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Adaptation and Standardization of Minimal Pair Test (MPT) in Indian English

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Abstract

The assessment of speech perception ability is important to understand the efficacy of amplification devices and for planning intervention.

The present study adapted the minimal pair test developed for Indian children and normative was established on 200 normal hearing children (100 males and 100 females) of 5-7 years. The test stimuli were selected after familiarity rating for monosyllable minimal pairs. Content validity was evaluated by a panel of professionals. The test has 45 pairs of (hand drawn) picturable minimal pairs in 4- alternate forced choice method which are presented in quiet room situation with controlled signal to environmental noise ratio of +10 dB HL. No other sensory clue other than auditory was provided. The test retest and inter tester reliability were evaluated and found to be high with coefficients of 0.9 and 0.7 ($p<0.01$). Difference was not significant when four age groups were compared statistically for age and gender. ($p<0.01$). The maximum score ceiling was seen at 41.6. In conclusion, the minimal pair test in Indian English was thus adapted and standardized on 5-7-year-old children. The application of the test needs to be evaluated in children with hearing impairment.

Keywords: Speech perception, minimal pairs, environmental noise

Introduction

Assessment of speech perception in the pediatric population is important for several reasons. Speech perception scores not only help determine whether a child has difficulty in comprehension of speech in natural situation but also helps decide if the child is benefiting from a hearing aid or is a candidate for a cochlear implant. The scores contribute as a factor for comparing differences between sensory devices and/or processing algorithms. The follow-up assessments to establish guidelines for habilitation require speech perception scores along with other speech and language evaluations.

A number of important factors must be taken into consideration when assessing speech perception in children, which include a combination of child, task, tester, and environmental influences on test outcomes. (Boothroyd, 2004). Some of the tests being used for assessment are Phonetically Balanced Kindergarten (**PBK**) Word Test (Haskins, 1949), Word Intelligibility by Picture Identification (**WIPI**) (Ross & Lerman, 1970), North Western University – Children's Perception of Speech(NU-CHIPS) Elliott & Katz, 1980), Pediatric Speech Intelligibility (PSI) Test (Jerger & Jerger, 1984), Minimal pair test (MPT) (Robbins, Renshaw, Miyamoto, Osberger & Pope, 1988), Early speech perception test (ESPT) (Moog & Geers, 1990), Lexical Neighborhood test (LNT) and multi-syllable lexical neighborhood test (MLNT) (Kirk, Pisoni, Osberger, 1995).

Among various speech stimuli to analyze speech perception skills, minimal pairs are considered as superior speech testing stimuli as they detect speech discrimination ability rather than just identification. (Robbins, Renshaw, Miyamoto, Osberger & Pope, 1988). A minimal pair can be

defined as “Two words of distinct meaning which exhibit different segments at one point but identical segments at all other points” (Trask, 1996).

The scores obtained on minimal pair test was found to have a good correlation with the measure of spoken word recognition and sentence comprehension (Bergeson, Pisoni & Davis,2003).

The Minimal Pairs Test in American English (Robbins, Renshaw, Miyamoto, Osberger & Pope, 1988) was developed with 2-alternate forced choice picture pointing task and 20 minimal pairs of words whose initial consonants or vowels differ only in consonant voicing, consonant place of articulation, consonant manner of articulation, vowel height, or vowel back-ness. In this test, monitored live voice was used, in an auditory-only condition, to be evaluated for age group of 4 to 6 years.

The application of the test and scores were not accurate for the children in Indian situation. This can be attributed to non-familiarity of words in the test, English being second language for Indian children. It being a recorded version the test could not be controlled depending on the attention span of the child and the instructions in the recorded version could not be understood due to differences in American and Indian English accents.

Considering the need to have a test for Indian English -speaking children a test with minimal pairs was developed by Ishita, Gore and Sashidharan (2012). In their study the stimuli evaluated for manner/ place of articulation or voicing, vowel height / back-ness and duration. They used web-edited pictures and conducted a study on 30 typically developing children, aged 4-6 years and compared the results with 7 children with cochlear implants. They evaluated the validity and reliability of the test. Significant difference in scores were found in scores of typically developing children and children with cochlear implants.

Thus, the present test is been adapted from the above study, in a way that it includes the vocabulary and articulation of typically developing children of 5-7 years and to include vowels, nasal, stops, fricatives and also affricates (which was absent in the original test in Indian English) for discrimination. The test was developed as live voice presentation under quiet room situation test with original hand drawn pictures for better visibility.

Method

The present study focused on adaptation and standardization of a closed set speech perception test using minimal pair of words. The speech stimuli included were vowels, stops, nasals, affricates and fricatives.

Selection of Test Stimuli

The words (bi-syllabic) for the test were chosen from the familiar vocabulary list of 5-7-year old typically developing children, from the kindergarten and primary school books designed for Indian school going children with English as a medium of instruction. The word pairs differed in one, two or three features example voicing, place or manner of articulation, voicing. The words were chosen based on the familiarity (very familiar / less familiar / unfamiliar) as rated by five teachers and then by five parents of the children with 5-7-year-old children. The words were further screened for single feature differences and also that the words can be represented by pictures. The data base collected for the vocabulary of the children 5-7 years in English had many more words than chosen here. The discretion was based in minimal pairs for all the sounds selected and pictoriality of the word.

Pilot Study

In pilot study, the test was administered on 30 typically developing 5-7-year-old children to re-evaluate the familiarity of words by the children and to see the goodness of the picture stimuli to the target stimuli. The pilot study helped to modify or change ambiguous picture stimuli. The word pairs and picture stimuli only correctly identified by the children were retained for the test. It was seen that more consistent and reliable scores were obtained for four alternate forced choice methods than 2 alternate forced choice methods.

The final stimuli consisted of 45 pairs of test items and 3 pairs of words for practice item (Appendix 1). However, the list did not have all the phonemes of the language in the initial, medial and final contexts.

Preparation of the Picture Test Plate for the Selected Words

The pictures were arranged in two rows with two pictures in each row horizontally. Four pictures of the target word-pair were represented on a test plate such that all three combinations of responses (for example, Fox-Socks, Fox-Fox and Socks- Socks) were available as an option to choose from. The pictures were hand drawn with color pencils (Appendix 2). The scanned pictures were arranged in the format required for four Alternate Forced Choice (AFC) method.

Administration of the Test

a. Inclusion criteria for the children selected for the study:

The following inclusion and exclusion criteria were adapted to select the children for the study. The children included in the study were between 5-7 years of age, studying in 1st to 3rd standard in an English medium school. The chosen schools were consisting of children from different socio-economic background. All the children had English as a second language. Hearing screening was done using pure tone screening audiometer at 250 Hz, 500Hz, 1000Hz, 2000 Hz, 4000 Hz, 8000 Hz and Immittance audiometry (A- type tympanogram and reflex screening at 1000 Hz at 90 dB HL). Implementing the exclusion criteria, Raven's colored progressive matrices (Raven 1952) was used to determine the child had adequate cognitive abilities to carry out the test. To screen for any other associated disabilities including speech and language difficulties, WHO ten questions disability check list, (Durkin, Wang, Shrout, 1971) was used. Care was taken that the child had no illness during the evaluation and also had no history of ear infections.

b. Informed consent:

The parents and teachers of the children chosen for the study were informed about the test and its application in identifying a child with hearing difficulty. They were also explained the test procedure clearly. Only after obtaining the consent (Appendix 3) the child was included in the study.

c. Instrumentation used:

Otoscope was used to evaluate any visible abnormalities in the external and middle ear. Portable Sound level meter (SLM) with A scale was used for measurement of ambient noise levels and the sound pressure level of the speaker or the tester was also evaluated using the SLM. Single channel portable audiometer Elkon 3N3 with supra aural earphone TDH 39 was used for audiometry in quiet room setup. Portable impedance audiometer was used for tympanometry screening.

d. Test environment:

The ambient noise level in the testing situation was maintained at or below 45-55 dB A on Sound level meter (SLM). The level of the speech stimulus presented by the tester was maintained at 60-65 dB A on SLM, providing the advantage of at least +10 dB Signal to noise ratio (SNR). Care was taken that the tester was seated next to the child to avoid any visual cues and the mouth of the tester was maintained at a distance of 10cms from the ear of the child. The availability of sufficient light to enable identification of pictures by the children.

e. Instructions to the child:

All children tested were instructed as follows. "You will be hearing two words together, please point to the picture of the words you hear in the same order. You can guess the two words if required". A trial test using the trial picture plates was provided before the administration of the test to see if the child understood the instructions clearly.

f. Procedure:

The test was administered on 200 children of 5-7 years as participants for the study. They were further divided into four groups, 5.00- 5.50 years (group 1), 5.51 – 6.00 years (group 2), 6.01-6.50 years (group 3), 6.51-7.00 years (group 4). The following table 1, represents the details of the children selected for the study.

Table 1: Details of the children participating in the study

Age in years	***Gender***		***Total***
	Female	**Male**	
5.0 - 5.5	33	32	65
5.51 - 6.0	18	24	42
6.01 - 6.5	28	19	47
6.51 - 7.0	21	25	46
Total	100	100	200

The test procedure was conducted in quiet room situation with required signal to noise ratio (SNR) and using live voice presentation. Post-instruction, trial test items were administered to see if the instructions are well understood by the child. The stimulus was presented by the primary investigator. The children were shown all the pictures (one by one as a list) in the test. The reliability and validity of the inter-tester, inter- testee differences were conducted. Test re-test reliability was measured after re-testing the children on all the items of the test by the same examiner.

The children's responses were tabulated on the response form. If the child did not respond to the picture identification task when the word pair has been presented by the tester first time, the child was given a second chance to recheck the response. The response form was also maintained with scores of each child for all 45 pairs of test items including the date of birth, date of testing and the pre-evaluation details like audiological and speech and language screening results. (Appendix 1). Care was taken to maintain the sound pressure level of the tester and the noise level of the environment using the sound level meter, throughout the testing duration. Scoring was done by obtaining percentage

correct response at each level. The responses were recorded in the response sheet, by using 0-1 scoring system, where 1 stands for correct response and 0 stands for incorrect response.

Test Re-test Reliability

Test-retest reliability was measured for about 50 % of the population in each group. This was carried out by computing bivariate correlation (for two variables) using Pearson's product moment correlation by considering only the total scores obtained by testing all the 45 items of the test. The obtained coefficient of correlation was 0.869 ($p<0.01$) which suggests that there is high correlation with the scores obtained by the participants on the first trial and the second trial. The value of significance indicates that the probability of this correlation being due to chance is less than 1%. Thus, the data shows high test re-test reliability.

Split Half Reliability

The internal consistency of the data was also examined by the measure of split half reliability. This method uses data obtained by administration of the test only once. The data can be divided into two halves (either randomly or by grouping even and odd items together). The obtained value of split half reliability was 0.976 which simply means that there is a positive correlation between the scores of the participants across the groups was 0.976 (any value above 0.7 can be considered to be showing high reliability of the data). This entails that the test has high internal consistency reflecting good content validity (Garrett, 1971).

Results

The raw scores obtained from 200 children was subjected to statistical analysis. The mean, median, and standard deviation was calculated for the four age groups, 5 to 5.50 years, 5.51 to 6.00 years, 6.00 to 6.50 years and 6.51 to 7.00 years, as represented by the following table 2.

Table 2: Raw scores obtained for the children:

Statistics	**5.00 - 5.50 years**	**5.51 - 6.00 years**	**6.01 - 6.50 years**	**6.51 - 7.00 years**
N (number of children)	65	42	47	46
Mean	39.3	40.0	41.5	41.6
Median	39.0	40.5	42.0	42.0
S D	2.78	3.28	2.11	2.21
Minimum	30	33	36	35
Maximum	45	45	45	45

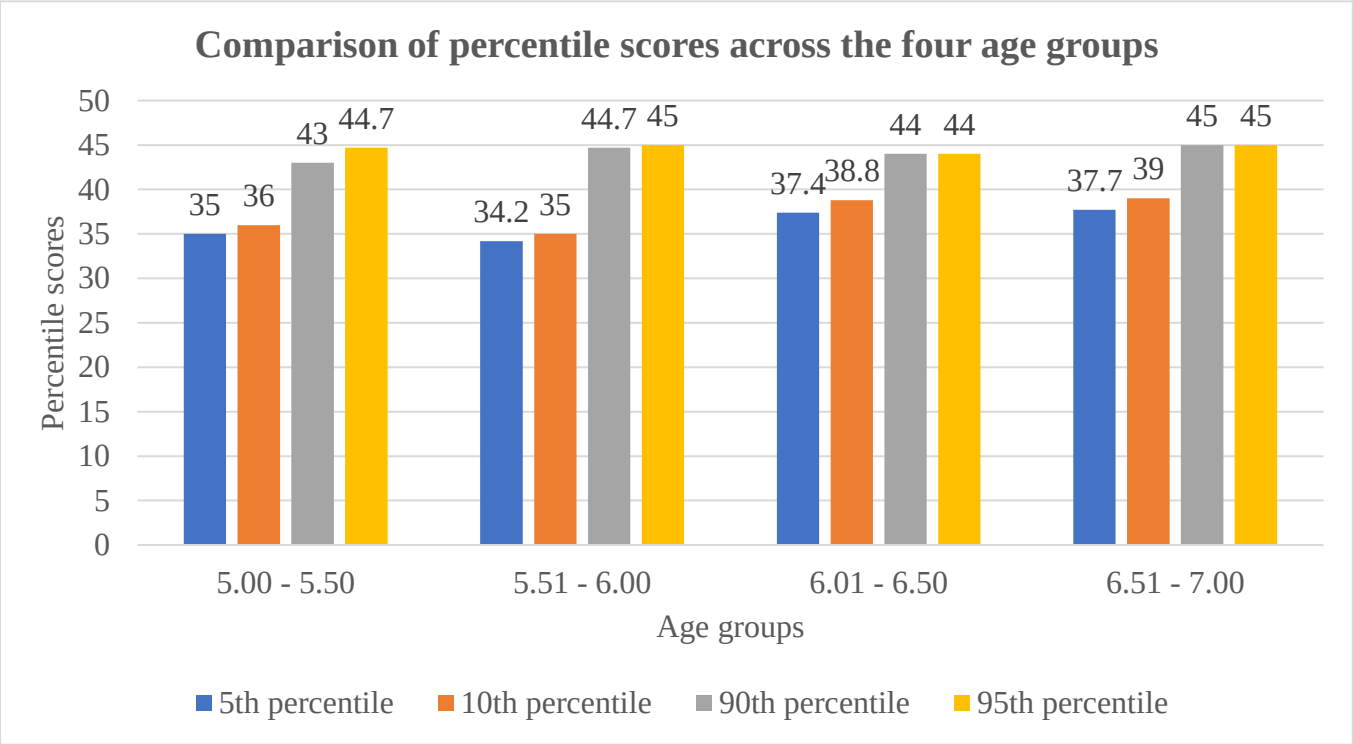
When the percentile scores were obtained for the results of the score and tabulated in table 3. and figure 1. The percentile scores do help in identifying the age group of the child being tested clinically.

Table 3: Details of percentile scores:

Percentile	**5.00 - 5.50 years**	**5.51 - 6.00 years**	**6.01 - 6.50 years**	**6.51 - 7.00 years**

5 th Percentile	35.0	34.2	37.4	37.7
10th Percentile	36.0	35.0	38.8	39.0
90th Percentile	43.0	44.7	44.0	45.0
95th Percentile	44.7	45.0	44.0	45.0

Figure 1: Details of Percentile scores of 200 children within 5-7 years of age group.



Findings

The mean scores increase from the age group of 5 to 5.5years to 6.5 to 7years. The percentile scores show an overlap in mean scores.

a. Gender differences:

Descriptive statistics was done to evaluate the statistical differences in the scores and the results were as in table 4

Table 4: T-test to evaluate gender differences among the children:

Age	Sex	N	Min	Max	Median	Mean	S D	t	df	p value
5.0 - 5.5	Female	33	35	45	39.0	39.3	2.28	0.03	63	0.975
	Male	32	30	45	39.0	39.3	3.25			
5.5 - 6.0	Female	18	35	43	40.0	39.2	3.04	1.43	40	0.160
	Male	24	33	45	41.5	40.7	3.37			
6.0 - 6.5	Female	28	36	44	41.0	40.9	2.09	2.85	45	0.006
	Male	19	39	45	43.0	42.5	1.78			
6.5 - 7.0	Female	21	37	45	41.0	41.5	2.23	0.30	44	0.768
	Male	25	35	45	42.0	41.7	2.25			

Findings

T-test was conducted to study the gender differences within speech perception scores. The results indicated that the p value was greater than 0.05 suggesting no statistical difference between the mean scores of both genders (except for group 3), indicating that the speech perception scores don't get effected by the gender of the children.

b. Age differences:

One- way ANOVA test was conducted across the mean scores of four age groups. Before conducting the one-way ANOVA test, assumptions for normality and homogeneity of variances were satisfied for the different groups. All the groups of samples were normally distributed and had a common variance. (figure 2). The histograms and bell-shaped normal curve obtained show that the scores follow normal distribution. The homogeneity of variances was satisfied as the standard deviation values are similar for all the age groups. (Table 5)

Figure 2: a, b, c, d.: Checking the normality in of total score in each age group

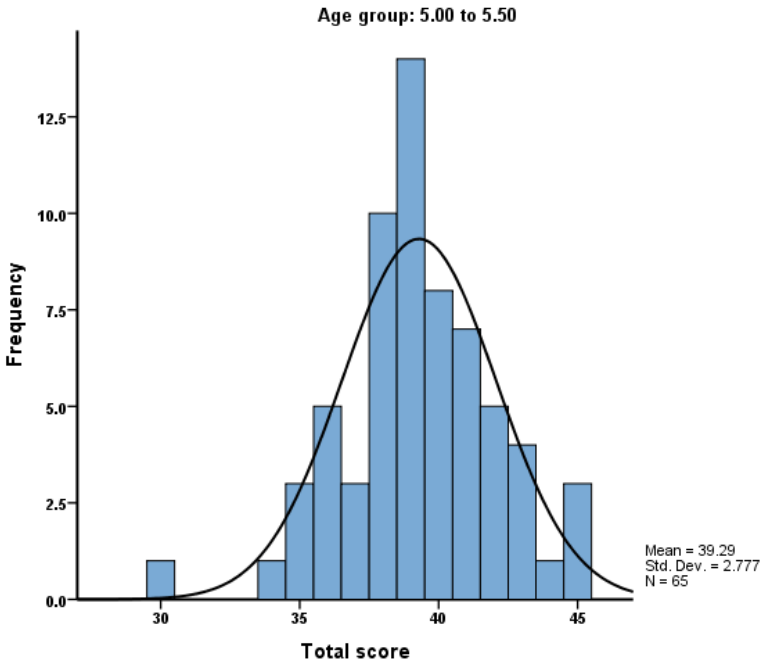


Fig 2a:

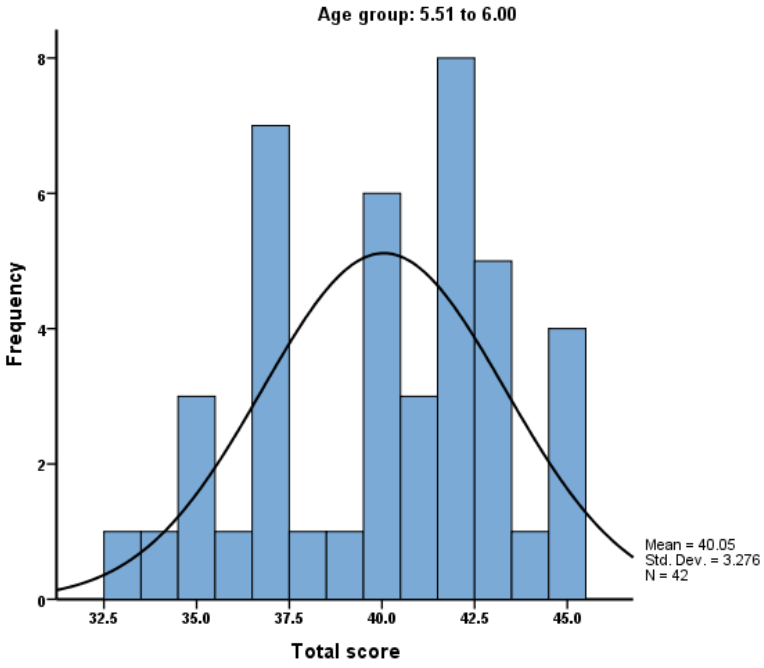


Fig: 2b

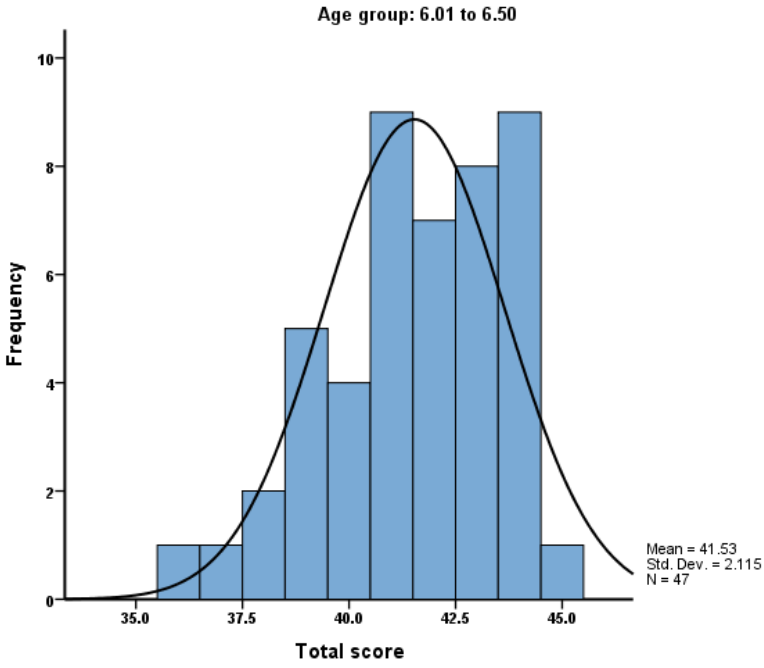


Fig: 2c

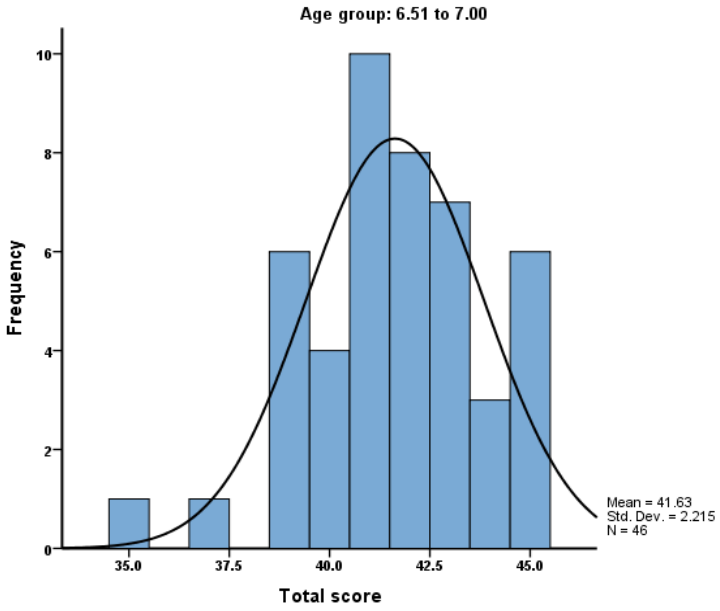


Fig: 2d

Table 5: Checking the homogeneity of variance of the data:

Descriptive Statistics						
Age group		N	Minimum	Maximum	Mean	Std. Deviation
5.00 to 5.50	totalscore	65	30	45	39.29	2.777
	Valid N (listwise)	65				
5.51 to 6.00	totalscore	42	33	45	40.05	3.276
	Valid N (listwise)	42				
6.01 to 6.50	totalscore	47	36	45	41.53	2.115
	Valid N (listwise)	47				
6.51 to 7.00	totalscore	46	35	45	41.63	2.215
	Valid N (listwise)	46				

When the scores were compared for any age differences among the four different age groups, the results were as in table 6.

Table 6: ANOVA results of age differences among the four age groups:

Age groups in years	N	Mean	S D	F	Sig.
5.0 - 5.5	65	39.3	2.78	10.195	< 0.001
5.5 - 6.0	42	40.0	3.28		

6.0 - 6.5	47	41.5	2.11		
6.5 - 7.0	46	41.6	2.21		
Total	200	40.5	2.81		

The one-way ANOVA results suggest that the F value is 10.195 and the value of significance is 0.001. This indicates that there is a statistical significance is present and we can conclude that there is a difference between the mean scores of the four age groups. Multiple comparisons using Tukey HSD test was done.

Post-hoc analysis:

As the one-way ANOVA test indicates only significance between the groups, Post-hoc analysis using Tukey Honest Significant Difference (HSD) test was conducted to check variance across multiple groups to evaluate which specific group's means are different. The results are as displayed in table 7.

Table 7: Tukey HSD results across the 4 age groups of children

Multiple Comparisons						
Tukey HSD						
(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
5.0 - 5.5	5.5 - 6.0	-.755	.521	.471	-2.11	.60
	6.0 - 6.5	-2.240	.504	**.000**	-3.55	-.93
	6.5 - 7.0	-2.338	.507	**.000**	-3.65	-1.02
5.5 - 6.0	5.0 - 5.5	.755	.521	.471	-.60	2.11
	6.0 - 6.5	-1.484	.559	.042	-2.93	-.04
	6.5 - 7.0	-1.583	.562	.027	-3.04	-.13
6.0 - 6.5	5.0 - 5.5	2.240	.504	**.000**	.93	3.55
	5.5 - 6.0	1.484	.559	.042	.04	2.93
	6.5 - 7.0	-.099	.546	.998	-1.51	1.32
6.5 - 7.0	5.0 - 5.5	2.338	.507	**.000**	1.02	3.65
	5.5 - 6.0	1.583	.562	.027	.13	3.04
	6.0 - 6.5	.099	.546	.998	-1.32	1.51

From the results of Tukey HSD, across the four age groups it was seen that, there was statistically significant differences ($p < 0.05$) among 4 comparisons. But the p-value was greater than 0.05 for other 8 comparisons, which suggests the no significant difference exist and the mean scores were same among the age group of 5-7 years.

Discussion

The aim of the present study was to develop a closed set speech perception test using Minimal Pairs in Indian English with identification paradigm and to administer the test on typically developing children with normal hearing aged 5-7 years. The test consisted of 45 minimal pairs as test items and 3 practice items differing in a single feature like place of articulation, manner of articulation, voicing, vowel back-ness, vowel height. The task of phoneme recognition was done with identification paradigm having four alternative forced-choice (4AFC) picture pointing procedure.

In any study involving test-retest an appropriate length of test-retest interval is important. A short interval between the tests will lead to learning practice effect, yet, a long interval between the tests might be invalid due to maturation effect (Garson, 2008; Hegde & Hegde, 2008). The criterion of test-retest and inter-rater reliability were met if the correlation coefficient between tests were 0.869 and above (Mc.Clauley, Swisher, 1984). The present study set 0.869 and 0.976 correlation coefficients as the standard for strong reliability. Garson (2008) , suggested that a typical interval is several weeks. Hence, in the present study, the test-retest interval selected was one month. The reliability study showed that the test-retest and inter-rater correlation coefficients the set criterion for correlation coefficient (0.76).

As for the gender effect in test items, the results supported in part the finding by Norris et al. (1989), Elliott & Katz (1980) in which there were no statistical significant difference in gender when comparing the performance of speech and language in children. Female subject had slightly higher mean score compared to male children. Similar finding seen by Karmiloff & Karmiloff-Smith (1996) that girls were faster and better than boys in speech and language development.

The present study also did not reveal any statistically significant differences across gender in all the age groups evaluated.

When the age groups were compared, it was seen from one-way ANOVA and post-hoc analysis with Tukey HSD results suggesting no statistical differences across the four age groups and hence the findings suggest there was no difference in mean scores between the four age groups.

The speech perception test with pictures is useful in assessment of 5 to 7-year-old school going children effectively as the speech production skills is not accounted here, only their perceptual abilities using the four alternate forced choice method is being assessed. The scores are in direct proportion to age, that is, the mean scores do show an increase with age group from 5 to 7 years, but not significantly. The results are also in accordance with the results of those obtained in speech perception test with pictures, applicability in children with hearing impairment study done by Queiroz et.al. in 2017. The studies using the 2 alternate forced choice method in both typically developing and children with hearing impairment within 2-11 years of age.

The obtained results across gender and age groups will help in normalizing the score and administrating the test on clinical population. The scores can thus be compared to the child being evaluated for speech perception skills. The application of the test in children with hearing impairment and using amplification devices is yet to be evaluated. The test holds significance as the children with hearing aids or cochlear implants join inclusive education at this age and thus helps in checking their inclusive abilities in speech perception in classroom situation. This will help in clinical application of the test, evaluation and setting therapy targets for children.

Conclusion

A minimal pair test in Indian English was thus adapted and standardized for 5-7-year-old children. It can be used in normal class room situation with better signal to noise condition and does not need much infrastructure like sound treated room or audiometer. The test will help the sound discrimination skills of the child in second language used in school and its effect on performance of the child. The application of the test needs to be evaluated in children with hearing impairment. This will help us understand the successful inclusion of the child in the normal schools and also set targets for discrimination training

Limitations of the Study

1. The significance of the test material needs to be evaluated in clinical population
2. Similar tests can be developed for children of different age groups to facilitate speech perception assessment.

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APPENDIX: 1

Response form for speech perception skills

Name of the child: Age/ sex:

Date of evaluation: Sample set used:

School: Grade:

S.No.	***Words shown***	***Target sound***	***Response (+/-)***	***Response after repetition (+/-)***
1	Goat / Gate	Vowel /o, a/		
2	Mat / Mat	Initial Nasal /m/ vs /b/		
3	Run / Run	vowel /u/ vs /ai/		
4	Rose / rose	Initial /s/ vs /n/		
5	Fox / Socks	Initial /s/ vs /f/		
6	Pen / Pen	Initial /p/ vs /t/		
7	Van / Fan	Initial /f/ vs /v/		
8	Cap / Tap	Initial /t/ vs /k/		
9	Tall / Tall	Final /l/ vs /k/		
10	Flower / Floor	Vowel /a,oo/		
11	Call / Call	Initial /t/ vs /k/		
12	Sheep / Ship	Vowel /e, i/		
13	Back / Back	Final stop /b/ vs /k/		
14	Wash / Watch	Final Fricative /sh/ vs /ch/		
15	Lip / Zip	Initial /l/ vs /z/		
16	Goat / Boat	Initial Stop /g/ vs /b/		
17	Read / Read	Vowel /ee/ vs /e/		
18	Pen / Pin	Vowel /e/ vs /i/		
19	Bell / Ball	Vowel /e/ vs /a/		
20	Hen / hen	Vowel /o/ vs /e/		
21	Cow / Key	Vowel /o/ vs /i/		
22	Bite / Bite	Vowel /i/ vs /o/		
23	Smile / Smile	Vowel /i/ vs /a/		
24	Talk / Lock	Initial Stop /t/ vs /l/		
25	Hen / Head	Final Nasal /n/ vs /d/		
26	Cup / Keep	Vowel /u/ vs /ee/		
27	Pot / Put	Vowel /o/ vs /u/		
28	Crow / Cry	Vowel /ow/ vs /i/		
29	Ball / Doll	Initial Stop /b/ vs /d/		
30	Ship / Ship	Initial /sh/ vs /ch/		

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31	Bag / Bag	Vowel /a/ vs /i/		
32	Lock / Lock	Initial /l/ vs /ch/		
33	Big / Big	Initial Stop /b/ vs /p/		
34	Red / Road	Vowel /e/ vs /o/		
35	Key / k	Vowel /e/ vs /i/		
36	Kite / Kite	Vowel /i/ vs /o/		
37	Goat / Coat	Initial stop /g/ vs /k/		
38	Boat / Boat	Initial Stop /b/ vs /g/		
39	Kite / Cat	Vowel /I/ vs /a/		
40	Book / Book	Initial stop /b/ vs /k/		
41	Jeep / keep	Initial /j/ vs /k		
42	Jail / nail	Initial /j/ vs /n/		
43	Mall / tall	Initial /m/ vs /t/		
44	Cook / book	Initial /k/ vs /b/		
45	Catch / watch	Initial /k/ vs /w/		

APPENDIX 2

Informed consent form

Name: Age/ Sex:

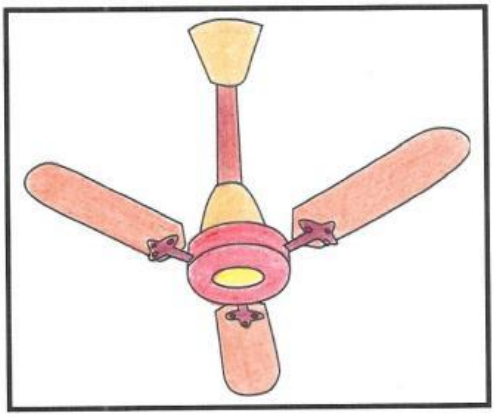
Address: Ph. No.

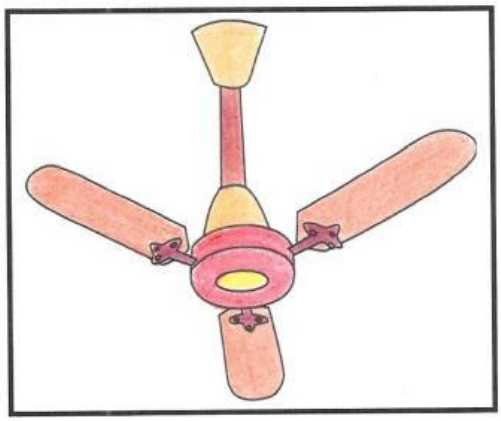
I, _____, the undersigned person give my informed consent to include myself / my child in the study titled 'Interaction between speech perception and speech production in children with cochlear implants and children with normal hearing'.

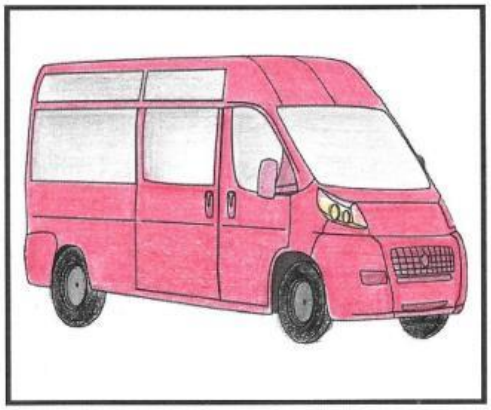
1. I have been explained about the assessment and methodology for the study.
2. I reserve my right to with draw from this study at any stage.
3. I understood that there will be no expenses for the assessment done.

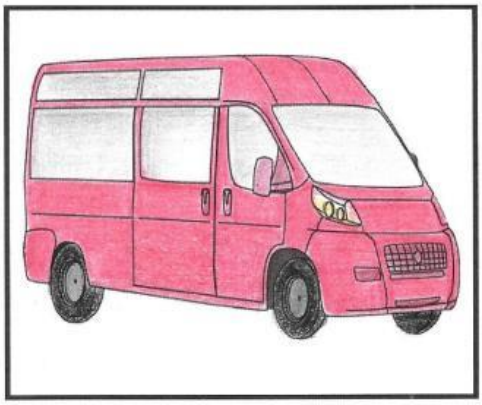
Signature

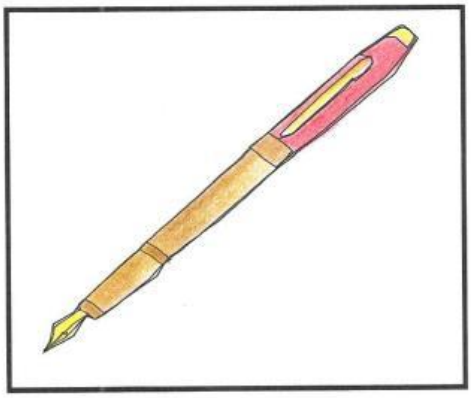
Appendix 3:

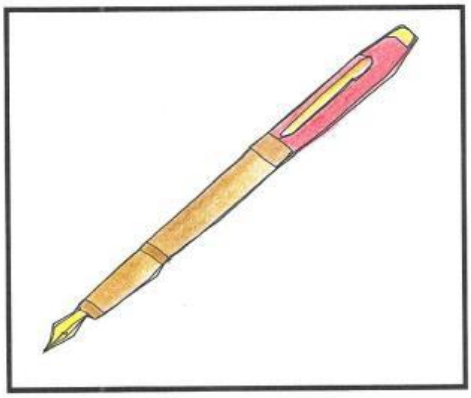


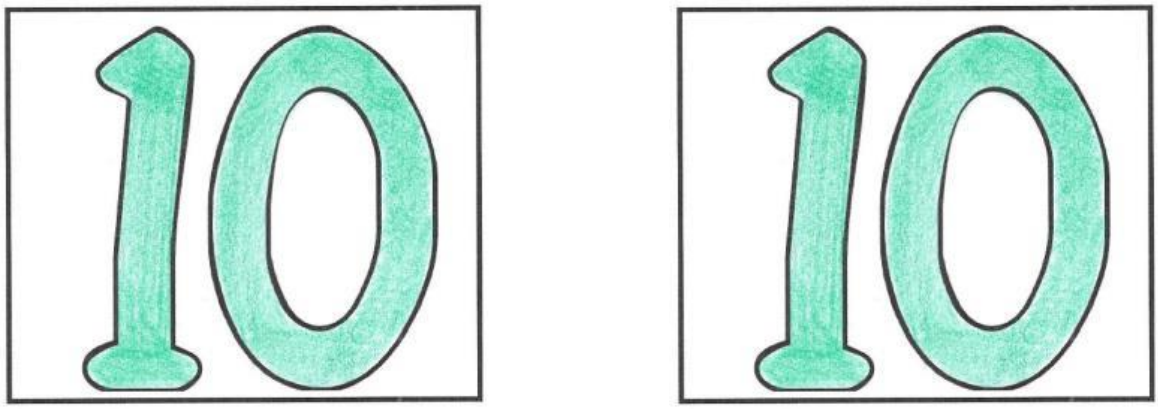












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References

- Bergeson TR, Pisoni DB, Davis R. A longitudinal study of audiovisual speech perception by hearing-impaired children with cochlear implants. The Volta Review 2003; 103:347–370.
- Boothroyd, A. (2004). Measuring auditory speech perception capacity in very young children. In R.T. Miyamoto (Ed.), Cochlear Implants. International Congress Series 1273 (pp. 292-295). Amsterdam: Elsevier.
- Durkin MS, Wang W, Shrout PE, et al. Evaluation of the Ten Questions screen for childhood disability: reliability and internal structure in different cultures. J Clin Epidemiol 1995;48: 657–66.
- Elliott LL, Katz D. Development of a new children's test of speech discrimination (Technical Manual). St. Louis, MO: Auditec, 1980.
- Elliott, L.L., & Katz, D. (1980). Development of a new children's test of speech discrimination (Technical Manual). St. Louis, MO: Auditec.
- Garrrett. Statistics in psychology and education. Published by Vakils, Feffer & Simons Private Ltd.; 1971.
- Garson D. Reliability: Reliability Analysis; 2008. Retrieved from http://www2.chass.nsu.edu/garson/pg765/reliab.htm.
- Haskins, H.A. (1949). *A phonetically balanced test of speech discrimination for children*. Unpublished master's thesis, Northwestern University, Evanston, IL.
- Hegde MN, Hegde MN. Hedge's Pocket Guide to treatment in speech-language pathology. Clifton Park, NY: Thomson Delmar Learning; 2008.
- Ishita K, Gore M, Shashidharan M. Development of Indian English minima pair test. Proceedings of the India Speech and hearing Association conference, Mumbai, 2012.
- Jerger, S., & Jerger, J. (1984). Pediatric Speech Intelligibility Test. St. Louis: Auditec of St. Louis.
- Karmiloff-Smith A, J Grant, M-C. Jones, K. Sims, and P. Cuckle. Rethinking metalinguistic awareness: representing and accessing what counts as a word. Cognition,58 1996:97-219.
- Kirk, K. I., Pisoni, D. B. & Osberger, M. J. (1995). Lexical effects on spoken word recognition by pediatric cochlear implant users. *Ear and Hearing*, 16: 470-481.
- McClauley RJ, Swisher L. Psychometric review of language and articulation tests for preschool children. Journal of speech and hearing disorder 1984;49 (3):4-42.
- Moog, J.S. & Geers, A. E. (1990). *Early speech perception test for profoundly hearing-impaired children. St.* Louis: Central Institute for the Deaf.

- Norris MK, Juarez MJ, Thomas (Perkins), MN. Adaptation of screening test for bilingual and bidialectal populations. Language, Speech, and Hearing Services in Schools 1989;20:381-390.
- Raven JC. Standard and colored progressive matrices: sets A, AB, B. Oxford, England: Oxford Psychologists,1952.
- Robbins AM, Renshaw JJ, Miyamoto RT, Osberger MJ, Pope ML. Minimal pairs test. Indianapolis, IN: Indiana University School of Medicine; 1988.
- Ross M, Lerman J (1970) A picture identification test for hearing-impaired children. *J Speech Hear Res*, Mar; 13(1): 44-53.
- Trask RL. A dictionary of phonetics and phonology: London: Routledge; 1996.
- Queiroz, Veronica Batista et al. Speech perception test with pictures: applicability in children with hearing impairment. *Rev. CEFAC* [online]. 2017, vol.19, n.2 [cited 2018-05-30], pp.180-189. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-18462017000200180&lng=en&nrm=iso>. ISSN 1982-0216. http://dx.doi.org/10.1590/1982-0216201719215716.

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