

Research Article

Speech Audiometry in Pakistan: Development of Urdu Spondee Words List (USWL)

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Abstract

Background: Hearing impairment (HI) is a common barrier to communication which impacts the HI in achieving higher educational goals, impacts them at work and leisure and can result in social exclusion

Objective: To developed Urdu Spondee Words List for establishing Speech Recognition Threshold in Urdu speaking hearing impaired population.

Methods: This descriptive study was conducted in twin cities of Rawalpindi & Islamabad from July 2018 to January 2019. Study involved development of a tool called Urdu Spondee Word list (USWL) and familiarity judgement utilizing a sample of N=50 Urdu speaking participants of both genders aged 10-16 years utilizing convenience sampling, and finally voice analysis on PRATT software. SPSS version 21 was used for data analysis.

Results: The results revealed that the final selected list of 18 spondee words has equally stressed syllables, with the accomplishment of the criteria of familiarity judgment for the participants. The recorded list shows minimum and maximum intensity variation of 3db to 8db in the homogenous audibility of the words making it suitable for speech recognition threshold measures.

Conclusion: The developed 18 item Urdu Spondee Word list (USWL) with criteria of familiarity and homogenous audibility of words is suitable for speech recognition threshold measurement for Urdu speaking population.

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Introduction

Hearing impairment (HI) is a common barrier to communication which impacts the HI in achieving higher educational goals, impacts them at work and leisure and can result in social exclusion.¹

Hearing Loss (HL) is highly prevalent with 466 million

people affected globally,² with bilateral profound HI affecting 1.6/ 1000 population and 70% being due to cousin marriages.³ HI is predicted to rise to 630 million by the year 2030,² with late detection of hearing loss (HL) in developing countries like Pakistan.⁴

A number of hearing assessment tests are in use and selection is based upon different factors including individuals' age. Speech audiometry is used to evaluate hearing sensitivity, speech perception ability, speech discrimination and to determine site of lesion.⁵ The Speech Recognition Threshold (SRT) being the least



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intensity of speech at which one can repeat 50% of spondees and above this one can repeat all spondees offered. Spondees are bi-syllabic words which have equal stress on both like rain bow etc. Hence the level as well as quality of acoustic signal a HI receives through his or her hearing assistive device requires speech recognition.⁵ The correctness of child's speech recognition test is also dependent upon the familiarity of the spondees being used with familiar and unfamiliar words impacting the accuracy of the results, hence it is essentially required to develop standardized test material in every language.⁶ Often audiologists use non standardized bi syllabic word lists for speech audiometry, which are not suitable. In a study by Sreedhar JS et al. speech reception thresholds of paired words were compared with untested bi-syllabic words list being used in clinics, which revealed lower speech recognition thresholds for paired words compared to existing bi syllabic words in use. The study provided evidence in favor of paired words for testing SRT, which should be used instead of unstandardized bi syllabic word list already in use in most clinics.⁷

Hearing loss affected child's recognition of spondees in conditions of speech shaped noise as well as two-talker masker, significantly more than in case of children with normal hearing, hence HL affects perceptual processing ability of children.⁸ Similarly cochlear implanted children with some residual hearing show better speech identification even on low frequencies.⁹ Analyzing aided recognition of word in clients who are being considered for hearing aids is also important.¹⁰ Different researchers develop test materials in their native languages, similarly a study conducted to standardize speech words in Bangla Language for speech audiometry¹¹. Spondees can also be used in Speech Motor Chaining Treatment¹², and for Staggered Sp0ndaic Word Test¹³.

Therefore keeping in view the importance of standardized spondee word list for assessment of speech reception thresholds, and importance of using a local language tool, with no standardized spondee word list available for use for Urdu speaking Pakistani population, importance of speech and word recognition assessment in cases using hearing assistive devices like hearing aids and cochlear implants current study was conceived with the objective to develop Urdu Spondee Words List for establishing Speech Recognition Threshold in Urdu speaking hearing impaired population. The study is of

importance to clinicians managing HI patients for their assessment and better fitting and adjustment of hearing aids and cochlear implant and for speech therapy purposes. It will also fill the gap by providing an Urdu spondee Word List, being deficient in literature and provide a tool for further research.

Methods

This descriptive study was conducted in twin cities of Rawalpindi & Islamabad over a period of 6 months from 1st August 2018 to 31st January 2019. Study involved development of a tool called Urdu Spondee Word list (USWL), familiarity judgment and finally voice analysis on PRATT software.¹¹

A sample of N=50 participants were recruited utilizing convenience sampling for familiarity judgment of words used in Urdu Spondee Word List (USWL) as per following selection criteria:

Study was conducted after obtaining ethical approval of the study protocol from Research Ethical Committee of Riphah College of Rehabilitation Sciences, Riphah International University, Islamabad vide Ref No. RIPHAH/ RCRS/REC/Letter-00412 and informed consent of participants.

Urdu Spondee Word List (USWL) development procedure was divided into seven steps starting from collection of different Bi-syllabic words from different Urdu language resources to ensuring homogenous audibility of the words by calculating maximum and minimum intensities levels. Steps included:

1. 22 Bi syllabic words were collected from different Urdu language resources
2. Four audiologists and speech pathologists identified equally stressed syllables. The words marked as "yes" were selected for further analysis
3. The syllable structure of each word was checked and then the Moraic weights for syllable stress were calculated.
4. Familiarity judgment of the equally stressed bi-syllabic Urdu spondee words was done by presenting lists to the participants having normal hearing thresholds and responses were obtained on a 4 point Likert's scale. The mean and standard deviation of the values were calculated and after that the 18 item final list was prepared.

5. These words were recorded in a sound proof room Acoustic analysis was performed on PRATT program 14 which was created by Paul Boersma & David Weenink. It has wide functionality as regards speech analysis which also covers spectral, pitch, formant, intensity analysis, annotation and manipulation. In the current study Praat was used and speech files for individual words were annotated and spectrographic & intensity analysis performed.

Results

Current study developed tool called Urdu Spondee Word list (USWL). The 22 words were collected from different Urdu Language Resources were analyzed by speech pathologist and audiologists for equal stress on each syllable and those marked "yes" were analyzed and Moraic weights for syllable stress calculated and listed in Table 1 with lowest Moraic weight of 2.2 for خوشبو and all remaining words had a Moraic weight of 3.3.

Sample Utilized for familiarity judgment equal gender distribution and a mean age of 11.52 ± 1.47 years and comprised of 11(22%) 4th Grade, 12(24%) 5th Grade, 19(38%) 6th Grade, 5(10%) 7th Grade and 3(6%) 8th Grade students. Familiarity judgement analyzed on a 5 point Likert's scale revealed highest mean score

Table 1: Syllable Structure and Moraic Weights (N=18)

Serial No.	Urdu Words	Phonetic Transcription	Syllable Structure		Moraic Weight
1	چاند رات	/tʃɑ:nd ra:t/	CVVCC	CVVC	3.3
2	عید گاہ	/i:ḍ ga:h/	VVC	CVVC	3.3
3	سیر گاہ	/sæ:r ga:h/	CVVC	CVVC	3.3
4	کھیل کود	/kʰel ku:d/	CVVC	CVVC	3.3
5	خوف ناک	/xo:f na:k/	CVVC	CVVC	3.3
6	بھاگ دوڑ	/bʰa:g ḍo:r/	CVVC	CVVC	3.3
7	مال دار	/ma:l da:r/	CVVC	CVVC	3.3
8	مار دھاڑ	/ma:r ḍʰa:r/	CVVC	CVVC	3.3
9	دوڑ دھوپ	/ḍo:r ḍʰu:p/	CVVC	CVVC	3.3
10	عام لوگ	/a:m lo:g/	VVC	CVVC	3.3
11	آس پاس	/a:s pa:s/	VVC	CVVC	3.3
12	خوشبو	/xuf bu:/	CVC	CVV	2.2
13	لیپ ٹاپ	/Læp ta:p/	CVVC	CVVC	3.3
14	درس گاہ	/ḍərs ga:h/	CVCC	CVVC	3.3
15	لاڈ پیار	/La:d pja:r/	CVVC	CCVVC	3.3
16	خار دار	/xa:r da:r/	CVVC	CVVC	3.3
17	رنگ ساز	/rəŋg Sa:z/	CVCC	CVVC	3.3
18	کام کاج	/ka:m ka:dʒ/	CVVC	CVVC	3.3

Table 2: Descriptive Statistics for Familiarity Judgment of Each Word (N=18)

Serial No.	Urdu Words	Mean \pm SD
1.	چاند رات	1.02 \pm 0.14
2.	عید گاہ	1.32 \pm 0.97
3.	سیر گاہ	1.84 \pm 1.57
4.	کھیل کود	1.0 \pm 0.00
5.	خوف ناک	1.24 \pm 0.85
6.	بھاگ دوڑ	1.00 \pm 0.00
7.	مال دار	1.2 \pm 0.67
8.	مار دھاڑ	2.00 \pm 1.46
9.	دوڑ دھوپ	3.32 \pm 1.58
10.	عام لوگ	1.1 \pm 0.58
11.	آس پاس	1.02 \pm 0.14
12.	خوشبو	1.00 \pm 0.00
13.	لیپ ٹاپ	1.00 \pm 0.00
14.	درس گاہ	2.76 \pm 1.78
15.	لاڈ پیار	1.06 \pm 0.24
16.	خار دار	4.56 \pm 0.93
17.	رنگ ساز	2.1 \pm 1.62
18.	کام کاج	1.06 \pm 0.31

Table 3: Intensity Levels (dB) for Each Syllable (n=18)

S No.	Urdu Words	Minimum intensity dB			Maximum Intensity dB		
		Syllable 1	Syllable 2	Difference	Syllable 1	Syllable 2	Difference
1.	چاند رات	50.74	57.55	6.81	84.61	83.71	0.9
2.	عید گاہ	50.06	57.58	7.52	86.35	85.03	1.32
3.	سیر گاہ	49.44	53.89	4.45	84.75	87.06	2.31
4.	کھیل کود	39.41	37.91	1.5	86.17	88.58	2.41
5.	خوف ناک	53.11	46.18	6.93	86.31	88.64	2.33
6.	بھاگ دوڑ	56.25	54.85	1.4	87.11	86.93	0.18
7.	مال دار	46.4	49.73	3.33	90.61	85.19	5.42
8.	مار دھاڑ	53.59	52.42	1.17	89.19	85	4.19
9.	دوڑ دھوپ	52.08	49.84	2.24	89.96	88.96	1
10.	عام لوگ	50.14	47.68	2.46	85.45	87.1	1.65
11.	آس پاس	49.4	50.30	0.9	85.36	85.23	0.13
12.	خوشبو	37.71	41.34	3.63	88.48	88.72	0.24
13.	لیپ ٹاپ	34.92	34.12	0.8	88.28	85.22	3.06
14.	درس گاہ	52.82	46.62	6.2	88.37	86.51	1.86
15.	لاڈ پیار	49.35	50.67	1.32	88.45	86.91	1.54
16.	خار دار	48.91	52.64	3.73	85.85	85.01	0.84
17.	رنگ ساز	43.12	45.83	2.71	86.54	84.75	1.79
18.	کام کاج	49.41	49.6	0.19	85.78	85.79	0.01

(4.56 ± 0.93) for دار خار and lowest (1.00 ± 0.00) for دورٔ بھاگ (Table 2).

The minimum intensity levels of all the words differ in a threshold range of 1dB to 8dB. While the maximum intensity levels of all the words varies from 1dB to 5dB (Table 3). The results show that all the words are very near to each other in audibility. The acoustic analysis show that this word list can be used for the Speech Recognition Threshold measures and it will also help in programming of the cochlear implants and hearing aids fitting procedures.

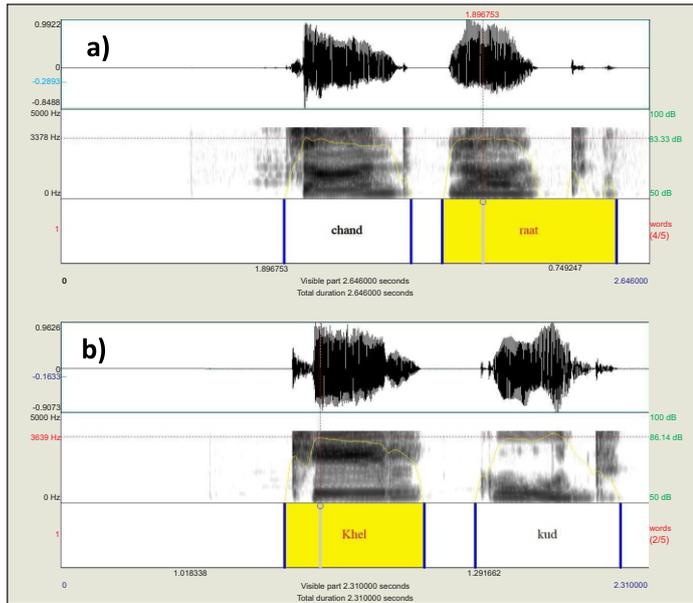


Figure 1: Speech spectrogram for word a) Chand Raat and b) Khel Kud.

Discussion

Current study to develop Urdu Spondee Words List (USWL) collected different Urdu bi syllabic words utilizing different resources, which were analyzed by speech language pathologists and audiologists to ensure equal stress levels of the syllables followed by examining the syllable templates and calculation of Moraic weights. The most commonly syllable template noted in the current study was “CVVC”, which is considered as a super heavy syllable. Similarly another local study while identifying syllable templates of Urdu from 5000 words they chose from Urdu dictionary, reported that the most frequent syllable templates in Urdu were heavy syllables and super heavy syllables.¹⁵ On the basis of segmentation in rhymes, syllable are grouped as mono, bi or tri-moraic with mono-moraic being light, bi-moraic being heavy while tri-moraic are super heavy i.e., a

syllable “لیپ” has been assigned a weightage of Moraic 3 because its template has long vowel as well as coda consonant (CVVC) with its respective syllable “ٹاپ” also has moraic 3 value.¹⁶ Current study highlight the moraic values of a number of Urdu language templates. The pattern of stress in case of compound words is assigned separately as has to be determined for both the words.¹⁷

In the current study the selected words familiarity judgment,¹⁸ was conducted utilizing Likert scale with items marked as 1 were declared most familiar, while those marked 5 as unfamiliar. Hence current study results reveal that the “most familiar” words were “چاند رات”, “خش حال”, “عید گاہ”, “کھیل کود”, “خوشبو”, “لیپ ٹاپ”, “کام کاج”. Familiarization is an important concept, since prior familiarization with the test words yields lower threshold levels.¹⁹

In the present study the word selected in the word list, were recorded in a sound proof room to cater to the distractions and effect of noise and the words were further analyzed on PRATT software. Further the speech files for individual words were annotated and spectrographic and intensity analysis was done e.g. speech spectrograms for words Chand Raat & Khel Kud attached at figure 1.

PRATT software is now used for acoustic and phonetic speech sound analysis,²⁰ with a local study reported Urdu annotation of words related to the developed speech corpus by utilizing this software.²¹

In the current study, intensity levels were measured in decibel (dB) by using PRATT and for audibility of words, assessment of homogeneity was done by assigning the maximum and minimum intensities levels which revealed that the intensities were close to each other and varied only by 3dB to 8dB. Literature has suggested that to check homogeneity in audibility ideally all words need to be recorded at same level of intensity, so that these are heard at the same level when spoken in normal voice tone.²² The same was followed in current study. Similarly, a study by Dutta & Chatterjee also took into account the criteria of assessing the maximum and minimum sound intensity level to ensure homogeneity of the spondees and reported variation level of 2.5 -8 dB.¹¹

Hence current study fulfills the required criteria for development of spondee words as described in literature and hence has provided a foundation to provide speech

audiometry material in Urdu language.

The study came up with Urdu Spondee Word List however keeping in view the local languages being spoken in different parts of the country, further similar studies are needed to cater to the whole population.

Conclusion

The developed 18 item Urdu Spondee Word list (USWL) with criteria of familiarity and homogenous audibility of words is suitable for speech recognition threshold measurement for Urdu speaking population.

Ethical Approval: The Research Ethical Committee approved the study vide letter No. RefRIPHAH/RCRS/REC/Letter-00412.

Conflict of Interest: The authors declare no conflict of interest.

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Authors' Contribution

TI: Data collection, methodology, data analysis and interpretation

HSK: Conception of work and writing of manuscript

GS: Data analysis, literature review and critical revision

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