Verbal Memory Span and Sequential Memory in Children with Learning Disability

Merry Elizabeth Roy[1], Sara Paul[1], and S.P. Goswami[1]

Abstract

The present study aimed at comparing verbal memory span and verbal sequential memory to picture stimuli, both forward and backward in children with learning disability. It also aimed to compare verbal memory span and verbal sequential memory. A total of 9 children (7 males and 2 females) of academic grades VII-X (ranging in age from 12-16 years) diagnosed as having learning disability by a qualified speech language pathologist were chosen for the study. The stimuli consisted of line drawn pictures of frequently occurring nouns, which were taken from Computerized Linguistic Protocol for Screening (CLIPS) (Anitha, 2004). Stimuli were presented using Microsoft Power Point presentation, in a series of six levels with 2 pictures in the first level, 3 pictures in the second level and so on till 7 pictures in the sixth level. All the items in each level were presented simultaneously for 30 seconds. After removal of the pictures, the participants named them in both forward and reverse order. Results revealed that children with learning disability performed better in verbal memory span than in verbal sequential memory tasks, both forward and backward. Forward memory and sequencing tasks were easier than backward tasks. This could be attributed to the fact that forward memory tasks are simpler, verbally oriented, and strongly sequential. Whereas backward memory span involves more complex cognitive processes that require transformation not necessary with forward memory. These findings have a strong implication while designing assessment and intervention programs for children with learning disability.

Keywords: *learning disability, forward and backward verbal sequential memory, forward and backward verbal memory span*

Cognitive studies of memory in normal individuals, functional neuroimaging studies and neuropsychological investigations of individuals with memory loss indicate that memory is not a unitary phenomenon (Giovanello & Verfaille, 2001). Rather, it has several functional systems which help in a unique way to encode, store and retrieve information. Children with learning disability face a variety of memory problems. A learning disability refers to retardation, disorder, or delayed development in one or more of the processes of speech, language, reading, writing, arithmetic, or other school subjects resulting from a psychological handicap caused by a possible cerebral dysfunction and/or emotional or behavioral disturbances. It is not the result of mental retardation, sensory deprivation, or cultural and instructional factors (Kirk, 1962). It has been reported that individuals deficient in memory skills, such as those with learning disability may have difficulty in a number of academic and cognitive domains (Stanovich & Siegel, 1994; Torgesen, 1988). These memory deficits can be identified and tracked down at an early stage.

The generally accepted classification of memory is based on the duration of memory retention and identifies two types of memory mainly short term memory or working memory and long term memory. Short-term memory allows one to recall something from several seconds to as long as a minute without rehearsal. Its capacity is also very limited. Short term memory can be either in the form of verbal memory and nonverbal memory. Also based on the type of stimuli it can be further classified as visual short-term memory and auditory short-term memory. In the visual memory the stimuli are presented in the visual mode and the person has to visualize, store and retrieve the number of stimuli and respond accordingly.

It has been reported that many dyslexics have poor visual sequential memory, i.e. a poor ability to perceive things in sequence and then remember the sequence. This inturn affects their ability to read and spell correctly. Individuals with poor visual memory find it difficult to recall visual images immediately or after a long period of time. A large number of memory studies undertaken with children exhibiting reading deficiencies have shown consistently that these children, relative to their peers without disability, have difficulty with short term verbal memory tasks. Verbatim, sequential memory appears to be one area of

1 All India Institute of Speech and Hearing, Mysore, India

primary deficit. These children exhibit difficulty on a large number of short term memory tasks that require recall of letters, digits, words or phrases in exact sequence (Corkin, 1974; Lindgren & Richman 1984; McKeever & VanDeventer, 1975; Ritchie & Aten, 1976).

Forward and backward digit, letter, words or phrase span tasks are the measures used to assess serial memory. Such tests are thought to tap the phonological articulatory loop of working memory (Swanson, 1994). Howes, Bigler, Burlingame, and Lawson (2003) reported that unlike the four verbal memory span tasks included in the serial memory composite, the fifth serial component is a visual- spatial memory span task, on which individuals with dyslexia consistently performed poorly. Swanson (1998) reported that on immediate memory tasks, poor readers have inconsistently demonstrated deficits of serial memory and of recall of visual representations with respect to age matched typically achieving readers.

It has been reported that poor readers performed more poorly than younger typical readers on tasks requiring the recall of serial verbal information, lists of words, and multi-syllabic names (Bradley & Bryant, 1981; Hulme, 1981; Watson & Willows, 1995). There are also evidences that poor readers use relative cognitive strengths to compensate for extreme processing deficiencies and decode the words as well as younger typical readers who have no processing deficits (Stanovich & Siegel, 1994; Stanovich, Siegel & Gottardo, 1997; Watson & Willows, 1995). Research has shown that our short-term memory can hold approximately six units of information. However, children with learning disability face difficulty in both auditory and visual memory (Strang & Rourke, 1985; Seigel & Feldman, 1983).

Thus, it can be summarized from the review of literature that children with learning disability show deficits in both visual and auditory short term memory. Researchers have used various stimuli such as digits, letters, words and multi-syllabic names. It has also been proposed that the kind of stimuli used and the type of responses required from the participants are important variables which can influence the performance. Thus, using verbal response to a different kind of stimuli would provide better insight of the effect of stimulus on memory span and sequential memory. In the Indian scenario very few attempts have been made to examine the effect of picture stimuli on memory span and sequential memory, hence the current study was taken up to address such issues and also to provide further corroborative evidence to the existing research in this area. The main aim of the study was to compare the verbal memory and sequential memory, both in forward and backward order in children with learning disability. The study also aimed to compare between the verbal memory span and sequential memory.

Method

Participants

A total of 9 children (7 males and 2 females) studying in academic grades 7th to 10th diagnosed as having learning disability by a qualified speech language pathologist were chosen for the study. The children were in the age range of 12 to 16 years. The language level of the children was found to be age adequate on clinical observation. Early Reading Skills (ERS) was administered to confirm the diagnosis of learning disability. Children with ERS of grade 4 to 5 were selected. All the participants had Kannada (L-1) as their mother tongue and English (L-2) as the medium of instruction in their school.

Stimuli

Standardized line drawn pictures of frequently occurring nouns taken from Computerized Linguistic Protocol for Screening (CLIPS), (Anitha, 2004) were chosen, as stimuli and were field tested. The stimuli were presented through Microsoft Power Point (2007 version) in a series of six levels with 2 pictures in the first level, 3 pictures in the second level and so on till 7 pictures in the sixth level. All the items in each level were presented simultaneously. Since it requires a minimum of 30 seconds to form a visual imagery, each stimulus was displayed for duration of 30 seconds.

Procedure

The participants were seated comfortably in front of the computer screen placed one and a half feet from the eyelevel. All the participants were given verbal explanations regarding the nature of the test, and written consents from caregivers were obtained. The environment was made as distraction free as possible by carrying out the procedure in a quiet room and by removal of any potential visual distracters. The following instructions were given to the participants:

"We will show you some pictures on the computer screen. The pictures will be arranged from left to right. The first slide will have 2 pictures and the number of pictures will gradually increase in every trial. The pictures will be displayed for 30 seconds after which you are required to name them in both forward and reverse order". Participants were instructed in Kannada (L-1)

A score of '1' was given for each correct verbal response and '0' for an incorrect response. A maximum score of '2' was possible for level-1 and for level six the maximum score was '7' across various tasks (forward memory, forward sequencing, backward memory & backward sequencing). The collected data were tabulated and appropriate statistical analyses were performed.

Statistical analyses

Statistical analyses were done on the collected data using SPSS software (Version 10). Mean and Standard deviation was calculated for both raw scores and percentage scores. A Two-way repeated measures ANOVA was performed to compare the difference in performance across different order (forward and backward order) and different tasks (memory and sequencing). Data were subjected to paired t-test for making a comparison between forward and backward memory, between forward memory and forward sequencing as well as between backward memory and backward sequencing.

Results

The results indicated that children with learning disability performed better in verbal memory span

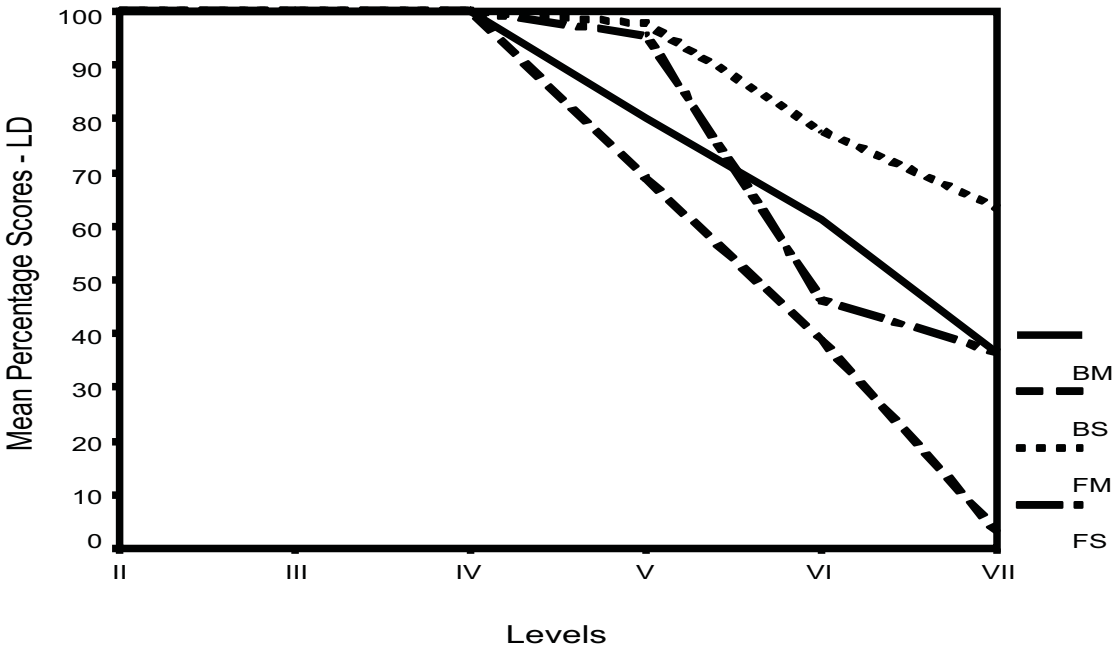

Fig. 1. Mean percentage scores obtained for each task across the different levels (BM: Backward Memory; BS: Backward Sequencing; FM: Forward Memory; FS: Forward Sequencing)

than in verbal sequential memory tasks, both forward and backward. They obtained a highest mean score of 23.55 in forward memory, followed by backward memory (20.55), forward sequencing (19.44) and the least mean score was obtained for backward sequencing (15.77). The mean and standard deviation of the data are tabulated Table 1.

Table 1. *Mean and Standard deviation of raw scores*

Tasks	*Mean*	Standard deviation
Forward Memory	23.55	2.00
Forward sequencing	19.44	3.04
Backward memory	20.55	3.43
Backward sequencing	15.77	3.59

Results of Two-way repeated measures ANOVA revealed a significant difference between forward and backward memory and sequencing [F (1, 16) =20.842, p<0.001]. This shows that the participants performed better in forward order (memory and sequencing) task than backward order. There was a significant difference between the two tasks of memory and sequencing (forward and backward) with an F (1, 16) value of 107.883 (p<0.001) signifying that the memory tasks were easier than the sequencing ones. There was no significant interaction between order and task [F (1,16) = 0.213, p>0.05)]. Paired t-test demonstrated a significant difference when comparison was made across the tasks. It was also observed that backward memory task was easier than backward sequencing task (t(8)= 5.439, p<0.001), forward memory task was easier than forward sequencing (t(8)= 5.203,p<0.001), forward memory task was easier than backward memory task t(8)=3.133,p<0.05) and forward sequencing task was easier than backward sequencing task (t(8)=2.772,p<0.05).

Figure 1 depicts the mean percentage scores obtained by children with learning disability across the 6 levels for all the tasks (forward memory and sequencing, backward memory and sequencing). It is evident from the above figure that children with learning disability obtained a maximum score (100%) till the fourth level for all the tasks. On the other hand, performance deteriorated as the level increased for all the tasks. A steep fall (falling below 10%) in the scores was seen only for the task of backward sequencing. However, it was not the same for the other three tasks i.e., forward memory, forward sequencing and backward memory which followed a gradual fall in the scores

Discussion

The results indicated that for computerized presentation of picture stimuli significant differences in performance were noted between forward and backward memory tasks in the participants of the study. Forward memory span was found to be less affected than backward memory span. This could be attributed to the fact that that forward memory tasks are simpler, verbally oriented, and strongly sequential. Forward memory span requires strong attentional and sequential demands, whereas backward memory span appears to have spatial and/or integrative elements not apparent in forward memory span. On the other hand, as Reynolds and Ramsay (1995) have reported backward memory span involves more complex processes that require transformation not necessary with forward memory and backward recall may also invoke visuo-spatial imaging processes for many individuals. However, the results of the study do support the findings of Reynolds and Ramsay (1995). Thus, the poor performances of children in backward memory task can not be attributed to the complexity of task.

It was observed in the present study that the sequential memory was more affected than memory span. The results thus show that these tasks require higher cognitive functioning. This has received support from literature (Corkin, 1974; Lindgren & Richman 1984; McKeever & VanDeventer, 1975; Ritchie & Aten, 1976). The results of these studies suggest that children with learning disability exhibit difficulty in recalling letters, digits, words or phrases in exact

sequence. Similar findings were also reported by Howes, Bigler, Burlingame and Lawson, (2003). They suggested that, in serial memory composite, the fifth serial component is a visual-spatial memory span task, on which individuals with dyslexia consistently performed poorly. Bradley and Bryant (1981), and O'Shaughnessy and Swanson (1998) also reported that children with learning disability performed more poorly than typically developing children on tasks requiring the recall of serial verbal information, lists of words, and multi-syllabic names. These corroborative evidences are strengthened by the present study which indicates that memory span is better than sequential memory.

Conclusion

The important findings drawn from the present study are that in children with learning disability, the memory span was better than the sequential memory and the forward ordered tasks were easier than backward order. Better performance was seen till level four and a gradual deterioration was evident after this level. However a steep fall was seen for backward sequencing. These findings have a strong implication while designing assessment and intervention program for children with learning disability. Findings of the study suggest the need for inclusion of picture stimuli to tap the memory during the course of therapy. The presentation of visual stimulus may provide more obvious cues which can be helpful in children with auditory processing deficits. Thus, it can be concluded that children with learning disability show deficits in both memory span and sequential memory, but the deficit is more pronounced in sequential memory.

Address for correspondence: Ms. Merry Elizabeth Roy, Undergraduate student, All India Institute of Speech & Hearing, Manasagangothri, Mysore - 06, India. Email:joyu4u@yahoo.com

References

Anitha, R. (2004). Computerized Linguistic Protocol for Screening (CLIPS). Unpublished dissertation, University of Mysore, Mysore.

Bradley, L., & Bryant, P., (1981). Visual memory and phonological skills in reading and spelling backwardness. *Psychological Research, 43,* 193-199.

Corkin, S., (1974). Serial- ordering deficits in inferior readers. *Neuropsychologia, 12,* 347-354.

Giovanello, M. S., & Verfaellie, M., (2001). Memory systems of the brain: A Cognitive Neuropsychological Analysis. *Seminars in speech and language, 22,* 107-116.

Howes, N. L., Bigler,E. D., Burlingame, G. M., & Lawson, J. S., (2003). Memory performance of children with dyslexia: A Comparative Analysis of Theoretical Perspectives. *Journal of Learning Disabilities, 36,* 230-246.

Hulme, C., (1981). The effects of manual tracing on memory in normal and retarded readers: Some implications for multi-sensory teaching. *Psychological Research, 43,* 179-191.

Kirk, S.A., (1962). *Educating exceptional children.* Boston: Houghton Mifflin.

Lindgren,S. D., & Richman, L. C. (1984). Immediate memory functions of verbally deficient reading disabled children. *Journal of Learning Disabilities, 17,* 222-225.

McKeever, W. F., & VanDeventer, A. D., (1975). Dyslexic adolescents: Evidence of impaired visual and auditory language processing associated with normal lateralization and visual responsivity. *Cortex, 11,* 361-378.

O'Shaughnessy, T. E., & Swanson, H. L., (1998). Do immediate memory deficits in students with learning disabilities in reading reflect a developmental lag or deficit? : A selective meta-analysis of the literature. *Learning Disability Quarterly, 21,* 123-148.

Reynolds, C. R., & Ramsay., (1995). Forward and backward memory span should not be combined for clinical analysis. *Archives of Clinical Neuropsychology, 11,* 440.

Ritchie, D. J., & Aten, J. L., (1976). Auditory retention of nonverbal and verbal sequential stimuli in children with reading disabilities. *Journal of Learning Disabilities, 9,* 312-318.

Siegel, L. S., & Feldman, W., (1983). Nondyslexic children with combined writing and arithmetic learning disabilities. *Clinical Paediatrics, 22,* 241-244.

Stanovich, K. E., & Siegel, L. S., (1994). Phenotypic performance profile of children with reading disabilities: A regression-based test of phonological-core variable- difference model. *Journal of Educational Psychology, 86,* 24-83.

Stanovich, K. E., & Siegel, L. S., & Gottardo, A., (1997). Converging evidence for phonological and surface subtypes of reading disability. *Journal of Educational Psychology, 89,* 114-127.

Strang, J. D., & Rourke, B. P., (1985). Adaptive behavior of children who exhibit specific arithmetic disabilities and associated neuropsychological abilities and deficits. In B.P. Rourke (Ed.), *Neuropsychology of Learning Disabilities: Essentials of subtype analysis* (pp. 302-330). New York: Guilford Press.

Swanson, H. L., (1994). Short term memory and working memory: Do both attribute to our understanding of academic achievement in children and adults with learning disabilities? *Journal of Learning Disabilities, 27,* 34-50.

Torgesen, J. K., (1988). Applied research and meta theory in the context of contemporary cognitive theory. *Journal of Learning Disabilities, 21,* 271-274.

Watson, C., & Willows, D. M., (1995). Information processing patterns in specific reading disability. *Journal of Learning Disabilities, 28,* 216-231.