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Development of Speech Audiometry Material in Goan Konkani Language

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Abstract

In the audiological test battery, speech audiometry plays an important role. It measures an individual's sensitivity to speech stimuli and higher level linguistic activities. In a standardized audiometric procedure, speech awareness threshold, speech recognition threshold and speech identification scores are measured using different speech stimuli such as consonants, spondees, phonetically balanced words and sentences. To enhance the accuracy of speech audiometry, speech stimuli should be developed and standardized in the native language of an individual.

Considering this, speech audiometry materials have been developed in several Indian languages and standardized. Konkani is one of the national languages of India and is official language and mother tongue of the Goa state (Southern State of India) which consists of two dialectal variations (Christian & Hindu). With reference to Konkani language, speech stimuli to assess speech audiometry scores are not available. The purpose of this study was to develop speech audiometry material (phonetically balance word list) in Goan Konkani language (common to both dialects) which can be used to assess speech identification performance in individuals with hearing impairment. Two lists of phonetically balanced words (20 words in each list) were prepared based on the frequencies of occurrence of different phonemes in Konkani language (common to both dialects). Using these two word list, Speech Identification Scores (SIS) were measured for normal hearing and sensori-neural hearing loss individuals. The two word lists developed were found to be effective in discriminating normal hearing from hearing impaired individuals. Test-retest reliability was found to be high. This indicates that the Phonetically Balanced (PB) words developed in this study are consistent enough to be used routinely when establishing SIS in the clinical population.

Key words: Speech audiometry, Konkani Language, Speech Identification Scores

Introduction

Pure tone audiometry serves as a primary procedure to evaluate the type and quantify the extent of an individual's hearing loss. But it cannot represent an individual's speech perception ability. Speech perception refers to an individual's ability to perceive the acoustic waveforms produced by a speaker (Goldinger, Pisonic & Logan, 1991). Thus, our communication is dependent on hearing system and difficulty in understanding speech is the greatest complaints from hearing impaired individuals. The hearing impairment inferred from a pure tone audiogram cannot depict accurately the degree of handicap in speech communication caused by a hearing impairment. Thus, the need for audiological test procedures that could test an individual's hearing sensitivity to speech stimuli surfaced and speech audiometry is being used widely as a part of routine audiological evaluation. Speech audiometry is a simple measurement of an individual's response to speech stimuli under controlled conditions. It validates the pure tone thresholds and provides an index for the hearing sensitivity for speech (Carhart, 1952; Chaiklin & Ventry, 1964). Speech detection/awareness threshold, speech recognoition threshold and speech discrimination /identification score are the most commonly used test procedures in a standard audiometric

procedure. Speech stimuli used in speech audiometry vary from consonants, phonetically balanced words, spondee words, digits, nonsense syllables and sentences.

Speech detection/awareness threshold is the lowest hearing threshold level at which an individual can correctly detect the presence of speech stimuli 50% of the time. Speech recognition threshold indicates, the lowest hearing level at which an individual correctly repeats speech stimuli 50% of the time (Carhart, 1946). Speech discrimination/identification scores (SIS) involves a procedure of establishing the percentage of correctly perceived phonetically balanced monosyllabic words (PB words) presented at a comfortable supra threshold level (Hood & Poole, 1980). Phonetically balanced words are selected depending on the frequency of occurrence of speech sounds in a language. According to Wang, Mannell, Newall, Zhang & Han (2007), speech sounds are more meaningful in assessing the function of auditory system because they involve the assessment of higher level linguistic activities and the effects of contextual constraints in processing auditory information. Clinically speech identification scores are used to; describe the extent of hearing impairment and how it affects speech understanding, identify the site of lesion, identify the benefits of hearing aids and monitoring patient performance over time for either diagnostic or rehabilitative purpose (Gelfand, 2007).

High quality, standardized speech audiometry materials have been developed and used extensively in English. However, for many of the world's languages, such materials are more limited or non-existent. In order to enhance the validity and accuracy of speech audiometry, speech tests should be administered in the patient's native language/dialect (Lehiste & Peterson, 1959; Ramkissoon, 2001). Test materials, in every language, should be developed and standardized in an experimental setting (Carhart, 1965). Therefore, speech stimuli should consist of words that are considered "familiar" in that language and accuracy of speech audiometry relies heavily on the subject's knowledge of the test material (Zubick, 1983). In other words, testing a patient in their non-native language may yield inaccurately low scores because the utilization of foreign words may appear as nonsense stimuli (Weisleder & Hodgson, 1989).

India being a land of diversity, constituting a multilingual & multicultural population comprises of nearly 29 independent languages. Many Indian researchers and audiologists have recognized this need and have developed speech audiometry stimuli in few languages like; Hindi (Abrol, 1972), Indian English (Swarnalatha, 1972), Kannada (Nagaraja, 1973), Tamil (Dayalan, 1976),

picture SRT for children and adults in Kannada (Rajashekhar, 1976), Gujarathi (Mallikarjun, 1984), Tulu (Samuel, 1998). Konkani is an Indo-European independent and literary language. In India, it was added to the list of National languages in 1992. Konkani language is widely used in the Western Coastal region of India known as Konkan i.e., Karnataka, Goa and Maharashtra. The number of Konkani speakers in India is around 7.6 million making up 0.245 of India's population. However, there are very high number of dialects exists in Konkani due to the influence of religion and local languages. Broadly the dialects of Konkani language are classified into three groups: Northern Konkani, spoken in the Ratnagiri district of Maharashtra with strong cultural ties to Marathi; Central Konkani, spoken in Goa influenced by Portuguese language; Southern Konkani, spoken in coastal region of Karnataka influenced by Tulu and Kannada languages. Among these states, Konkani is the predominant language (70% of the population) for the auditory texture of the Goan linguistic environment with two dialectal variations depending on Hindu and Christian population.

Konkani was accepted as official language of Goa state since 1987 with Devanagari script. It has 16 basic vowels, 36 consonants, 5 semivowels, 3 sibilants, 1 aspirate and many diphthongs. Different types of nasal vowels are a special feature of the Konkani language (Bhat & Sunita, 2004). However, till date with reference to Konkani language no test material available for measuring speech identification performance for Goan population. Hence there is a need to develop material for assessing speech identification score which includes words which are familiar and commonly used in two dialects (Hindu & Christian) of Goan Konkani. Thus, the purpose of the study was to develop and evaluate word lists in Konkani (common to both Goan dialects) for assessing speech identification performance.

Method and Materials

In order to fulfill the aim of the study, the following method was adopted. The study was conducted in three phases:

Phase 1: Development of PB word lists in Goan Konkani as a test material for assessing speech identification performance.

Phase 2: Assessing the validity of word list

Phase 3: Assessing the reliability of the word list

Phase 1: Development of PB word lists in Konkani as a test material for assessing speech identification performance.

The following steps were involved while developing the word lists in Konkani for assessing speech identification performance: 1) Collection of words 2) Familiarity assessment of collected words 3) Construction of final word lists

1. Collection of words in Konkani

The monosyllabic words were collected from different sources like consulting linguists having good knowledge in Konkani language, Goa Konkani-English Dictionary (Borkar, Thali & Ghanekar, 2004) & from a fairly recent publication entitled "Konkani Utravoll" (Goeant challant gholpi) which consisted of the most frequent occurrence of phonemes and frequently used words in spoken & written Konkani, compiled by Mahale (1995). With the help of a linguist, approximately 75 words were selected based on frequency of occurrence of phonemes and words which are common to both dialects.

2. Familiarity check.

The collected 75 monosyllabic words were assessed for familiarity in order to ensure that the selected words were known to native speakers of Konkani and were commonly used in both dialects (Hindu & Christian Konkani). To assess the familiarity, the monosyllabic words were presented to one hundred normal native Konkani speaking individuals above the age of 16yrs belonging to the general Goan population. The subjects were instructed to rate the monosyllabic words on a 3 point rating scale as; unfamiliar, familiar, or very familiar. Out of 75 words, 8 words were rated as unfamiliar, 19 were rated as familiar & 48 were rated as very familiar. The words rated as familiar and most familiar were considered for constructing the final word lists.

3. Construction of final word lists

The 67 words which were rated as familiar and very familiar were presented to 10 normal hearing individuals at 40 dB SL to assess whether the normal hearing individuals can identify these words without difficulty. All the listeners identified all 67 words at 40 dB SL with 100% accuracy. Finally, two word lists of 20 words (Appendix I & II) each were prepared from these 67 words based on the frequencies of occurrence of different phonemes in Konkani language. Further, 10 words were selected as practice items.

Phase 2: Assessing the validity of word list

A formal study was carried out to evaluate the validity of the word lists by comparing the performances of two groups of subjects: normal hearing and sensori-neural hearing impaired using the following method.

Subjects:

A total of 20 subjects (group I) in the age group of 18-30 (M = 23.08 yrs) years with normal hearing and no speech disorders and 20 subjects (group II) in the age range of 45-70(*M* = 60.06 yrs) years of age having bilateral mild to moderately severe SN hearing loss served as subjects. All the subjects were native speakers of Goan Konkani (equal number in both the social dialect groups).

Audiometric testing

The audiometric assessments including otoscopic examination, pure-tone audiometry, speech audiometry and tympanometry were conducted to ensure that suitable subjects with normal hearing and sensori-neural hearing loss were selected for the experimental procedures. The pure-tone average threshold (PTA) and speech recognition threshold (SRT) was obtained for all the subjects using Arphi Diagnostic Audiometer 2001diagnostic clinical audiometer with TDH 39 headphones. Tympanometry was carried out using Madson Zodiac 901 middle-ear analyzer.

Administration procedure

The subjects were tested in a sound-treated audiometric room. The examiner presented the speech stimuli using monitored live voice, ensuring that the deflection of the VU meter was zero. The stimuli were presented using live voice by a native female speaker of Goan Konkani through a microphone positioned approximately 5 cm from the mouth of the talker at 0° azimuth. Prior to the speech identification score testing, each subject's Speech Recognition Threshold was obtained using Konkani Spondees developed & standardized by Saldanha (2008). Before the assessment of the speech identification performance, each subject was given following instructions in Konkani "You will hear a list of words, through your earphones. Listen carefully and when you hear a word repeat the words". Initially ten practice items were presented in order to familiarize the subjects about the test procedure. All the words obtained were presented at presentation level of SRT+40 dB SL as reported that, normal hearing individuals obtain maximum SIS scores at 40 dB SL relative to SRT (Eldert & Davis, 1951; Silman & Silverman,

1991). Each correct response was given a score of 1 and an incorrect response was given a score of 0. The raw score was then converted to percentage as follows:

$$\text{Test score \%} = \frac{\text{Total number of correct response} \times 100}{\text{Total number of words presented}}$$

Phase 3: Assessing the reliability of the word list

Test Retest reliability of the word list was verified by administering the same PB word list to the same group of 20 normal hearing subjects (40 ears) after a gap of one week, at the same intensity level (40 dB above the SRT). The number of correct responses given by each subject for the list tested was carefully noted for both administrations. The data obtained was subjected to statistical analysis, where their means and standard deviations were obtained.

Results

Speech identification scores are represented as the percentage of words correctly identified or recognized by an individual at a comfortable supra threshold level (40 dB SL). The mean and standard deviation values for each Konkani PB word list for two groups are summarized in table 1.

Table1. Mean speech identification scores (%) of each list for two groups

Word list	Presentation level	Group I (Normal hearing)		Group II (SN hearing Loss)	
		Mean	SD	Mean	SD
1	40 dB SL	100	0.00	89.3	4.95
2	40dB SL	100	0.00	88.2	4.35

It can be noted from the above table that, at 40 dB SL (above the SRT) level, normal hearing subjects attained maximum speech identification scores when compared to SN hearing impaired subjects using both word lists and was statistically significant ($p = 0.001$). Hence, it can be concluded that, the two PB word list developed in Konkani language equally capable in differentiating normal hearing subjects from that of hearing impaired subjects.

Test Retest reliability of the word list was verified by administering the two word lists to the same group of 20 (40 ears) normal hearing subjects after a gap of one week, at the same intensity level (40 dB above the SRT). The subjects obtained 100% speech identification scores for both word lists. This clearly indicates a high test retest reliability of the Konkani word list developed.

Discussion

It is a well-established fact that, speech audiometry testing assesses the higher level linguistic functions and hence, is clinically more acceptable than pure tone audiometry. Despite its widely accredited applications, the accuracy of Speech audiometry is often marred by the utilization of foreign/unfamiliar words due to the limited or non-existent speech material in many of the world's languages. Speech audiometry to be a valid and accurate evaluation, individuals should be tested in their native language (Ramkissoon, 2001).

The present study intended to develop Speech Audiometry material (phonetically balanced words) in Goan Konkani. Following the selection of the most familiar monosyllabic words in the Konkani language, a list of PB words was created. A vital phase in this study was the determination of the Speech Identification Scores in normal hearing native Goan Konkani speakers. As reported by Eldert & Davis (1951)**,** at intensity levels 35 to 40 dB above the SRT normal hearing individuals obtain a maximum SIS score of 95 to 100%. Taking this into account, phonetically balanced familiar words were presented to 20 normal hearing individuals (40 ears) at 40 dBSL. All the subjects with normal hearing thresholds attained maximum (100%) SIS scores when presented at 40 dB SL. This indicates that the PB words developed in this study are consistent enough to be used routinely when establishing SIS in the clinical population.

The next logical and important step was to test the same material (PB words) on individuals who have sensory neural hearing impairments, as eventually the materials created were to be used with individuals with possible hearing impairment**.** Jerger (2006) suggested that the word lists need to be tested on the population for which the test is intended in order to establish a more accurate test. Goetzinger (1978) found that the Speech Identification Scores can vary from 90 - 100% in normal hearing individuals to 80 – 95% in individuals with varied degree of sensory deafness. McArdle and Wilson (2006) reported that there is a significant difference in the performance of individuals with normal hearing and those with hearing impairment. Similarly, the results of the present study also indicated a prominent difference in the SIS scores between

normal hearing subjects and individuals with hearing loss (100% and 89.3% respectively). Hence it can be inferred that the SIS obtained using the Konkani PB words developed in this study can be used consistently to discriminate between an individual with normal hearing & one with hearing loss.

Conclusion

Speech audiometry is very essential component of audiological test battery. It gives information about an individual's sensitivity to speech stimuli and understanding speech. Routine assessment of speech perception skills is necessary using reliable and valid clinical assessment tools in specific native languages. In India there are nearly 29 independent languages and very few languages have speech audiometric test materials. Many Indian researchers and audiologists have recognized this need and have begun to develop speech audiometry material across different Indian languages in an attempt to enhance the validity & accuracy of the speech audiometry procedure & thereby boosting the precision of audiological testing in the diagnosis of hearing impairment. Considering this, the current study developed 2 word lists (20 words each) in Goan Konkani language for assessing speech identification performance in adults. The word lists developed in Goan Konkani language were found to be reliable and was able to differentiate the performance of normal hearing and hearing impaired individuals.

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APPENDIX – I

P.B. WORD LIST 1

1. भूक /bʱuːk/
2. घाण /gʱaːɳ/
3. तीख /ʈiːkʰ/
4. दोन /ɖon/
5. धा /ɖʱaː/
6. पोट /poʈ/
7. मास /maːs/
8. लांब /laːmb/
9. शेत /ʃeʈ/
10. वेळ /ʋeɭ/
11. ढोल /ɖʱol/
12. थय /ʈʰəj/
13. घर /gʱər/
14. गांठ /gaːnʈʰ/
15. चोर /tsor/
16. छाप /cʰaːp/
17. जीब /ɟiːb/
18. झाड /zʰaːɖ/
19. वाट ˈ/ʋaːʈ/
20. फोड ˈ/foɖ/

APPENDIX – II

P.B. WORD LIST 2

1. झेत /ɟʰeʈ/

2. कांय /kãːj/

3. जाप /zaːp/

4. फळ /fəɭ/

5. तेल /ʈel/

6. ढ्ग /ɖʱəg/

7. णव /ɳəv/

8. धर /dʱɽər/

9. सुख /sukʰ/

10. पांच /pãːts/

11. चड /tsəɖ/

12. हय /həj/

13. भाव /bʱav/

14. शीत /ʃiːʈ/

15. बस /bəs/

16. छा /cʰaː/

17. माड /maːɖ/

18. देव /deɽv/

19. मीठ /miːʈʰ/

20. बोट /boʈ/

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