristics make it harder to predict which specific information is being used by the listener (Mc. Ardle & Hnath-Chisolm, 2009). Thus one needs to consider large number of test items for constructing sentence list. Also for sentences low frequency components are given greater weightage than high frequencies in the speech spectrum compared to monosyllables (Kollmeier & Wesselkamp, 1997).

Need to develop sentence material in different languages:

Sentences consist of string of phonetic segments and for each language there is a subset of functional phonetic categories described by universal phonetic inventory. Two phonetic segments that are distinctive in one language may not occur in other language. Thus the languages across world differ with respect to phonetic segments (Winifred, 1995). Majority of the cross language studies indicated that some of speech contrasts pose greater perceptual difficulty for non-native speakers than native speakers. Thus it calls for separate sentences lists across different languages.

Some of available sentences for speech recognition in English include CID every day sentence list by Silverman and Hirsh (1955); Hearing in Noise Test (HINT) sentences by Nilsson et al. (1994). Similarly other languages in which sentence materials presently available include African (Scourfield, 2011), Cantonese (Wong &

Soli, 2008), Dutch language Leuven intelligibility sentence test (LIST) (Van-Wieringen & Wouters, 2008), French (Vaillancourt et. al., 2005), German (Kollmeier & Wesselkamp, 1997), Mandarin (Wong, Soli, Lieu, Han, & Huang, 2007), Polish (Ozimek, Kutzner, Sek, & Wicher 2009), and Swedish (Hagerman1982; Hällgren, Larsby, & Arlinger, 2006).

Houben et al. (2015) developed Dutch matrix sentence list utilizing SNR50 scores in presence of background noise. Results indicated that an average of -8dB SNR would be required for 50% intelligibility score. Similarly Finnish matrix test was developed by Dietz et al. (2015) in which SRT range for normal-hearing young adults for adaptive measurements is –9.7 ± 0.7 dB SNR. Further, Warzybok et al., (2015) shown an average SRT of -9.5 +/- 0.2 dB and a slope of 13.8 +/- 1.6%/dB for the closed set Russian matrix test.

Further, in Indian context, there are multi languages spoken across country. Currently only few sentence materials are available in Indian languages which include Hindi (Jain, Narne, Kumar, & Kumar, 2012) and Kannada Sentences list (Geetha & Sharath, 2013) Thus, sentence lists in different languages used across country is much needed. Along with the above list the other major languages spoken in southern part of India include Telugu (being spoken by 74 million individuals) and Malayalam by 33 million individuals (Census of India, 2001). Thus, systematically constructed sentence materials for speech recognition testing in both these languages are highly essential.

Need to develop sentence test in the presence of noise.

The ability to understand speech in the presence of background noise constitutes a great challenge to any listener, especially those who suffer from hearing

impairments. Over the years it has been demonstrated that speech perception tests in presence of background noise are superior when compared to speech perception in quiet conditions. More over speech in noise tests provide powerful information directly related to some of communication difficulties encountered in regular real life situations (Taylor, 2003). Carhart and Tillman (1970) recommended that speech recognition performance should be tested in back-ground noise as a standard part of audiological test battery. Speech recognition in noise will also be helpful in accounting for the benefits from amplification and further in counseling the patients (Wilson & Mc Ardle, 2005).

Generally speech-in-noise procedures can be classified into two categories based on the method of procedure involved as fixed signal to noise ratio (SNR) tests and adaptive SNR tests (Taylor, 2003). Fixed SNR tests measure a percent correct score at a fixed SNR while adaptive SNR tests measure the SNR as the intensity level of either speech or the noise varied. An adaptive SNR method offers effective placement of presentation levels within the region of interest with concomitant improvements in the efficiency and accuracy of the estimation. Over a sequence of trials, the level of a subsequent stimulus is increased when the response to the current stimulus is incorrect, and, likewise, the level of a subsequent stimulus is decreased when the current response is correct. In this way, the presentation level would approach the listener's SRT quickly (Nilsson, Soli, & Sullivan., 1994).

Along with this, the major disadvantages of fixed SNR tests in clinical use include difficulties to know where to fix the SNR and also the percent intelligibility measures are inherently limited by floor and ceiling affects (Nilsson, Soli, & Sullivan,

1994). Additionally, for more reliable measure using fixed SNR test procedure; testing might have to repeat over certain range of fixed SNR values.

On the other hand adaptive SNR procedures demonstrate advantage of less time consumption for test procedure and a reliable measure of speech perception skills (Nilsson, Soli, & Sullivan, 1994). Thus it is wise to have an adaptive procedure for the purpose of estimating speech perception scores with the use of sentence material.

Objectives

1. To develop sentence test in Malayalam & Telugu languages.
2. To collect normative data for the developed sentence test in the presence of speech noise.
3. To investigate the utility of developed test among clinical populations' across conductive and sensorineural hearing loss.

Chapter II

Method

The present project was carried out in two major experiments. In the first experiment sentence lists of equal difficulty were developed in two languages; Malayalam and Telugu. The equivalency of the developed lists was verified in the second experiment for both languages, however the verification of the developed lists was done only in Malayalam language due to unavailability of clinical population having Telugu as mother tongue.

Participants:

The study was conducted on 169 subjects. The subjects participated were divided into group N, group CHL and group SHL. Group N included a total of 136 volunteered healthy normal hearing individuals aged between 18 to 30 years with mean age of 24 years. Of these 136 subjects, 68 subjects had their native language as Malayalam and rest 68 had as Telugu. All subjects were selected based on the screening audiological evaluation. Subjects in group N were allowed to participate in the study if the subjects meet following selection criteria.

- ✓ No history and compliant of middle ear infection, tympanic membrane perforation, head trauma, noise exposure and ear discharge at the time of participation in the study.
- ✓ Subjects with pure-tone air conduction and bone conduction thresholds less than 15 dB HL at octave frequencies between 250 Hz to 8000 Hz by using a modified version of Hughson and Westlake procedure (Carhart & Jerger, 1959).

- ✓ Speech recognition scores ± 12 dB with reference to pure tone average and also speech identification scores greater than 90% in both the ears at 40dB SL presentation levels with reference to speech recognition threshold.
- ✓ Have bilateral 'A'/ 'As' type tympanogram with 226 Hz probe tone and positive ipsilateral and contralateral acoustic reflexes at 500, 1k, 2k & 4kHz in both the ears.
- ✓ No illness at the time of testing.

Group CHL involved 15 subjects who were subjects evaluated at Medical College Hospital, Calicut and Welcare institute of Speech and Hearing, Calicut and diagnosed as having conductive hearing loss in one or both ears. All subjects had their native language as Malayalam. The selection criteria for group CHL was as follows:

- ✓ No compliant of ear pain and ear discharge on the day of evaluation.
- ✓ Air conduction pure tone threshold greater than 16 dB HL and less than 60 dB HL.
- ✓ Air bone gap of more than 10 dB with bone conduction threshold within 15 dB HL from 250 Hz to 4000 Hz.
- ✓ Middle ear dysfunction as indicated by immittance evaluation (Either abnormal tympanogram patterns as described by Jerger (1970) and/or absent acoustic reflex responses.
- ✓ Speech identification scores proportionate to their pure tone average.
- ✓ No history of any neurologic problems.
- ✓ No illness on the day of testing.

Group SHL involved 19 subjects who were subjects evaluated at Medical College Hospital, Calicut and Welcare institute of Speech and Hearing, Calicut and diagnosed as having sensorineural hearing loss in one or both ears. All subjects had

their native language as Malayalam. The following criterion was used to have subjects for group SHL.

- ✓ Air conduction and bone pure tone threshold greater than 16 dB HL and less than 60 dB HL.
- ✓ Air bone gap of less than 10 dB.
- ✓ A normal middle ear functioning as indicated by immittance evaluation.
- ✓ Speech identification scores proportionate to their pure tone average.
- ✓ No history of any otologic, neurologic problems.
- ✓ No illness on the day of testing.

Subjects under group SHL were further categorised based on degree of hearing loss obtained from pure tone audiometry. Categories contained 3 subjects as minimal sensorineural hearing loss, 7 subjects as mild sensorineural hearing loss, 6 subjects as moderate sensorineural hearing loss and 3 other subjects as having moderately severe sensorineural hearing loss.

All the participants were informed about the purpose of the study before participating in the study and all the procedure used in the study were approved by the AIISH ethical committee.

Instrumentation:

The instruments involved in both the phases of the study include

- ✓ A calibrated two channel audiometer with TDH 39 headphone with MX-14 ear cushion and Radio ear B-71 bone vibrator was used to estimate air and bone conduction thresholds respectively.
- ✓ A calibrated immittance meter, GSI-Tympstar to assess middle ear functioning using tympanogram and acoustic reflexes.

- ✓ A personal computer loaded with MATLAB software, APEX software, Adobe Audition (version 3) along with Sennheiser-HDA 2000 headphones was used for the purpose of development and equalization of the stimuli.
- ✓ Tucker-Davis Technology (TDT) was used for the levelling of the stimulus.
- ✓ Computer Science Lab

Test environment:

All the audiological tests and experiments were administered in a well-ventilated air conditioned sound treated room with noise levels within permissible limits as per ANSI S3.1 (1991).

Stimuli and Procedure:

The present project was carried out in two major experiments. In the first experiment sentences lists of equal difficulty were developed in two languages; Malayalam and Telugu. The procedure followed in the study was as followed:

Experiment I

First experiment involved three sequential phases in both languages individually. First phase involved collection and recording of sentences and second phase consisted of selecting the sentences that were equally intelligible in presence of equivalent speech noise; whereas, the third phase aimed to construct lists with equal difficulty.

Phase I.

a. *Collection of sentences in Malayalam and Telugu languages:*

Commonly spoken/ used meaningful sentences (no specific dialect was used) of four to five words length (syllable count ranges from 12 to 19 per sentence) were collected from textbooks, magazines or day to day conversation in both languages.

The following criteria were employed in selection of sentences in both languages (Versfeld, Daalder, Festen, & Houtgast, 2000).

- ✓ The selected sentence should have a total of four to five words of which three to four content words should be present in each sentence.
- ✓ The sentences should not have with punctuation characters.
- ✓ The sentences should not be repeated or duplicated.
- ✓ Each sentence should be syntactically correct and semantically neutral.
- ✓ Sentences should not have questions, proverbs, names, and exclamations. And sentences related to politics, war or gender context were eliminated to maintain semantic neutrality.

Based on the availability five hundred sentences in Malayalam (syllable count ranges from 12 to 17 per sentence), each comprising of four words, of which three were content words were selected for further procedure. However in Telugu, only 439 sentences with four to five words of length (syllable count ranges from 12 to 19 per sentence), of which 3-4 content words in each, were selected. This was due to constrain in the commonly used sentences in Telugu language matching the set criteria.

All the selected sentences were assessed for their naturalness and predictability by presenting printed material to 10 native speakers of respective languages. Subjective rating procedure used by Wong and Soli (2005) was adopted for the current project (Appendix-A). The subjects were instructed to rate the naturalness based on the familiarity and correctness of the sentence structure (for given sentence) and also predictability based on toughness to predict if some portions of the given sentence is missed. All the subjects were asked to rate the naturalness of the each sentence on a five point rating scale (in which 5 indicated highly natural and

frequently encountered and 1 indicated totally unnatural also not encountered at all). Predictability of these sentences were rated on a three point rating scale (where 3 rating indicated not predictable and 1 rating indicates as highly predictable). Sentences that were highly natural and low predictable (rated as either '4' or '5' on naturalness rating scale and '2' or '3' on the predictability) by at least 80% of individuals were selected for further procedures. Based on these measures 196 sentences in Malayalam & 73 in Telugu were eliminated. Thus, a total of 304 sentences in Malayalam and 366 sentences in Telugu were considered for the further procedures.

b. Recording of sentences in Malayalam and Telugu:

Three female native speakers of both the languages were selected randomly for audio recording of the selected sentences. Initially 10 eliminated natural sentences were given to all the three speakers and were instructed to speak naturally and the audio samples recorded using Computerized Speech Lab (CSL). The audio recorded samples of each speaker were rated on six parameters (rate of speech, sentence intonation and stress, intelligibility, pronunciation, and voice quality) by five native speakers of the respective language with normal hearing. The most preferred speaker in all six aspects was considered for the rest of recording procedure. Later with the selected speaker all sentences were recorded using CSL at a sampling rate of 44.1 kHz with 24-bit resolution. The speaker was instructed to maintain constant intonation with normal stress patterns throughout the sentence and also to repeat each sentence thrice. The most suitable sentence with equal loudness and intelligibility out of three recordings was selected through auditory perception and saved on to hard disk of computer as a wave file. Adobe Audition (version 3) software and Matlab 2009b were

used to edit and off line analysis purposes. All the audio samples of the sentences were equalized in root mean square (RMS) amplitude prior to further procedures.

c. Generation of speech shaped noise.

All the selected audio samples of sentences were concatenated in random order and Fast Fourier Transformer (FFT) was performed for these concatenated sentences separately for each language. Using obtained spectral values a reverse FFT was constructed with random phase to produce back auditory speech noise signal. Thus, the noise generated had similar frequency spectrum as long-term average spectrum of the selected sentences.

This was carried out based on the rationale that a spectrally matched noise would represent actual type of noise which would mask the speech in real life situation (Prosser, Turrini, & Arslan, 1991). The RMS level of the generated noise was matched to the same level as the sentences. The one third octave spectra of noise and concatenated sentences are presented in Figure-1(a) for Telugu and Figure-1(b) for Malayalam.

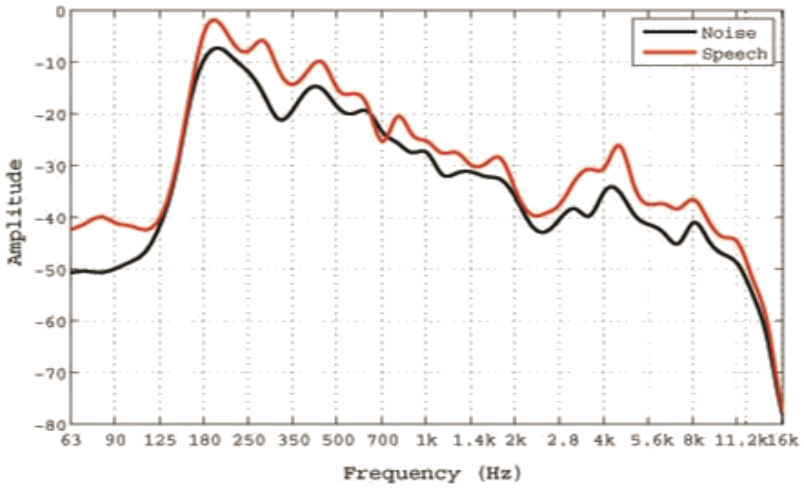

Figure 1(a): *One third Octave frequency analyses of recorded sentences and noise created for Telugu*.

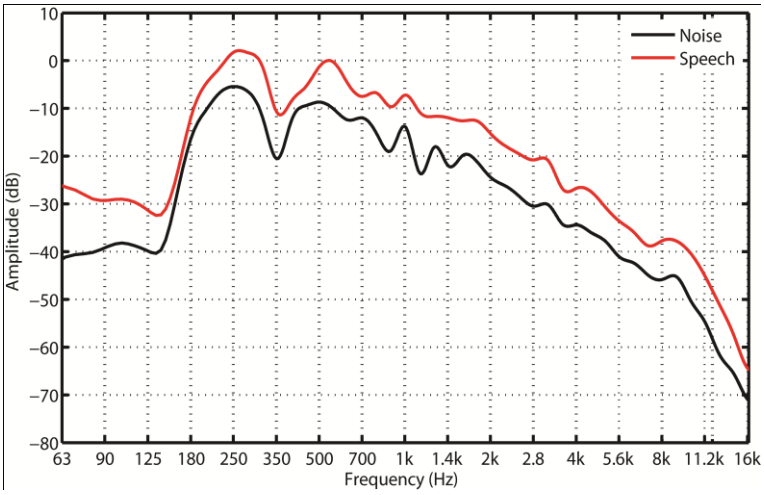

Figure 1(b): *One third Octave frequency analyses of recorded sentences and noise created for Malayalam.*

Phase II: Selection of equally intelligible sentences in presence of background noise:

a. Stimulus:

For studying the intelligibility of the sentences, all the sentence tokens were mixed with speech shaped noise at four different SNR (i.e.) at -2dB, -4dB, -6dB and -8dB SNR using MATLAB command. The range of SNR values were considered based on the previous investigations of Jain et al. (2012) for developing Hindi sentences lists, as the study involved similar procedure and concluded 50% of the speech identification was obtained at a mid-value between -6dB SNR and -4dB SNR. Thus to have psychometric function curves for the speech identification scores, identification scores at -2dB, -4dB, -6dB and -8dB SNR values were obtained for both languages separately. However, as the identification scores for Malayalam sentences at -8 dB was higher than those of Telugu sentence, perception

scores at -10 dB SNR was also obtained to note if any significant differences exist due to the effect of language.

To avoid unintended onset and offset effects of speech and of noise, a systematic procedure utilized by Neilson and Dau (2009) was used in the present study. The onset of noise signal preceded that of sentence by 600 ms and also continued till 600 ms after the end of the sentence. Over all noise was ramped using the Cosine square function with ramp duration of 200 ms. 20 subjects (not included in earlier/later phases/experiments of the study) in group N were used to have the speech identification scores at different SNR values.

b. Procedure:

Stimulus was presented at different SNR to the subjects using custom made MATLAB program. The presentation of the signals were from personal computer routed through the Tucker Davis Technology system using auxiliary input and played at a sampling rate of 44.1 kHz with 24-bit resolution. The output was routed monaurally to the individual's ear using Sennheiser-HDA 2000 headphones at an intensity of 70 dB SPL.

The individuals were asked to repeat the heard message completely as much as possible and the percentage of identification was calculated based on number of correctly repeated content words. They were also encouraged to guess the content words if uncertain. The responses were marked by the experimenter without any feedback provided after each sentence presentation. Each subject was tested at only one SNR level of all sentences to avoid replication of sentences and thus at each SNR value five normal hearing subjects were tested for identification scores.

Identification scores for each sentence at a specific SNR, obtained from five individuals were averaged. Hence, there were four speech identification data points

across different SNR for each sentence. These points were used to derive sentence-specific psychometric function curves with a logistic shape using MATLAB script using the following function.

$$S(L) = \frac{100}{1 + e^{\frac{-(SNR - SNR_{50})}{S}}}$$

Where the parameter 'SNR_{50}' denotes the level corresponding to 50% intelligibility for each respective sentence; '*S'* denotes the spread of the psychometric function which is inversely proportional to the slope '*m'* of the psychometric function (S=*25/m*). Both SNR_{50} and also S values were derived form the data obtained for each sentence. Of all 301 sentences of Malayalam sentences tested, 160 sentences were found to have similar slopes (with in one standard deviation across all SNR points) and SNR50 point. Thus these 160 sentences were selected for further procedures to maintain the uniformity and reduce the variability in score obtained at different SNR values across lists. Similarly in Telugu from 366 sentences tested, 200 sentences were identified to have similar slope on psychometric function curve and similar (with in one standard deviation) SNR50 points. Hence these 200 sentences were used for subsequent phases of this project.

Phase III: Construction of equalized and phonemically balanced sentence lists

The selected sentences from the procedure of phase II were grouped into different list of each contain 10 sentences. Thus, from the selected sentences pool 16 sentence lists in Malayalam and 20 sentence lists in Telugu were constructed. The grouping procedure utilized was similar to that described by Kollmeier and Wesselkamp (1997) for both languages. The equal difficulty lists were constructed by optimization of *L*50 and spread '*S'* obtained from psychometric functions in addition

to the number of phonemes and the frequency distribution of the 50 different phonemes for both Malayalam and Telugu sentence material. Thus in total, there were 52 parameters optimized for both languages separately.

The optimization was accomplished using a numerical optimization procedure (similar to the one used by Otten & Van-Ginneken, 1989). A customized MATLAB program was used to formulate uniform distribution of selected sentences into lists. The actual parameter values of all 200 sentences of Telugu were placed into a vector P_j (j=1-200). The average values of $L50$, S, the number of phonemes and frequency distribution across all 200 test Telugu sentences were placed as the ‘‘desired’’ value into the vector ‘V’. In addition, a vector ‘g’ of weighting factors was defined which determined the priority of the parameters to be optimized by the algorithm. The algorithm tried to optimize the ‘important’ parameters $L50$, S and number of phonemes with higher priority than the frequency distribution of the phonemes. The minimization algorithm, thus, had to minimize the function.

$$\mathrm{d} = \sum_{k=1}^{20} \left|\left| g \times (p_j - v) \right|\right|$$

The global minimum of ‘d’ was obtained by randomly selecting a set of 10 sentences from the pool of 200 sentences with the optimization algorithm. These 10 sentences, which achieved a global minimum of ‘d’, were grouped as one list and were permanently deleted from the pool of 200 sentences. This optimization process was repeated until 20 lists were formulated in Telugu. Same procedure was followed for construction of Malayalam sentence lists from a pool of 160 selected sentences.

Experiment II

Experiment II was aimed to verify the equivalency of established sentence lists and also to obtain the preliminary data necessary for clinical use of lists that were developed. This was carried out in two phases as described below.

In first phase SNR_{50} values were obtained using adaptive method in individuals with normal hearing (Group N)). The second phase consists of obtaining SNR_{50} using adaptive procedure in individuals with different types of hearing loss (Group CHL & Group SHL). However, the second phase was carried out in only subjects who are native speakers of Malayalam language and could not be carried out in subjects those are native speakers of Telugu due to constrain in availability during stipulated project period.

a. Participants

For Phase I, 30 native speakers of each selected language from group N were selected to find out SNR_{50} using adaptive procedure. None of the subjects were participated in any of the earlier phases of the study. For phase II, SNR50 was obtained from all subjects from group CHL and group SHL using only Malayalam sentence lists.

b. Stimulus

Derived speech noise was fixed at 65 dB SPL. All recorded and rms equalized audio samples of selected sentences were presented as stimulus in presence of the speech noise.

c. Procedure

The testing was carried out in a sound-proof booth and the stimuli were presented through Sennheiser HDA 200 headphones. The noise onset and offset was controlled in the same manner as in the equalization procedure. To familiarize with the

procedure one trail list was present before the actual lists were presented. Trial list consisted of sentences that were left out form experiment I. APEX was programmed to perform the procedure and experimenter scored the sentences by pressing on-screen buttons according to the listener's response. Only when the subject repeated the whole sentence correctly then it was scored as correct, even if a part of the sentence was repeated incorrectly experimenter scored it as wrong. Visual feedback was provided to the subject during testing for every trial. The same procedure was carried for all 20 lists in Telugu and 16 lists in Malayalam for each subject participated in experiment II. As it was performed with 1-down and 1-up procedure with step size being 2dbB SNR, the average of last four reversal SNR values was considered to obtain SNR_{50}.

Chapter III

Results

The present project was aimed to develop and validate a sentence list in Malayalam and Telugu. To fulfill the aim of the present study data was collected on subjects with normal hearing sensitivity (group N) and also from subjects with conductive (group CHL) and sensorineural (group SHL) hearing loss. Data obtained from the subjects were tabulated and analysis was done using statistical package for social sciences (SPSS) software version 17. The results were discussed under the following headings:

Experiment I:

First experiment involved three sequential phases in both languages individually. In the first phase a total of 500 sentences in Malayalam and 439 sentences in Telugu were collected, however only 304 Malayalam sentences and 366 Telugu sentences were selected from familiarity and predictability scores. In the second phase, sentences that were equally intelligible in presence of equivalent speech noise were selected. The results obtained in the Phase II were described below.

Phase II: Selection of equally intelligible sentences in presence of background noise:

Key words identification scoring was computed for all sentences across the selected SNR values. Further estimated slope values were computed from these data points for each sentence. Across all tested sentences the minimum slope of speech ineligibility obtained was 3.4% per dB SNR and the maximum slope was 38.13% per dB SNR. However, the mean of the slope was 10.5% with a standard deviation of 7.37%

per dB. Whereas in Malayalam, the minimum slope obtained was 4.06% per dB SNR and maximum slope was 37.30% with an average value of 9.25% per dB SNR and standard deviation of 4.73% per dB.

Mean and Standard deviation of percentage of words correctly identified at all tested SNR for each language are shown in Table 1.

Table 1: *Mean and Standard Deviation of identification scores at four SNRs in Malayalam & Telugu.*

SNR	***-10dB***	***-8dB***	***-6dB***	***-4dB***	***-2dB***
Telugu					
Mean	--	10.9	34.7	57.4	78.7
SD	--	13.84764	27.27637	28.9813	21.71457
Malayalam					
Mean	2.80	22.5	55.1	73.0	95.0
SD	1.71	5.51	5.50	10.1	2.81

From the derived psychometric function curves, only 200 sentences were found to have similar psychometric slopes and SNR_{50} (within in one standard deviation) for Telugu. These 200 sentences were used in subsequent phases of the study. This procedure ensured uniformity of the speech identification scores of sentences across all SNR tested. Whereas, in Malayalam only 160 sentences were found to have similar psychometric slope and SNR_{50}, and thus used in subsequent phases of study.

Phase III: Construction of equalized and phonemically balanced sentence lists

Using a numerical optimization procedure all the selected sentences were grouped into lists of 10 sentences each. The constructed sentence lists were checked for phoneme balance in accordance to the values described by Ramakrishna, Nair, Chiplunkar, Atal, Ramachandran and Subramanian (1992) in both languages. In both languages a total of 50 different phonemes were compared with average frequency of

occurrence quoted by Ramakrishna, et al. (1992). The frequency distribution of the phonemes is plotted in Figure 2 (a) as average values and their variability across all 20 formed sentence lists in Telugu language and similarly Figure 2 (b) depicts the same in Malayalam language for 16 formulated lists.

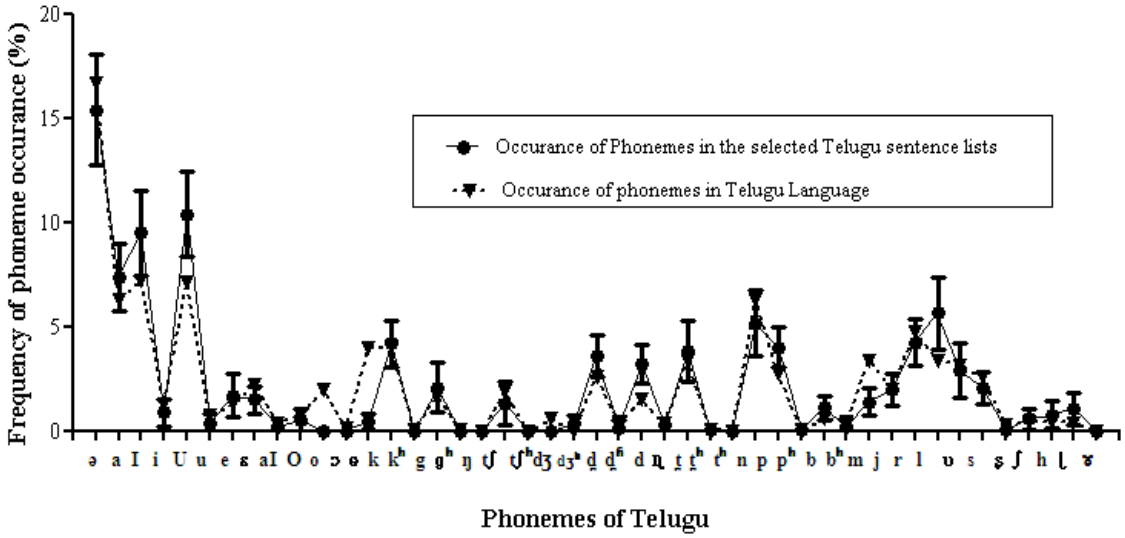

Figure 2(a): *Mean and standard deviation of frequency occurrence of each phoneme in the Telugu sentence list (Dark line) in comparison with the average occurrence of phonemes in Telugu language (dashed line).*

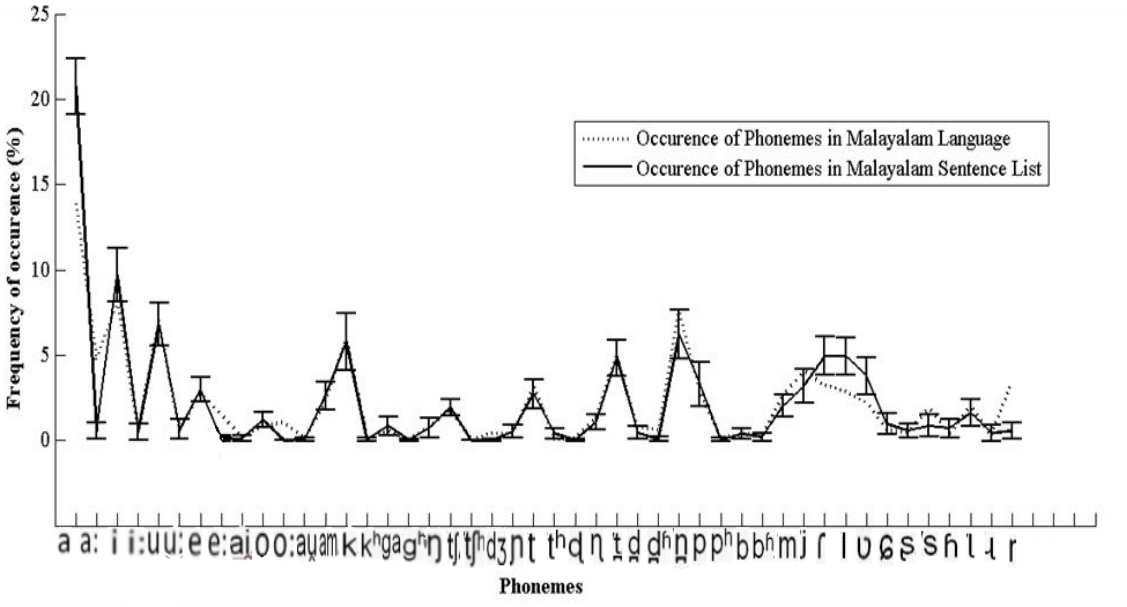

Figure 2(b): *Mean and standard deviation of frequency occurrence of each phoneme in the Malayalam sentence list (Dark line) in comparison with the average occurrence of phonemes in Malayalam language (dashed line).*

Concluding experiment I, a total of 20 lists of each having 10 sentences were formed in Telugu, where as in Malayalam 16 lists of each having 10 sentences were formed. The formation of the list ensured phonemically balancing of the phoneme occurrence with that of values indicated by Ramakrishna, et al. (1992).

Experiment II:

Experiment II was carried out in two phases to verify the equivalency of established sentence lists and to obtain the preliminary data necessary for clinical use of lists that were developed. Using APEX platform SNR_{50} was determined using 1-down and 1-up procedure and the last four reversals were averaged.

Phase I:

The SNR50 data was obtained from 30 individuals of group N. Each subject was tested with all 20 lists, thus having 30 SNR_{50} points for each list. Descriptive statistics obtained from the data for each list in both languages were tabulated and shown in Table 2. All the values were depicted after decimated to two points. An overall mean value of all the mean SNR50's across lists were also depicted in Table 2. Along with the overall average, standard deviation of the all mean values was also computed to note the variations in the mean values across lists and depicted in the Table 2.

Table 2: *Mean and Standard deviation of SNR_{50} for all test lists obtained (Obtained adaptively in both Malayalam and Telugu languages).*

List no	Malayalam		Telugu	
	Mean SNR_{50} (dB)	**SD of SNR_{50} (dB)**	**Mean SNR_{50} (dB)**	**SD of SNR_{50} (dB)**
1.	-3.75	0.36	2.23	2.72
2.	-4.40	0.69	-2.27	2.17
3.	-4.45	0.56	-3.00	1.62
4.	-4.52	0.46	-3.40	1.93
5.	-4.75	0.43	-2.80	1.87
6.	-4.48	0.59	-2.17	1.49
7.	-4.73	0.45	-2.70	1.95
8.	-4.33	0.51	-2.47	1.63
9.	-3.98	0.50	-3.25	1.54
10.	-3.85	0.37	-3.07	1.84
11.	-4.48	0.44	-2.52	1.65
12.	-3.89	0.44	-3.37	1.58
13.	-4.00	0.42	-3.17	1.39
14.	-4.28	0.60	-2.62	1.50
15.	-4.43	0.61	-3.42	1.55
16.	-4.22	0.55	-2.48	1.53
17.	--	--	-3.33	1.49
18.	--	--	-2.30	1.78
19.	--	--	-2.58	2.39
20.	--	--	-2.82	1.93
Mean	**-4.28**	--	**-2.57**	--
SD	**0.30**	--	**1.20**	--

It can be noted from the table 2 that mean of SNR50 for Malayalam lists was lower than that of Telugu sentences, indicating Telugu sentences require high signal to noise ratio to have better perception. This indicates there were differences of speech identification performance across languages.

The data obtained for each list was checked for normality using Kolmogorov-Smirnov test of normality and result revealed the obtained data was normally distributed at a significance level more than .05 for both the selected languages. For further statistical analysis, a repeated measure analysis of variance (ANOVA) was

carried out to note any significant difference in the SNR_{50} scores across various lists developed in both languages separately.

In Telugu, the results revealed a significant difference in SNR_{50} obtained using different lists (20 lists X 30 Subjects) [$F_{(1,19)}$ =193.344, $p<0.01$] (Partial eta squared value = .870). Further to observe differences between pairs of lists, multiple pair wise comparison was performed after Bonferroni correction. The results indicated that SNR_{50} scores obtained using List1 were significantly different from that of other developed lists ($p < 0.001$). The statistical measure also revealed a significant difference between scores obtained through List 12 and list 18 at $p = .031$ (< .05). There were other differences noted between the scores obtained using list 6 with that of list 12 (p=0.224), list 13 (p=0.371), list 15 (p=0.066) and list 17 (p=0.226). However these differences were not significant at $p < .05$. Rest all the other pairs revealed no significant differences, indicating there are no evidence of difference in the SNR_{50} score obtained with other lists.

Whereas in Malayalam, repeated measure analysis of variance of SNR_{50} data obtained using developed sentences revealed a significant difference (16 lists x 30 Subjects) [$F_{(1,15)} = 407$, $p<0.01$] (Partial eta squared value = .463). Further, pair wise comparisons done after Bonferroni correction to observe difference between individual pairs of lists. The results indicated that scores obtained for the List 1, 9, 11 and 12 were significantly different from all the other developed lists ($p < 0.001$) and hence those lists were also removed.

Further, difference between individual SNR_{50} and grand average of SNR_{50} across all lists computed. The mean difference value with corresponding standard deviation values are plotted in the figure 3(a) for Telugu and 3(b) for Malayalam.

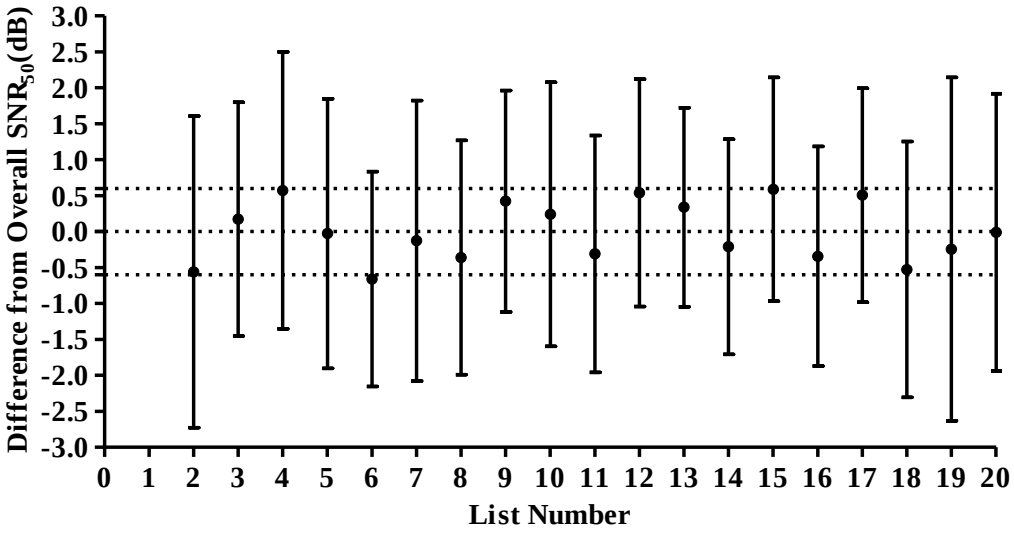

Figure 3(a): *SNR_{50} of individual list with reference to the overall averaged SNR_{50} in Telugu.*

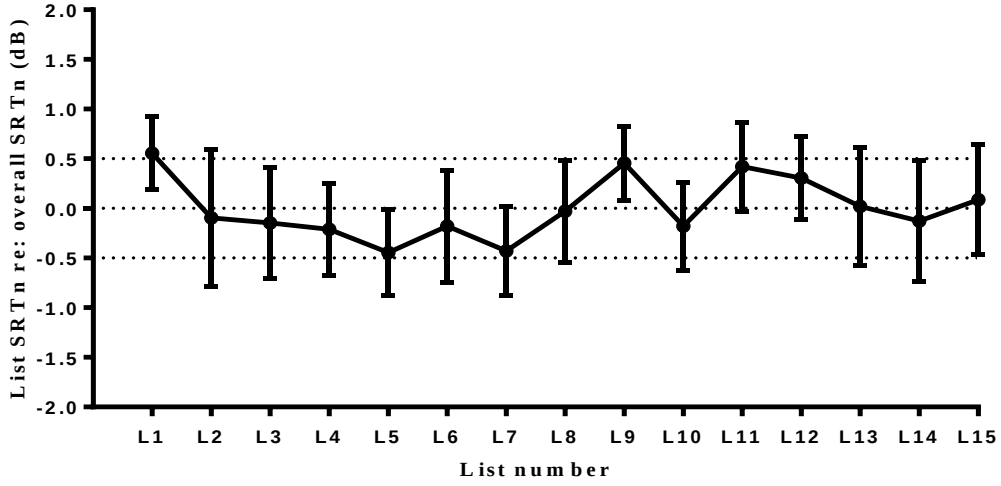

Figure 2(b): *SNR_{50} of individual list with reference to the overall averaged SNR_{50} in Malayalam*

From figure 3(a) it can be noted that the difference between mean SNR50 of individual lists 4, 6, 12, 17 and 18 and overall SNR50 was greater than 0.5. Thus, these lists were discarded from final stimulus. Overall from the statistical measures and mean difference disparities, six lists were discarded (namely list1, list4, list 6, list12, list 17 & list 18) from the final sentences lists in Telugu. Also, from figure 3(b) it is clear that the differences with reference to overall SNR50 for all the 15 lists are

within 0.5 for Malayalam language. However, as statistically significant difference was seen in the scores obtained with four lists, (list 1, list 9, list 11 and list 12) these were removed, thus only 12 lists were considered for construction of sentence lists in Malayalam.

Thus, only 14 lists in Telugu (Appendix C) and 12 lists in Malayalam (Appendix B) were considered in the formulation of final lists.

Phase II (Data obtained on clinical population)

Adaptive SNR_{50} was estimated for all subjects in groups SHL and CHL. All the subjects were native speakers of Malayalam with different type and degree of hearing loss.

a. ***Stimuli:***

12 lists of sentences that were created in the previous phases of study.

b. Results:

Clinical utility of all sentence list in Malayalam was assesses in individuals with conductive hearing loss and those with different degree of sensorineural hearing loss (SNHL). The following comparisons were done to validate the clinical utility of developed sentence lists.

1. Comparison of SNR_{50} values across normal hearing sensitivity group, conductive hearing loss group and SNHL group
2. Comparison of SNR_{50} values across different degree of SNHL

Comparison of SNR_{50} values across normal hearing sensitivity group, conductive hearing loss group and SNHL group.

Within and across group comparison of SNR_{50} was done across normal hearing sensitivity group, conductive hearing loss group and SNHL group. Descriptive statistics of SNR_{50} in conductive hearing loss and SNHL in comparison to normal hearing sensitivity is shown in table 3.

Table 3: Mean and standard deviation of SNR_{50} for each list in normal hearing sensitivity, conductive and sensorineural hearing loss

List	**Normal**			**Conductive**			**SNHL**		
	N	**SNR_{50}**	**SD**	**N**	**SNR_{50}**	**SD**	**N**	**SNR_{50}**	**SD**
1	30	-4.4000	.68732	15	-4.1333	.29681	19	1.2368	2.28138
2	30	-4.4500	.56248	15	-4.1667	.30861	19	1.6711	2.54686
3	30	-4.5167	.46393	15	-4.0333	.35187	19	1.3289	2.35120
4	30	-4.7500	.43052	15	-4.1333	.35187	19	1.2105	2.22402
5	30	-4.4500	.59234	15	-4.1333	.35187	19	1.9211	2.47354
6	30	-4.7333	.44978	15	-4.1000	.33806	19	1.3289	2.38638
7	30	-4.3333	.51417	15	-4.0333	.22887	19	1.9211	2.26852
8	30	-4.4833	.44496	15	-4.0667	.25820	19	1.5132	1.68423
9	30	-4.0000	.41523	15	-4.1333	.39940	19	2.1579	2.24260
10	30	-4.2833	.59717	15	-4.0000	.32733	19	1.6053	2.30084
11	30	-4.4333	.61214	15	-4.1000	.33806	19	1.1447	2.20371
12	30	-4.2167	.55216	15	-4.1667	.48795	19	1.6842	2.25592

Kruskal-Wallis test was done to compare SNR_{50} of normal hearing sensitivity group with conductive and sensorineural hearing loss groups. Result of the analysis revealed that there was statistically significant difference in SNR_{50} was present across three groups; normal, conductive and sensorineural hearing loss ($p<0.01$). Successively, Mann Whitney test was carried out to analyze differences in SNR_{50} between groups. Results of Mann Whitney comparison of normal vs. conductive hearing loss revealed statistically significant difference ($p<0.05$) in SNR_{50} for all lists.

Similarly, the comparisons done across normal hearing sensitivity vs. sensorineural hearing loss group and conductive vs. sensorineural hearing loss group also revealed statistically significant difference for all lists ($p<0.01$). Z values are shown in table 4.

Table 4: *Z value for comparison across groups*

List Number	***Normal vs. Conductive (Z value)***	***Normal vs. SNHL (Z value)***	***Conductive vs. SNHL (Z value)***
1	-1.06	-5.88	-5.00
2	-2.14	-5.92	-4.99
3	-3.24	-5.93	-4.98
4	-4.03	-5.96	-5.02
5	-1.91	-5.90	-4.99
6	-4.13	-5.94	-4.99
7	-2.16	-5.92	-5.61
8	-3.20	-5.93	-5.05
9	-0.89	-5.92	-4.98
10	-1.58	-5.89	-4.99
11	-1.95	-5.90	-4.98
12	-0.42	-5.89	-4.98

Comparison of SNR_{50} across different degree of SNHL.

Validation of equivalency of sentence list in SNHL was done by comparing SNR_{50} of each list across and within degree of SNHL.

Between group comparison.

Friedman Test was done to compare the SNR_{50} across different degrees of sensorineural hearing loss. Result of the analysis revealed statistically significant difference ($p<0.01$) in SNR_{50} across all degree of SNHL. Later, Kruskal-Wallis test was done to study how each list is statistically significantly different across all degree of hearing loss. Results of the analysis revealed statistically significant difference for each list across different degree of hearing loss.

In order to study the difference in SNR_{50} for each list between two degrees of hearing loss Mann Whitney U test was used. Six independent Mann Whitney U test was done to compare between two degrees of SNHL (minimal vs. mild, minimal vs. moderate, minimal vs. moderately severe, mild vs. moderate, mild vs. moderately severe, moderate vs. moderately severe). Result of the analysis showed statistically significant difference for all list ($p<0.01$) between all comparison except mild and moderate degree of SNHL. Results of the descriptive statistical analysis and the Z value of Mann Whitney U test for each comparison is shown in table 5 and table 6 respectively.

Table 5: *Mean and SD values across various degrees of hearing loss*

List Number	Degree of Hearing Loss											
	Minimal			Mild			Moderate			Moderately Severe		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
1	3	-1.50	0.50	7	0.86	1.18	6	1.00	1.44	3	5.33	0.28
2	3	-1.75	0.75	7	1.71	2.07	6	1.41	1.39	3	5.50	0.50
3	3	-1.75	0.75	7	1.00	2.00	6	1.42	0.97	3	5.00	0.00
4	3	-1.25	0.25	7	0.71	0.70	6	1.25	1.63	3	4.75	2.75
5	3	-1.50	1.00	7	1.71	1.52	6	1.83	1.16	3	6.00	1.00
6	3	-2.00	0.50	7	1.00	1.41	6	1.41	1.31	3	5.25	0.75
7	3	-1.00	1.50	7	2.00	1.84	6	2.00	2.07	3	4.50	0.50
8	3	-0.83	0.28	7	1.36	0.38	6	1.25	0.52	3	4.75	0.25
9	3	-1.50	0.50	7	2.64	1.86	6	2.25	1.44	3	4.50	0.50
10	3	-2.00	1.00	7	1.57	1.51	6	2.00	1.67	3	4.50	0.50
11	3	-1.58	0.52	7	0.78	1.98	6	1.25	1.08	3	4.50	0.50
12	3	-1.17	0.29	7	1.50	1.96	6	1.67	1.48	3	5.00	0.00

Table 6: Comparison across degree of hearing loss

Comparison	List Number	Z value	Level of Significance
Minimal vs. Mild	1	-2.29	0.02
	2	-2.192	0.03
	3	-1.94	0.05
	4	-2.41	0.02
	5	-2.31	0.02
	6	-2.29	0.02
	7	-1.96	0.05
	8	-2.46	0.01
	9	-2.40	0.01
	10	-2.39	0.01
	11	-2.06	0.04
	12	-1.83	0.06
Minimal vs. Moderate	1	-2.20	0.03
	2	-2.33	0.02
	3	-2.33	0.02
	4	-2.34	0.02
	5	-2.34	0.02
	6	-2.32	0.02
	7	-1.82	0.07
	8	-2.35	0.02
	9	-2.32	0.02
	10	-2.32	0.02
	11	-2.33	0.02
	12	-2.11	0.03
Minimal vs. Moderately severe	1	-1.99	0.05
	2	-1.96	0.05
	3	-2.08	0.04
	4	-1.96	0.05
	5	-1.96	0.05
	6	-1.96	0.05
	7	-1.96	0.05
	8	-1.99	0.04
	9	-1.96	0.05
	10	-1.96	0.05
	11	-1.96	0.05
	12	-2.12	0.03
	1	-0.14	0.88
	2	-0.36	0.71

Mild vs. Moderate	3	-0.21	0.82
	4	-0.44	0.65
	5	0.00	1.00
	6	-0.50	0.61
	7	-0.14	0.88
	8	-0.38	0.70
	9	-0.43	0.67
	10	-0.43	0.66
	11	-0.58	0.57
	12	-0.07	0.94
Mild vs. Moderately Severe	1	-2.41	0.02
	2	-2.40	0.02
	3	-2.43	0.01
	4	-2.31	0.02
	5	-2.42	0.01
	6	-2.40	0.02
	7	-2.04	0.04
	8	-2.45	0.01
	9	-1.49	0.13
	10	-2.39	0.01
	11	-2.29	0.02
	12	-2.42	0.01
Moderate vs. Moderately Severe	1	-2.33	0.02
	2	-2.33	0.02
	3	-2.37	0.02
	4	-2.08	0.04
	5	-2.34	0.02
	6	-2.32	0.02
	7	-1.68	0.09
	8	-2.34	0.01
	9	-2.20	0.03
	10	-1.94	0.05
	11	-2.33	0.02
	12	-2.38	0.01

Chapter IV

Discussion

The aim of the present study was to develop sentence material in Malayalam and Telugu for assessing SNR 50. Study involved two independent experiments; Experiment I and II. Discussion of the results obtained in each experiment is described in detail as below.

Experiment I

Experiment I involved three phases; collection of sentences in Malayalam and Telugu languages, selection of equally intelligible sentences in the presence of background noise and construction of equalized sentence lists. All collected sentences in both languages in the initial stage were assessed in terms naturalness and predictability. After this 304 in Malayalam and 366 sentences in Telugu were obtained. These entire sentences were rated as highly natural and less predictable.

Selection of equally intelligible sentences was done by means of deriving the slope of the psychometric function and SNR_{50}. This procedure ensured equality in the difficult of the sentences and sentences and those which are variable in terms difficulty were discarded. The procedure of excluding sentences followed in the present study minimized the testing time and number of subjects tested. This procedure was similar to the procedure adopted by several other studies in development of sentence lists of equal difficulty (Versfeld, Daalder, Festen, & Houtgast,2000, Theunissen, 2008). Procedures in previous studies involved 'Rescaling the intensities and verification' for the selection of equally intelligible sentences. This procedure involves seven rounds of testing (Nielson et.al, 1994, Vaillacourt et. al, 2005; Wong &Soli, 2005; Wong et. al, 2008) and due to this the

entire procedure time was prolonged. In comparison to this, the current study reduced the time required for the selection of equally intelligible sentences study used a better method for. When performance is taken for a comparison, both procedures used for selection of equally intelligible sentence yielded same performance (Theunissen, 2008). This was in accordance with the findings of Jain etal. (2012).

The next step was construction of equalized sentence list. Previous studies employed the method of phonemic balancing for this purpose (Nielson & Dau, 1997; Theunissen, 2008). But, phonemic balancing method resulted in high variability in the sentence list prepared by Theunissen, 2008; and also resulted in less performance equivalence. Hence the present the construction of equalized sentence list. This involved the selection of sentences based on three parameters; SNR_{50}, slope of the psychometric function and phonemic content (number) and distribution. Kollmeier and Wesselkamp (1997) established that selection of sentences using these parameters resulted in equivalence between the lists. Phonemic distribution of both languages approximated the exact same phonemic distribution in the respective language except phoneme /a/ in Malayalam. /a/ was slightly over measured in the sentences list in comparison to actual occurrence of phonemes in Malayalam Language. This happened because most of the initial word of the sentences was started with /a/ (example: /aval/, /avan/, avar/ etc.). This was done to make the sentences more natural.

Experiment II

Experiment II was done to establish sentence list equivalency and to obtain preliminary data necessary for clinical usage of the sentences. In this experiment SNR_{50} was measured. The range of SNR_{50}across different studies varied from -2.7 to -7.8 with an average of -4.24. In the current study the SNR_{50} obtained for Malayalam

and Telugu were-4.28 dB and -2.58 dB respectively; which are in accordance with the values established in previous studies (Kollmeier & Wesselkamp, 1997; Nielson & Dau, 1997; Versfield, 2000; Wong, et al., 2007). Other important parameter to understand the variability across list is standard deviation. From the normative data obtained, all list of Malayalam had an mean standard deviation of 0.53 and in Telugu it was observed to be 1.78. All final lists had a mean SNR_{50} relative to the overall mean were within ± 0.5 dB. This finding is in accordance with the previous studies (Kollmeier & Wesselkamp, 1997; Nielsen & Dau, 1997; Jain et al., 2012; Geetha & Sharath, 2013). Other set of studies also had a standard deviation of ± 1 dB (Nielson et al., 1994; Vaillancourt et al., 2005), these findings are in support with the current study. Low variability is established across all final lists in Telugu and Malayalam.

The next and the final step of this project were to establish clinical utility of all sentence lists in each language. Due to the unavailability of clinical population in native Telugu language the same was done only for Malayalam sentence lists. The overall result in clinical population showed a significant difference in comparison to normal hearing group. These differences are described as below for each group with reference to the data obtained in normal hearing individuals.

Normal vs. conductive hearing loss.

Statistically significant difference in SNR_{50} scores of individuals with normal hearing sensitivity and those with conductive hearing loss was observed. Audibility is the contributing factor in case of conductive hearing loss. But, the difference may also be attributed to the fact that majority of the individuals who participated in the study had long standing conductive pathology, which in turn might have lead to speech perception problems, in addition to less audibility.

Normal vs. Sensorineural hearing loss.

The difference in SNR_{50} between individuals with normal hearing and those with sensorineural hearing loss can be attributed to the impaired cochlear mechanism in the latter group. The alterations like impaired temporal analysis, loss in frequency resolution, and loss in sensitivity, occur primarily because of damage to cochlear outer (and, for more severe losses, inner) hair cells (Moore, 1996). The deficits in speech understanding experienced by many listeners with hearing impairment may be attributed in part to this combination of effects. These individuals required large signal to noise ratio for speech perception in comparison to those with normal hearing (Turner, Fabry, Barret, & Horwitz, 1992). They also demonstrate poor consonant and vowel identification in quite as well as noisy backgrounds. This might be because of the inability to resolve formant transitions and formant frequencies due to widened auditory filters. In a sensorineural impaired cochlea, the auditory filters are broader in bandwidth; and in many cases show asymmetry (Glasberg & Moore, 1986; Leek & Summers, 1993). This variation produces an abnormal internal representation of an input sound; and hence, a varied pattern of stimulation is transmitted to higher auditory processing centers. One of the major alterations in the internal representation is reduced differences in amplitude between peaks and valleys in the spectrum, making it difficult to locate the concentrations of energy that provide cues for the perception of different speech sounds. The frequency location of the spectral peaks (such as formants) is a crucial cue to the identity of some speech sounds; and hence, extreme spectral flattening may result in poor speech perception ability (Bacon & Brandt, 1982; Turner, Chi, & Flock,1999**;** Henry, Turner, & Behrens**,**2005).

Across different degrees of SNHL.

The study revealed significant difference for each list across all degree of hearing loss. The speech perception abilities of people with mild cochlear hearing loss can be primarily attributed to less audibility. In case of higher degrees of hearing losses, reduced frequency selectivity of cochlea plays a significant role, apart from reduced audibility. The impairment in cochlear mechanisms worsens as the severity of hearing loss increases. This justifies the worsening of SNR_{50}scores with increase in degree of hearing loss as observed in the present study results. However the difference in SNR_{50} scores for each list between mild and moderate sensorineural hearing loss was not statistically significant. This indicates that, the impaired cochlear active mechanism may not be so severe in these two groups to worsen the in SNR_{50} scores in comparison to higher degree of hearing loss.

Chapter IV

Summary and Conclusions

The project aimed at developing sentence lists in Malayalam and Telugu languages for use in clinical and research work. The study was designed to be carried out in three phases including collection, equalization and standardization of the sentences.

A set of 500 sentences in Malayalam and 439 sentences in Telugu languages were collected from books & magazines and their naturalness and predictability were evaluated by 10 native speakers of Malayalam and Telugu. High and less predictable sentences were not considered for the recording and hence deleted from the collected ones. LTAS was calculated for the remaining 304 sentences in Malayalam & 366 sentences in Telugu which were audio recorded. Using same LTAS values of each language a reverse FFT transformed speech shaped noise was generated and mixed with each sentence at different predefined SNR values. The intelligibility of these sentences was assessed on 25 individuals with normal hearing in the age range of 18 to 25 years at SNRs of -10dB, -8dB, -6dB, -4dB and -2dB (except for -10 dB in Telugu). Based on the data obtained, those sentences with similar psychometric slopes were selected and easily perceived sentences (scores >75%) and difficult sentences (<25%) were removed. Using custom designed MATLAB program code these selected sentences were grouped into 16 lists for Malayalam and 20 lists for Telugu (10 sentences in each list) were developed. The phoneme occurrence in each list was well correlated with the overall phoneme occurrence given by Ramakrishna et al. (1992). This ensured the phonemic balance across all lists of sentences developed.

Using adaptive procedure, SNR_{50} was estimated for all the lists and Mean and standard deviations were computed. Standardization was done by administering speech in noise test on native speakers of each language separately. For Malayalam all subjects were divided into three groups. First group comprised of individuals with normal hearing and the second and third group consisted of individuals with conductive and sensorineural hearing loss with flat configuration and PTA not more than 60 dB respectively. However, for Telugu only one group of subjects with normal hearing abilities were included for normative data. Due to lack of availability of participants the test could not be administered on individuals with hearing loss. Hence, sentence list in Telugu can be used for clinical and research purpose only after validation.

Based on data obtained, 12 lists in Malayalam and 14 sentences lists in Telugu were developed. Overall, the Malayalam sentence lists could be used in speech perception testing in various contexts and are made available for clinical and research utility and Telugu sentences needs further validation.

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Appendix - A

Rating of the sentences for their naturalness was based upon five point rating scale as given below. (Adopted from Wong and Soli, 2005)

1. Totally unnatural, and not encountered at all.
2. Somewhat unnatural, it is unlikely that one such sentence is encountered.
3. Sentence is unusual, but you may have heard.
4. Natural but less frequently encountered in everyday conversation.
5. Natural and frequently encountered in everyday conversation.

Rating of the sentences for the predictability was based upon three point rating scale as given below:

1. Highly predictable
2. Predictable
3. Not predictable

Appendix - B

List 1

Sl No.	***Sentences in Malayalam***	***IPA***
1.	വാണിജ്യരങ്ങത്ത് പുരോഗതി ഉണ്ടായി	ʋaːɳɪɲjarʲangaʈ̪ pʊrʲoːgaʈ̪ɪ unʈ̪aːjɪ
2.	അവൻ ചുമതലകള് അന്യരെ ഏൽപ്പിച്ചു	aʊan cʊmaʈ̪alakaɭ anjarɜ eːlpɪccʊ
3.	കള്ളന്മാർ വനത്തിലെ മരങ്ങള് മോഷ്ടിച്ചു	kaɭɭanmaːr vanaʈ̪ʈ̪ɪlɜ marʲaŋaɭ moːʂʈ̪ɪccʊ
4.	മാധ്യമ പ്രവർത്തകർ സമ്മേളനത്തിന് വന്നു	maːɖʰjama praʊarʈ̪ʈ̪akar sammeːlanaʈ̪ʈ̪ɪnə ʊaɳɳʊ
5.	പ്രായമായപ്പോൾ തലയിലെ മുടി നരച്ചു	praːjamaːjappoːɭ ʈ̪alajɪlɜ mʊdɪ ɳarʲaccʊ
6.	വിദ്യാർത്ഥി പുസ്തകത്തിലെ തെറ്റുകൾ കണ്ടുപിടിച്ചു	ʊɪɖʰjaːrʈ̪ʈ̪ʰɪ pʊsʈ̪akaʈ̪ʈ̪ɪlɜ ʈ̪ɜtʊkaɭ kaɳʈ̪ʊpɪccʊ
7.	വൈദ്യുതിയുടെ ഉപഭോഗം വാലേ കൂടി	ʊaɪɖjʊʈ̪ɪjʊʈ̪ɜ ʊpabʰoːgam ʊaɭarɜ kʊːdɪ
8.	കടലാസ് കഷ്ണങ്ങൾ പറന്നു പോയി	kaʈalaːsə kaʂɳaŋaɭ paraɳɳʊ poːjɪ
9.	കൃഷിക്കാരൻ വയലില് വിത്ത് വിതച്ചു	krɪʂɪkkaːran vajalɪl vɪʈ̪ʈ̪ə vɪʈ̪accʊ
10.	അവർ തണലില് ഇരുന്ന് വിശ്രമിച്ചു	aʊar ʈ̪aɳalɪl ɪrʲʊɳɳə ʊɪsramɪccʊ

Appendix - C

List 2

Sl. No	Sentences in Telugu	IPA
1	ఫ్యాను గాలికి దీపం ఆరిపోయింది	pʰjanU galIkI ɖipəm arIpoIndI
2	అతడు ఎల్లప్పుడు ముందడుగు వేస్తాడు	əʈədU elləppudU mUnɖədUgU vɛsʈadU
3	స్వాతంత్ర్యదినోత్సవం రోజు పాటపాడుతున్నారు	svaʈənʈrja ɖInoʈsəvəm rodʒU patə padUʈUnnarU
4	విద్యార్థులకు సమయస్ఫూర్తి చాల అవసరం	vIɖjarʈʰUləkU səməjəspurʈI tʃalə əvəsərəm
5	ఆఊరిలో దొంగలు అందరు పట్టుబడ్డారు	aurIlo ɖongəlU ənɖərU pəttUbəddarU
6	చెట్టుకొమ్మ విరిగి క్రింద పడింది	tʃettU kommə vIrIgI krInɖəpədInɖI
7	బాబు ఇవ్వాళ త్వరగా నిద్రపోయాడు	babu Ivvaɭə ʈvərəga nIɖrəpojadU
8	కలంలో సిర అయిపోయింది	kələmlo sIrə əIpoIndI
9	ఒక సంవత్సరానికి పన్నెండు నెలలు	okə səmvəʈsəranIkI pənnendU neləLu
10	ఇతడు తల్లిదండ్రుల కల నెరవేర్చాడు	IʈədU ʈəllIɖəndrUlə kələ nerəvɛrʈʃa:dU

List 3

Sl. No	Sentences in Telugu	IPA
1	ఆ పక్షులు నీరు తాగుతున్నాయి	a pəkʃUlU nirU ʈagUʈUnnajI
2	ఆమె చెట్టుకు నీళ్ళుపోస్తుంది	a me tʃettUkU niɭɭU posʈUnɖI
3	ఆమె గదిని పరిశుభ్రంగా ఉంచుతుంది	ame gəɖInI pərIsubʰrəmga UntʃUʈUnɖI
4	పరులకు సహాయంచేయడం ఉత్తమ గుణం	pərUləkU səhajəm tʃɛjədəm Uʈʈəmə gUɳəm
5	అక్క తమ్ముడితో తగువులాడుతుంది	əkkə ʈəmmUdIʈo ʈəgUʋUladUʈUnɖI
6	తాత కట్టెలకు వెళ్ళి గొడ్డలి పారవేసుకున్నాడు	ʈaʈə kətteləkU ʋeɭɭI goddəlI parəʋɛsUkUnnadU
7	ఇతడు ప్రతిభావంత విద్యార్థి	IʈədU prəʈI bʰaʋənʈə ʋI ɖʰjar ʈʰI
8	రైతులకు పంటలు బాగా పండాయి	rəIʈuləkU pəntəlU baga pəndəJi
9	బంతి బాగా పైకి ఎగురుతుంది	bənʈI baga pəIkI egUrUʈUnɖI
10	అతను చదువు పూర్తయి విదేశాలకు వెళ్ళాడు	əʈənU tʃəɖUʋU purʈhəI ʋIɖɛʃaləKu ʋeɭɭadU

List 5

Sl. No	Sentences in Telugu	IPA
1	అగ్గిపుల్ల నీటిలోపడి ఆరిపోయింది	əggIpUllə nitIlo pədI arIpojInɖI
2	పాల పదార్థాలు అతడికి నచ్చవు	palə pəɖarʈʰalU əʈədIkI nətʃtʃəʋU
3	భార్య భర్తకు సహాయం చేసింది	bʰarjə bʰərʈəkU səhajəm tʃɛsInɖI
4	పిల్లవాడు ఆడుతూ మట్టి తిన్నాడు	pIlləʋadU adUʈu məʈʈI ʈInnadU
5	ఆసభలో జనం చేపల వలేఉన్నారు	asəbʰəlo dʒənəm tʃɛpələʋəlɛ unnarU
6	వాళ్ళు భోజనం వేడిగా వడ్డించారు	ʋaɭɭU bʱodʒənəm ʋɛdIga ʋəddIntʃarU
7	రైతులకు విద్యుత్తు చాలా అవసరం	rəIʈUləkU ʋIɖjUʈʈU tʃala əʋəsərəm
8	అక్క ఉదయం చపాతి చేసింది	əkkə Uɖəjəm tʃəpaʈI tʃɛsInɖI
9	ఆ ఏనుగుకు దంతాలు పెద్దవిగా ఉన్నాయి	a jɛnUgUkU ɖəntalU peɖɖəʋIga UnnəjI
10	ఎదురు గాలిలో సైకిలు తొక్కటం కష్టం	jeɖUrU galIlo səIkIlU ʈokkətəm kəʂtəm

List 7

Sl. No	Sentences in Telugu	IPA
1	అతడి నెలసరి ఆదాయం ఎక్కువ	ətɨədI neləsərI aɖajəm ekkUʋə
2	తనకు విదేశాలకు వెళ్ళాలని కోరిక	ʈɨənəkU ʋIɖɛʃaləkU ʋeɭɭalənI korIkə
3	రోడ్డు మధ్యలో పాముంది	roddU məɖʱjəlo pamUnɖI
4	పట్టణాలలో కాలుష్యం రద్దీ ఎక్కువ	pəttəɳaləlo kalUʂjəm rəɖɖi ekkUʋə
5	పాపకు పాలు చల్లారబెడుతుంది	papəkU palU tʃəllarə bedU ʈUnɖI
6	ఎండాకాలంలో బావులు ఎండిపోతాయి	enda kaləmlo baʋUlU endIpoʈajI
7	ఆ ఇంట్లో పిల్లలసంత ఎక్కువ	a IntIlo pIllələsənʈə ekkUʋə
8	ఆమె ముఖం చంద్రబింబంలా ఉంది	ame mukʰəm tʃənɖrəbImbəmla UnɖI
9	మంచితనం అందరిని కాపాడుతుంది	məntʃI ʈɨənəm ənɖərInI kapadUʈUnɖI
10	అతడు సీసాలో నీళ్ళు నింపుతున్నాడు	ətɨədU sIsalo niɭɭU nImpUʈUnnadU

List 8

Sl. No	Sentences in Telugu	IPA
1	ఈ కవిత అందరిని మెప్పించింది	i kəʋIʈə ənɖərInI meppIntʃInɖI
2	కుక్క పిల్లిని వీధిలో తరుముతుంది	kUkkə pIllInI ʋidʰIloʈərUmUʈunɖI
3	సీత రాముడిలో అడవికి వెళ్ళింది	siʈə ramUdIʈo ədəʋIkI ʋeɭɭInɖI
4	వర్షంలో నెమలి నాట్యం చేస్తుంది	ʋərʂəmlo neməlI natjəm tʃɛsʈUnɖI
5	వీధి దీపం సరిగ్గా వెలగటంలేదు	ʋIɖʰIɖIpəm sərIgga ʋeləgətəm lɛɖU
6	ఊళ్ళో పాడి పంటలు సంవృద్ధిగా వుంటాయి	uɭɭo padI pəntəlU səmʋrUɖʰIga untajI
7	ఇంటిలో ఇవ్వాళ దీపం వెలిగించ లేదు	IntIlo Iʋʋaɭə ɖipəm ʋelIgIntʃə lɛɖU
8	అతడి ఇంటిని తణికి చేశారు	əʈədI IntInI ʈəɳIkI tʃɛʃarU
9	దేవుడికి చాలా పూలదండలు వేశారు	ɖɛʋUdIkI tʃala puləɖəndəlU ʋɛsarU
10	రైతులకు పంటలు పండించడానికి ధనంలేదు	rəIʈUləkU pəntəlU pəndIntʃədanIkI ɖʰənəmlɛɖU

List 9

Sl. No	Sentences in Telugu	IPA
1	నాటకంలో పగటివేషం వేసాడు	natəkəmlo pəgətIʋeʂəm ʋɛsadU
2	అమ్మాయి ఆటలో రిబ్బను పొగొట్టుకుంది	əmməjI atəlo rIbbənU pogottUkUnɖI
3	మొక్క చాలా పొడవుగా ఉంది	mokkə tʃalapodəʋUgə ʋUnɖI
4	ఇవ్వాళ వంటవాడు రాలేదు	Iʋʋaɭə ʋəntəʋadU ralɛɖU
5	నాన్న ఎన్నికలలో గెలిచారు	nannə ennIkələlo gelItʃarU
6	ప్రసంగానికి అందరు చప్పట్లుకొట్టారు	prəsənganIkI ənɖərU tʃəppətlU kottarU
7	భవిష్యత్తుకోసం ధనం కుడబెట్టవలెను	bʰəʋIʂəʈʈukosəm ɖʰənəm kudə bettəʋəlenU
8	పాపను అమ్మ ఊయలలో ఊపుతుంది	papənU əmmə ujələlo upUʈunɖI
9	బయటిగాలి జోరుగా వీస్తుంది	bəjətIgalI dʒorUga ʋisʈUnɖI
10	సంతలో పిల్లవాడు తప్పిపోయాడు	sənʈəlo pIlləʋadU ʈəppIpojadU

List 10

Sl. No	Sentences in Telugu	IPA
1	ఆమె స్నేహితురాలు సహాయం చేసింది	ame snɛhIʈuralU səhajəm ʧsIɳdI
2	నాకు లేత గులాబి ఇష్టం	nakU lɛʈəgUlabI Iʂtəm
3	విద్యర్థులకు సెలవులు ఆటవిడుపు	ʋIɖjarʈʰUləkU seləʋUlU atəʋIdUpU
4	దీపావళికి టపాకాయలు పేలుస్తారు	ɖIpaʋəɭIkI təpakajəlU pɛlUsʈarU
5	ఇంటిముందు చాలావాహనాలు నిలబడ్డాయి	IntImUnɖU ʧala ʋahənalU nIləbəddajI
6	పిల్లలు పెద్దలను గౌరవించాలి	pIlləlU peɖɖələnU gəɔrəʋIntʃalI
7	వర్షాలకు చెరువులు నిండాయి	ʋərʂanIkI ʧerUʋUlU nIndajI
8	బాబు కిటికిలో నుండి కిందపడ్డాడు	babU kItIkIlonUndI kInɖəpəddadU
9	అక్కడి బెల్లం చేదుగా ఉంది	əkkədI belləm ʧɛɖUgaUnɖI
10	అన్న సైకిలు నేర్చుకుంటున్నాడు	ənnə səIkIlU nɛrʧUkUntUnnadU

List 11

Sl. No	Sentences in Telugu	IPA
1	సింహం అడవి నుండి తప్పించుకున్నది	sImhəm ədəʋI nUndI ʈ̪əppIntʃUkUnnəɖ̪I
2	పిల్లవాడు తప్పులులేకుండా చదివాడు	pIlləʋadU ʈ̪əppUlU lɛkUnda tʃəɖ̪IʋadU
3	పిల్లలు వీధిలోఆట చూస్తున్నారు	pIlləlU ʋIʈ̪ʰIloatə tʃusʈ̪UnnarU
4	ఈరోజు ఆఫీసులోచాలా పని ఉంది	irodʒU apʰisUlo tʃalapənI Unɖ̪I
5	అమ్మ తలస్నానం చేసి గుడికి వెళ్ళింది	əmmə ʈ̪ələsnanəm tʃɛsI gUdIkI ʋeɭ̪Inɖ̪I
6	పిల్లలు అమ్మకు సహాయం చేసారు	pIlləlU əmməkU səhajəm tʃɛsarU
7	ఇవ్వాళ మాస్నేహితురాలి పెళ్ళి	Iʋʋaɭ̪ə masne:hIʈ̪UralI peɭ̪I
8	పెరడులో తులసిమొక్క ఉంది	perədUlo ʈ̪UləsI mokkə Unɖ̪I
9	పాఠశాలను పూలతో అలంకరించారు	patəʃalənU puləʈ̪ho ələnkərIntʃarU
10	ఆబావిలో రాళ్ళు కప్పలు ఉన్నాయి	a baʋIlo raɭ̪U kəppəlU UnnajI

List 13

Sl. No	Sentences in Telugu	IPA
1	నాన్న పాలుతీసుకురావడం మరచిపోయారు	nannə palU ʈisUkUraʋədəm mərətʃIpojarU
2	ఆ విన్యాసానికి జనం బాగావచ్చారు	a ʋInjasanIkI ɖʒənəm bagə ʋətʃtʃarU
3	అతడు గోడకు రంగు వేస్తున్నాడు	əʈədU godəkU rəngU ʋɛsʈUnnadU
4	సంతరోజు దుకాణాలు రద్దీగా ఉండును	sənʈərodʒU ɖUkaɳalU rəɖɖiga UndUnU
5	మనము యెల్లప్పుడు మంచినీటిని త్రాగవలెను	mənəmU jelləppUdU məntʃI nitInI ʈragəʋəlenU
6	అతడి కోరికలకు అంతంలేదు	əʈədI korIkələkU ənʈəm lɛɖU
7	కుండలో నీరు అయిపోయాయి	kUndəlo nirU əjIpojajI
8	స్నేహితురాలి ఇల్లు పక్కననేఉంది	snɛhIʈUralI IllU pəkkənənɛUnɖI
9	అతడు రాయితో కుక్కను కొట్టాడు	əʈədU rajIʈokUkkənU kottadU
10	నీరు పల్లంవైపు ప్రవహిస్తుంది	nirU pəlləm ʋəIpU prəʋəhIsʈUnɖI

List 14

Sl. No	Sentences in Telugu	IPA
1	గోడకు పెద్ద గడియారం ఉంది	godəkU peɖɖəgədIjarəm UnɖI
2	ఇంటి తాళంచెవిని అన్న పారేసుకున్నాడు	IntI ʈaɭəmtʃevInI ənnə parɛsUkUnnadU
3	తమ్ముడు అన్నం సరిగా తినలేదు	ʈəmmUdU ənnəm sərIga ʈInəlɛɖU
4	ఆమె ఊరగాయ అమ్ముతుంది	ame urəgajə əmmUʈUnɖI
5	తను స్నేహితురాలికి ఉత్తరం రాస్తుంది	ʈənU snehIʈUralIkI Uʈʈərəm rasʈUnɖI
6	ఆ విన్యాసాలు ప్రజలకు కాలక్షేపాన్నిచ్చాయి	a vInjasalU prədʒələkU kaləkʂɛpannIʧajI
7	ఆకాశమంతా కారుమబ్బులతో నిండింది	akaʃəmənʈə karU məbbUləʈo nIndInɖI
8	ఆమె సంగీత పాఠాలు నేర్పుతుంది	ame səngiʈə pathalU nɛrpUʈUnɖI
9	క్రీడలతో స్నేహబంధాలు పెరుగును	kridələʈho snɛhəbənɖhalU perUgUnU
10	నేను దీపావళికి ఇంటికి వెళ్తాను	nɛnU ɖipavəɭIkI IntIkI veɭʈanU

List 15

Sl. No	Sentences in Telugu	IPA
1	అతడి ఉంగరంలో నవరత్నాలున్నాయి	ət̪ədI Ungərəmlo nəʋərət̪nalUnnajI
2	అడవినుండి భయంకర శబ్దం వస్తుంది	ədəʋI nUndI bʰəjənkərə ʃəbɖ̪əm ʋəst̪Unɖ̪I
3	ఆవు చేనులో గడ్డి మేస్తుంది	aʋU ʧ̪ʃɛnUlo gəddI mɛst̪Unɖ̪I
4	వేసవికాలంలో నీటి సమస్య అధికం	ʋɛsəʋI kaləmlo nI:tI səməsyə əɖ̪ʰIkəm
5	అక్కడ ఒక సంఘటన జరిగింది	əkkədə okə səngʰətənə dʒərIgInɖ̪I
6	అతడు స్పూనుతో అన్నం తింటున్నాడు	ət̪ədU spunUt̪o ənnəm t̪IntUnnadU
7	పాప చేతి గాజులు బాగున్నాయి	papə ʧ̪ʃe:t̪I gadʒUlU bagUnnajI
8	పిచ్చి కుక్క కరవడం హానికరం	pItʃtʃIkUkkə kərəʋədəm hanIkərəm
9	అనుకోకుండ వాళ్ళ ప్రయాణం ఆగిపోయింది	ənUkokUndə ʋaɭ̪ə prəjaɳəm agIpojInɖ̪I
10	రాత్రంతా పిల్లి మంచంక్రింద నిదురపోయింది	raʈ̪rənʈ̪a pIllI məntʃəm krInɖ̪ə nIɖ̪UrəpojInɖ̪I

List 16

Sl. No	Sentences in Telugu	IPA
1	ఆవు పేడతో ఇల్లు అలికారు	avU pɛdə̱to IllU əlIkarU
2	అతను రాత్రి ఆకలితో నిద్రపోయాడు	ə̱t̪ənU ra̱t̪rI aklI̱to nId̪rəpojadU
3	ఇవి మన ఇంటి పత్రాలు	IvI mənə IntI pə̱t̪ralU
4	అక్క వంట నేర్చుకుంటుంది	əkkə vəntə nɛrtʃU kUɳtUnd̪I
5	వారు కొత్త కారు కొన్నారు	varU ko̱t̪̱tə̱ karU konnarU
6	భయంతో పాప తలుపులు తెరిచింది	bʰəjəmt̪o papə t̪̱əlUpUlU t̪̱erItʃInd̪I
7	ఎల్లపుడు మంచిని కోరుకోవాలి	elləpUdU məntʃInI korUkovalI
8	అప్పడాలు కిటికి లోని డబ్బాలో ఉన్నాయి	əppədalU kI̱t̪IkIlonI dəbbalo UnnajI
9	పదవివిరమణ అయి పది సంవత్సరాలవుతుంది	pəd̪əvivIrəməɳə aI pəd̪I səmvə̱t̪̱sərələvU̱t̪̱und̪I
10	నీళ్ళలో వలనుండి చేప తప్పించుకున్నది	niɭɭəlo vələnUndI t̪̱ʃɛpə̱t̪̱əppIntʃUkUnnəd̪I

List 19

Sl. No	Sentences in Telugu	IPA
1	అవ్వ కర్రపట్టుకొని నిదానంగా నడుస్తుంది	əʊʊəkərrə pəttUkonI nIɖanənga nədUsʈUnɖI
2	అమ్మ పెరుగన్నం డబ్బా లో పెట్టింది	əmmə perUgənnəm dəbbalo pettInɖI
3	ఆ నలుగురు సభను వణికించారు	anəlUgUrU səbʰənU ʊəɳIkIntʃarU
4	ఇప్పుడు రైలు బయలుదేరుతుంది	IppUɖU rəIlU bəjəlUɖɛrUʈUnɖI
5	అతడి కళ్ళు కోపంతో ఎర్రబడ్డాయి	əʈədI kəɭɭU kopəmʈo errəbəddajI
6	పాప ఏనుగు మీద షికారుకు వెళ్ళింది	papə ɛnUgU miɖəʂIkarUkU ʊeɭɭInɖI
7	రోడ్డుకు ఇరువైపుల దుకాణాలున్నాయి	roddUkU IrUʊəIpUla ɖUkaɳalUnnajI
8	పిల్లలు బయట గట్టిగా గోలచేస్తున్నారు	pIlləlU bəjətə gəttIga golətʃɛsʈUnnarU
9	ఆమెకళ్ళు పెద్దగా భయంకరంగా ఉన్నాయి	ame kəɭɭU peɖɖəgabʰəjənkərənga UnnajI
10	కొలనులో కలువలు ఉన్నాయి	kolənUlo kəlUʊəU UnnajI

List 20

Sl. No	Sentences in Telugu	IPA
1	కుటుంబ రక్షణ అతడి ప్రధానకర్తవ్యం	kUtUmbə rəkʂəɳə ə̠ɖI prə̠ʈʰanəkər̠ʈəʊjəm
2	చలికి ఉలనుబట్టలు వేసుకుంటారు	ʧəlIkI UlənU bəttəlU ʊɛsUkUntarU
3	పాపకు కొత్తగౌను సరిపోలేదు	anəlUgUrU səbʰənU ʊəɳIkIntʃaru
4	అతడు దారిలో కళ్ళుతిరిగి పడిపోయాడు	ə̠ɖU ɖ̠arIlo kəl̪l̪U̠ʈIrIgI pədIpojadU
5	రేపు ఉద్యో గానికి మొదటి రోజు	rɛpU Uɖ̠joganIkI moɖ̠ətIro dʒu
6	అమ్మ వంటగదిలో పని చేస్తుంది	əmmə ʊəntəgəɖ̠IlopənI ʧɛsʈ̠UnɖI
7	ప్రతిఒక్కరు మంచి పనులను ప్రసంశించాలి	prə̠ʈIokkərU məntʃIpənUlənU prəsImʃIntʃalI
8	పండుగకు ఖరీదైనదుస్తులు కొన్నాడు	pəndUgəkU kʰəriɖ̠əInəɖ̠UsʈUlU konnadU
9	అతడు చిన్నతనంలో బలశాలి	ə̠ɖU ʧInnə̠ʈənəmlo bələ̱ʃalI
10	ఈ మంటలో అన్నం సరిగ్గా ఉడకదు	i məntə̠ʈo ənnəm sərIgga Udəkəɖ̠U

List 2

Sl No.	***Sentences in Malayalam***	***IPA***
1.	ഉച്ചത്തിലുള്ള ശബ്ദങ്ങൾ കേൾവിയെ ബാധിക്കുന്നു	ʊccaʈɪl ʊlla ʃabɖaŋal keːlʊɪjɜ baːɖʰɪkkʊɳɳʊ
2.	അവൻ കൂട്ടുകാരന് കത്ത്അയച്ചു	aʊan kʊːʈʈʊkaːɾʲanə kaʈʈə ajaccʊ
3.	കൃഷിക്കാരന് കാളയും പശുവും ഉണ്ട്	krɪʂɪkkaːranə kaːlajʊm paʂʊʊʊm ʊɳʈə
4.	കുട്ടികൾക്കായി ചിത്രരചന മൽസരം നടത്തി	kʊʈʈɪkalkkaɪ cɪɽraracana malsaram ɳaʈaʈʈɪ
5.	അമ്മ അലമാരയിൽ തുണികൾ വച്ചു	amma alamaːɾajɪl ʈʊɳɪkal vaccʊ
6.	മാലിന്യത്തിൽ നിന്നു ഊർജ്ജം ഉൽപാദിപ്പിച്ചു	maːlinjaʈʈɪl ɳɪɳɳə ʊːrʲʲam ʊlpaːɖɪppɪccʊ
7.	അയാൾ രാജ്യത്തെ സംബന്നരിൽ ഒരാളാണ്	ajaːl raːɟjaʈʈɜ sambannarɪl oraːlaːɳə
8.	പ്രകാശം വളരെ വേഗത്തിൽ സഞ്ചരിക്കുന്നു	prakaːʂam ʊalarɜ ʊeːgaʈʈɪl sanɟarɪkkʊɳɳʊ
9.	ചിലർ വീട്ടില് മൃഗങ്ങളെ വളർത്തുന്നു	cɪlar ʊɪːʈʈɪl mrigaŋalɜ ʊalarʈʈʊɳɳʊ
10.	വർഷം തോറും പരിസ്ഥിതി പ്രശ്നം കൂടി	ʊarʂam ʈoːrʊm parɪsʈɪʈʰɪ praʃnam kʊːdɪ

List 3

Sl No.	***Sentences in Malayalam***	***IPA***
1.	അവർ ഇളനീര് വാങ്ങി കുടിച്ചു	avar ɪɭaɳːr vaːŋɪ kʊʈɪccʊ
2.	അവിടെ അവന് സുഖമാണെന്ന് പറഞ്ഞു	avɪʈɜ avanə sʊkʰamaːnɜɳɳə paraɲɲʊ
3.	അവന് പാത്രത്തിൽ ഭക്ഷണം കഴിച്ചു	avan paːʈraʈʈɪl bʰakʂaɳam kaɻɪccʊ
4.	അധികാരി പ്രവാസികളുടെ പ്രശ്നം പരിഹരിച്ചു	aɖɪkaːrɪ pravaːsɪkaɭuʈɜ praʃnam parɪharɪccʊ
5.	യാത്രക്കാർ സഞ്ചരിച്ച തോണി മറിഞ്ഞു	jaːʈrakkaːr sanʧarɪcca ʈoːɳɪ marɪɲɲʊ
6.	അമ്മ അവന്റെ ഇഷ്ടത്തിന് വഴങ്ങി	amma avantɜ ɪʂtaʈʈɪnə vaɻaŋɪ
7.	കാട്ടിൽ നിരവധി ജീവജാലങ്ങൾ ഉണ്ട്	kaːʈʈɪl ɳɪravaɖʰɪ ʝɪːvaʧaːlaŋaɭ unʈə
8.	വഴിയോരങ്ങളിൽ മരങ്ങള് നാറ്റ് വളർത്തി	vaɻɪjoːraŋaɭɪl maraŋaɭ ɳaʈʈʊ vaɭarʈʈɪ
9.	പദ്ധതിയുടെ നടത്തിപ്പിന് പണം അനുവദിച്ചു	paɖɖʰaʈɪjʊʈɜ ɳaʈaʈʈɪppɪnə paɳam anʊvaɖɪccʊ
10.	അമ്മ കുട്ടിക്ക്ചോറ് കൊടുത്തില്ല	amma kʊʈʈɪkkə coːrə koʈʊʈʈɪlla

List 4

Sl No.	***Sentences in Malayalam***	***IPA***
1.	നഗരത്തിലെ സ്വകാര്യ ബസുകൾ പണിമുടക്കി	nagaraʈɪlɜ swakaːrja basʊkaɭ paɳɪmʊʈakkɪ
2.	പരിപാടിയിലെ ആദ്യ ഇനം പാട്ട് ആയിരുന്നു	parɪpaːʈɪjɪlɜ aːɖja ɪnam paːʈʈə aːjɪrʊɳɳʊ
3.	അവന് പരീക്ഷയിൽ ഒന്നാം സ്ഥാനം വാങ്ങി	aʊan parɪːkʂajɪl oɳɳaːm sʈʰaːnam vaːŋɪ
4.	ഇന്ന് അവിടെ ചെണ്ടമേളം ഉണ്ടായിരുന്നു	ɪɳɳə aʊɪʈɜ cɜɳʈameːɭam ʊɳʈaːjɪrʊɳɳʊ
5.	രുചിയുള്ള ആഹാര പദാർഥങ്ങള് കഴിച്ചു	ɾʊcɪjʊlla aːhaːra paɖaːrʈʈʰaŋaɭ kaɻɪccʊ
6.	കുറെ പേർ വള്ളം കളി കാണാൻ വന്നു	kʊreː peːr vaɭɭam kaɭɪ kaːɳaːn ʊaɳɳʊ
7.	അവനൊരു ആനയെ വിലയ്ക്ക് വാങ്ങി	aʊanoɾʊ aːnajɜ ʊɪlaɪkkə vaːŋɪ
8.	അവൾ കുറെ സമയം പ്രാർഥിച്ചു	aʊaɭ kʊrɜ samajam praːrʈʈʰɪccʊ
9.	വീട്ടിലെ നായ കുട്ടിയെ കടിച്ചു	ʊɪːʈʈɪlɜ naːja kʊʈʈɪjɜ kaʈɪccʊ
10.	മലയാളത്തിൽ അൻപത്തിയാറ് അക്ഷരങ്ങൾ ഉണ്ട്	malajaːlaʈʈɪl anpaʈʈɪjːrə akʂaraŋaɭ ʊnʈə

List 5

Sl No.	***Sentences in Malayalam***	***IPA***
1.	രാജ്യം സാമ്പത്തിക വളർച്ച നേടി	raʄjam saːmbaʈʈɪka ʊaɭarcca n̪eːʈɪ
2.	പേന താഴെ വീണു പൊട്ടി	peːna ʈaɻɜ vɪːɳə poʈʈɪ
3.	വർഷങ്ങള് പഴക്കമുള്ള ശില കണ്ടെത്തി	ʊarʂaŋaɭ paɻakkamʊɭla ʃɪla kaɳʈɜʈʈɪ
4.	അച്ഛന്റെ കത്തിന് മകന് മറുപടി അയച്ചു	atʃʰantɜ kaʈʈɪnə makan marʊpaʈɪ ajaccʊ
5.	അവർ നിരാശരായി വീട്ടിലേക്ക് മടങ്ങി	aʊar n̪ɪraːʃaraːjɪ ʊɪːʈʈɪlɜkkə maʈaŋɪ
6.	സമ്മേളന സ്ഥലത്ത് കോടി ഉയർന്നു	sammeːɭana sʈʰalaʈʈə koʈɪ ʊjarn̪n̪ʊ
7.	സംസ്ഥാനം സംബൂർണ്ണ സാക്ഷരത നേടി	samsʈʰaːnam sambʊːrɳɳa saːkʂaraʈa neːdɪ
8.	നാട്ടിലെ ആളുകളുടെ എണ്ണം കൂടി	n̪aːʈʈɪlɜ aːɭʊkaɭʊʈɜ ɜɳɳam kʊːʈɪ
9.	ഭക്ഷണം ചവച്ചരയ്ക്കാൻ പല്ലുകൾ വേണം	bʰakʂanam caʊatʃʰarajkkaːn pallukaɭ veːnam
10.	യാത്രക്കാർ കൊട്ടാരം കാണാൻ വന്നു	jaːʈrakkaːr koʈʈaːram kaːnaːn ʊan̪n̪ʊ

List 6

Sl No.	***Sentences in Malayalam***	***IPA***
1.	വാഴയിലയിൽ ചൂട് ചോറ് വിളമ്പി	ʋaːɻajɪlajɪl cʊːʈə coːrə vɪɭambɪ
2.	അയാൾ അവന് പുസ്തകം കൊടുത്തു	ajaːɭ aʊanə pʊsʈakam koʈʊʈʈʊ
3.	അയാൾ വയലില് വാഴ നട്ടു	ajaːɭ ʋajalil ʋaːɻa ɳaʈʈʊ
4.	അമ്മ കുഞ്ഞിന്റെ പരിചരണത്തിൽ ശ്രദ്ധിച്ചു	amma kʊɲɲɪnte parɪcaraɳaʈɪl sraɖɖʰɪtʃʊ
5.	അവന് പച്ചവെള്ളത്തിൽ കുളിക്കാനാണ് ഇഷ്ടം	aʊanə patʃaʊeɭɭaʈʈɪl kʊɭɪkkaːnaːnə ɪʂtam
6.	വഴിയരികിലെ മരങ്ങൾ മുറിച്ച് മാറ്റി	ʋaɻɪjarɪkɪlɜ maraŋal mʊrɪccʊ maːttɪ
7.	അദ്ദേഹം സ്നേഹത്തോടെ അവനെ യാത്രയാക്കി	aɖɖeːham snehaʈʈoːʈe aʊanɜ jaːʈrajaːkkɪ
8.	അവർ മരത്തിന്റെ തണലിൽ വിശ്രമിച്ചു	aʊar maraʈʈɪnte ʈaɳalɪl ʊɪsramitʃʊ
9.	ജലത്തിൽ നിന്നും വൈദ്യുതി ഉണ്ടാക്കുന്നു	ɟalaʈʈɪl ɳɪɳɳʊm ʊaɪɖjʊʈɪ ʊɳʈaːkkʊɳɳʊ
10.	പൂവിൽ നിന്നും തേന് ശേഖരിക്കുന്നു	pʊːʋɪl ɳɪɳɳʊm ʈeːn ʃeːkʰarɪkkʊɳɳʊ

List 7

Sl No.	***Sentences in Malayalam***	***IPA***
1.	അമ്മ കുഞ്ഞിനെ തൊട്ടിലിൽ ഉറക്കി	amma kʊʈʈɪjɜ ʈoʈʈɪlɪl ʊrakkɪ
2.	അവൾ പാത്രത്തില് ഭക്ഷണം കഴിച്ചു	aʊaɭ paːʈraʈʈɪl bʰakʂaɳam kaɻɪtccʊ
3.	മുക്കുവൻ വല വീശി മീന് പിടിച്ചു	mʊkkʊʊan ʊala ʊɪːʃɪ mɪːn pɪʈɪccʊ
4.	കുട്ടികൾക്ക് കളിക്കുവാനൊരു പന്ത് കിട്ടി	kʊʈʈɪkaɭkkə kaɭɪkkʊvaːnoɾʊ panʈə kɪʈʈɪ
5.	കുറെ ആളുകൾ ഉൽസവത്തിന് വന്നു	kʊreː aːɭʊkaɭ ʊlsaʊaʈɪnə ʊaɳɳʊ
6.	ശിഷ്യൻ വീണ്ടും ഗുരുവിനെ വഞ്ചിച്ചു	ʃɪʂjan vɪːɳtʊm gʊɾʊʊɪnɜ ʊanɟɪccʊ
7.	അവർ പട്ടണത്തില് ജീവിക്കാൻ തുടങ്ങി	aʊar paʈʈaɳaʈʈɪl ɟɪːʊɪkkaːn ʈʊtaɳɪ
8.	അമ്മ കുഞ്ഞിനെ നന്നായി വളർത്തി	amma kʊɲɲɪnɜ ɳaɳɳaːjɪ ʊaɭarʈʈɪ
9.	വൈദ്യുതി നിലച്ചപ്പോൾ വിളക്ക് കത്തിച്ചു	ʊaɪdʰjʊʈɪ ɳɪlatʃʰappoɭ ʊɪɭakkə kaʈɪccʊ
10.	അവന് കൂട്ടുകാരന്റെ കല്യാണത്തിന് പോയി	aʊan kʊːʈʈʊkaːrantɜ kaljaːɳaʈʈɪnə poːɪ

List 8

Sl No.	***Sentences in Malayalam***	***IPA***
1.	അവർ കൂട്ടുകാരെ സ്നേഹപൂർവം സ്വീകരിച്ചു	avar kuːʈʈukaːrɜ snɜhapuːrvam swiːkarɪccu
2.	മേളയിൽ പലതരത്തിലുള്ള പൂവുകൾ പ്രദർശിപ്പിച്ചു	meːl̪ayɪl palaṯ̪araṯ̪ṯ̪ɪlul̪l̪a puːvukal̪ praḏ̪arʃɪppɪccu
3.	പുതിയ ഉല്പന്നങ്ങൾ വിപണിയിൽ വന്നു	puṯ̪ɪja ulpannaŋal ʋɪpaɳʲjɪl ʋan̪n̪u
4.	നഗരത്തിൽ വലിയ കെട്ടിടങ്ങൾ നിർമ്മിച്ചു	nagaraṯ̪ṯ̪ɪl ʋalɪja keʈʈɪʈaŋal̪ n̪ɪrmmɪtʃʰu
5.	കോടതി നിരപരാധികളെ വിട്ടയയ്ക്കാൻ തീരുമാനിച്ചു	koːʈaṯ̪ɪ nɪrapaɾaːḏ̪ʰɪkal̪ɜ ʋɪʈʈajajkkaːn ṯ̪iːɾʊmaːnɪccu
6.	എല്ലാ സാധനങ്ങൾക്കും വില കൂടി	ɜl̪l̪a saːḏ̪ʰanaŋal̪kkʊm ʋɪla kuːʈɪ
7.	കുട്ടി നല്ല ഉടുപ്പ് ധരിച്ചു	kuːʈʈɪ nalla ʊʈʊppə ḏ̪ʰarɪccu
8.	പണത്തിന്റെ മൂല്യം കുറെ ഇടിഞ്ഞു	paɳaṯ̪ṯ̪ɪntɜ muːljam kʊrɜ ɪʈɪɲɲu
9.	പോഷക സമൃദ്ധമായ പച്ചക്കാരികൾ വാങ്ങിച്ചു	poːʂaka samrɪḏ̪ḏ̪ʰamaːja paccakkarɪkal̪ vaːŋɪccu
10.	മുളകിന്റെ വില വീണ്ടും കൂടി	mʊl̪akɪntɜ ʋɪla ʋɪːnʈʊm kuːʈɪ

List 9

Sl No.	***Sentences in Malayalam***	***IPA***
1.	പ്ലാസ്റ്റിക് ഉപയോഗിച്ച് കളിപ്പാട്ടം ഉണ്ടാക്കി	pl̪aːstɪk ʊpajoːgɪccə kal̪ɪppaːʈʈam ʊɳʈaːkkɪ
2.	മരത്തിലെ ഇലകൾ കൊഴിഞ്ഞു വീണു	maraʈ̪ɪl̪ɜ ɪlakal̪ koɻɪɲɲə vɪːɳʊ
3.	നാട്ടിലെ പഴങ്ങളും പച്ചക്കറിയും സ്വദിഷ്ടമാണ്	n̪aːʈʈɪl̪ɜ paɻaŋal̪ʊm paccakkarɪjʊm swaːd̪ɪʂʈamaːɳə
4.	കുലത്തിലെ വെള്ളത്തിൽ പായൽ നിറഞ്ഞു	kʊl̪aʈ̪ɪl̪ɜ ʊɜllaʈ̪ɪl paːjal nɪraɲɲʊ
5.	ഭങ്ങിയുള്ള നക്ഷത്രം ആകാശത്തു മിന്നിത്തിളങ്ങി	bʰaŋɪjʊlla n̪akʂaʈ̪ram aːkaːʃaʈ̪ʈə mɪnnɪʈ̪ɪl̪aŋɪ
6.	കൃഷിക്കാർ രാസവളം അമിതമായി ഉപയോഗിച്ചു	krɪʂɪkkaːr ɾaːsaʊal̪am amɪʈ̪amaːjɪ ʊpajoːgɪccʊ
7.	അവന് പ്രശസ്തനായ കളിക്കാരിൽ ഒരാളാണ്	aʊan praʃasʈ̪anaːja kal̪ɪkkaːrɪl oraːl̪aɳə
8.	അവന് അവസരം പരമാവധി ഉപയോഗിച്ചു	aʊan aʊasaram paɾamaːʊad̪ʱɪ ʊpajoːgɪccu
9.	ഗ്രാമത്തിൽ ജനസംബർക്ക പരിപാടി നടത്തി	graːmaʈ̪ɪl ɟanasambarkka paɾɪpaːʈɪ naʈaʈ̪ʈɪ
10.	കുപ്പിയിൽ നിറയെ മഷി നിറച്ചു	kʊppɪjɪl nɪrajɜ maʂɪ n̪ɪraccu

List 10

Sl No.	***Sentences in Malayalam***	***IPA***
1.	കുട്ടിയുടെ പുതിയ ഉടുപ്പിൽ ചെളിയായി	kʊʈʈɪjʊʈɜ pʊʈ̪ɪja ʊʈʊppɪl cɜɭɪjaːjɪ
2.	മുക്കുവൻ മീന് പിടിക്കാൻ പോയി	mʊkkʊʊan mɪːn pɪʈɪkkaːn poːjɪ
3.	അവർ ഇന്നലെ വിവാഹത്തിൽ പങ്കെടുത്തു	aʊar ɪn̪n̪alɜ ʊɪʊaːhaʈ̪ʈ̪ɪl pangeʈʊʈ̪ʈ̪ʊ
4.	അച്ഛൻ മകനൊരു പാവയെ നല്കി	atʃʰan makanoɾʊ paːʊajɜ nalkɪ
5.	അവൻ കണ്ണുകള് മൂടിക്കെട്ടി	aʊan kannʊkaɭ mʊːʈɪkkɜʈʈɪ
6.	അയാൾക്ക് ധീരതയ്ക്കുള്ള പുരസ്കാരം ലഭിച്ചു	ajaːɭkkə ɖʰɪːraʈ̪aɪkkʊl̪la pʊɾaskaːram labʰɪccʊ
7.	പരീക്ഷാക്കാലത്ത് മറവി ഉണ്ടാകുന്നത് സാധാരണമാണ്	paɾɪːkʂakkaːlaʈ̪ʈə maraʊɪ ʊɳʈaːkʊn̪n̪aʈ̪ə saːɖʰaːraɳamaːɳə
8.	മുതിർന്ന പൌരൻമാർക്ക് പരിഗണന നല്കി	mʊʈ̪ɪrn̪n̪a paʊranmaːrkkə paɾɪgaɳana n̪alkɪ
9.	വിവാഹത്തിന് വന്ന ബന്ധുക്കൾ എല്ലാം പോയി	ʊɪʊaːhaʈ̪ʈɪnə van̪n̪a banɖʰʊkkaɭ ɜllaːm poːjɪ
10.	അച്ഛൻ രാവിലെ അമ്മയോടൊപ്പം പോയി	atʃʰan ɾaːʊɪlɜ ammajoːʈoppam poːjɪ

List 11

Sl No.	***Sentences in Malayalam***	***IPA***
1.	കാട്ടിൽ പലതരത്തിലുള്ള പഴങ്ങൾ ഉണ്ട്	kaːʈʈɪl palaʈaraʈʈɪlʊl̪la paɻaŋal̪ ʊɳʈə
2.	പട്ടണത്തിൽ വായ് മലിനീകരണം കൂടി	paʈʈanaʈʈɪl vaːjʊ malɪn̪iːkaranam kʊːʈɪ
3.	ഇക്കാലത്ത് കൂട്ടുകുടുംബങ്ങൾ കുറവാണ്	ɪkkaːlaʈʈə kʊːʈʈʊkʊʈʊmbaŋal kʊraʊaːɳə
4.	കാലക്രമേണ നിയമങ്ങൾ മാറി	kaːlakrameːɳa nɪjamaŋal̪ maːrɪ
5.	പണിക്കർ അണക്കെട്ടിലെ പണി പൂർത്തിയാക്കി	paɳɪkkaːr aɳakkɜʈʈɪle paɳɪ pʊːrʈʈɪjaːkkɪ
6.	അവർ ചിട്ടയോടെ കാര്യങ്ങൾ ചെയ്തു	aʊar cɪʈʈajoːʈɜ kaːrjaŋal̪ cɜjʈ̪ʊ
7.	കോടതി ഉത്തരവ് ജനങ്ങൾക്ക് സഹായകമായി	koːʈaʈ̪ɪ ʊʈ̪ʈaraʊə ɟanaŋal̪kkə sahaːjakamaːjɪ
8.	കുട്ടി പണി പിടിച്ച് കിടപ്പിലായി	kʊʈʈɪ paɳ̪ɪ pɪtɪccə kiʈappɪlaːjɪ
9.	ചേട്ടൻ അമ്മയുടെ കൂടെ വീട്ടിലെത്തി	cɜʈʈan ammajʊʈɜ kooʈɜ vɪːʈʈɪlɜʈʈɪ
10.	കുതിര വേഗത്തിൽ ഓടുന്ന മൃഗമാണ്	kʊʈ̪ɪra veːgaʈʈɪl̪ oːʈʊɳ̪ɳa mrɪgamaːɳə

List 12

Sl No.	***Sentences in Malayalam***	***IPA***
1.	മരുഭൂമിയിലെ സസ്യങ്ങൾ വളരെ ചെറുതാണ്	marʊbʰʊːmɪjɪlɜ sasjaŋaɭ vaɭarɜ cɜrʊʈaːɳə
2.	കിടക്ക നിർമ്മിക്കുവാന് പഞ്ഞി ഉപഗോഗിക്കുന്നു	kiʈakka ɲɪrmɪkkʊvaːn paɲɲɪ ʊpajoːgɪkkʊɳɳʊ
3.	അപകടത്തിൽ വളരെ പേർ കൊല്ലപ്പെട്ടു	apakaʈaʈʈɪl vaɭarɜ peːr kollappɜʈʈʊ
4.	പക്ഷികൾ വളരെ ദൂരം പറന്നു	pakʂɪkaɭ vaɭarɜ ɖʰʊːram paraɳɳʊ
5.	കള്ളൻ പൂട്ട് പൊളിക്കുവാൻ ശ്രമിച്ചു	kaɭɭan pʊːʈʈə poɭɪkkʊvaːn sramɪccʊ
6.	വവ്വാൽ പഴുത്ത മാങ്ങ തിന്നു	ʊaʊʊaːl paɻʊʈʈa maːŋa ʈɪɳɳʊ
7.	ആശുപത്രിക്കിടക്കയിൽ രോഗികൾ കിടക്കുന്നു	aːʃʊpaʈɾɪkkɪʈakkajɪl roːgɪkaɭ kɪʈakkʊɳɳʊ
8.	പഴത്തിൽ ജലാംശം ധാരാളം അടങ്ങിയിരിക്കുന്നു	paɻaʈʈɪl ɟalaːmʃam ɖʰaːraɭam adaŋɪjɪrɪkkʊɳɳʊ
9.	അവനൊരു പാട്ട് മുഴുവനായി പാടി	aʊanoɾʊ paːʈʈə mʊɻʊʊanaːjɪ paːʈɪ
10.	ഇന്നലെ ആകാശം മേഘാവൃതമായി കാണപ്പെട്ടു	ɪɳɳalɜ aːkaːʃam meːgʰaːʊrɪʈamaːjɪ kaːɳappɜʈʈʊ

Appendix - C

List 2

Sl. No	Sentences in Telugu	IPA
1	ఫ్యాను గాలికి దీపం ఆరిపోయింది	pʰjanU galIkI ɖipəm arIpoIndI
2	అతడు ఎల్లప్పుడు ముందడుగు వేస్తాడు	əʈədU elləppudU mUnɖədUgU vɛsʈadU
3	స్వాతంత్ర్యదినోత్సవం రోజు పాటపాడుతున్నారు	svaʈənʈrja ɖInoʈsəvəm rodʒU patə padUʈUnnarU
4	విద్యార్థులకు సమయస్ఫూర్తి చాల అవసరం	vIɖjarʈʰUləkU səməjəspurʈI tʃalə əvəsərəm
5	ఆఊరిలో దొంగలు అందరు పట్టుబడ్డారు	aurIlo ɖongəlU ənɖərU pəttUbəddarU
6	చెట్టుకొమ్మ విరిగి క్రింద పడింది	tʃettU kommə vIrIgI krInɖəpədInɖI
7	బాబు ఇవ్వాళ త్వరగా నిద్రపోయాడు	babu Ivvaɭə ʈvərəga nIɖrəpojadU
8	కలంలో సిర అయిపోయింది	kələmlo sIrə əIpoIndI
9	ఒక సంవత్సరానికి పన్నెండు నెలలు	okə səmvəʈsəranIkI pənnendU neləLu
10	ఇతడు తల్లిదండ్రుల కల నెరవేర్చాడు	IʈədU ʈəllIɖəndrUlə kələ nerəvɛrʈʃa:dU

List 3

Sl. No	Sentences in Telugu	IPA
1	ఆ పక్షులు నీరు తాగుతున్నాయి	a pəkʃUlU nirU ʈagUʈUnnajI
2	ఆమె చెట్టుకు నీళ్ళుపోస్తుంది	a me tʃettUkU niɭɭU posʈUnɖI
3	ఆమె గదిని పరిశుభ్రంగా ఉంచుతుంది	ame gəɖInI pərIsubʰrəmga UntʃUʈUnɖI
4	పరులకు సహాయంచేయడం ఉత్తమ గుణం	pərUləkU səhajəm tʃɛjədəm Uʈʈəmə gUɳəm
5	అక్క తమ్ముడితో తగువులాడుతుంది	əkkə ʈəmmUdIʈo ʈəgUʋUladUʈUnɖI
6	తాత కట్టెలకు వెళ్ళి గొడ్డలి పారవేసుకున్నాడు	ʈaʈə kətteləkU ʋeɭɭI goddəlI parəʋɛsUkUnnadU
7	ఇతడు ప్రతిభావంత విద్యార్థి	IʈədU prəʈI bʰaʋənʈə ʋI ɖʰjar ʈʰI
8	రైతులకు పంటలు బాగా పండాయి	rəIʈuləkU pəntəlU baga pəndəJi
9	బంతి బాగా పైకి ఎగురుతుంది	bənʈI baga pəIkI egUrUʈUnɖI
10	అతను చదువు పూర్తయి విదేశాలకు వెళ్ళాడు	əʈənU tʃəɖUʋU purʈhəI ʋIɖɛʃaləKu ʋeɭɭadU

List 5

Sl. No	Sentences in Telugu	IPA
1	అగ్గిపుల్ల నీటిలోపడి ఆరిపోయింది	əggIpUllə nitIlo pədI arIpojInɖI
2	పాల పదార్థాలు అతడికి నచ్చవు	palə pəɖarʈʰalU əʈədIkI nətʃtʃəʋU
3	భార్య భర్తకు సహాయం చేసింది	bʰarjə bʰərʈəkU səhajəm tʃɛsInɖI
4	పిల్లవాడు ఆడుతూ మట్టి తిన్నాడు	pIlləʋadU adUʈu məʈʈI ʈInnadU
5	ఆసభలో జనం చేపల వలేఉన్నారు	asəbʰəlo dʒənəm tʃɛpələʋəlɛ unnarU
6	వాళ్ళు భోజనం వేడిగా వడ్డించారు	ʋaɭɭU bʱodʒənəm ʋɛdIga ʋəddIntʃarU
7	రైతులకు విద్యుత్తు చాలా అవసరం	rəIʈUləkU ʋIɖjUʈʈU tʃala əʋəsərəm
8	అక్క ఉదయం చపాతి చేసింది	əkkə Uɖəjəm tʃəpaʈI tʃɛsInɖI
9	ఆ ఏనుగుకు దంతాలు పెద్దవిగా ఉన్నాయి	a jɛnUgUkU ɖəntalU peɖɖəʋIga UnnəjI
10	ఎదురు గాలిలో సైకిలు తొక్కటం కష్టం	jeɖUrU galIlo səIkIlU ʈokkətəm kəʂtəm

List 7

Sl. No	Sentences in Telugu	IPA
1	అతడి నెలసరి ఆదాయం ఎక్కువ	ətɨədI neləsərI aɖajəm ekkUʋə
2	తనకు విదేశాలకు వెళ్ళాలని కోరిక	ʈɨənəkU ʋIɖɛʃaləkU ʋeɭɭalənI korIkə
3	రోడ్డు మధ్యలో పాముంది	roddU məɖʱjəlo pamUnɖI
4	పట్టణాలలో కాలుష్యం రద్దీ ఎక్కువ	pəttəɳaləlo kalUʂjəm rəɖɖi ekkUʋə
5	పాపకు పాలు చల్లారబెడుతుంది	papəkU palU tʃəllarə bedU ʈUnɖI
6	ఎండాకాలంలో బావులు ఎండిపోతాయి	enda kaləmlo baʋUlU endIpoʈajI
7	ఆ ఇంట్లో పిల్లలసంత ఎక్కువ	a IntIlo pIllələsənʈə ekkUʋə
8	ఆమె ముఖం చంద్రబింబంలా ఉంది	ame mukʰəm tʃənɖrəbImbəmla UnɖI
9	మంచితనం అందరిని కాపాడుతుంది	məntʃI ʈɨənəm ənɖərInI kapadUʈUnɖI
10	అతడు సీసాలో నీళ్ళు నింపుతున్నాడు	ətɨədU sIsalo niɭɭU nImpUʈUnnadU

List 8

Sl. No	Sentences in Telugu	IPA
1	ఈ కవిత అందరిని మెప్పించింది	i kəʋIʈə ənɖərInI meppIntʃInɖI
2	కుక్క పిల్లిని వీధిలో తరుముతుంది	kUkkə pIllInI ʋidʰIloʈərUmUʈunɖI
3	సీత రాముడిలో అడవికి వెళ్ళింది	siʈə ramUdIʈo ədəʋIkI ʋeɭɭInɖI
4	వర్షంలో నెమలి నాట్యం చేస్తుంది	ʋərʂəmlo neməlI natjəm tʃɛsʈUnɖI
5	వీధి దీపం సరిగ్గా వెలగటంలేదు	ʋIɖʰIɖIpəm sərIgga ʋeləgətəm lɛɖU
6	ఊళ్ళో పాడి పంటలు సంవృద్ధిగా వుంటాయి	uɭɭo padI pəntəlU səmʋrUɖʰIga untajI
7	ఇంటిలో ఇవ్వాళ దీపం వెలిగించ లేదు	IntIlo Iʋʋaɭə ɖipəm ʋelIgIntʃə lɛɖU
8	అతడి ఇంటిని తణికి చేశారు	əʈədI IntInI ʈəɳIkI tʃɛʃarU
9	దేవుడికి చాలా పూలదండలు వేశారు	ɖɛʋUdIkI tʃala puləɖəndəlU ʋɛsarU
10	రైతులకు పంటలు పండించడానికి ధనంలేదు	rəIʈUləkU pəntəlU pəndIntʃədanIkI ɖʰənəmlɛɖU

List 9

Sl. No	Sentences in Telugu	IPA
1	నాటకంలో పగటివేషం వేసాడు	natəkəmlo pəgətIʋeʂəm ʋɛsadU
2	అమ్మాయి ఆటలో రిబ్బను పొగొట్టుకుంది	əmməjI atəlo rIbbənU pogottUkUnɖI
3	మొక్క చాలా పొడవుగా ఉంది	mokkə tʃalapodəʋUgə ʋUnɖI
4	ఇవ్వాళ వంటవాడు రాలేదు	Iʋʋaɭə ʋəntəʋadU ralɛɖU
5	నాన్న ఎన్నికలలో గెలిచారు	nannə ennIkələlo gelItʃarU
6	ప్రసంగానికి అందరు చప్పట్లుకొట్టారు	prəsənganIkI ənɖərU tʃəppətlU kottarU
7	భవిష్యత్తుకోసం ధనం కుడబెట్టవలెను	bʰəʋIʂəʈʈukosəm ɖʰənəm kudə bettəʋəlenU
8	పాపను అమ్మ ఊయలలో ఊపుతుంది	papənU əmmə ujələlo upUʈunɖI
9	బయటిగాలి జోరుగా వీస్తుంది	bəjətIgalI dʒorUga ʋisʈUnɖI
10	సంతలో పిల్లవాడు తప్పిపోయాడు	sənʈəlo pIlləʋadU ʈəppIpojadU

List 10

Sl. No	Sentences in Telugu	IPA
1	ఆమె స్నేహితురాలు సహాయం చేసింది	ame snɛhIʈuralU səhajəm ʧsIɳdI
2	నాకు లేత గులాబి ఇష్టం	nakU lɛʈəgUlabI Iʂtəm
3	విద్యర్థులకు సెలవులు ఆటవిడుపు	ʋIɖjarʈʰUləkU seləʋUlU atəʋIdUpU
4	దీపావళికి టపాకాయలు పేలుస్తారు	ɖIpaʋəɭIkI təpakajəlU pɛlUsʈarU
5	ఇంటిముందు చాలావాహనాలు నిలబడ్డాయి	IntImUnɖU ʧala ʋahənalU nIləbəddajI
6	పిల్లలు పెద్దలను గౌరవించాలి	pIlləlU peɖɖələnU gəɔrəʋIntʃalI
7	వర్షాలకు చెరువులు నిండాయి	ʋərʂanIkI ʧerUʋUlU nIndajI
8	బాబు కిటికిలో నుండి కిందపడ్డాడు	babU kItIkIlonUndI kInɖəpəddadU
9	అక్కడి బెల్లం చేదుగా ఉంది	əkkədI belləm ʧɛɖUgaUnɖI
10	అన్న సైకిలు నేర్చుకుంటున్నాడు	ənnə səIkIlU nɛrʧUkUntUnnadU

List 11

Sl. No	Sentences in Telugu	IPA
1	సింహం అడవి నుండి తప్పించుకున్నది	sImhəm ədəʋI nUndI ʈ̪əppIntʃUkUnnəɖ̪I
2	పిల్లవాడు తప్పులులేకుండా చదివాడు	pIlləʋadU ʈ̪əppUlU lɛkUnda tʃəɖ̪IʋadU
3	పిల్లలు వీధిలోఆట చూస్తున్నారు	pIlləlU ʋIʈ̪ʰIloatə tʃusʈ̪UnnarU
4	ఈరోజు ఆఫీసులోచాలా పని ఉంది	irodʒU apʰisUlo tʃalapənI Unɖ̪I
5	అమ్మ తలస్నానం చేసి గుడికి వెళ్ళింది	əmmə ʈ̪ələsnanəm tʃɛsI gUdIkI ʋeɭ̪Inɖ̪I
6	పిల్లలు అమ్మకు సహాయం చేసారు	pIlləlU əmməkU səhajəm tʃɛsarU
7	ఇవ్వాళ మాస్నేహితురాలి పెళ్ళి	Iʋʋaɭ̪ə masne:hIʈ̪UralI peɭ̪I
8	పెరడులో తులసిమొక్క ఉంది	perədUlo ʈ̪UləsI mokkə Unɖ̪I
9	పాఠశాలను పూలతో అలంకరించారు	patəʃalənU puləʈ̪ho ələnkərIntʃarU
10	ఆబావిలో రాళ్ళు కప్పలు ఉన్నాయి	a baʋIlo raɭ̪U kəppəlU UnnajI

List 13

Sl. No	Sentences in Telugu	IPA
1	నాన్న పాలుతీసుకురావడం మరచిపోయారు	nannə palU ʈisUkUraʋədəm mərətʃIpojarU
2	ఆ విన్యాసానికి జనం బాగావచ్చారు	a ʋInjasanIkI ɖʒənəm bagə ʋətʃtʃarU
3	అతడు గోడకు రంగు వేస్తున్నాడు	əʈədU godəkU rəngU ʋɛsʈUnnadU
4	సంతరోజు దుకాణాలు రద్దీగా ఉండును	sənʈərodʒU ɖUkaɳalU rəɖɖiga UndUnU
5	మనము యెల్లప్పుడు మంచినీటిని త్రాగవలెను	mənəmU jelləppUdU məntʃI nitInI ʈragəʋəlenU
6	అతడి కోరికలకు అంతంలేదు	əʈədI korIkələkU ənʈəm lɛɖU
7	కుండలో నీరు అయిపోయాయి	kUndəlo nirU əjIpojajI
8	స్నేహితురాలి ఇల్లు పక్కననేఉంది	snɛhIʈUralI IllU pəkkənənɛUnɖI
9	అతడు రాయితో కుక్కను కొట్టాడు	əʈədU rajIʈokUkkənU kottadU
10	నీరు పల్లంవైపు ప్రవహిస్తుంది	nirU pəlləm ʋəIpU prəʋəhIsʈUnɖI

List 14

Sl. No	Sentences in Telugu	IPA
1	గోడకు పెద్ద గడియారం ఉంది	godəkU peɖɖəgədIjarəm UnɖI
2	ఇంటి తాళంచెవిని అన్న పారేసుకున్నాడు	IntI ʈaɭəmtʃevInI ənnə parɛsUkUnnadU
3	తమ్ముడు అన్నం సరిగా తినలేదు	ʈəmmUdU ənnəm sərIga ʈInəlɛɖU
4	ఆమె ఊరగాయ అమ్ముతుంది	ame urəgajə əmmUʈUnɖI
5	తను స్నేహితురాలికి ఉత్తరం రాస్తుంది	ʈənU snehIʈUralIkI Uʈʈərəm rasʈUnɖI
6	ఆ విన్యాసాలు ప్రజలకు కాలక్షేపాన్నిచ్చాయి	a vInjasalU prədʒələkU kaləkʂɛpannIʧajI
7	ఆకాశమంతా కారుమబ్బులతో నిండింది	akaʃəmənʈə karU məbbUləʈo nIndInɖI
8	ఆమె సంగీత పాఠాలు నేర్పుతుంది	ame səngiʈə pathalU nɛrpUʈUnɖI
9	క్రీడలతో స్నేహబంధాలు పెరుగును	kridələʈho snɛhəbənɖhalU perUgUnU
10	నేను దీపావళికి ఇంటికి వెళ్తాను	nɛnU ɖipavəɭIkI IntIkI veɭʈanU

List 15

Sl. No	Sentences in Telugu	IPA
1	అతడి ఉంగరంలో నవరత్నాలున్నాయి	ət̪ədI Ungərəmlo nəʋərət̪nalUnnajI
2	అడవినుండి భయంకర శబ్దం వస్తుంది	ədəʋI nUndI bʰəjənkərə ʃəbɖ̪əm ʋəst̪Unɖ̪I
3	ఆవు చేనులో గడ్డి మేస్తుంది	aʋU ʧ̪ʃɛnUlo gəddI mɛst̪Unɖ̪I
4	వేసవికాలంలో నీటి సమస్య అధికం	ʋɛsəʋI kaləmlo nI:tI səməsyə əɖ̪ʰIkəm
5	అక్కడ ఒక సంఘటన జరిగింది	əkkədə okə səngʰətənə dʒərIgInɖ̪I
6	అతడు స్పూనుతో అన్నం తింటున్నాడు	ət̪ədU spunUt̪o ənnəm t̪IntUnnadU
7	పాప చేతి గాజులు బాగున్నాయి	papə ʧ̪ʃe:t̪I gadʒUlU bagUnnajI
8	పిచ్చి కుక్క కరవడం హానికరం	pItʃtʃIkUkkə kərəʋədəm hanIkərəm
9	అనుకోకుండ వాళ్ళ ప్రయాణం ఆగిపోయింది	ənUkokUndə ʋaɭ̪ə prəjaɳəm agIpojInɖ̪I
10	రాత్రంతా పిల్లి మంచంక్రింద నిదురపోయింది	raʈ̪rənʈ̪a pIllI məntʃəm krInɖ̪ə nIɖ̪UrəpojInɖ̪I

List 16

Sl. No	Sentences in Telugu	IPA
1	ఆవు పేడతో ఇల్లు అలికారు	avU pɛdə̱to IllU əlIkarU
2	అతను రాత్రి ఆకలితో నిద్రపోయాడు	ə̱t̪ənU ra̱t̪rI aklI̱to nId̪rəpojadU
3	ఇవి మన ఇంటి పత్రాలు	IvI mənə IntI pə̱t̪ralU
4	అక్క వంట నేర్చుకుంటుంది	əkkə vəntə nɛrtʃU kUɳtUnd̪I
5	వారు కొత్త కారు కొన్నారు	varU ko̱t̪̱tə̱ karU konnarU
6	భయంతో పాప తలుపులు తెరిచింది	bʰəjəmt̪o papə t̪̱əlUpUlU t̪̱erItʃInd̪I
7	ఎల్లపుడు మంచిని కోరుకోవాలి	elləpUdU məntʃInI korUkovalI
8	అప్పడాలు కిటికి లోని డబ్బాలో ఉన్నాయి	əppədalU kI̱t̪IkIlonI dəbbalo UnnajI
9	పదవివిరమణ అయి పది సంవత్సరాలవుతుంది	pəd̪əvivIrəməɳə aI pəd̪I səmvə̱t̪̱sərələvU̱t̪̱und̪I
10	నీళ్ళలో వలనుండి చేప తప్పించుకున్నది	niɭɭəlo vələnUndI t̪̱ʃɛpə̱t̪̱əppIntʃUkUnnəd̪I

List 19

Sl. No	Sentences in Telugu	IPA
1	అవ్వ కర్రపట్టుకొని నిదానంగా నడుస్తుంది	əʊʊəkərrə pəttUkonI nIɖanənga nədUsʈUnɖI
2	అమ్మ పెరుగన్నం డబ్బా లో పెట్టింది	əmmə perUgənnəm dəbbalo pettInɖI
3	ఆ నలుగురు సభను వణికించారు	anəlUgUrU səbʰənU ʊəɳIkIntʃarU
4	ఇప్పుడు రైలు బయలుదేరుతుంది	IppUɖU rəIlU bəjəlUɖɛrUʈUnɖI
5	అతడి కళ్ళు కోపంతో ఎర్రబడ్డాయి	əʈədI kəɭɭU kopəmʈo errəbəddajI
6	పాప ఏనుగు మీద షికారుకు వెళ్ళింది	papə ɛnUgU miɖəʂIkarUkU ʊeɭɭInɖI
7	రోడ్డుకు ఇరువైపుల దుకాణాలున్నాయి	roddUkU IrUʊəIpUla ɖUkaɳalUnnajI
8	పిల్లలు బయట గట్టిగా గోలచేస్తున్నారు	pIlləlU bəjətə gəttIga golətʃɛsʈUnnarU
9	ఆమెకళ్ళు పెద్దగా భయంకరంగా ఉన్నాయి	ame kəɭɭU peɖɖəgabʰəjənkərənga UnnajI
10	కొలనులో కలువలు ఉన్నాయి	kolənUlo kəlUʊəU UnnajI

List 20

Sl. No	Sentences in Telugu	IPA
1	కుటుంబ రక్షణ అతడి ప్రధానకర్తవ్యం	kUtUmbə rəkʂəɳə ə̠ɖI prə̠ʈʰanəkər̠ʈəʊjəm
2	చలికి ఉలనుబట్టలు వేసుకుంటారు	ʧəlIkI UlənU bəttəlU ʊɛsUkUntarU
3	పాపకు కొత్తగౌను సరిపోలేదు	anəlUgUrU səbʰənU ʊəɳIkIntʃaru
4	అతడు దారిలో కళ్ళుతిరిగి పడిపోయాడు	ə̠ɖU ɖ̠arIlo kəl̪l̪U̠ʈIrIgI pədIpojadU
5	రేపు ఉద్యో గానికి మొదటి రోజు	rɛpU Uɖ̠joganIkI moɖ̠ətIro dʒu
6	అమ్మ వంటగదిలో పని చేస్తుంది	əmmə ʊəntəgəɖ̠IlopənI ʧɛsʈ̠UnɖI
7	ప్రతిఒక్కరు మంచి పనులను ప్రసంశించాలి	prə̠ʈIokkərU məntʃIpənUlənU prəsImʃIntʃalI
8	పండుగకు ఖరీదైనదుస్తులు కొన్నాడు	pəndUgəkU kʰəriɖ̠əInəɖ̠UsʈUlU konnadU
9	అతడు చిన్నతనంలో బలశాలి	ə̠ɖU ʧInnə̠ʈənəmlo bələ̱ʃalI
10	ఈ మంటలో అన్నం సరిగ్గా ఉడకదు	i məntə̠ʈo ənnəm sərIgga Udəkəɖ̠U