Research Article

Auditory Memory Training in Children with Learning Disability: A Pre-Post Therapy Comparison

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Abstract

Children with Learning Disability (LD) often have impairments in working memory, which may contribute to deficiencies in other cognitive areas. An increased awareness of the negative consequences of working memory difficulties among educational and health practitioners has augmented demand for targeted interventions over recent years. The present study attempted to investigate the effectiveness of auditory memory training on auditory memory in children with LD. Two groups in the age range of 6 to 8 years served as of participants in the present study. Group I consisted of 16 normal children and group II consisted of 10 children studying in the academic grades 1st to 3rd diagnosed as having LD. The study was carried out in three different phases. In phase one pre- therapy auditory memory testing while in phase two auditory memory training and phase three had therapy auditory memory testing. The two groups were compared using independent sample t-test and the results indicated a significant difference in performance in auditory memory tasks between the two groups before the training programme. However, after the training programme there was no statistically significant difference between normal children and children with LD. The results of the present study indicate that intensive training improves the auditory memory of children with LD.

Background

Memory is an active system that stores, organizes, alters and recovers information (Baddeley, 1996). The generally accepted classification of memory is based on the duration of memory retention, and identifies two types of memory namely, short term memory or working memory and long term memory. Based on the type of stimuli the short term memory can be further classified as visual short-term memory and auditory short-term memory. Auditory short term memory involves being able to take in information that is presented orally, process that information, store it in the mind and then recall what is heard (Cusimano, 2010).

Working memory is used to process and store information during complex and demanding activities (Holmes. Gathercole, Place, Alloway, & Ellrot., 2012). It supports many activities that children routinely engage in school. For example, attempting to read and comprehend a passage in the textbook. The process of reading sentences, holding them in mind and integrating the information to uncover the meaning relies heavily on the ability to simultaneously process and store information over short term. Similarly, following a set of complex instruction, which a child will often have to do in classroom rely on the ability to remember the various part of instruction (Holmes, et al., 2012). Hence, working memory impairments can cause educational failure in children.

There is a limit to the amount of information one can hold and manipulate in working memory (Holmes, et al., 2012). Among typically developing children, the working memory capacity increases steadily up to the age of 15 years where it reaches the adult level (Alloway, Gathercole & Pickering, 2006). However, for some children, working memory follows atypical developmental pattern that results in a smaller capacity compared to their peer group (Westberg, Hirvikoski, Forssberg & Klingberg, 2004).

Deficits in working memory are a common feature of a wide range of developmental disorders such as Specific Language Impairment, Attention Deficit Hyperactivity Disorder, Reading and Mathematical difficulties (Archibald, Gathercole, 2007; Geary, Hoard, Byrd-Craven, Nugent & Numtee, 2007; Holmes, Gathercole, Hilton, Place, Alloway, Elliott, 2012; Jeffries & Everatt, 2004). They can also occur in the absence of any diagnosed disorder, and represent a significant risk factor for poor educational progress (Gathercole & Alloway,

2008).

Learning Disability (LD) is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to central nervous system dysfunction. Children with LD face a variety of memory problems (National Joint Committee on Learning Disabilities, 1980).

Memory is a critical area of focus in the field of LD for three reasons. First it reflects applied cognition; that is, memory functioning reflects all aspects of learning. Secondly, several studies have suggested that the memory skills used by children with LD do not appear to exhaust, or even to tap their ability. Finally, several cognitive intervention programs that attempt to enhance the overall cognition of children and adults with LD rely on principles derived from memory research (Lee Swanson, Cooney & Shaughnessy, 1998).

Children with LD often have impairments in working memory, which may contribute to deficiencies in other cognitive areas (Hulme and Mac Kenzie, 1992). Siegel & Ryan (1989) have suggested that reading disabilities stem from a deficit in working memory. Learning to read requires specific components of working memory to allow for the coding, storage, and retrieval of associations between spoken and written words. Thus, impairments in these working memory functions can impede reading ability.

Children with LD often experience difficulty in developing a good understanding of words, remembering terms and information that has been presented orally. Poor readers perform more poorly than younger typical readers on tasks requiring the recall of serial verbal information, list of words, and multisyllabic names (Bradley and Bryant, 1981; Hulme, 1981; Watson & Willows, 1995). Theaja and Meghashree (2012) compared iconic (visual) and echoic (auditory) memory in children with LD and reported that children with LD exhibit deficits in both iconic and echoic memory. The above review of literature suggests that children with LD show deficit in auditory memory. Children with working memory impairments often fail in the classroom because the working memory loads of each activity exceed their capacity. When the working memory is limited, children may often forget what they are doing and this can lead to inattentive behaviour. The end result is frequent academic failure and slow rate of educational progress (Holmes, 2012). Training children with LD in auditory memory may improve their working memory skills which in turn can improve their academic performance. In Indian scenario studies focusing on auditory memory training and its effectiveness in children with LD is scanty. Hence, the present study attempted to investigate the effectiveness of auditory memory training on auditory memory in children with LD.

Aim: The present study attempted to investigate the effectiveness of auditory memory training on auditory memory in children with LD.

Research Hypotheses

1. There is a significant difference in auditory working memory between normal and children with LD before auditory memory training.
2. There is a significant difference in auditory working memory between normal and children with LD after the auditory memory training.

Method

Participants

Two groups with a total of 26 in the age range of 6 to 8 years participated in the study. Group I consisted of 16 normal children (8 males and 8 females) and group II consisted of 10 children (5 males and 5 females) studying in the academic grades 1st to 3rd diagnosed as having LD by a qualified speech language pathologist using the test material Early Reading Skills (Karanth, 1999).

Stimuli

Two tasks were used in the study. To check Task one (T1) - immediate recall of nouns, 10 frequently occurring nouns were selected. For Task two (T2) - backward sequencing of numbers, five sets of numbers were chosen. Among the five sets, the first two sets contained three single digit numbers and the third and fourth set contained four single digit numbers and the last set contained 5 numbers among which three were single digit and rest were two digit numbers.

Procedure

The study was carried out in three different phases. In phase I pre-therapy auditory memory testing, phase II auditory memory training for children with LD and the phase III post therapy auditory memory testing was carried out . The same stimuli were used for the auditory memory in phase I and III. The subjects in-group 1 (normal children) had participated only in phase I and III of the study. Entire testing was carried out in a quiet distraction free classroom in the school.

Phase 1: Two tasks were used to check the auditory memory. Task one (T1) - immediate recall of nouns. For task 1 the participants were instructed

to repeat back all the nouns which were presented to them auditorily. The repetition of the nouns was irrespective of the sequential order. Task two (T2) - backward sequencing of numbers. Here, the investigator presented 5 sets of numbers and the participants were instructed to listen to each set, and repeat the numbers of each set in the backward manner of presentation. A score of '1' was awarded for correct response and a score of '0' for the wrong response for both the tasks. The time taken to complete the tasks was approximately ten minutes.

Phase II: In this phase auditory memory training were given to participants in group two. They were equally divided into two groups for the training programme. Children in each group attended 30 minutes therapy programme for about 40 sessions. The programme included following activities.

1. One minute game - A lexical category was given to the child. The child had to name orally as many items as possible in that lexical category in one minute.
2. Connecting game - One lexical category was chosen. Each child had to name orally an item in the lexical category and the next child should remember the first word uttered by the previous child and add another name of the item in the same lexical category with the present one and so on. This had to be carried out in a sequential order.
3. Odd one out - A set of five words were presented to the child orally by the trainer. Among the words one word was odd one. The child had to carefully listen to the words and say the odd word.
4. Missing number - A set of numbers in a numerical order was given, with a missing number in between. The participants had to carefully read the numbers and write the missing number.
5. Word reversal task - A set of words were given in an order. The child had to repeat it back in the reverse order.

Phase III- (Post therapy testing): The same test which was carried out in phase I of the study was repeated for all the children in group two and scoring was done. The time taken to complete the tasks was approximately ten minutes. The practice effect was avoided as the test was repeated after a month.

Results

The scores obtained for immediate recall of nouns (T1) and backward sequencing (T2) between normal children and children with LD was subjected to statistical analysis using SPSS version 17 software. The scores obtained for immediate recall of nouns (T1) and backward sequencing (T2) were compared between male and female children in both the groups using independent sample t-test. The results indicated that there were no significant differences in the performances on both the tasks between males and females in both the groups. Hence, the data obtained from males and females for Task 1 and Task 2 were clubbed in both the groups for the further analysis.

The scores obtained for immediate recall of nouns (T1) and backward sequencing (T2) were compared between normal children and children with LD. Descriptive statistics were obtained for both the groups on each one of the task. The mean scores obtained for normal children for T1 was 3.43 (SD=0.62) and for T2 was 7.5 (SD=0.73). Mean score obtained for children with LD before the training programme for T1 was 1.5 (SD=1.17), for T2 it was 4.3 (SD= 0.67). The Figure 1 represents the mean scores obtained by normal children and pre therapy mean scores of children with LD for Task 1 and Task 2 respectively.

Independent sample t test was used to compare the mean scores obtained by normal children and children with LD on task 1 and task 2 for before and after training phase. The results indicated significant differences in the score on task I [t (24) =5.48; $P<0.05$] and task 2 [t (24)=11.18; $P<0.05$] before training phase. The normal children performed significantly higher than that of children with LD before the training phase. Hence the research hypothesis that stated a significant difference in auditory working memory between normal and children with LD before auditory memory training was accepted.

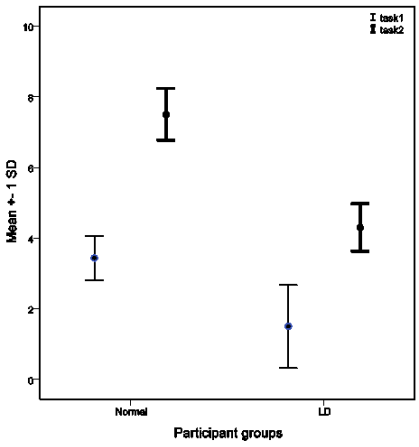

Figure 1: Mean scores obtained by normal children and pre therapy mean scores of children with LD for Task 1 and Task 2.

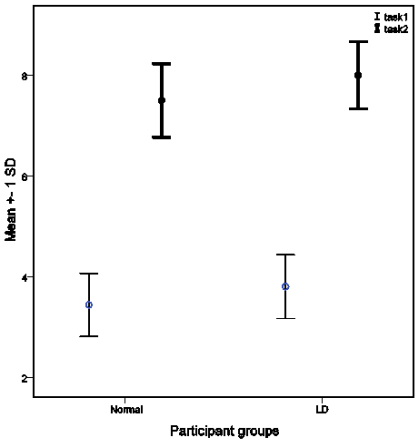

Figure 2: Mean scores obtained by normal children and post therapy mean scores of children with LD for Task 1 and Task 2.

However, after the training session when the mean scores were compared it was noticed that there was an improvement in the mean scores for both the tasks in children with LD i.e. the mean scores obtained by children with LD after the training phase was similar to that of scores obtained by normal children in phase 1 of the study. The Figure 2 represents the mean scores obtained by normal children and post therapy mean scores of children with LD for Task 1 and Task 2 respectively.

Further, Independent sample t test was used to compare between the mean scores obtained by normal children and post therapy mean scores of children with LD for both the tasks. The results indicated that there were no significant differences in the scores of task I [t(24)=1.43;p¿ 0.05] and task II [t(24)= 1.75;p¿0.05] after training phase. Hence, the research hypothesis states, a significant difference in auditory working memory between normal and children with LD after the auditory memory training was rejected.

Discussion

The present study attempted to investigate the effectiveness of auditory memory training on auditory memory in children with LD. The results indicated that children with LD could improve their auditory memory by intensive training. There are currently two approaches for intervention; the first focuses on accelerating learning for children with memory problems by adapting the child's environment and the second attempts to target and train the working memory functions directly (Holmes et al., 2009). The present study used the second approach i.e. training the working memory functions directly through practice on working memory tasks. The classroom based approach focuses on increasing teacher's awareness of the warning signs of working memory failures and encouraging them to adapt their approach to teaching to reduce memory loads in the classroom. This can be achieved through breaking tasks and instructions down into smaller steps, representing information and fostering an environment in which children feel free to ask if they have forgotten some information (Holmes, 2012; Gathercole & Alloway, 2008).

Numerous studies have supported the present findings. Dahlin (2010) reported that training in working memory facilitated the memory and enhanced the reading comprehension. Enhancement in memory have been found in children with poor working memory, Attention Deficit Hyperactivity Disorder and cochlear implants after direct intervention programme (Beck, Hanson, Puffenberger, Benninger & Benninger, 2010; Dunning, Holmes & Gathercole, 2012; Klinberg et al., 2005; Holmes, et al.,2009, 2010; Kronenberger, Pisoni, Henning, Colson & Hazzard, 2011). Gathercole and Dunning (2009) also reported that working memory training benefited student's growth in mathematics and problem solving. Gathercole et al., 2012 utilised cogmed working memory training on children with specific language impairment, where in children were trained for 20 to 25 sessions and each session was about 30 to 45 minutes. They reported of improvement in working memory skills after training in SLI population. Working memory training programs are effective both as treatments for attention-deficit/hyperactivity disorder (ADHD) and other cognitive disorders in children and as a tool to improve cognitive ability and scholastic attainment in typically developing children and adults

Olesen and Klingberg (2004) reported increased brain activity in the pre frontal cortex, the area associated with memory functions following working memory training. In the present study, there was significant difference in performance on both the tasks after the training sessions. Intensive training on these aspects could probably be bring changes in neural activity in the brain associated with working memory. Although these findings suggest training improves working memory, the field of cognitive training is very much in its infancy and we still know very little about how gains resulting from these activities might, or might not, transfer to meaningful improvements in an individual's day to day life.

Conclusions

The results of the present study indicated a better performance on working memory tasks after the training programme. This could help them to improve their performance in day-to-day activities as well as in their academic performance. Further studies can be carried out to validate the findings across large population. Similar studies can be

done to find out the effect of memory training on academic skills.

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