AN EXPLORATORY STUDY OF THE PERFORMANCE OF NORMAL INDIAN LISTENERS ON THE STAGGERED SPONDIAC WORD TEST DEVELOPED IN ENGLISH FOR INDIAN POPULATION

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The Staggered Spondiac Word Test offers the diagnostician many sources of information concerning an individual's ability to respond to and cope with complex speech stimuli. Higher auditory functioning from both theoretical and diagnostic points of view is now receiving considerable interest.

In light of the increasing use of the SSW test and its potential for both a clinical as well as a research tool, it was the purpose of this investigation to pursue the following:

1. To study the performance of normal Indian listeners on the SSW test, and establish the mean C-SSW scores for normal Indian listeners.
2. To investigate pattern effects on the SSW test.
3. To investigate ear effect on the SSW test.
4. To investigate sex differences on the SSW test.
5. To establish which errors are typical of normal Indian listeners.

Methodology

Sixty subjects were chosen for participation in this study. The total number consisted of thirty males (a large group according to Garrett, 196/) and thirty females. The subjects tested were in the age group of 16 to 29 years. The selection of the subjects was dependent on the following criteria and the same criteria were maintained for all the subjects regardless of the age and sex of the subject:

(a) Patient indicating essentially normal hearing in both ears, obtaining pure tone average of not more than 20 dB Hearing Level(ISO)
(b) No family history of hearing disorders.
(c) No extreme exposure to noise.
(d) No history of trauma caused by a blow to the head
(e) No significant otological history.
(f) No significant neurological history.

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The above criteria were felt to be not very stringent. The effect of this on the norms probably will be to increase the mean number of errors and also perhaps the standard deviation. Thi s is felt to be more realistic and or conservative standard.

Children were not taken up for the study because the word list which was chosen in this study for preparing the SSW test tape, was standardized only for adult Indian population.

All subjects were naive listeners with regard to the SSW test. The measures obtained for each subject were:

(a) Pure tone average for each eat.
(b) Discrimination scores using PB words for each ear.
(c) Staggered spondiac word test.

The pure tone average for each ear was always obtained prior to the SSW testing since the presentation level for the SSW test was dependent upon pure tone average for each ear in this investigation. However, Katz (1968) and others keep the presentation level for the SSW[r] rest dependent upon SRT. But this was not followed in this investigation since it was felt that the subject would be familiarized with the spondee list during SRT testing and hence their performance on the test might be biased. This was a special problem for Indian conditions since the number of spondees available for testing were fifty, and moreover from the same list of spondees the SSW list was prepared in the present investigation.

The SSW items were recorded in the sound-treated room using two Philip's Casette Monophonic Tape Recorders, one UHER Variocord 263 Stereo Tape Recorder and one Amplivox 103 Clinical .Audiometer.

The output of the two monophonic tape recorders was fed into the stereo tape recorder through the audiometer. When the required overlap of the spondiac words (as seen on the RADART. 530-A Cathode Ray Oscilloscope screen) was obtained, on the two monophoric tape recorders, it was transferred to the stereo tape recorder. The recording on the stereo tape recorder was done at seven and one-half inches per second.

The Staggered Spondiac Word test-Hst of the present investigation consisted of twenty four items. Spondiac Words of the auditory test lists which have been standardized for adult Indian population (Swarnalatha, 1972) were employed to construct the SSW list.

A calibrated diagnostic speech audiometer which satisfies the USA criteria of essential elements of speech audiometer (Arphi, Model II 700) and UHER Variocord, stereo tape recorder were used in the present investigation to administer the SSW test. Since the audiometer used had only one input for tape, it was modified at the All India Institute of Speech and Hearing, Mysore. The output of the stereo tape recorder served as the input for the audiometer. One channel of the stereo tape recorder was fed to the audiometer via the tape input provision in the audiometer, and a provision was made to feed the second channel of the stereo tape recorder.

Ten practice items consisting of spondiac words taken from the children's spondee-list and which were not over-lapped in time sequence were given prior to the twenty four item SSW test list. The subject was given the twenty four item SSW test list if he or she repeated five items correctly out of the ten items in the practice items. If the subject failed to repeat five items during the practice session, he was again given a practice session.

The SSW test list was presented through earphones, setting the intensity to 50 dB above the pure tone average. This level was expected to provide a maximum score (Balas and Simon, 1965) and therefore, deviations from normal performance cannot be attributed to lack of sensitivity.

The responses of the subject were recorded using the talk-back system in the following way:

The first ear to which the stimuli was to be presented, was noted down on the form.

Items were totalled in five ways:

(i) Total Monosyllables missed: The total percentage of correct responses indicates an individual's overall success on this test. There were 48 possible errors for each ear.

(ii) Right Ear Non-Competing Errors (R-NC): These monosyllables were heard in the right ear when no stimulus was presented in the left ear. There were 24 possible errors on this.

(iii) Left Ear Non-Competing Errors (L-NC): These monosyllables were heard in the left ear when no stimulus was presented in the right ear. There were 24 possible errors on this.

(iv) Right Ear Competing Errors (R-C): These words were heard in the right ear while simultaneously a monosyllable was heard in the left ear. There were 24 possible errors on this.

(v) Left Ear Competing Errors (L-C): These words were heard in the left ear while simultaneously a monosyllable was heard in the right ear. There were 24 possible errors on this.

All scores were corrected for discrimination scores obtained on the PB word list standardized for Indian population.

Results and Discussion

The sample tested in the present investigation consisted of thirty (30) males and thirty (30) females. Majority of the subjects tested were college students. All the subjects were right-handed. However, no attempt was made in the present investigation to control the level of knowledge of English in the subjects and to match the subjects according to whether English was their 'first language' or 'second language' (Houston 1972).

Reliability of the scores was established through test-retest procedure. The correlation co-efficients obtained between the scores of two testings were 0.81 and 0.88 for males and females respectively. The obtained correlation co-efficients were significant at 0.01 and 0.05 levels of confidence.

The first consideration of the present investigation was to establish the mean corrected SSW error scores for normal Indian listeners. Table 1 provides the results for this problem.

TABLE 1

The C-SSW scores of the competing and non-competing conditions for right and left ears, the total C-SSW score of right ear and left ear, to' a! competing score, total non-competing score and the total test score. All the scores are expressed in percentage.

Conditions	*Males*	*Females*
R-NC	9.75	10.22
R-C	17.25	19.76
L-C	17.82	20.71
L-NC	8.26	10.31
R-Ear Score	13.50	14.99
L-Ear Score	13.04	15.51
Total Non-Competing	9.005	10.26
Total Competing Score Total	17.53	20.23
Test Score	13.27	15.25

An analysis of the response patterns indicated unique type of responses on particular SSW items. Generally, the responses emitted were 'text-book' for 'cook-book', 'plum-cake' for 'pan-cake' and 'mid-wife' for 'mid-way'. Of course, these responses were considered as errors. However, these responses can be explained since they probably differ qualitatively from the other types of responses. These typical responses probably indicate th; t knowledge of the lexical, semantic and syntactic rules of the language, which *the* listener already has, is influencing his present performance. The SSW item is probably a 'Complex Linguistic Context' since the listener will be getting speech stimulii in a time sequence which staggers the words which are being presented. Hence, the performance in this 'Complex Linguistic Context' may be influenced by the abstractions of the linguistic rules on the part of the listener. Though the listener is being given the word 'pan-cake' in association with another word to the opposite ear, he might be rounding it off to 'plum-cake'. This might be because of the greater probability of the word 'cake' preceded by the word 'plum' rather than by the word 'pan' (at least this may be true in the Indian situation). A similar thing might have happened with the words 'cook-book' and 'mid-way'.

The above analysis is probably supported by B. Malmerg (1%7) who says:

'. . . any act of perception is intimately tied up with the perceiver's background, i.e., his anterior experience, his memory, and his attitudes. . . .'

Furthermore, the finding that a listener in the mode of perception has capabilities (with regard to discrimination and identification of the signal) that are governed almost entirely by the framework of linguistic segments and features that are at his disposal as the user of a particular language (Stevens and House, 1972), is in support of the above analysis. Similarly Katz and Fodor (1964) write, 'in decoding an acoustic speech signal into a sequence of segments, a listener not only uses his knowledge of the phonological and syntactic rules, the lexicon, and the semantic rules of the language'.

Thus from an analysis of the errors using the 'Analysis by Synthesis' model given by Stevens and Halls (1967), which involves a process of specifying an unknown sign in terms of the best match selection from a standard inventory, it may be possible to explain these unique error responses observed in the normal listeners in the present investigation.

In 1965 when Jack Katz finalized the forty item clinical version of the SSW . list EC, he found that on some words the rate of error was high for normals and also they appeared relatively unfamiliar. However, such things have also been found in the present investigation. Subjects had the greatest difficulty on some items. For example, the rate of error was high on the item 'although-farewell' and also on the item 'outlaw-cargo'. Probably this is either due to the unprobable nature of these words appearing on a test such as this, or, indeed, the words may not appear in the vocabulary of the subjects.

In a normative study done by Turner (1966) on the American Population, the normal performance on the SSW test is taken as 5 per cent or fewer errors on the non-competing condition and 13 per cent or fewer errors on the competing condition. According to Katz (1968) normals got a total score of 5 per cent, ear score of 10 per cent and condition score of 15 per cent. However, in the present investigation the total mean corrected SSW error scores were 15.25 per cent and 13.27 per cent for females and males respectively. Males obtained a mean corrected SSW error score of 9.005 per cent on the non-competing condition and a mean corrected SSW error score of 17.53 per cent on the competing condition. The female group got a corrected error score of 10.26 per cent and 20.23 per cent for non-competing and competing conditions respectively.

The second consideration of the present investigation was to investigate pattern effect on the SSW test. The Wilcoxon Matched Pairs Signed Ranks Test, was used in the present investigation to test the null hypothesis formulated for this problem. The two patterns employed in the present investigation are:

Pattern	I:	R-NC(A)	R-C(B)	L-C(C)	L-NC(D)
Pattern	II:	L-NC(E)	L-C(F)	R-C(G)	R-NC(H)

The null hypothesis was accepted at 0.01 level in all the four conditions indicating no pattern effect on each condition. However, the null hypothesis was rejected at 0.05 level for R-NC and R-C conditions. This was seen both in males and in females.

Studies on the dichotic listening tasks are suggestive of laterality effect on SSW test since the test has similarity with the dichotic listening experiments. Consequently, the third consideration of the present investigation was to investigate the laterality effect on SSW test. The Wilcoxon Matched Pairs Signed Ranks Test was used in the present investigation to test the null hypothesis formulated for this problem. The null hypothesis was accepted at 0.01 level both in males and females for all the conditions. However, in females the null hypothesis was rejected at 0.05 level indicating significant difference at this level between L-C(F) and R-C(G) conditions. Nevertheless, it can be tentatively said that laterality effect is absent on SSW test.

The above results on the laterality effect on SSW test are in accordance with the findings of Turner (1966), Katz (1968), Brunt and Goetzinger (1968) and Chapnick and Brunt (a 1970). In all these investigations no laterality effect was seen on SSW test. However, in a study by Chapnick and Brunt (b 1970), the results indicated laterality effect, i.e., right ear superiority when filtered version of the SSW test was administered.

With the results of the present investigation in hand, and also having the findings of other studies, however, it may be said that the SSW test seems free of a clinically significant laterality effect, except under conditions modified from the usual presentation.

Several factors may contribute to the SSW test's resistance to this effect. Most reports on dichotic listening utilize items in which all portions of the verbal signal are overlapped in time. In contrast, on the SSW test for each item, one ear always leads in the time of stimulation. This may allow the listener to better separate the spondiac words, and this may be reflected in the subject's questioning whether any portion of the items are competing. Apart from item formation, correct responses are facilitated by word association as the two monosyllable of each spondiac word, are highly associated. This may be related to the lack of ear laterality on the SSW test.

The fourth consideration of the present investigation was to find out the sex differences on the SSW test. The Mann-Whitney U Test, was used in the present investigation to test the null hypothesis formulated for this problem. The null hypothesis was accepted at 0.01 level in all the conditions indicating statistically insignificant difference in the performance between males and females. The null hypothesis was rejected at 0.05 level for L-C(C) condition only. However, with the available data it can be said that sex differences are insignificant on the SSW test.

The fifth consideration of the present investigation was to establish the type of errors which were apparent in the case of normals. The type of errors consisted of omissions and substitutions. The Wilcoxon Matched Pairs Signed Rank

Test was used in the present investigation to test the null hypothesis formulated for this problem. The null hypothesis was accepted at 0.01 level and also at 0.05 level in all the conditions both in the case of males and females.

However, the most apparent response bias seen in the present investigation, was reversal and partial reversal and the other types of response biases were either absent or if present, were insignificant. Probably the reversal responses are due to the influence of the instructions which were given to the subject apart from the standard instructions. The subjects were instructed that they can repeat the spondiac words which they heard in any order and they were also told that they will not be penalized for any change in the original order. Probably, this instruction might have influenced the subject's performance and that the subject might have become less curious, as far as the order of presentation was concerned, in his attempt to repeat both the spondees correctly.

The Wilcoxon Matched Pairs Signed Ranks Test was used in the present investigation to test statistical significance of the difference between raw SSW scores and corrected SSW error scores. The null hypothesis was tested against the hypothesis that raw SSW error scores are higher than corrected SSW error scores. However, both in the case of males and females the null hypothesis was rejected at 0.01 and 0.05 levels confirming the hypothesis that the total raw SSW error scores are higher than the total corrected SSW error scores.

Similarly using the Wilcoxon Matched Pairs Signed Ranks Test the statistical significance of the difference between competing and non-competing conditions, was determined. The null hypothesis was tested against the hypothesis that competing scores are higher than the non-competing scores. However, both in case of males and females the null hypothesis was rejected at 0.01 and 0.05 levels confirming the alternative hypothesis. This finding is in accordance with the results of other studies on SSW test. Probably this finding is of little diagnostic significance except to underscore the probability that most errors will be made in the competing conditions when normal subjects are tested.

On an experimental basis the SSW test tape prepared in the present investigation, was administered on three cases who had reported at the AIISH clinic either with the complaint of hearing loss or speech defect.

The case, X, a male aged 28 years reported to the AIISH clinic with the complaint of speech defect and hearing loss. The following data was obtained through case history:

The case sustained head injury at the age of fifteen due to motor cycle accident. At that time there was profuse bleeding from nose and ears and the case was unconscious for three days. It was also reported that since then the case had developed hearing loss in both the ears and speech defect. Regarding his speech defect it was complained by the case that he could not make fast movements of his articulators.

On examination the case had bilateral mixed hearing loss, and slurred speech. There was nothing significant in other examinations. However, a detailed neurological examination was not done in this case. Table 2 gives the performance

of this case in comparison with the performance of normals and the other two cases.

The case, Y, a male aged 22 years reported to the AIISH clinic with the complaint of speech defect. On examination the case had bilateral sensory neural hearing loss. Speech was found to be jerky, arythmic and explosive. Neurological examination revealed basal nuclear lesion. Table 2 provides the performance of this case on the SSW test.

TABLE 2

Corrected SSW error scores of normal males, normal females, Case X, Case Y, and Case Z. All the scores are expressed in percentage

	Normal Males	*Normal Females*	*Case X*	*Case Y*	*Case Z*
R-NC	9.75	10.22	57.47	33.81	5.85
R-C	17.25	19.76	61.64	42.14	18.32
L-C	17.82	2071	63.30	37.98	22.48
L-NC	8.26	10.31	63.30	25.48	-2.3
N-C	9.005	10 26	60.38	29.64	1.77
C	17.53	20.23	62.47	40.06	20.40
R	13.50	14.99	59.55	37.97	12.08
L	13.04	15.51	63.30	31.23	10.09
Total	13.27	15.25	61.42	34.10	11.08

The case, Z, a male aged 19 years reported to the AIISH clinic with the complaint of hearing loss. On examination the case had moderate sensory neural hearing loss in the right ear and severe mixed loss in the left ear. No significant findings were reported in other examinations. Table 2 provides the performance of this case on the SSW test.

The present investigation has the following limitations:

(a) Subjects were not matched according to whether English was their 'first language' or 'second language'.

(b) Subjects were not matched for intelligence quotient.

(c) No attempt was made to control the level of knowledge of English in the subjects.

However, in light of the data of the present investigation the following are the suggestions for further research:

(a) Attempt may be made to reconstruct the SSW list by deleting certain items which have been found to be more difficult for the normal listeners in the present investigation.

(b) Norms may be established for central auditory disorder group.

(c) Further work on standardization of the text could be carried out.