Development and Standardization of Spondee and Phonetically Balanced (PB) Word Lists in Mizo Language

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Abstract

The aim of the study was to develop and standardize Spondees and PB words in Mizo language that can be used to measure the Speech Recognition Threshold (SRT) and Speech Identification Scores (SIS) for native speakers of Mizo, a language spoken in Mizoram, India. Method: Two lists each of Spondees and PB words with high familiarity were developed as per standard procedures and the SRT and SIS evaluated for 100 (one hundred) native speakers of Mizo language in the age ranged between 18 years to 40 years, with normal hearing. Performance – intensity function for each word lists were evaluated at 6 intensity levels (0 to 10 dBSL) in 2 dB increments. To establish the reliability of these materials, 10% of the subjects were retested after a minimum period of 5 days. Results: No significant differences were found between the two Spondee lists and PB word lists for both the right and the left ear across gender. The two lists of spondaic words and PB words yielded equivalent SRTs and SIS (at 40 dB SL, ref: SRT). For the spondees at different presentation levels, there was a significant difference in scores between spondee lists I & II at lower presentation levels (0 dBSL to 4 dBSL). However, as the presentation level increases, no significant difference in scores were found and at 10 dBSL of presentation, the scores of list I & II were equal. There was no significant difference in scores between PB word lists 1 & 2 at six different levels of presentation (0 dBSL to 10 dBSL).

Introduction

Hearing Assessment

A comprehensive evaluation of an individual's hearing acuity requires several different types of diagnostic techniques. A commonly utilized procedure is pure-tone audiometry.

a) Pure Tone Audiometry: This procedure assesses the thresholds at which a listener is able to detect sinusoidal frequencies. Pure-tone testing is a relatively quick and reliable method to obtain an assessment of an individual's ability to detect specific frequencies. However, to accurately evaluate a listener's ability to comprehend the more complex acoustic signals such as speech, additional auditory tests need to be performed.

b) Speech Audiometry: Speech audiometry is a procedure that is used to evaluate a listener's ability to hear, recognize and understand speech communication (ASHA, 1988; Young, Dudley, & Gunter, 1982). This type of assessment is valuable in the diagnosis of peripheral and central auditory disorders, evaluation of hearing aid candidacy,

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assessment of hearing aid performance, as well as locating possible lesions within the auditory system. In addition, speech audiometry can be used to validate previously obtained pure-tone average (PTA) results.

Diagnostic significance of Speech Audiometry

Speech Audiometry serves many clinical purposes. The basic purpose is to quantify the listener's hearing level for speech. Speech audiometry is often utilized as a diagnostic tool in determining whether a hearing impairment exists (Bell & Wilson, 2001) and whether the impairment is conductive, sensory, or neural (Egan, 1979; Hagerman, 1984). It is also helpful in diagnosing central and peripheral auditory disorders (Jerger et al, 1983) as well as being used to assess performance and function of cochlear implants (Dowell et al, 1986; Cowan et al, 1997; Sarant et al., 2001). It provides more information than pure-tone audiometry concerning a person's hearing impairment because it analyzes not only residual hearing threshold but also sound distortion, loudness, localization, and speech comprehension (Martin, 2001). It serves as a validity check for the pure tone audiometry. Speech Identification (SI) on the other hand makes it possible to evaluate the functional integrity of the auditory system. The poorer the SI scores, greater is the involvement of sensori-neural mechanism. SI scores can be used to differentiate cochlear pathology to retrocochlear pathology in addition with other test results (Goetzinger, 1972).

Using speech audiometry, audiologists set out to answer questions regarding patients' degree of hearing loss for speech, the levels required for the speech to be most comfortable, uncomfortable loudness levels, the range of comfortable loudness and perhaps most importantly, their ability to recognize the sounds of speech. Speech-language pathologists and audiologists use findings of speech audiometry in both therapy planning and counseling (Martin & Clark, 2003).

Various kinds of speech stimuli have been used to determine the SRT. They are sentences, connected discourse, spondaic words, spoken digits etc. the kind of stimuli used for speech discrimination testing are monosyllables, nonsense syllables, synthetic speech etc. For the estimation of SRT, spondaic words are the most widely used test stimuli and mono syllabic words in case of SI tests (Carhart, 1971).

Need for the study

High-quality, standardized speech audiometry materials have been developed and used extensively in English. Since India is a multilingual country, there is a need to develop the language specific test material. Several Speech Recognition Tests have been developed in Indian languages, such as, Spondaic word lists in Tamil, Telugu and Malayalam by Kapur (1971), SRT Test for adults and children in Kannada by Rajashekhar (1976), Speech Test material in Manipuri by Tanuza (1984), SRT Test in Bengali by Ghosh (1986), SRT Test in Gujarati by Mallikarjuna (1990) and SRT Test in Oriya by Behera (2004).

Among the Speech Identification tests developed for the adults were Phonetically Balanced (PB) words list in Hindi by Abrol (1971, cited in Nagaraja, 1990), Speech Perception Test in Tamil, Telugu and Malayalam by Kapur (1971), Hindi PB list for Speech Audiometry and Discrimination Test by De (1973), Synthetic Sentence Identification Test in Kannada by Nagaraja (1973), Common Speech Discrimination Test for Indians by Mayadevi (1974), PB Test in Tamil by Samuel (1976), Speech Identification in Manipuri by Tanuza (1984), Speech Identification Test in Bengali by Ghosh (1986), Speech Identification Test in Gujarati by Mallikarjuna (1990) and Speech Identification Test in Oriya by Behera (2004).

Mizo is a language spoken in the North- Eastern state of Mizoram, with a population of 9 lakhs. This kuki- chin branch of Tibeto- Burman language is unique in the sense that it is tonal in nature, having 5 vowels and 28 consonants.

No speech test material for evaluating the speech recognition threshold and speech identification ability is available in Mizo language. Hence, there was a need to develop and standardize speech material in Mizo for assessing the hearing abilities of subjects who know only Mizo language.

Aims & objectives of the study

The main objectives of the study were:

1) Construction of a bisyllabic word list to assess speech reception threshold in Mizo language
2) Construction of a monosyllabic word list to assess speech identification scores in Mizo language.
3) Standardization/ normalization of the lists prepared.

Method

The study was conducted with an aim to develop and standardize spondees and phonetically balanced word lists for speech recognition and identification tests in Mizo language. The study was carried out in two stages:

Stage I: Construction of test material for the Speech Recognition Threshold Test and Speech Identification Tests.

Stage II: Standardization of the test material using Mizo speaking adult subjects.

Stage 1: Construction of the test material-

a) Obtaining familiar, equally stressed bisyllabic words and monosyllabic (cvc) words
b) Constructing lists of bisyllabic and monosyllabic words.

a) Procedure of familiarity

In the absence of documents on phonemic and morphophonemic counts in Mizo language, familiar bisyllabic and monosyllabic words were selected randomly from different sources like magazines, newspapers, books and telephonic conversations of individuals fluent in the language. From a corpora of about 1,00,000 words, familiar 713 bisyllabic and 414 monosyllabic words were selected randomly. A linguist who is familiar with Mizo language was consulted to confirm whether the bisyllabic/ monosyllabic words selected were indeed bisyllabic or monosyllabic respectively.

To further ensure familiarity of the words selected, they were given to 20 normal adults in the age range of 18 years to 40 years, whose mother tongue was Mizo. The subjects were asked to rate the words on a three-point scale of familiarity (i.e., most familiar, familiar and unfamiliar). Words rated as 'most familiar' to 90% of the subjects were selected for inclusion in the test lists.

b) Construction of the lists:

For the SRT testing, two lists (List I and II) were developed consisting of 25 bisyllabic words each. It was ensured that each list has all the phonemes of the language and equal stress maintained on both the syllables of the bisyllabic word.

For the SI testing, two lists (List 1 and List 2) were developed consisting of 50 monosyllabic words each. The phonemic balance in the word lists were done based on the frequency of occurrence of phoneme in Mizo. Due to unavailability of documents on frequency count of occurrence of a phoneme in Mizo language, the frequency of occurrence of each phoneme in the same corpora was taken. The number of times each phoneme occurred in the corpora was tallied and counted, and then their percentage of occurrence was calculated and ranked in the order of decreasing frequency. The ranking was divided into 4 equal quadrants. The 1st quadrant consisted of sounds occurring very frequently, the 2nd and 3rd quadrants consisted of sounds occurring frequently and the 4th quadrant consisted of sounds not occurring frequently. The relative frequency of occurrence of phonemes in Mizo language was kept in mind while choosing the words with different phones in the list. Thus the phonemic balance was maintained in each of the lists.

Stage II: Obtaining normative data

One hundred (100) adults in the age range of 18 years to 40 years (mean age 25 years) were selected for obtaining normative data. The subjects who participated in the familiarity rating were excluded from this group. The subjects met the following criteria to be considered for the study:

i) Hearing sensitivity within normal limits i.e. air conduction thresholds less than or equal to 15 dBHL at all frequencies from 250 Hz to 8 KHz for both the ears.

ii) Have normal middle ear functioning.

iii) Do not have any history/presence of otological problems.

iv) Do not have any speech problems

v) The mother tongue and language spoken at home is Mizo, a language spoken in the state of Mizoram, in India.

Instrumentation

i) A calibrated two channel diagnostic audiometer (OB 922), with TDH- 39 headphones housed in MX- 41/ AR ear cushion, calibrated in accordance with ANSI, 1996 S3.6 was used for initial hearing assessment as well as to carry out speech audiometry.

ii) A calibrated GSI- Tympstar Immittance meter to ensure normal middle ear condition in the subjects.

iii) Philips CD player, which fed the recorded speech material to the tape input of the audiometer which in turn was fed to the earphone (TDH- 39) housed in MX-41/AR cushions.

Test environments

The test was carried out in a sound treated double room situation. The ambient noise levels were within permissible limits, as recommended by ANSI, 1991 S3.1 standards.

Test procedure

i) All the subjects were subjected to routine audiological testing by obtaining air conduction and bone conduction thresholds for the frequencies 250 Hz-8000 Hz and 250 Hz-4000 Hz respectively using modified Hughson & Westlake procedure (Carhart & Jerger, 1959). Only those who obtained normal hearing were selected for further evaluation.

ii) Tympanometry for 226 Hz probe tone was done for all subjects. Ipsilateral and contralateral acoustic reflex thresholds were obtained for 500Hz, 1 KHz, 2 KHz and 4 KHz for all the subjects.

Instructions

The subjects were given the following instructions in Mizo language:

Instruction for SRT testing: “You will hear a word after the sentence, “Sawi rawh le” through your headphones. Listen carefully to each word and repeat them. The words will get softer. If you are not sure of the word, you can guess the word”.

Instruction for SI testing: "You will hear some short words through the headphone. Listen carefully to each word and repeat them".

Normative data for SRT test material

Using the material developed for SRT, each of the subjects was tested for the following:

a) Establishment of SRT

b) Performance intensity (articulation gain) function of the spondee word lists.

a) Establishing SRT

The ASHA (1988) method for SRT determination was followed to evaluate the speech recognition threshold. The procedure is as follows:

Preliminary phase to obtain starting level:

i) The hearing level was set to 30-40dB above the estimated SRT and one spondaic word was presented to the client. If the response was correct, then the level was descended in 10 dB decrements, presenting one spondaic word at each level until the client responded incorrectly. If the client did not respond correctly to the first spondaic word at the first level, the level was increased in 20 dB steps until a correct response was obtained. Then the 10dB decrements were initiated.

ii) When one word was missed, a second spondaic word was presented at the same level.

This process of descending in 10dB steps was continued until a level was reached at which two consecutive words were missed at the same hearing level.

iii) The hearing level was increased by 10 dB (above the level at which two spondaic words were missed). This defined the starting level.

Test Phase

- Five spondaic words were presented at the starting level and at each successive 5dB decrement.
- This was continued if five out of the six words were repeated correctly.
- If this criterion is not met, the starting level was increased by 4- 10 dB.
- The descending series was terminated when the client responded incorrectly to five of the last six words presented.

Then thresholds were calculated for both the ears, as per ASHA (1988) recommendations.

b) Performance intensity function of the spondee word lists

The word recognition of the spondee word lists were established at different intensities, starting from 0 dBSL to 10 dBSL progressing in 2 dB steps. The subjects were instructed to repeat the test words and the responses noted down. At each intensity, both lists (I&II) were presented. At each intensity level, the order of words in the lists was randomized in order to avoid familiarity effect. The average percentage correct scores for both the lists (I&II) were plotted as a function of intensity. This is called the Performance Intensity function.

Normative data for Speech Identification (SIS) material

Using the material developed for Speech Identification Scores, each of the subjects was tested for the following:

a) Establishment of SIS

Each list (List 1 and List 2) was presented at intensity, 40 dB SL (ref SRT). All the subjects were tested at this intensity level and each subject was tested in both the ears. The number of monosyllabic words correctly identified in each list was noted.

b) Performance Intensity- Phonetically Balanced (PI-PB) function of the word lists

The word identification of the PB word lists were established at different intensities, starting from 0 dBSL to 10 dBSL (reference: SRT) progressing in 2 dB steps. The subjects were instructed to repeat the test words. At each intensity, both lists (1&2) were presented. At each intensity level, the order of words in the lists was randomized in order to avoid familiarity effect. The average percentage correct scores for both the lists (1&2) were plotted as a function of intensity (Performance Intensity function).

Reliability check

10 % of subjects were subjected to retesting for a time gap of at least five days. Test-retest reliability was calculated using this data.

Statistical analysis

Appropriate statistical analyses were carried out for the data.

Results and Discussion

The present study was carried out with an aim of developing and standardizing spondees and phonetically balanced word lists for speech recognition and identification tests in Mizo language.

Spondee word lists

Results of mean and standard deviation of SRT for the spondee word lists I & II

Table 1: Mean and Standard deviation (S.D) of SRT for spondee word lists I & II for Right ear and Left ear across gender.

	Spondee word list I				Spondee word list II			
	Male		Female		Male		Female	
	Left	Right	Left	Right	Left	Right	Left	Right
Mean (dBHL)	13.46	13.37	13.12	12.91	13.43	13.38	13.12	13.29
S.D (dBHL)	3.33	3.49	2.54	2.85	3.34	3.48	2.70	2.90

It is evident from Table 1 that the mean SRT scores for both the lists across both the genders and ears (left & right) are comparable. Figure 1 shows the graphical representation of the same results.

The mean SRT, considering both males & females and right & left ear together using list I was attained at 13.21 dB HL (re: PTA) with a SD of 3.05 and that for list II was attained at 13.30 dB HL (re: PTA) with a standard deviation (SD) of 3.10.

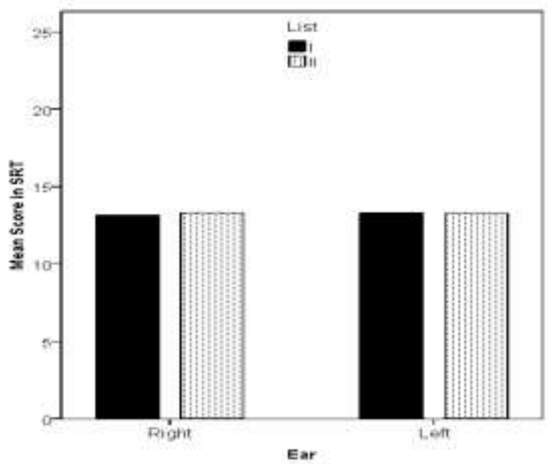

Figure 1: Mean SRT scores for right and left ear for List I & II.

Mixed analysis of Variance (ANOVA) was done to see if there is any statistical difference between the lists, between the ears, between genders. The results of Mixed ANOVA revealed that there was no significant difference between the lists [$F (1, 98) = 0.726$, $p > 0.05$], no significant difference between the ears [$F (1, 98) = 0.049$, $p > 0.05$] and no significant difference was found for gender [$F (1, 98) = 0.264$, $p > 0.05$]. Also, no significant interaction was found between the lists & gender [$F (1, 98) = 0.948$, $p > 0.05$], ear & gender [$F (1, 98) = 0.013$, $p > 0.05$], list & ear [$F (1, 98) = 1.080$, $p > 0.05$] and also for the three factor interactions i.e. list, ear and gender [$F (1, 98) = 0.619$, $p > 0.05$].

Thus, the averaged data of the hundred participants showed no significance in scores for spondee word lists I and II for right and left ear across gender at 0.05 confidence levels. Also, the results demonstrated that the two lists of spondaic words yield equivalent SRTs.

The findings of the present study are also in consonance with various studies, Hirsh et al., 1952, Swarnalatha (1972) obtained SRT for spondees at 9 dBHL (re: PTA), Ghosh (1986) obtained SRT at 12 dBHL re: PTA), Tanuza (1984) obtained SRT at 13 dBHL for spondees in Manipuri language and Behera (2004) obtained SRT at 10 dBHL (re: PTA) for Oriya language.

Performance Intensity function of the Spondee list I & list II

Mean and SD of performance intensity function for spondee word lists I & II were calculated and are given in Table 2.

Table 2: Mean and SD of scores on spondee lists I & II at different intensity levels (0 to 10 dBSL with reference to pure tone average) across gender (raw scores).

	Intensity (dBSL) ↓ Re : PTA	**Female**		**Male**	
		Mean	**SD**	**Mean**	**SD**
Spondee List- II	Zero	10.85	2.27	11.30	2.37
	Two	16.10	2.83	15.86	2.82
	Four	20.50	2.35	20.32	2.57
	Six	23.37	1.59	23.65	1.54
	Eight	24.83	0.51	24.84	0.41
	Ten	25.00	0.00	25.00	0.00
Spondee List- I	Zero	11.47	1.90	11.67	2.12
	Two	16.66	2.54	16.53	2.99
	Four	20.85	2.28	21.00	2.48
	Six	23.68	1.51	23.98	1.37
	Eight	24.91	0.34	24.92	0.38
	Ten	25.00	0.00	25.00	0.00

From Table 2 we can see that the performance intensity function increases as the intensity is increased and almost reaches to a saturation level between 8 to 10 dBSL. The scores do not differ across Males and Females. 50% correct criteria was met between 0 & 2 dBSL (ref PTA). The 50% correct criteria for spondee words were obtained at 0 dBHL for normal hearing young adults (ANSI, 1989). The finding of the present study is consistent with the correlation between SRT & PTA reported in the literature, thus validating the speech material developed.

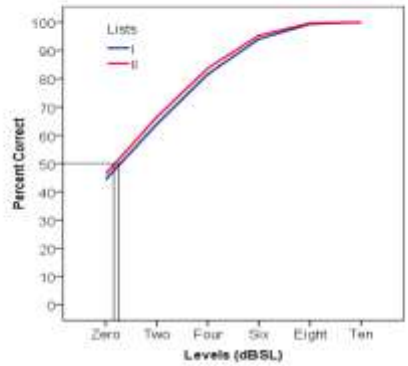

Figure 2: Performance intensity function of spondee Lists I and II across the six intensity levels.

Mixed ANOVA was done to test the statistical significance of the lists across the different intensity levels and also to see the interaction effects between different variables. Mixed ANOVA revealed that at 0 dBSL to 4 dBSL there was a statistical significance between the two spondee lists I & II [$F(1, 98) = 8.592$, $p < 0.01$], however, at higher presentation levels of 6 dBSL [$t(99) = 1.976$, $p > 0.05$] and 8 dBSL [$t(99) = 1.469$, $p > 0.05$], there was no significant difference between the two lists and the scores at lists I & II are equal at 10 dBSL. Also there was a statistical significance between list & level interaction [$F(5, 490) = 3.588$, $p < 0.01$]. However, there was no significant difference across genders [$F(1, 98) = 0.080$, $p > 0.05$, list & gender interaction [$F(1, 98) = 0.017$, $p > 0.05$], level & gender interaction [$F(5, 490) = 0.502$, $p > 0.05$] and interaction between lists, levels and genders [$F(5, 490) = 0.502$, $p > 0.05$].

Bonferroni Multiple Comparison Test indicates that the intelligibility of the lists improved significantly with increase in presentation level. A study by Hirsh et al. (1952) reported that, with increase in presentation levels, the identification scores for bisyllabic words increases.

Mean SRT across List I and II across the six levels (Figure 2) showed that as the intensity level was increased from 0 dBSL to +10 dBSL, the performance intensity function showed a steeply rising curve from 0 dBSL to 8 dBSL. However, at +10 dBSL, the curve flattens out as the intelligibility reached 100 %. This showed that, there was an increase in scores as the intensity of the presentation level is increased.

The performance intensity function for W-1 showed similar results. The scores reached the 100% point at about +14 dB above threshold.

Table 2 showed that as the presentation level was increased from 0 dBSL to 10 dBSL, the standard deviation (SD) of scores on spondee List I & II reduced from 2.27 to 0 and 1.90 to 0 respectively.

In agreement with our findings, a study on 'Development and evaluation of Mandarin disyllabic materials for Speech Audiometry in China by Wang et al (2007), SD reduced as the presentation level was increased (from 0 to 15 dB HL) in the mean performance-intensity function test, indicating that at higher presentation levels the subjects' performance became less variable.

Monosyllabic Phonetically Balanced Word Lists

Results of mean and standard deviation of SIS for monosyllabic PB word lists I & II

Table 3: Mean and Standard deviation (S.D) of SIS for PB word lists I & II for Right ear and Left ear across gender and across Ear.

	PB word list-1				PB word list-2			
	Male		Female		Male		Female	
	Left	Right	Left	Right	Left	Right	Left	Right
Mean (%)	97.52	99.26	97.24	97.2	97.88	97.52	97.28	96.82
S.D (%)	2.58	2.52	3.90	2.78	2.38	2.70	2.34	2.84

It is evident from the table that the mean SIS scores across both the genders are comparable and is almost similar across the ears. Thus, the two lists are equivalent. Figure 3 shows the graphical representation of the same results.

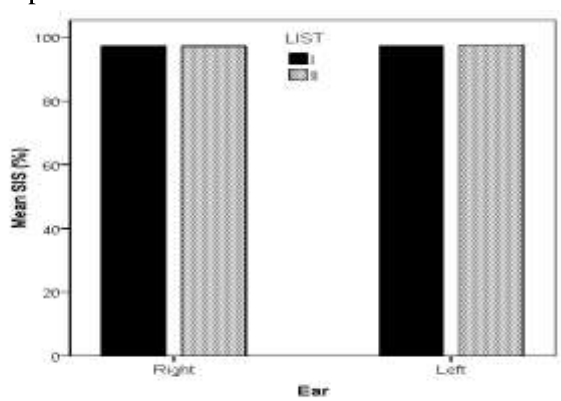

Figure 3: Mean SIS scores for Right and Left ear for PB List-1 and List-2.

Mixed analysis of Variance (ANOVA) was done to see if there is any statistical difference between the lists, between the ears, between genders. The results of Mixed ANOVA revealed that there was no significant difference between the lists [$F (1, 98) = 0.647$, $p > 0.05$], no significant difference between the ears [$F (1, 98) = 0.159$, $p > 0.05$] and no significant difference was found for gender [$F (1, 98) = 1.618$, $p > 0.05$].

Studies in other languages have also yielded similar results, where they found no significance between their lists. Hirsh et al., 1952, Abrol (1971) in Hindi, Kapur (1971) for Tamil PB word lists.

Performance Intensity function for Phonetically Balanced (PB) word list I & list II

Table 4: Mean and Standard deviation (S.D) of SI (in %) for PB word lists I & II at different intensity levels (0 to 10 dBSL with reference to SRT) across gender.

	Intensity (dBSL) (re: SRT)	**Subjects (N = 100)**	
		Mean	**SD**
List-1	Zero	24.48	9.09
	Two	43.60	11.93
	Four	63.70	12.68
	Six	81.00	9.95
	Eight	93.70	5.49
	Ten	99.78	1.05
List-2	Zero	24.06	9.20
	Two	43.70	11.19
	Four	64.40	12.97
	Six	81.14	10.55
	Eight	94.04	6.18
	Ten	99.78	1.36

From Table 4 we can see that mean raw scores of SIS increases as the intensity is increased and also the SIS does not differ across Males and Females.

For PB word lists I and II, the SD was lesser for higher sensation level reflecting lesser variance.

The results are in consonance with findings of Swarnalatha (1972), Mayadevi (1974), Tanuza (1984), Ghosh (1986) and Behera (2004).

As it can be seen from figure 4 that as the intensity level increases, the mean scores of SIS also increases and almost reaches the saturation level between 8 to 10 dBSL. The scores of SI are reaching to 100% at 10 dBSL.

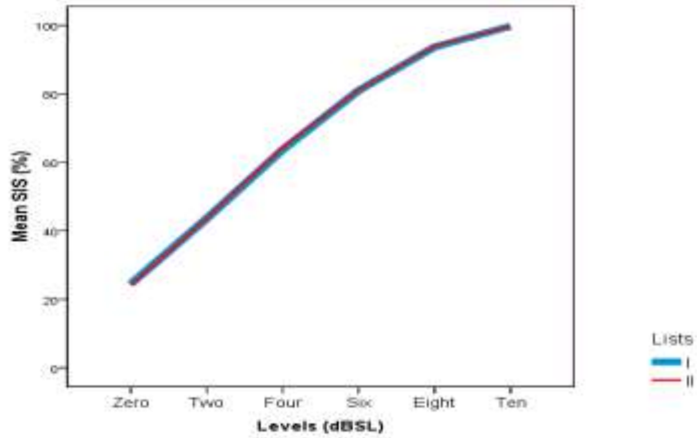

Figure 4: Mean SIS (in percentage) for PB Lists I and II across the six intensity levels.

Mixed ANOVA was done to see the statistical significance of the lists across the six intensity levels and also to see the interaction effects between different variables. Mixed ANOVA revealed that there was no statistical significance between the two PB word lists [F (1, 98) = 0.026, p > 0.05], list & level interaction [F (5, 490) = 1.273, p > 0.05], across genders [F (1, 98) = 2.188, p > 0.05, list & gender interaction [F (1, 98) = 0.026, p > 0.05], level & gender interaction [F (5, 490) = 1.658, p > 0.05] and interaction between lists, levels and genders [F (5, 490) = 1.097, p > 0.05. However, there was a statistical significance at the six intensity levels [F (5, 490) = 2353.716, p < 0.01].

Further Paired sample t-test was done to compare the two lists at different intensity levels which revealed that there is no significant difference between list I & II at all the levels.

From this study it can be seen that the mean scores for the SIS is almost similar across the gender and ears. And the mean scores for the intelligibility of the PB word lists at increasing intensities showed that as the intensity level increases, the speech identification scores increases, and reached a score of 100% at 10 dBSL (with reference to SRT) for both the lists. The curve is sharply rising indicating a positive relationship with the percentage scores and the level at which the material is presented. The maximum score on the PI-PB function is called the PB max.

These findings are in high correlation with that of earlier studies done by several authors where essentially a same curve is obtained for normal hearing subjects. Maroonroge and Diefendorf (1984) in their study of speech identification scores for 3 word lists- NU-6, California Consonant Test and Pascoe high frequency word lists found that the speech identification scores tend to improve up to about 30 dBSL for normals.

For the CID Auditory Test W-22, it was found that the scores increased sharply with increasing levels of presentation and scores remained constant at about 40 dBSPL (Hirsh et al., 1952).

Hood & Poole (1980), based on their study had stated that, in normal hearing subjects, the performance intensity function (curve) derived for a single list is no different from that obtained with a number of equivalent lists. Lau and So (1988), on their study of Cantonese Speech Audiometry, stated that, averaged discrimination scores over all lists tends to increase with increase in stimulus level and the Standard deviation decreases as the level increases, they found that at 30 dBHL all the 10 lists have equivalent intelligibility.

Similar findings have been listed on studies relating to Speech Identification for monosyllabic words across different languages.

Reliability

Reliability check was performed on 10% of the obtained data. Cronbach's Alpha Coefficient was done to check the reliability of the data.

Percent reliability of Spondee list I & II and PB list 1 & 2:

SRT list I: 95%, SRT list II: 89%, SI list I: 83%, SI list II: 85.5%.

Cronbach's Alpha Coefficient thus indicated that there is correlation for SRT and SIS of lists I and II. Thus this shows that the Spondee word lists and the Phonetically Balanced word lists are reliable.

Conclusions

The purpose of this study was to develop and standardize Spondees and PB words in Mizo language that can be used to measure the Speech Recognition Threshold (SRT) and Speech Identification Scores (SIS) for native speakers of Mizo, a language spoken in Mizoram, India. Two lists each of Spondees and PB words with high familiarity were developed as per standard procedures and the SRT and SIS evaluated for 100 (one hundred) native speakers of Mizo language in the age ranged between 18 years to 40 years, with normal hearing.

The results of the study revealed-

- No significant difference in scores between the two Spondee lists and PB word lists for both the ears across gender
- The two lists of spondaic words and PB words yielded equivalent SRTs and SIS
- Significant difference in scores between spondee lists I & II at lower presentation levels (0 dBSL to 4 dBSL). As the presentation level increases, there was no significant difference in scores and at 10 dBSL, the scores were equal
- As the intensity increases, the scores were found to increase (v) There was no significant difference in scores between PB word lists 1 & 2 at six different levels of presentation (0 dBSL to 10 dBSL).

The materials developed were found to have excellent reliability. Thus the Spondee and the PB word lists developed can be used in clinical situations for Speech Audiometry.

Future research directions

- There have been no materials developed for speech audiometry for children in Mizo language. So, extensive studies could be carried out to develop speech audiometry materials for different age groups.
- These tests could be used to evaluate the speech perception abilities through different hearing aids and thus, its utility in hearing aid selection can be assessed.
- The tests can be used to assess the utility of different devices such as frequency modulation (FM) systems, cochlear implants etc.
- It can also be used to assess the efficacy of intervention with different therapy programs.

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