



Problem Solving Ability and Working Memory among Children with and without Dyslexia

Dr. Maya Rathnasabapathy*

ArchikaJohari. P**

Ganesh Kumar. J***

Funded by DEPwD-Delhi, India

School of Social Sciences and Languages,

VIT University, Chennai-India

ABSTRACT

Dyslexia is a specific learning disability in which children have difficulty in reading, writing, spelling, comprehension including a deficit in working memory. Many researchers have argued that Working Memory(WM) and problem solving ability are related to one another. This study attempted to understand the problem solving ability (PSA) using the Tower of London test and Working Memory (WM) using Immediate working memory test from Bhatia's battery among children with and without dyslexia. In this study, a sample of 98 children were taken, out of which, 45 (31 boys,14 girls) children were with dyslexia and 53 (30 boys, 23 girls) children were without dyslexia. Results showed that there was no difference in Direct order memory, but a significant difference in PSA and Reverse order memory was found between the two groups. It was also found that PSA was positively correlated with WM. The post test results showed that the difference in PSA of the two groups was no more significant after the implementation of the strategies.

Key Words: Dyslexia, Working Memory(WM), Problem Solving Ability(PSA), learning disability

Introduction

In day to day life, working memory (WM) plays a vital role in planning, organization, execution and problem solving. (e.g., Cowan et al., 2005; Miyake & Shah, 1996). The storing capacity of working memory is limited and can hold the information temporarily and manipulate less information (Kane & Engle, 2002). It is evident from the studies that capacity of working memory is very important in the acquisition of knowledge and skills (Alloway, Gathercole, Adams, & Willis, 2005) and influences the scholastic achievement of the children(Alloway, Gathercole, Kirkwood, & Elliott, 2009;). Children with learning disabilities have difficulty in accessing higher- order cognitive functions. LD children experience significant difficulties in working memory and problem solving ability(e.g., De Jong, 1998; Siegel & Ryan, 1989; Swanson, Ashbaker, & Sachse-Lee, 1996; Swanson, 1993). Working memory was

found to be less effective in children with dyslexia when compared to their counterparts. (Poblano, Valad!ez-Tapec, Arias, &Garia-Pedroza, 2000.). According to (Klormanet al., 1999), the executive functions in children with dyslexia are not consistently impaired. Tower of London task explores the higher order functions such as planning, execution and problem solving ability.(Morris, 1987;Miotto, Feigenbaum, Bullock, &Polkey, 1997; Shallice, 1982.WM is a crucial factor for most of the cognitive processes, including problem solving and is associated closely with language and reading abilities. The problems at hand, require immediate planning and executing it sequentially for which the related information should remain active in the memory. (Siegel, 1994; Swanson, 1994). Individuals with dyslexia have poor auditory working memory and hence keeping the multiple sounds and letters active in the memory is a tedious task for them. This is one of the reasons to which their reading difficulty is attributed. Children with dyslexia have difficulty in rehearsing or repeating the information in order to remember it due to the poor verbal working memory skills. This makes them run short of time and leaving tasks incomplete that involves memory (Alloway T.P, Seed, T., &Tewolde, F. 2016).

Methodology

Objectives of the study

1. To assess the difference in problem solving ability and working memory of children with and without dyslexia.
2. To assess the correlation between the problem solving ability and working memory of children with and without dyslexia.

Hypotheses of the study

1. There is a significant difference between children with and without dyslexia in their problem solving ability.
2. There is a significant difference between children with and without dyslexia in their direct order Working memory.
3. There is a significant difference between children with and without dyslexia in their reverse order Working memory
4. There is a significant relationship between problem solving ability and working memory of children with and without dyslexia.

Materials and Method

This study adopted the purposive sampling method. A sample of 98 children were taken, among them 45 (31 boys,14 girls) children with dyslexia and 53(30 boys, 23 girls) IQ matched children without dyslexia. Children between the Age group of 10-13 years with Male female ratio was 3:1.Children with dyslexia were screened by using Dyslexia Screening test senior (DST- senior). Children who fell into the category of at risk were taken in this study.

The Tower of London Test (Shallice, 1982) is a well-known neuropsychological tool, commonly employed in clinical practice to identify problems in the planning

aspects of executive function. Tasks in the Tower of London test are considered as the planning tasks in which, children first plan the movements mentally to reach the goal state before executing it. Children have to visualize the solution or goal state many ways in advance to reach the goal state with a minimum number of moves. (Levinet al., 1994). This test consists of two identical wooden boards(one for the examiner and the other for the subject) with each having three wooden pegs of different heights (Big, Medium, Small). There are three colored wooden balls such as red, green and blue. The tallest peg can hold three balls, whereas the middle peg can hold two balls and the smallest can hold just one ball. The subjects were given 14 problems which include two practice trials. The problems were given in an increasing order of complexity starting with two moves, three moves, four moves and five moves. Subjects were instructed clearly about the test and were given two practice trials to make clear whether he/she has understood the rules clearly. The different goal state was presented by the examiner one by one and the time was noted for each problem. The time taken and the number of failed attempts was noted and the time score was calculated for each item as given in the procedure.

Immediate Memory Test: The working memory was assessed by using, Immediate Memory subtest from Bhatia's battery. It consists of two sub-tests such as direct order and reverse order. As mentioned in the introduction part, problem solving requires working memory to keep the plan in mind and work. In the sub-test- Direct Order Memory, the examiner tells the numbers randomly in an increasing order such as three digits, four digits and so on. The numbers were told until the child changed the sequence of numbers in a given series. The subject repeats it in the same order after the examiner finishes. Eg. The examiner says 4 7 6 and the subject says it as 4 7 6. The no. of digits said correctly in the same order gets the corresponding points.

In the sub-test, Reverse Order Memory the examiner tells numbers in series with an increasing no. of digits, such as three digits, four digits and so on. The subject repeats it in the reverse order after the examiner completes. (i.e The examiner says 5 3 7 and the subject says 7 3 5). The no. of digits said correctly in the reverse order gets the corresponding points.

Statistical Techniques

By using SPSS, t-test and Karl Pearson Product Moment Correlation were performed.

Results& Discussion

Table:1 Problem solving ability between the groups of children with and without dyslexia

| S.No | Type of child | N | M | SD | t- value | Significance |
|------|---------------------------|----|-------|------|----------|--------------|
| 1 | Children without dyslexia | 53 | 68.90 | 4.23 | 1.977 | 0.05* |
| 2 | Children with dyslexia | 45 | 64.17 | 5.20 | | |

*Significant at 0.05 level (p< 0.05)

From the above table, the t-value of 1.977 was found to be significant at 0.05 level. The mean score shows that children with dyslexia have scored less than the children without dyslexia, which means that their problem solving ability is lower than the children without dyslexia. Hence the hypothesis stating that, “there is a significant difference in Problem Solving Ability between the two groups of children with and without dyslexia” is verified. This outcome is similar to the one reported by Swanson, H. L., & Beebe-Frankenberger, M. (2004) who evidently showed that the performance of children with reading disabilities was poor on working memory and problem solving tasks when compared to their counterparts.

Table:2 Direct order memory between the groups of children with and without dyslexia

| S.No | Type of child | N | Mean | SD | t- value | Sig. |
|------|---------------------------|----|------|-----|----------|------|
| 1 | Children without dyslexia | 53 | 4.73 | .74 | 0.941 | 0.35 |
| 2 | Children with dyslexia | 45 | 4.15 | .90 | | |

The t-value from the above table clearly shows that there is no significant difference in the direct order memory between the two groups of children. In other words, children with dyslexia were found to have almost equal working memory in the case of direct order memory. The results showed that though there was a difference in the mean score of the two groups, it was not a significant one to be considered. Since direct order memory test required the repetition of the numbers after the examiner, the children with dyslexia found it easier, as it involved only the phonological processing and hence not much effort was needed in performing this task.

Table: 3 Reverse order memory between the groups of children with and without dyslexia

| S.No | Type of child | N | Mean | SD | t value | Sig. |
|------|---------------------------|----|------|------|---------|-------|
| 1 | Children without dyslexia | 53 | 3.17 | .461 | 1.997 | 0.05* |
| 2 | Children with dyslexia | 45 | 2.87 | .681 | | |

*Significant at 0.05 level ($p < 0.05$)

A significant difference was found in the reverse order memory between the children with and without dyslexia. Since the reverse order memory involved more attention, the children with dyslexia, who have difficulty in attention scored lower ($M=2.87$) than the children without Dyslexia ($M=3.17$). which coincides with the results of Willcutt et al., 2001, who revealed through their study that working memory is less effective in children with dyslexia when compared to children without dyslexia. The outcome is also supported by the study conducted by Miles (1983) which emphasized that deficits on digit span, especially the backward span is common in children with dyslexia.

Table:4 Correlation between Problem solving ability and Immediate memory

| Correlation(N=98) | Problem solving ability | Immediate Memory |
|-------------------|-------------------------|------------------|
| PSA | 1 | 0.464** |
| Immediate Memory | 0.464** | 1 |

From the table no.4, the r value ($r=0.46$) is found to be significant at 0.05 level. It is evident that there is a significant positive correlation between the problem solving ability and Immediate memory which means that the problem solving solving ability increases with an increase in the capacity of the working memory. Hence the hypothesis stating that “there is a significant difference in the problem solving ability and the immediate memory” is verified. This is supported by Carretti et. al (2009), who concluded from their study that working memory correlate highly with reading disorders.

Table 5: After strategies applied: Problem solving ability

| S.no | Type of child | N | Mean | SD | t-value | Sig. |
|------|---------------------------|----|-------|------|---------|------|
| 1 | Children without Dyslexia | 53 | 70.00 | 3.61 | 1.527 | 0.26 |
| 2 | Children with Dyslexia | 45 | 68.10 | 3.72 | | |

The children with dyslexia whose scores were significantly different from the children without dyslexia in PSA were later found to be equal after the implementation of strategies. In other words, children with dyslexia performed well after giving some elaborative strategies which revealed or pointed out that children with dyslexia are also capable enough to perform (provided that they are taught their way) and are not impaired as usually are being considered. This is supported by (Klorman et al., 1999; Narhi&Ahohen, 1995; Tant& Douglas, 1982) who indicated from their study that the children with dyslexia have not consistently been found to be impaired in their ability to plan or organize.

STRATEGIES USED

Instructions:

Instructions were given in their mother tongue. (Tamil)

Children with dyslexia were asked to repeat the instructions back to make clear if they had understood the instructions. It was seen that the dyslexic children understood more clearly when the instructions involved both visual and tactile senses rather than just oral instructions. Instructions were given simultaneously while performing the Tower of London test which helped them in two things :To stay on the track (thereby making them understand the instructions more clearly) rather than getting deviated from the instructions.

By looking at the colored balls they made use of their visual sense and by lifting the balls they made use of their kinesthetic sense. When they were prevented from lifting more than one ball at a time during their practice trials (2-3 times), they understood the instructions better by remembering that they were being prevented from lifting the ball.

Exemption from Time Limit:

They were exempted from the time-limit unlike the Non-dyslexic children. Once the time-limit was exempted, these children were free to perform. They had no anxiety, which usually exists with children when time-limit is set.

Motivation

Motivation at every juncture enhanced their performance. Many studies have shown a positive association or positive correlation between self-esteem and performance (be it verbal or non-verbal), among the dyslexic children. They were not demotivated at any point and neither were they made aware of their mistakes as that would block them from performing further. Children were rewarded with stars (Instead of pin pointing their mistakes it was told like following: “Baby, you have done well and I give you one star. If you fix the balls exactly as in the other board, you will get few more stars. Do you want few more stars? You try it in different way.”

Motivation increased their self-esteem and they performed so well that the problem solving ability of children was found to be almost equal to their counter parts.

CONCLUSION

This study concluded that Children with dyslexia have language and attention problem because of which they require very elaborative instructions than the children without dyslexia. And when support is given in the form of clear instructions, exemption from time-limit, separate room and devoid of any kind of distractions, and especially motivation, their performance improves. These strategies that were used in this study gave psychological support to the children. It is suggested that if other causes, due to which they lag behind, are found and worked on, they would perform with excellence. The outcomes of the present study are supported by the findings revealed by (Klorman et al., 1999; Narhi & Ahonen, 1995; Tant & Douglas, 1982) that concluded that the dyslexic children have not consistently been found to be impaired in their ability to plan or organize. Finally, it is concluded that these children are not incapable of, but just that they need support to bring out their latent talents.

Implications of the study:

Individuals with dyslexia want things to be explained concretely. It is not that their intelligence is lower than their counterparts, but that they need a clear explanation so as to understand the concept. The results of this study revealed the importance of the few strategies that were applied to help children with dyslexia to excel or improve in their academics and problem solving ability. The performance of children with dyslexia on any given tasks depends on the understanding of the concept. The foremost thing on which the understanding relies is the way the instructions are imparted. Instructions could be orally given or in some cases, demonstrated for a concrete understanding. Whichever method of instructions is used, the instructor must make sure that the instructions are made very clear. In case of oral instructions, it is to

be ensured that the child has understood the instructions clearly by asking the child to repeat the instructions given and if any point is left out by the child, the examiner can put it in terms of questioning. This is to make sure that the child is aware of all the instructions before beginning the task.

In case of the demonstration method of imparting instructions, the instructor should show the child concretely and ask the child to perform the task at hand more than once to make sure that the child has understood the concept very clearly. Once the examiner is sure about the child's understanding of the concept, the process can be proceeded further.

This study is useful for the parents, special educators and teachers handling the children with dyslexia or any learning disability. The study also lays emphasis on rapport development and motivation which has shown difference in the performance. These are very simple strategies yet very useful for children with dyslexia as many children with such difficulties encounter such problems and lack these very simple techniques which, if implemented, can help them overcome their issues to some extent.

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