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Quantitative test for pseudohypacusis in Marathi: Comparison of monosyllabic v/s Bi-syllabic homogeneous words

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Abstract
Introduction: There is a lack of quantitative test for Pseudohypacusis testing especially in Indian languages. Other objective tests such as ABR, ASSR & OAE are available but it is an Expensive, time-consuming and also there is a lack of infrastructure to carry out these tests. Falconer's lip-reading test (1966) using mono-syllabic homopheneous words was used to detect pseudohypacusis. Same had to be modified and could be used for developing it into a quantitative test for pseudohypacusis.
Need of the study: With the advent of growing pseudohypacusis cases especially in India due to governmental scheme benefits, it is highly necessary to develop a suitable, effective and quick Quantitative test to detect thresholds for pseudohypacusis cases reducing the time-constraints, expenses & also keeping in mind the infrastructure. Also, there is a lack of quantitative test in the world scenario.
Objectives of the study: To develop a Quantitative test to detect thresholds of pseudohypacusis. Developing the same in Marathi language. Creating normative data. Also, comparing effectiveness of mono-syllablic homopheneous words v/s bi-syllablic homopheneous words in the same test.
Methodology: The test was developed in Marathi and comparison was done between mono-syllablic homopheneous words v/s bi-syllablic homopheneous words at different intensity levels. Also, 20 males & 20 females were included in the study for creating normatives.
Results: Appropriate statistical analysis was done where monosyllabic homopheneous words showed scores of 50.2%, 28%, 66.6% & 83.40% whereas bi-syllabic homopheneous words showed scores of 53.2%, 32%, 71.6% & 87.4% respectively at 4 different intensity level wrt SRT. Same where being analyzed amongst males v/s females.
Discussions: Scores showed that there were significant differences amongst the 2 list of words and that Bi-syllabic homopheneous words yielded better results & could be a better material to detect pseudohypacusis. On gender comparison there were no significant differences.
Conclusion: A better quantitative test was developed to detect thresholds of pseudohypacusis with modifications to the original Falconer's Lip-reading test wrt intensity levels and also using Bi-syllabic Homopheneous words rather than mono-syllabic words. Thus, a simple, quick, effective and a much better Quantitative test was evolved for pseudohypacusis in an Indian language (Marathi).

Keywords: pseudohypacusis, homogeneous, Bi-syllabic

1. Introduction

Pseudohypacusis is a condition in which a hearing loss is exhibited in the absence of any organic disease. It was first coined by Raymond Carhart (1961). Guttman, 1938; Doefler & Stewart, 1946; Fournier, 1958, referred *auditory malingering to those persons who deliberately falsify their responses on hearing tests for some personnel gain*. The mainstay of diagnosis is a lack of consistency in audio logical testing (Pracy, J. P., Walsh, R.M., Mepham, G.A., Bowdler, D.A., 1996) [11]. It is usually easier to diagnose in children than in adults, as children are less able to produce consistently erroneous results on repeated testing. The prevalence of Pseudohypacusis is increasing as governmental benefits are being available for persons with hearing impairment. As Pseudohypacusis is easier to manifest rather than physically & visually handicap, more cases of Pseudohypacusis are being reported daily. Also, the test battery approach reported to detect the functional hearing loss do not give a good correlation always. Especially there is a lack of test available in order to detect Pseudohypacusis through Speech audiometry. Few of the tests available which are used till date are Stenger test, Modified Stenger test, low-level PB Word Tests etc. Other objective tests would include ABR, ASSR & OAE. But these objective tests are time consuming & expensive.

Further, very few tests have been developed or adapted in Indian languages for the purpose of testing the Pseudohypacusis. In order to detect functional hearing loss, it is necessary to develop a test for Pseudohypacusis in Marathi language which will serve the various clinical purposes in this particular language.

Falconer's Lip-reading Test for Pseudohypacusis (1966)

The falconer lip reading test is one of the test-devices which are used for the evaluation of Pseudohypacusis. It was designed by Falconer in 1966. This test tries to measure lip-

reading skill by using mono-syllable, homopheneous words i.e. words which look alike but are different in audition e.g. /kola/ - /khola/; /misa/ - /bisa/; /mud/ - /bud/. The words are presented by auditory & visual sense (lip-reading) both. This deception type test seemed to be quite sensitive in estimating an SRT considerably below the conventionally-measured SRT in EHL patients. According to Falconer the test is effective with much smaller degree of functional hearing loss.

Based on this test, Subha Rao T. A. (1982) [7] developed & standardized Falconer's lip reading test in Kannada. Saheer, S. (1982) [10] developed this test in Hindi. Also, Sridhar K. M. (1987) [4] developed this test Tamil. Similarly, Banik, A. (1997) [2] developed the Lip-reading test for Pseudohypacusis in Assamese based on Falconer's lip-reading test. But all the test developed used monosyllabic words.

2. Need for the study

Due to the advent of benefits schemes for hearing impaired in the recent years, there is been perceptual sudden rise in Pseudohypacusis, as people want to take these benefits. So to protect such illegalities from happening there is a need to develop a test that could predict approximately the hearing or speech reception thresholds in an individual exhibiting functional hearing loss.

There are very few reported speech tests for Pseudohypacusis testing. Out of these test, only Speech-Stenger test is known to detect approximate speech thresholds i.e. quantitative analysis. Apart from this, there are no other speech tests for quantitative Pseudohypacusis testing.

Also, objective testing like ABR, ASSR, OAE etc. are very costly as well as time consuming such as ASSR & ABR. So keeping in mind the cost & time factor in a developing country like India, it is highly necessary to evolve with other tests which are suitable & effective.

Hence, there is a strong need to develop a Speech test which can give Quantitative results for Pseudohypacusis. So, Falconer's lip-reading test can be adapted with suitable modifications and develop a Quantitative test using Speech for Pseudohypacusis.

Also that Falconer considers Monosyllable-homopheneous words & uses SRT method to detect Pseudohypacusis. But it is known that Bi-syllabic words are better to obtain SRT, which has not been mentioned in the original Falconer's lip-reading test.

So, a comparative study needs to be done between monosyllabic & bi-syllabic words, homopheneous words using falconer's lip-reading test and see the significant difference if any, is noted to detect Pseudohypacusis better.

Hence, this test being a simple, effective & quick test to evaluate Pseudohypacusis, there arise a need to develop the same in Marathi language as there are no standardized test available in this language. This test would be very useful as Maharashtra holds a large area & large population and as AYJNIHH is the pioneer institute in this province and a lot of Pseudohypacusis cases report in order to obtain hearing disability certificate & gain benefits falsely.

3. Objectives

1. To develop the test material to assess Pseudohypacusis in Marathi language.
2. Creating normative values on normal population.
3. To compare the significant difference of Monosyllabic – homopheneous words vs Bi-syllabic - homopheneous words in detecting Pseudohypacusis.

4. Hypothesis

1. There will be a significant change in scores of the monosyllabic and bi-syllabic words across each intensity level (i.e. levels of presentation) among the normal hearing subjects.
2. There would be no significant difference in the average scores in males v/s female category within:
   a. Monosyllabic homopheneous words
   b. Bi-syllabic homopheneous words.
3. There will be significance difference in the overall mean score of monosyllabic and bi-syllabic words among the normal hearing persons.

5. Review of literature

Falconer (1966), states that it is relatively impossible to distinguish single-syllable, homopheneous words from other words by lip-reading only.

Durmaz A., Karahatay S., Satar B., Birkent H. & Hidir Y., (2009), [6] conducted a study on "Efficiency of Stenger test in confirming profound, unilateral Pseudohypacusis." He performed click-ABR & Stenger test on 200 military candidates showing unilateral profound hearing loss and found that click-ABR was much better to detect true thresholds in difficult cases than Stenger test.

Qiu, W.W., Yin, S.S., Stucker, F.J. & Welsh, L.W., (1998) [8] stated in their article, "Current evaluation of Pseudohypacusis: Strategies and classification" that, in complex functional hearing loss cases electrophysiological tests are more reliable than other puretone or speech tests. This study was being carried out on 64 patients with Pseudohypacusis over a 4-year period.

Schmäl, F., Kumpf, W., (1995) [9] conducted a study titled, "Clinical and experimental studies of Stenger's experiment with speech". He performed speech-stenger using numeral words of the German "Freiburger" test material on 46 cases of suspected Pseudohypacusis & could detect positive speech stenger in 73% of them.

Martin & Shipp (1982) found that sophistication with the speech stenger test resulted in higher MCILs, which can lead the unsuspecting clinician to accept an exaggerated SRT as correct. This would result in failure to detect Pseudohypacusis.

6. Methodology

6.1 Development of test material

1) **a) List of BI-syllabic -** homopheneous words would be developed in Marathi.
   b) List of MONO-syllabic - homopheneous words would be developed in Marathi.
2) The materials selected would have either meaning or meaningless words but having the phonetics in Marathi language.
3) 2 lists would be made in a random order but having a mixture of all the phonological sounds in every list. The lists would be as:
   - L1 = List of MONO-syllabic - homopheneous words (25 words)
   - La = List of BI-syllabic - homopheneous words (25 words)

6.2 Validation

- The materials were validated by professionals' viz. Audiologist & Speech-language Pathologist & Linguists whose native language is Marathi & are well-versed with it.
- From 50 words in each category, finally 25 words were selected which was voted as most appropriate for the use in this study.

6.3 Subjects

- **Sample Size**: 40 Marathi Speaking Subjects (20 males & 20 females)
- **Age Range:** 18 years to 35 years

6.4 Instrumentation & Procedure

- **Setup & instruments:** Otoscope, 2-channel Audiometer with AC/BC and Speech audiometry, talk-back facilities with TDH-39 ear-phones and 2-room audiometric setup. The glass-reflections from the observation window were eliminated.
- **Otoscopy:** To identify any impacted cerumen, infections or perforation etc are present or not.
- **Audiometry:** All subjects were made to pass a screening Pure Tone Audiometry test at 20 dBHL from 250 Hz to 8000 Hz through a calibrated audiometer. SRT would be attained using Standardized Marathi language spondee words.
- **Speech & Language Evaluation:** All subjects were checked for any OPM defects and screened on Photo Articulation test (Marathi) to rule out any Articulation/Phonological Disorders.
- **Other medical test:** Subjects underwent an opthamological test to screen any visual defects. Any subjects with visual defects were corrected by suitable medical management or suitable spectacles.

Procedure

- Instructions were given in simple Marathi language to obtain Speech Recognition Threshold (SRT).
- SRT was obtained without giving any visual cues using Standardized Marathi language Spondee words.
- Administrating the "Lip-Reading test material" with both auditory & visual cues i.e. lip-reading.
- Live mode of presentation was used. Clinician was careful to restrict the output less than 0 dB in the V-U meter.

6.5 Levels of Presentation

Four levels were taken for presentation with reference to the obtained Speech Recognition Threshold (SRT) of each subject. The levels of presentation were:

i. SRT + 0 dB…….....S1
ii. SRT - 10 dB…….S2
iii. SRT + 10 dB……S3
iv. SRT + 20 dB……....S4 …(*S = Intensity level)

2 lists were made

- L1 = List of monosyllabic - homopheneous words (25 words)
- La = List of bi-syllabic - homopheneous words (25 words)

Levels of Presentation	Mode of Presentation	
SRT + 0 dB	L1.S1	La.S1
SRT - 10 dB	L1.S2	La.S2
SRT + 10 dB	L1.S3	La.S3
SRT + 20 dB	L1.S4	La.S4

6.6 Presentation of list

- For each level of presentation (intensities) the whole 25 words in each category would be given in a random order.
- Also, the intensity level of presentation would be in the order: SRT + 0; SRT -10; SRT +10 & SRT + 20; in order to diminish familiarity.
- The score for each category would be noted for each subject.

6.7 Scoring

- Each word repeated correctly would be given 4 %.
- So the maximum attainable score in each category would be 4 % x 25 words = 100%

All subject's scores in each category was averaged.
Statistical analysis was done.

7. Results

The purpose of this study is to develop a test material & also create the normative through which Pseudohypacusis could be detected. This study looks into creating a quantitative analysis to predict an approximate threshold based on SRT.
40 subjects i.e. 20 Male & 20 Female native Marathi speaker subjects were taken for the study.
The test was administered on the subjects following all the criteria, protocol, levels of presentation & mode of presentation.
Each word correctly repeated using auditory & lip-reading cues were given 4% each.

Average Scores of the Number of words repeated correctly and their corresponding percentages

- **L1** = Mono-syllabic Homopheneous words
- **La** = Bi-syllabic Homopheneous Words

Table 1: Male V/s Female

		SRT + 0 dB (S1)		SRT – 10 dB (S2)		SRT + 10 dB (S3)		SRT + 20 dB (S4)	
		Avg. No. of words correctly Repeated	Avg. %	Avg. No. of words correctly Repeated	Avg. %	Avg. No. of words correctly Repeated	Avg. %	Avg. No. of words correctly Repeated	Avg. %
L1	Male	12.6	50.4%	6.9	27.6%	16.7	66.8%	20.8	83.2%
	Female	12.5	50%	7.1	28.4%	16.6	66.4%	20.9	83.6%
La	Male	13.6	54.4%	8.0	32%	18.0	72%	21.8	87.2%
	Female	13	52%	8.0	32%	17.8	71.2%	21.9	87.6%

In TABLE 1, the scores of the Number of Words Correctly Repeated in each category & their corresponding Percentages scored by the subjects (Male V/s Female) have been Averaged & analyzed.

Table 2: Overall mean scores of monosyllabic homopheneous words & bi-syllabic homopheneous words

	SRT + 0 dB (S1)		SRT – 10 dB (S2)		SRT + 10 dB (S3)		SRT + 20 dB (S4)	
	Avg. No. of words correctly Repeated	Avg. %	Avg. No. of words correctly Repeated	Avg. %	Avg. No. of words correctly Repeated	Avg. %	Avg. No. of words correctly Repeated	Avg. %
L1	12.55	50.2%	7	28%	16.65	66.6%	20.85	83.4%
La	13.3	53.2%	8	32%	17.9	71.6%	21.85	87.4%

In TABLE 2, the scores of the Number of Words Correctly Repeated in each category & their corresponding Percentages scored by the subjects (Combined Male & Female) have been Averaged & analyzed.

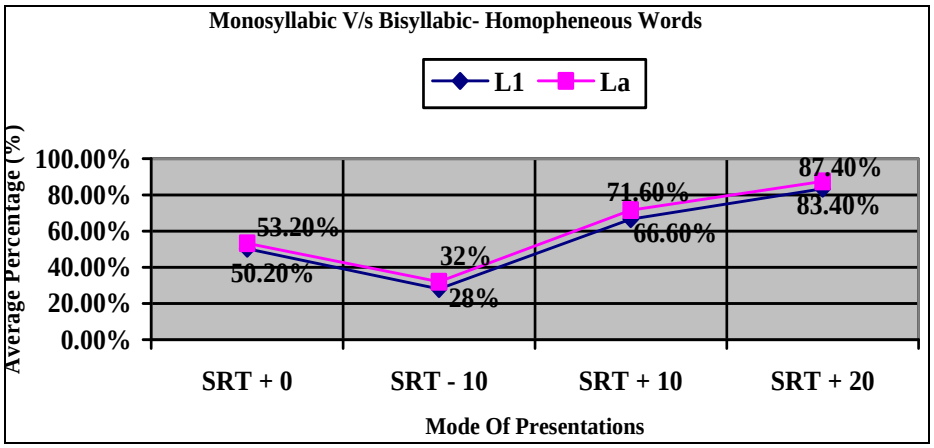

Fig 1: Monosyllabic V/s Bisyllabic- Homopheneous Words

Normative scores in percentage to detect Pseudohypacusis

	SRT + 0 dB (S1)	SRT – 10 dB (S2)	SRT + 10 dB (S3)	SRT + 20 dB (S4)
L1	35 % to 55 %	0 to 30 %	60 % to 70 %	75 % to 100%
La	40 % to 55 %	0 to 35 %	60 % to 75 %	80 % to 100 %

8. Discussions

8.1 Comparing scores of Mono-syllabic & Bi-syllabic homopheneous words across the levels of presentation (different intensity)

As shown in Table 2, it is seen that there is significant difference between the scores across all the levels of presentation. The scores of the Mono-syllabic homopheneous words are 50.2%, 28%, 66.6% & 83.4% for S1, S2, S3 and S4 respectively. Similarly, there is also significant difference between the scores across all the intensity levels for Bi-syllabic homopheneous words. The scores are 53.2%, 32%, 71.6% & 87.4% for S1, S2, S3 and S4 respectively. Hence, it is clearly indicating the significant differences in the scores that with increase & decrease by 10 dB steps create a lot of difference in the total percentage of scores obtained.

8.2 Gender comparison of Mono-syllabic & Bi-syllabic homopheneous words

It is been noted in Table 1, there is no significant difference between male & female scores in both the category (L1 & La) and across all the mode of presentation i.e. intensity levels. Their scores are 50.4%, 27.6%, 66.8%, & 83.2% for Males; 50%, 28.4%, 66.4%, & 83.6% for females in the Monosyllabic Homopheneous words category (L1). Also, in Bi-syllabic homopheneous words (La) category the scores are 54.4%, 32%, 72%, & 87.2% for males; 52%, 32%, 71.2%, & 87.6% for females. So these scores indicate that within the category of the material there is no difference between the genders expect in the Bi-syllabic homopheneous words at SRT + 0 dB there is a slight significant difference in the scores of males & females but as the intensity changes there is no difference noted.

8.3 Comparison between the overall mean score of the Mono-syllabic & Bi-syllabic homopheneous words

The mean score between the monosyllabic homopheneous words & bi-syllabic homopheneous words show a slight significant difference amongst the two lists of words. For SRT + 0 dB the score differences for L1 & La were 50.2% & 53.2% respectively. Similarly, for L1.S2 & La.S2 the scores were 28% & 32% respectively. L1.S3 & La.S3 had scores of 66.6% & 71.6% whereas L1.S4 & La.S4 had scores of 83.4% & 87.4% respectively. So comparing the scores between Mono-syllabic & Bi-syllabic homopheneous words it is noted that there is significance difference between them and that Bi-syllabic homopheneous words yield better results & are easier to identify.

So, it is suggested that Bi-syllabic homopheneous words should be used rather than monosyllabic homopheneous words as it yields better results, easier to be identified & in the whole bargain it would be easier to detect Pseudohypacusis as they would feel the ease to repeat these words. And if they do so they would be caught accordingly.

Also, the scores derived as normative would give *Quantitative results* to the test & an approximate threshold of SRT would be obtained. E.g. if a Pseudohypacusis subject shows a hearing loss & gets a SRT of 70 dBHL on speech audiometry test then this test could be used & if he scores suppose 88% at 70dBHL

then it would indicate that it is a score of SRT + 20 dB which means that the approximate SRT is 20 dB less i.e. at 50 dBHL. In this way, approximate SRT could be obtained on basis of the normative scores given above & help a lot in detecting Pseudohypacusis & giving quantitative results in the test.
In future research, the same test may be standardized on a large normal population and large population of Pseudohypacusis patients. Similarly, the same test should be developed in different languages and used in all states.

9. Conclusion

Considering all the above results it can be stated that Falconer's Lip-reading test should be modified by using Bi-syllabic words as a superior option over monosyllabic words.
Secondly, this present study gives a normative through which quantitative results are yield & it is much more helpful to detect approximate thresholds of SRT through which functional hearing loss individuals could be barred from giving hearing disability benefits falsely.
By the development of this test a value has been added to the Pseudohypacusis test battery especially in Marathi language context as there is no test using speech stimuli are available in this language to detect Pseudohypacusis. Also, it is a much better, simple, effective & quick test that has been evolved to quantitatively give results for Pseudohypacusis.

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