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Effect of different types of non-words on repetition performance in children with learning disability and typically developing children

[1]Bushaira Afreen. K, [2] Ravali. Mathur P, [3] Shruti Kumari, [4] Pallavi S. Paithankar
Ph.D scholar, MASLP, Lecturer (Speech and Hearing)

[1, 2, 3] Ph.D, Head of the department Ali Yavar Jung National Institute for the Hearing Handicapped K.C Marg, Bandra reclamation, Mumbai, India.
[4] Pallavi S. Paithankar Sion hospital, Sion, Mumbai, India.

Abstract
The study was aimed to evaluate non-word repetition skills in learning disabled and typically developing children with respect to different types of non-words. A total of 60 subjects participated in the study among which 30 were children with learning disability and 30 were typically developing. A Non-word repetition test was administered on the participants which consisted of 50 words with short, long and other vowels, blends and multisyllabic words. The participant's responses of repetition were analysed descriptively and statistically. Results indicated children with learning disability having poorer performance on total non-word repetition task irrespective of the type of words compared to the typically developing children. The overall performance of children with learning disability was better for non-words with short vowels & Long vowels than blends and multisyllabic words. Therefore, type of non-words should be considered as an important variable in clinical situations as it provides an index of phonological coding.

Keywords: Learning disability, Non-words, Phonological coding, Short-term memory.

1. Introduction

Learning disability (LD) is a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. Specific learning disability does not include learning problems that are primarily the result of visual, hearing, or motor disabilities, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage (IDEA, 2004) [11]. According to studies it is a fact that the LD category accounts for 52% of all students with disabilities served in special education under the Individuals with Disabilities Education Act. In India it is thought that approximately ninety million people to be having varying degrees of learning disabilities. Studies have also indicated that 10-14% of 416 million children in India have LD [13].

On review of literature, children with LD are found to have major problems with short term memory (STM). STM involves the ability to recall Information after a short period of time. Deficits in STM reflects in classroom activities such as maths & reading of children with LD as these depend more on STM. It also appears to be crucial for word recognition and reading comprehension [14]. STM allows about 250 milliseconds to 25 seconds to an individual to think of ways to remember the information, or else it will be forgotten. In order to increase remembering, it's common in people to use labelling. These labels help to organize, rehearse, store, and recall the visual information. This labelling process is called as phonological coding when referring to the analysis of sound sequences in words during reading. Children with learning disability have difficulty in decoding words and remembering what they have just read because they don't use their working memory time to phonologically or verbally code the information [15]. Therefore it has been hypothesized that less efficient phonetic coding process in short-term memory may be the basis for some of the language deficiency characteristics of children with LD [4].

The phonological short-term memory plays a major role in Non-word repetition NWR tasks [10].These tasks have received much attention in the investigation of childhood language disorders because of their potential to identify children with language impairment. NWR is a task in which children are asked to repeat novel phonological forms or non-sense words [1]. It is a complex psycholinguistic task that heavily relies upon the phonological segmentation, phonological knowledge, and even lexical knowledge [12]. NWR tasks have an important role in identifying childhood language disorders, because of their potential to evaluate the client's ability to temporary store phonological representations. During NWR the child cannot rely on a pre-existing phonological representation of a word to repeat the non-words. Instead, she or he must construct a new phonological representation of the newly presented non-word based on a single exposure to the auditory stimulus. Further, it should be transformed into a newly formed representation as an output. On the other hand, real word tasks measures the child's ability to reproduce a word with the help of its pre-existing phonological representation in his or her long-term memory. The rationale for the use of non-words rather than real words is to assess the application of word structure knowledge in reading, decoding, spelling encoding, and repetition to

minimize the influence of the participant's previous vocabulary knowledge and memorized word patterns [17].

Researchers had revealed that repetition of non-words requires the storage of its constituent phonological segments in the short-term memory store, and that the quality of this storage varies markedly between each individuals [7]. As the production of non-words doesn't rely upon the previous lexical representation in long-term memory, non-word repetition tasks provide a purer assessment of phonological storage ability.

Gathercole 1995 [8] studied 70 children with specific language impairment between 4 and 5 years of age on performance of NWR task. The non-words selected for the study were based on the word-likeliness i.e. high word-like and low word-like. The results of the study revealed better performance of high word-like non words compared to low word like nonwords. Further, the author concluded that NWR for low word-like stimuli to be largely dependent on phonological memory, whereas repetition for high word-like stimuli to be dependent on long-term lexical knowledge and therefore it is less sensitive to phonological memory constraints.

Although the literature supports a significant difference in performance on NWR tasks for children with and without learning disability [5] it's also found that it differs with regard to different types of non-words. Gathercole 2006 [9] stated that phonemic context, word-likeliness, length, number of syllables in non-words also have an effect on performance of children with LD.

Nonword repetition is sensitive to the broad spectrum of language impairments as it taps many of the processes involved in language which involve hearing, perceiving, and segmenting the phonological form, encoding and retaining the phonological representation, and planning, programming, and executing the output. Hence, it seems reasonable to study the effect of different types of nonwords in the repetition performance of children with learning disability.

2. Need of the study: In present scenario there is ample data on NWR abilities of children with LD in western countries. However, there are very limited studies in Indian context considering the clinical significance of the use of different types of nonwords in the evaluation of nonword repetition skills in children with LD. Hence the present study was aimed to compare the different types of nonwords in the NWR performance of children with LD and typically development (TD).

3. Aim of the study: The study was aimed to compare the different types of nonword repetition performance in children with LD and typically developing (TD) children within the age range of 11-13 years.

4. Methodology

4.1. Subjects: A total of 60 subjects in the age range of 11-13 years with a mean age of 11.7 years were participated in the study. They were further divided into two groups. Group 1 LD consisted of 30 children diagnosed as LD & Group 2 TD consisted of 30 typically developing children. All subjects were screened for oral peripheral mechanism abnormalities, articulation problems and any history of neurological or any other associated problems like hearing impairment, mental retardation and so on.

4.2. Procedure

To assess different types of non-words repetition a test of non-word repetition (Wiley Blevins, 2001) [18] was administered on the subjects. The test contained 50 non-words among which 10 words were with short vowels, 10 words were with long vowels, 10 words were with other vowels, 10 words were with blends, and 10 words were with multisyllabic words. These words were audio recorded with an interval of 3 seconds between each words and presented through the headphones to the subjects. The subjects were asked to repeat the non-words heard and the responses were recorded using Sony digital voice recorder. A score of "1" was given for correct repetition of words, and "0" for incorrect repetition.

4.3. Statistical analysis of data

The raw data was tabulated and analysed using SPSS Software (version 16). Descriptive statistics was done to find the mean and standard deviation values of short vowels, long vowels, other vowels, blends, and multi-syllabic words in each group. As a part of inferential statistics, the data was subjected to one way ANOVA to find out significant differences and the results revealed that there was a statistical significant difference ($P< 0.05$) between and within the groups. The data was further subjected to Post hoc analysis.

5. Results: The study was undertaken to determine the performance of children with LD to repeat different types of non-words and compare their abilities to do so with those of TD children. The analysis results are as following:

5.1. Non words with Short vowels: The mean values of non-words with short vowels for group 1 (LD) was 8.96 (SD=1.04), and for group 2 (TD) was 10 (SD=0) indicating that there was a statistical significant difference ($P<0.05$) between both the groups. The findings are presented in Table 1.

Table 1: Mean and Standard deviation of non-words with short vowels in both the groups

Groups	N	Mean	Standard deviation	F-value	P-value
LD	30	8.96	1.04	29.999	0.000
TD	30	10	0		

5.2. Non words with Long vowels: The mean value of non-words with long vowels for group 1 (LD) was8.63 (SD=1.49), and for group 2 (TD) was 10 (SD=0) indicating that there was a statistical significant difference ($P<0.05$) between both the groups. The findings are presented in Table 2.

Table 2: Mean and Standard deviation of non-words with long vowels in both the groups

Groups	n	Mean	Standard deviation	F-value	P-value
LD	30	8.63	1.49	25.361	0.000
TD	30	10	0		

5.3. Non words with other vowels: The mean value of non-words with other vowels for group 1 (LD) was 8.46 (SD=1.49), and for group 2 (TD) was 9.9 (SD=0.3) indicating that there was a statistical significant difference ($P<0.05$) between both the groups. The findings are presented in Table 3.

Table 3: Mean and Standard deviation of non-words with other vowels in both the groups

Groups	N	Mean	Standard deviation	F-value	P-value
LD	30	8.46	1.52	25.916	0.000
TD	30	9.9	0.3		

5.4. Non words with Blends: The mean value of non-words with blends for group 1 (LD) was 8.0 (SD=1.52), and for group 2 (TD) was 9.9 (SD=0.3) indicating that there was a statistical significant difference (P<0.05) between both the groups. The findings are presented in Table 4.

Table 4: Mean and Standard deviation of non-words with blends in both the groups

Groups	N	Mean	Standard deviation	F-value	P-value
LD	30	8	1.53	45.117	0.000
TD	30	9.9	0.3		

5.5. Non words with Multisyllabic words: The mean value of non-words with multisyllabic for group 1(LD) was 7.73 (SD=1.63) and for group 2 (TD) was 9.5 (SD=0.67) indicating that there was a statistical significant difference (P<0.05) between both the groups. The findings are presented in Table 5.

Table 5: Mean and Standard deviation of multisyllabic nonwords in both the groups

Groups	n	Mean	Standard deviation	F-value	P-value
LD	30	7.73	1.63	30.261	0.000
TD	30	9.5	0.67		

5.6. Non-word repetition within group 1 (LD): The mean values of non-words with short vowel was 8.96 , with long vowels was 8.63, with other vowels was 8.46, with blends was 8, and with multisyllabic was 7.73 indicating that there was a statistical significant difference (p<0.05) between non-words with short vowels compared to blends & multisyllabic words. The non-words with long vowels were statistically significant (p<0.05) compared to multisyllabic words. These findings are presented in Table 6.

Table 6: Mean and Standard deviation of Group 1 (LD) across all types of non-words.

Type of non-word	Mean	Standard deviation	F-value	P-value
Short vowels	8.96	1.04	3.4260	0.0104
Long vowels	8.63	1.49		
Other vowels	8.46	1.52		
Blends	8.0	1.53		
Multi-syllabic	7.73	1.63		

6. Discussion: The present study examined the NWR skills among the 2 groups of children i.e. with and without LD. Comparing both the groups, NWR performance was poor in children with LD compared to typically developing. Similar findings were reported in a study conducted by Apthorp (1995) [2]. Secondly, evaluation of the repetition skills of children of both the groups with respect to different types of non-words, inferred that performance of non-words with short vowels & long vowels were better than non-words with blends and multisyllabic. This findings are supported by the Brady, Poggie, & Rapala (1990) [3] work which suggested that NWR performance varies with increase in number of phonemes, decreasing syllable familiarity, phonetic context etc. Also the possibility of poor performance in non-words with blends & multisyllabic could be due to the articulatory complexity of blends and multisyllabic compared to short and long vowels non words as stated by Evans, et al., (2007) [6].

On the whole, the repetition performance of multisyllabic non-words were poorer compared to all other types of non-words in children with learning disability. According to short-term memory model (Gathercole, 2006) [9], decay is present in the phonological representations of a newly presented non-word. Thus quality of representation of a non-word declines with an increase in the length of non-word. Therefore, longer stimuli will be more vulnerable to decay than shorter stimuli due to the increased time of phonological representation. Thus, the information about the repetition performance and factors influencing the non-word repetition performance would enable professionals to design and provide more effective intervention strategies.

7. Conclusion

Phonological storage capacity plays a key role in supporting learning of the sound structure of new words during vocabulary acquisition. Non-word repetition task provides a sensitive index of phonological coding or storage, and it is determined by the factors that influence the perception of a non-word. Factors can be familiarity of the constituent segments, intrinsic storage factors such as phonological similarity, stimulus length etc. Thus it can be inferred from the study findings that the type of non-words should be considered as an important variable in situations to identify and evaluate language and learning disabled children. Therefore, future research should focus on the sensitivity and specificity of different types of non-words in non-word repetition task for further clinical application.

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