Monosyllable, Bisyllable and Trisyllable Word Identification Test for Children in Indian English

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Abstract

The study aimed at developing a monosyllable, bisyllable and trisyllable word identification test for children in Indian English. The developed test consisted of five lists, each containing five monosyllabic, five bisyllabic and five trisyllabic words. Each word list had almost equal representation of low, mid, and high frequency speech sounds. The developed test material was administered on children with normal hearing sensitivity aged 7 years to 8 years. The results indicated that there was no significant difference between the mean identification scores within a word length, across all five lists. An exception to this was the mean monosyllabic word score obtained on list-5 which was significantly lower than that obtained on the other lists. Further, the monosyllabic word identification scores were significantly different from the bisyllabic and trisyllabic word scores. However, there was no significant difference between the bisyllabic and trisyllabic word identification scores. It is recommended that the developed test be used to assess word length identification as well as speech identification scores in individuals above the age of 7 years.

Keywords: *Speech identification score, Pattern perception, word length identification*

A wide variety of speech materials have been employed in the construction of speech identification tests. These include nonsense syllables (Levitt & Resnick, 1978); monosyllabic words (Alusi, Hinchcliffe, Ingham, Knight, & North, 1974; Ashoor & Prochazka, 1985; Begum, 2000; Jijo, 2008; Mayadevi, 1974; Peterson & Lehiste, 1962; Prakash, 1999; Swarnalatha, 1972; Vandana, 1998); bisyllabic words (Ashoor & Prochazka, 1985; Begum, 2000; Jijo, 2008; Moog & Geers, 1990; Wang, Mannell, Newall, Zhang & Han, 2007); trisyllabic words (Nissen, Harris, Jennings, Eggett & Buck, 2005); monosyllable, trochee-spondee words (Erber & Alencewicz, 1976; Erber & Witt, 1977); monosyllable-bisyllable-trisyllable words (Begum, 2000; Jijo, 2008; Moog & Geers, 1990; Plant & Westcott, 1983; Zeiser & Erber, 1977), and spectral/pattern perception using numbers (Erber, 1980). The majority of tests have made use of words having only a particular syllabic length or stress pattern throughout the test. A few tests have used words with varying syllabic length and/or syllable stress within the test (Begum, 2000; Erber, 1982; Erber & Alencewicz, 1976; Erber & Witt, 1977; Jijo, 2008; Moog & Geers, 1990; Plant & Westcott, 1983; Zeiser & Erber, 1977). While the tests developed by Erber and Alencewicz (1976), and Erber and Witt (1977) evaluated stress categorization, those developed by Begum (2000), Jijo (2008) and Zeiser and Erber (1977) evaluate perception of number of syllables. In addition, to evaluating stress pattern perception or word length perception, some tests also have sub-sections to identify word identification scores (Begum, 2000; Erber & Witt, 1977; Jijo, 2008; Moog & Geers, 1990). Thus, these tests have the advantage of evaluating two different aspects of speech perception.

Erber and Alencewicz (1976), using the monosyllable-trochee-spondee test developed by them, determined stress pattern perception in 160 children with hearing impairment in the age range of 3 to 16 years. Their test consisted of 12 words having 4 monosyllables, 4 trochees and 4 spondees. They reported that children with hearing threshold levels better than 95 dB HL had little difficulty in perceiving stress patterns. However, the scores on pattern perception for children with hearing threshold levels poorer than 95 dB HL varied widely from 33% to 100%.

Erber and Witt (1977) evaluated word recognition abilities of 10 children with severe hearing impairment and 10 with profound hearing impairment, using 10 monosyllables, 10 trochee and 10 spondaic words at different sensation levels (SL). The results showed that both word recognition and stress-pattern categorization scores reached a maximum at 24-36 dB SL for the group with severe hearing impairment. However, for the group with profound hearing impairment, word recognition scores were low regardless of

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SL, but their perception of the stress patterns of words improved as a function of increasing intensity, and reached a maximum at 12-30 dB SL. In line with Erber and Alencewicz (1976), Moog and Geers (1990) developed the 'Early Speech Perception Test'. A sub-test of the standard version of the test was designed to evaluate pattern perception, spondee identification, and monosyllable identification scores. This test has been used extensively and found to be useful in selection of candidates for cochlear implants (Tyler, 1995).

The perception of number of syllables was evaluated by Zeiser and Erber (1977) using 60 monosyllabic, bisyllabic and trisyllabic words. This was done on 20 individuals with normal hearing sensitivity and 20 individuals with profound hearing impairment. The results indicated that the perception of syllabic patterns in words by children with profound hearing impairment differed considerably from those with normal auditory perception. It was found to be very similar to vibro-tactile perception by adults with normal hearing sensitivity.

In 1987, Geers and Moog utilized the monosyllable-trochee-spondee test developed by Erber and Alencewicz (1976) to classify children with hearing impairment into four different speech perception categories based on word recognition and word categorization scores. In 1992, they noted that these categorization scores provided useful information regarding the way children with hearing impairment acquired speech in an oral program. They evaluated speech production and speech perception skills of 227 adolescents with severe to profound hearing impairment. The results indicated that there was little difference in the rate of spoken language acquisition of children having categorization scores below 70% versus those having scores equal to and above 70%. However, children having recognition scores above 51% demonstrated a significant advantage in the rate at which they acquired speech in an oral program compared to those who could only perceive the stress pattern of words.

Jamieson, Kranjc, Yu, and Hodgetts (2004) examined the ability of 40 young children (aged 5 to 8 years) to understand speech (monosyllables, spondees, trochees, and trisyllables) when listening in a background of real-life classroom noise. The results revealed that in general, the accuracy was highest for trisyllables, followed by spondees, monosyllables with mid-back vowels, and least for trochees and monosyllables with mid-front vowels.

The above review indicates that tests with varying stress patterns/word length provide useful information regarding the perception skills of individuals with hearing impairment. Hence, it is essential to use such tests while evaluating individuals with hearing impairment.

While studies have evaluated whether individuals with hearing impairment can perceive differences in stress patterns or word length, very few of them provide information regarding which stress pattern/word length is more easily perceived. Studies done in the 1970s, have demonstrated that the performance-intensity function of monosyllables differed from that of spondees (Olsen & Matkin, 1979). This demonstrates that words having different syllable lengths should be scored separately and not merged. Such information would be useful while determining the exact difficulty faced by those with hearing impairment. This information in turn would help in designing therapy programs for them.

Most tests developed using words with different stress or word length, calculate categorization scores using a different set of words from that used to obtain word identification scores. This increases the test duration. Hence, a test that enables both evaluation of categorization and word identification with a single word list would reduce the time taken for evaluation. Further, Indian-English speakers do not use the same stress patterns as those used by native speakers of English. The former group tends to use more of durational cues rather than intensity or F0 cues, due to the influence of native language. Studies on speakers of Indian languages have demonstrated that duration is the primary cue used for the perception of stress (Kumar & Bhat, 2009; Rajupratap, 1991; Savithri, 1999a, 1999b). On the other hand, native speakers of English have been noted to use more of F0 cues along with duration and intensity (Fry, 1955, 1958; Bolinger, 1958; Gay, 1978). Also, due to cultural differences, vocabulary that is very familiar to native English speakers may not be very familiar to Indian English speakers. Hence, a test developed for native English speakers cannot be directly utilized for Indian-English speakers. Thus, the present study was undertaken to develop a multi-list speech identification test for Indian-English speakers, which also determines the perception of words differing in length. The study also aimed to compare the speech identification scores across monosyllables, bisyllables and trisyllables in children who are non-native speakers of English and checking the equivalency of the multiple lists of the developed test.

Method

Initial stage of the study involved the development of a speech identification test in Indian-English having five lists; each containing monosyllabic, bisyllabic, and trisyllabic words. The developed material was later evaluated on a group of typically developing children.

Participants

Eighty participants, in the age range of 6 to 9 years, were evaluated. Twenty of these participants, aged 6 to 7 years, participated in the initial stage to determine the familiarity of the developed material. The remaining 60 participants, aged 8 to 9 years, underwent word recognition testing for the later stage of validation of the test material. The former group had English as a medium of instruction, for a duration of 2 to 5 years. Their mean duration of exposure to English was 3.5 years. The latter group was exposed to the language for a duration of 2 to 6 years with the mean exposure being 4.5 years.

For the validation, 30 males and 30 females in the age range of 8 to 9 years were selected. They had no history of any hearing impairment or any speech and language problem. Their air-conduction thresholds were less than 15 dB HL in the frequency range of 250 Hz to 8000 Hz in both ears while their bone conduction thresholds were within 10 dB HL in the frequency range of 250 Hz to 4000 Hz. Further, to ensure that they had normal middle ear functioning, it was ascertained that they had an 'A' type tympanogram with reflexes present. They also had no history of poor academic performance, and had grade appropriate reading and writing skills, as informed by the school teachers.

Instrumentation

A calibrated two-channel diagnostic audiometer (Madsen OB-922) with TDH 39 supraaural earphones housed in audiocups was used to estimate the pure-tone thresholds and evaluate speech identification ability. To estimate middle ear function, a calibrated immittance meter (GSI-Tympstar) was used.

Development of the test material

The material for the test was developed in Indian-English. The vocabulary appropriate for children aged 6 to 7 years of age, was selected from the age appropriate books. Information was also obtained from caregivers and teachers. A list of about 600 monosyllabic, bisyllabic, and trisyllabic words was prepared. The familiarity of the words was checked on a group of 20 typically developing children in the age range of 6 to 7 years. The participants had to inform whether they used each of the words during daily conversation. If they did use a word, they were also asked to provide the meaning of the word. Based on their responses the words were classified on a three-point scale as 'highly familiar', 'familiar' or 'non-familiar'. The following guidelines were used while classifying the words: 'highly familiar words' were those words which were used in regular communication and the children were able to indicate their meaning correctly; 'familiar words' were those words which they used often in communication but did not know the meaning; 'non-familiar words' were those words which they did not use in regular communication and did not know the meaning. The words that were 'highly familiar' to 90% of the children were used in the development of the test.

The highly familiar monosyllabic, bisyllabic and trisyllabic words were categorised as low, mid, and high frequency words. This was done based on the classification of consonants by Jorgensen (1967) and vowels by Peterson and Barney (1952). Though the numbers of 'highly familiar' words were large, not all were used in the final test. This was done to curtail the duration of the test. Each list consisted of five monosyllabic, five bisyllabic and five trisyllabic words, with almost equal representation of low, mid, and high frequency speech sounds. It was also ensured that the frequency composition was equal across the lists for each word length category (monosyllable, bisyllable, and trisyllable).

The stimuli were recorded onto a Pentium Dual-Core computer, using the Adobe Audition (version 2.0) software. A female who had clear speech served as the speaker. The material was recorded using a sampling rate of 44 kHz with 16 bit resolution, in a sound treated room. An inter-stimulus interval of 5 seconds was used. The recorded stimuli were scaled to ensure that the intensity across words did not vary. Prior to each list, a 1 kHz calibration tone was recorded which had the same average intensity as that of the words.

Procedure for test administration

All the audiological tests were carried out in a sound treated double-room suite. The ambient noise levels were within permissible limits as recommended by ANSI (S3.1, 1991). The recorded material was administered individually on each of the 60 participants. The stimuli were played through a computer, the output of which was routed to an audiometer. The stimuli were presented through a loud-speaker kept at a distance of 1 meter from the head of the participant, using a 0° azimuth. Prior to the presentation of the lists, it was ensured that the VU meter of the audiometer deflected to zero, using the 1 kHz calibration tone. The stimuli were presented at 40 dBHL. This intensity represented a normal conversation level at a distance of one meter. The participants were instructed to write down their responses. Written responses were used to avoid the auditory perception of the experimenter biasing the results. They were told that they could guess the words in case they were not sure of what they heard. All five lists were administered on each participant. The sequence of the lists was randomized to eliminate an order effect.

Scoring

The written responses from all the participants were scored. Each correct response was assigned a score of '1', while a wrong response was given a score of '0'. The scoring was done separately for different word lengths and different lists. The raw scores were analyzed using the SPSS version 10 software. Besides descriptive statistics, a repeated measures ANOVA was also carried out to determine whether there was a difference between scores obtained on the five lists and three word lengths.

Results

The mean and standard deviation (SD) for the combined scores, monosyllable, bisyllable, and trisyllable words are depicted in Table 1. The scores are provided separately for each of the five lists. It is evident from the table that the mean scores were similar for all word lengths across all lists. The only exception to this was the monosyllabic word score obtained for list-5. This was not only lower than that obtained in the other lists and other word lengths, but also had the highest standard deviation.

A two-way ANOVA with repeated measures was carried out to check if the word length or the lists had any influence on the scores. A significant main effect was observed [$F (4, 236) = 15.97$, $p < 0.001$] with word list and word length as the independent variables and scores as the dependent variable. For further information, a Bonferroni pair-wise comparison was done to study the effect of the word lists as well as the word lengths on the word identification scores.

Each of these is discussed separately.

Effect of list on word scores

Effect of the lists on word identification scores was checked with responses combined across all the three word lengths (monosyllables, bisyllables and trisyllables) as well as for each word length. This was done to see if the lists were equivalent when the overall scores were calculated as well as when they were obtained separately for each word length.

With the monosyllable, bisyllable and trisyllable scores combined, the Bonferroni pair-

Table 1 *Mean and standard deviation (SD) of total scores, and scores on monosyllable, bisyllable, and trisyllable words for 60 participants*

List	*Total scores (M+B+T)*		*Monosyllable*		*Bisyllable*		*Trisyllable*	
	Mean**	SD	Mean*	SD	Mean*	SD	Mean*	SD
List -1	14.35	0.93	4.61	0.55	4.83	0.58	4.83	0.55
List -2	14.33	1.05	4.71	0.49	4.78	0.41	4.85	0.48
List -3	13.91	1.29	4.58	0.49	4.91	0.27	4.75	0.62
List -4	14.31	0.83	4.56	0.62	4.83	0.41	4.86	0.43
List -5	13.45	1.35	3.76	0.85	4.80	0.54	4.80	0.57

Note: M = monosyllable B = bisyllables, T = trisyllables
**Maximum score = 5; ** Maximum Score = 15*

wise comparison test indicated that the scores on list-5 were significantly different from the scores on the remaining four lists ($p < 0.001$). It was also observed that when all the word length scores were combined, there was a significant difference ($p< 0.05$) between list-1 and 3. To determine a possible reason for these differences, the raw scores were checked. From the raw scores it was evident that two of the participants had performed poorly across the lists. Their performance was slightly poorer for lists 1, 2, 4, and 5. Their poorer scores could be attributed to their reduced exposure to English. Unlike the other children, who were exposed to English for a duration of 3 to 6 years, these two children were exposed to the language only for a duration of 2 to 3 years. Hence, their data were deleted and the responses of the remaining 58 participants were re-analyzed. Table 2 depicts the mean and SD of the 58 participants, after the elimination of the two participants who had uniformly poor scores across all the lists.

On the two way ANOVA with repeated measures, the responses of the 58 participants also revealed a significant main effect [$F (4, 228) = 26.68$, $p < 0.001$]. Further, on analysis with the Bonferroni pair-wise comparison test it was found that only list-5 continued to be significantly

Table 2 *Mean and Standard deviation (SD) for the total scores, monosyllable, bisyllable, and trisyllable words for 58 participants*

List	*Total scores (M+B+T)*		*Monosyllable*		*Bisyllable*		*Trisyllable*	
	Mean**	SD	Mean*	SD	Mean*	SD	Mean*	SD
List -1	14.50	0.62	4.67	0.47	4.93	0.25	4.89	0.35
List -2	14.56	0.72	4.84	0.36	4.73	0.40	4.93	0.25
List -3	14.50	0.68	4.68	0.46	4.93	0.25	4.87	0.32
List -4	14.44	0.62	4.63	0.51	4.87	0.32	4.93	0.25
List -5	13.58	1.12	3.79	0.83	4.87	0.32	4.91	0.28

Note: M = monosyllables, B = bisyllables, T = trisyllables
**Maximum score = 5; ** Maximum Score = 15*

different (p< 0.001) from the remaining four lists. The remaining four lists did not show any significant difference between each other.

The effect of word scores across lists within a word length (monosyllables, bisyllables and trisyllables) for the 58 participants was also analyzed. The ANOVA results revealed that there was a significant main effect within the monosyllabic word lists [F (4, 228) = 39.44, p < 0.001]. However, there was no such main effect for the bisyllabic and trisyllabic word lists. The Bonferroni's pair-wise comparison test was done for the monosyllable word lists. This revealed a significant difference between list-5 and the remaining lists (1, 2, 3 and 4) at the 0.001 level. This indicated that all the lists within a word length were equal except list-5 of the monosyllabic word lists.

Effect of word length on identification scores

Identification scores across word lengths were analyzed with the responses combined for all the five lists. In addition, the effect of word length was also examined independently for each of the five lists.

The effect of word length with scores for the lists combined was evaluated using ANOVA. A significant main effect (p<0.001) was obtained for the 25 words across the 3 word lengths [F (2,114) =58.30, p<0.001]. The Bonferroni pair-wise comparison showed a significant difference (p<0.001) between the scores on the monosyllables and the other two word lengths. However, there was no significant difference found between the bisyllables and trisyllables scores.

The effect of the word length within each list was also analyzed. As observed with the combined word scores, the monosyllable scores were significantly different from the other two word lengths (p<0.001) for each of the lists.

Discussion

The purpose of the study was to develop a speech identification test having words of different lengths for non-native speakers of English. The equality of the five lists that were developed was also assessed. The results of the study are discussed with reference to the equality of the lists and with reference to the influence of word length.

Equality of the lists

From the scores obtained when word lengths were combined, it is evident that the first four lists are equivalent and thus can be used interchangeably. In contrast, list-5 was found to yield lower scores when compared to the other four lists. On examination of the raw data, it was observed that identification of two of the monosyllabic words in list-5 was consistently wrong. The participants tended to replace these test words in this list with more familiar words. The word /foam/ was frequently replaced with the word /phone/ and /rope/ was replaced with /road/. It is possible that, though the test items were initially reported to be familiar by children in the age range of 7 years to 8 years, they tended to substitute them with words used more frequently. It has been reported by Savin (1963), Schultz (1964), and Devaraj (1983) that the level of familiarity affects the perception of words. They also noticed that there continued to be identification errors, even when words were classified as being very familiar. The error words were found to be invariably used more frequently than the test stimuli.

Thus, in the present study though familiar words were used, parameters other than word familiarity may have affected the test results, as was observed in list-5 of the developed test. Luce and Pisoni (1998) and Pisoni, Nusbaum, Luce and Slowiaczek (1985) observed that the neighbouring phonemes influenced the perception of phonemes. They noted that “hard” words, that had a low frequency of occurrence and had many lexical neighbours, were difficult to identify. In contrast, “easy” words, that had a higher frequency of occurrence and few phonetically similar neighbours with which they could be confused, were more easily identified. This could account for the reason why words that were originally classified as being familiar were misperceived.

Based on the finding of the present study, it is recommended that while evaluating children using the developed test, list-5 cannot be used when the scores across word lengths are combined. However, the remaining four lists can be used as they yield equivalent scores.

Further, the results brought to light that the scores between lists within a word length also varied in case of the monosyllabic word lists. List-5 was found to yield a significantly lower score when compared to the other four lists. However, all five lists were found to be equivalent for the bisyllabic and trisyllabic words. As was mentioned earlier, the two words that the participants tended to replace with words that were probably used more frequently by them, were both monosyllables. This was despite the fact that all the monosyllables had been initially rated as being familiar by children. Hence, if scores are being analyzed separately for different word lengths, all five lists can be used interchangeably for the bisyllabic and trisyllabic words. However, only the first four lists can be used interchangeably for the monosyllabic words.

Effect of word length on identification scores

From the results, it is evident that there was a significant difference in scores across the word lengths. This was observed when the analysis was done for each of the word lists and when all the word lists were combined. While there was no difference between the scores on bisyllabic and trisyllabic words, the monosyllabic words were found to result in significantly poorer scores. The poorer monosyllabic word scores cannot be attributed to the two monosyllabic words that were not being perceived correctly by several of the participants. Poorer monosyllabic word scores were seen for all the word lists in which there was no difficulty in perceiving any of the words. Hence, it can be inferred that besides familiarity, other factors may have lead to the differences in scores between monosyllables and other word lengths. Monosyllables are known to be less redundant when compared to multi-syllables (Kirk, Hay-McCutcheon, Sehgal, & Miyamoto, 2000). This could have led to the poorer monosyllable word scores.

Jamieson et. al, (2004) analysed the effect of word length on speech identification, and reported findings similar to those noted in the present study. They too observed that monosyllabic words were more difficult to perceive than polysyllabic words. The speech intelligibility accuracy was highest for trisyllables, followed by spondees, trochees, and then monosyllables. Studies on clinical populations have also revealed that monosyllabic words are more difficult to recognize than multisyllabic words.

This has been observed in children using cochlear implants and also in hearing aid users (Fryauf-Bertschy, Tyler, Kelsay, & Gantz, 1992; Fryauf-Bertschy, Tyler, Kelsay, Gantz, & Woodworth, 1997; Kirk, et al. 2000; Kirk, Pisoni, & Osberger, 1995).

However, in the literature, the majority of tests that make use of stimuli with varying syllabic lengths, have utilized a combined score for determining speech identification scores. Though they recommend calculation of pattern / stress / categorization perception, they do not suggest scoring each word length separately (Ashoor & Prochazka, 1985; Begum, 2000; Erber & Alencewicz, 1976; Erber & Witt, 1977; Jig, 2008; Moog & Geers, 1990). Such a scoring procedure would not enable the evaluator to know what caused an error. Scoring each word length separately would provide information as to which of the word lengths was misperceived. This in turn would help in making recommenda-tions in the rehabilitation of the individual with hearing impairment.

Thus, it can be construed that while studying the perception of words with varying lengths, it is essential to analyze the scores obtained on monosyllables separate from those of bisyllables or trisyllables. This recommendation is based on the finding of previous researchers and that of the present study. Further, the observations of the present study indicate that the scores of bisyllables and trisyllables can be combined.

Conclusion

It can be concluded from the findings of the present study that speech identification abilities can be assessed using the developed monosyllable, bisyllable and trisyllable test for speakers of Indian-English. The developed test material can be used for individuals above the age of 7 years. Of the five lists that were developed, the first four lists were found to be equivalent when total scores were calculated. Thus, they can be used interchangeably. However, list-5 is not recommended to be used when word lengths are combined as this list resulted in lower scores.

When scores are calculated independently for the different word lengths, the five lists can be interchanged while using the bisyllabic and trisyllabic words. However, this cannot be done for the monosyllabic words. For the monosyllabic word lists, only the first four lists can be used, as they are equivalent.

Further, it is recommended that when using tests with varying word lengths, the scores for monosyllables should be calculated separately as they yield scores that are significantly different from that of bisyllabic and trisyllabic words. However, responses can be combined when scoring bisyllabic and trisyllabic words, since scores are similar on these two word lengths.

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Appendix

Monosyllabic, Bisyllablic and Trisyllablic Word Identification Test

Monosyllabic words

List 1	List 2	List 3	List 4	List 5
Post	Cool	Nut	Beep	Foam
Show	Play	Rail	Force	Silk
Card	Cow	Jute	Talk	Ring
Roof	Fruit	War	Poor	Goat
Bank	Page	Pot	Thick	Rope

Bisyllabic words

List 1	List 2	List 3	List 4	List 5
Bucket	Finger	Basket	Paper	Window
Shampoo	Hockey	Mango	Sweater	Tennis
Butter	Soldier	Sister	Balloon	Mother
Tortoise	Mountain	Flower	Little	Sudden
River	Rubber	Money	Farmer	Cupboard

Trisyllabic words

List 1	List 2	List 3	List 4	List 5
Hospital	Furniture	Beautiful	Aeroplane	Festival
Calendar	Butterfly	Crocodile	Umbrella	Wonderful
Kangaroo	Newspaper	Grand father	Coconut	Capable
Tomato	Basket ball	Dinosaur	Banana	Potato
Direction	Telephone	Encourage	Thirty three	Sharpener