PERFORMANCE OF TYPICALLY DEVELOPING CHILDREN AND CHILDREN WITH LEARNING DISABILITY ON SPEECH IN NOISE TEST

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ABSTRACT *Children with central auditory processing deficits exhibit salient behaviours like difficulty in hearing in noisy environments, following complex verbal command etc. They often have to work harder than others in trying to receive auditory information in a meaningful manner.*

Aim: *The present study aimed at comparing the performance of the typically developing children with normal hearing and children with Learning Disability on Speech in Noise Test (Kannada- a Dravidian language).*

Methods: *The study was done on children of age range 7-13 years who were native speakers of Kannada language. 20 children with no history of learning related problem formed the control group and 20 children with the formal diagnosis of learning disability formed the clinical group. Both the groups had normal hearing sensitivity with no middle ear problems. Kannada High frequency speech in noise test at +10dBSNR was administered.*

Results: *Significantly high scores in the control group compared to the clinical group indicate that the auditory processing in the presence of noise was affected, even as the test was done in the native language.*

Conclusion: *Assessment tests like speech in noise in native language would assess auditory separation ability in children at an earlier age. Identifying auditory processing problem, learning related problem or academic failure early will prevent children struggling with learning language, if early intervention is sought.*

Keywords: Speech in Noise test, Learning Disability, High frequency words, monosyllables, Auditory processing disorder

I. INTRODUCTION

Auditory function is a complex process that develops and changes throughout life. Auditory skills related to basic perception of frequency, intensity, and time develops early, reaching maturity by 5 to 6 years of age [1], [2]. In contrast, development of more advanced auditory behaviour related to aspects of speech perception and listening in noise progresses into the school years[3] [4, 5]. Normal auditory development provides a solid foundation for the acquisition of more complex processes such as speech and language and in turn, academic skills such as reading [6] and written language.

Children with central auditory processing deficits manifest some salient behaviours such as inattentiveness to sounds, difficulty in hearing in noisy environments and in following verbal instructions especially, when they are complex[7-9]. They frequently request for repetition of the verbal messages, need more time to process information, they have trouble paying attention to and remembering information presented orally and also fail to follow series of instruction presented auditorily.

Existence of auditory processing problem in children with learning disability has been widely reported [10, 11]. Due to the inability to process signals in a competing auditory environment many children develop an academic difficulty. As a consequence, these children are labeled as dullards, poor listeners and at times they may even dropout of school and indulge in anti social / asocial activities. Typically, individual with a central auditory disorder have normal hearing when taking a traditional pure tone and speech hearing test are done, however they are unable to interpret or process speech with in an environment which is less than quiet[12]. The environments such as a classroom setting, the work place, community gathering, worship places etc are often seen as threatening because of this auditory difficulty. These individuals often have to work harder than others just trying to receive auditory information in a meaningful manner.

At present there are many subjective tests or diagnostic tools in identifying children who may have auditory processing problem. However, the challenge remains when the child is exposed to many languages. If the testing is done in any other language other than their native language or language exposed to since birth then outcomes of such study will depend on language competency. Failure in performance in such condition will be not merely due to auditory processing problem but due to language itself. In order to overcome such factors testing the children in their native language is recommended[13].

Further, the words or sounds used should be in the vocabulary of the children. It is important that when children are tested the test stimuli should be testing the auditory skills and not their language skills. Hence, use of monosyllabic sounds which are very much in the childrens' vocabulary like/ ch/, /f/, /t/ etc may be used along with other monosyllabic words.

In the present study High Frequency words and Monosyllables are used as they are found to be more difficult to be perceived in the presence of noise. Adapting a test material which may comprises of both Monosyllables and Multi-syllabic words when presented along with speech noise may provide better audiological understanding. Thus, the present study aimed at comparing the performance of the Normal Children and Learning Disabled on Speech in Noise Test developed in Kannada, a Dravidian language, by adapting the material from already existing High frequency Kannada speech in noise test by Saugat Roy [14].

II. METHOD

Present research is taken by analysing part of the data from the larger study. The study was done in urban area in the southern part of India, were multi-cultural variation is dominant. The children in the present study were multi-lingual knowing more than one language. However, the present study was taken up to assess their auditory perception in noise of high frequency words in their native language (Kannada).

A. *Participants*

A total of 40 subjects aged between 7-13 years participated in this study. 20 children in the control group were with no history of learning related problems. In the clinical group 20 children with the formal diagnosis of learning disability by the speech therapist and Clinical Psychologist were recruited. These subjects were selected based on certain inclusion criteria. In the present study children both male and females were native speakers of Kannada language. These subjects were attending Kannada medium formal school. The subjects did not have any history of Neurological, Otological, Audiological or Speech and language related problems. And their hearing thresholds were less than 15dB, bilaterally with AB gap < 5dB and with A type Tympanogram and Ipsilateral reflexes present.

B. *Test Material*

After all the participants were categorized into two groups based on the inclusion criteria. They were assessed using adapted version of speech in noise test by Sougat Roy [14]. The adaptation done was to insert six high frequency monosyllabic sounds along with existing monosyllabic high frequency word list. This was done to increase the difficulty in identifying the syllables. Thus, the two lists with 20 mono-syllabic words and three monosyllabic sounds formed the test stimuli. There by maximum possible test stimuli were 23 and the maximum score was 23.

C. *Instrument used and Environment*

MAICO MA-53 a double channel audiometer, which had the facility to do both monitored live voice and recorded voice testing was used. It was compatible to external input (i.e. compact disc player, Panasonic) for delivering the recorded high frequency Kannada speech in noise test. The audiometer was calibrated according to the standards .The same instrument was also used for pure tone audiometry screening. Acoustic Immitance Meter: GSI Tympstar was used to test all the subjects to find out the integrity of the middle ear system. Compact Disc Player: Panasonic. This instrument was used to play the CD which consisted of the High frequency Kannada speech in noise test stimuli. Compact disc: Sony was used for recording the speech stimuli. The audiometer was connected through jacks to the CD player. The output of the CD player was connected to the input of the audiometer. The audiometer delivered the stimuli through head phones TDH 39.

This study was carried out in a double room which was sound treated and the ambient noise levels were checked using a sound level meter, which was found to be in the prescribed ANSI standards, ANSI S3.1-1999 [15]

Response sheet: The responses were recorded on a response sheet. Each subject had a separate response sheet, on which their responses were noted. Later their performance was calculated into percentages and compared using appropriate statistical analysis.

D. *Procedure*

The Pure tone audiometry, for frequencies between .25 KHz to 8 KHz for Air conduction testing using TDH-39 head phones and for frequencies between .25KHz to 4KHz for Bone conduction testing using BM-71bone vibrator were done. Further, tympanometry and reflexometry screening was done for all the subjects using a calibrated GSI-Tympstar. Static compliance of 0.3 cc to 1.6 cc was considered normal. The reflexes were checked at 1kHz and BBN at 95 dB HL and 85 dB HL respectively. For all the subjects the speech stimulus was presented at 40 dB SL (ref. PTA).

All the children were instructed in Kannada, that they will hear a list of Kannada words or sounds through the head phones, and they must repeat those words or sounds just as they hear it. These children were encouraged to guess the words if they were not sure. The 1 kHz calibrated tone which came prior to the word list was used to set the volume unit meter readings at zero. Each list was presented to the subject either in the left ear or right ear randomly. The speech noise from the audiometer was routed on top of the same ear which was selected for stimulus presentation at +10dBSNR. This SNR was selected as per the preliminary test findings done on normal hearing children at 0dBSNR, + 5dBSNR and +10dBSNR with the three different word lists. All the children had scored well in +10 dBSNR when compared to the other two levels. Hence, the responses of children were taken at +10dBSNR. Responses from these children were recorded for analysis using a talk back system. A separate score sheet was used for each client, the no. of correct and incorrect responses given by each subject were noted down on the response sheet. These were converted into percentage of correct responses for each subject for further statistical analysis.

The responses from the children were entered into SPSS software for the analysis. The scores from both the group were analyzed. Shapiro-Wilk test was administered to check for normal pattern of distribution. Descriptive and inferential statistical analysis was carried out.

III. RESULTS AND DISCUSSION

In the present study Kannada high frequency word list was used, that consisted of 20 monosyllabic words and 3 phoneme or sounds in each list, that was used to assess the auditory perception in speech noise of children with and without learning disability. The analysis done using Shapiro-Wilk test of normality revealed that data was not normally distributed for the participants in the normal group. Hence, the non-parametric analysis was done. The following were the findings of the analysis-

A. *Descriptive statistics*

The mean and the median values in the normal children on the High frequency Kannada Speech in noise test were higher than that of the children with learning disability. The mean value was 89.56; median value was 90.31 with SD 5.53 and range 17.39 for the control group. Whereas the mean value was 46.96; median value was 48.71 with SD 7.86 and range 28.27 in the clinical group.

B. *Inferential statistics*

Non-parametric statistical analysis was done using Mann-Whitney U test to identify the significance of difference between the two group and it was observed that children in the control group had significantly higher performance than those in the clinical group ($U=.00, p=.000, r=.85$). The inferential analysis revealed that these results are true to be generalised to the larger population due to its effect size, even though the sample size is small.

This study indicates that though the children with learning disability were tested for their auditory separation ability using the test stimuli which is in their native language (Kannada) they still have great difficulty in understanding speech in noise. The understanding of speech is crucial in learning process. Inability to perceive the speech or separate the speech from background noise can lead to difficulty in learning. The study by White-Schwoch T, Woodruff Carr K, Thompson EC, Anderson S, Nicol T, Bradlow AR, et al. [6] reported that neural markers of reading skills have been identified in school-aged children many pertain to the precision of information processing in noise. Identifying, difficulty in perceiving speech in noise in the children's native language (exposed to the native language since birth) becomes important tool for assessment. Were in the component of lack of exposure to the language does not act as a contributing factor in failure to perform in the auditory separation task. Further, children who struggle to listen in noisy environments may struggle to make meaning of the language they hear on a daily basis, which can in turn set them at risk for literacy challenges[6]. Further, identifying such auditory processing difficulty early can change the way these children are handled at school particularly in terms of their seating and strategies with learning.

IV. CONCLUSIONS

Present study was carried out with the aim to test if there exists any difference in performance between the normal hearing children, with no academic difficulty with that of children with learning disability on Speech in noise test in their native language (Kannada). The present study reveals that there exists marked difference in performance in the two groups, even when they are tested using the words from their native language, on an auditory separation task. Such assessment tools in native language which assesses speech in noise ability in children at an earlier age can help in identifying auditory processing problem that may result in learning related problem or academic failures. Early identification may prevent children struggling with learning language, if early intervention is sought.

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