



Cognitive Processing Among Normal And Learning Disabled Children: Evidence For Successive And Simultaneous Processing

Dr. Cyma Anjum

Asst. Professor of Education

LNMCBM(Edu.) BRABU.Muzaffarpur.

Abstract

The study was designed to explain and compare the information processing skills among normal and learning disabled children particularly with reference to simultaneous and successive processing as advocated in the PASS model. Sixty students of grade seven including 30 normal children and 30 learning disabled children matched for non-verbal intelligence and age participated in the study. Figure memory, Token's test and Block designs were used to measure the simultaneous processing. Similarly, Successive ordering, Digit span, and Serial recall were used to measure successive processing of the participants. For each of the simultaneous processing tests, means of the two groups were compared by 't' test and all three of them were found significant in favour of normal children to suggest that learning disabled children are relatively poor in simultaneous processing compared to normal children. Having significant 't' values for each of the test, effect size of 't' were calculated using Cohen's d, which showed that 90% of learning disabled children fall below the mean of the normal children in each of the three measures. Similarly, with respect to successive processing, all the three 't' values were significant in favour of the normal children, suggesting that learning disabled children are also poor in successive processing. Cohen's d also pointed out that 90% of learning disabled children fall below the mean of the normal children in each of the three measures. Serial recall is found as the most difficult processing measure for learning disabled children.

Introduction

Learning disabilities are disorders that affect the ability of children to understand or use spoken or written language, do mathematical calculations, coordinate movements, or direct attention. The four major types of learning disabilities are relating to: (i) spoken language including listening and speaking, (ii) written language including reading, writing and spelling, (iii) arithmetic including concepts and calculations and (iv) reasoning including organization and integration of ideas and thoughts. Students with any form of learning disability have trouble in performing specific types of skills or completing tasks if left to do by them or if taught in conventional ways. Several studies have reported that nature of information processing is one of the major hurdles among the learning disabled children in performing specific tasks (e.g., Das, 1984b; Kirby et al., 1987; Ooi et al., 2011; Elwan et al., 2019).

Kirby and Robinson (1987) administering a battery of tests of simultaneous and successive processing on a group of 105 reading disabled children reported that these children employed simultaneous processing in reading tasks that normally require successive processing. Further, they also observed that learning disabled children make overuse of simultaneous processing and a deficit use successive processing due to an inclination not to use successive processing. Aysto (1998) examining the development of cognitive processes relating to PASS theory among 163 normal students and 60 language impaired students in the age group of 7 to 19 years reported that the cognitive development of the language impaired students is not as conspicuous as for the normal students. Especially, successive processing did not show developmental trend in the sample of learning disabled students. However, the cluster analysis of data relating to the normal and learning disabled groups resulted in two very

distinct cognitive subgroups in both categories. Identified as high and low functioning groups, the results showed that the normal high functioning groups are better in planning, simultaneous and successive processing than their counter parts as normal low functioning groups. However, compared to both normal groups, both the disabled groups performed very poorly in nonverbal successive than in verbal successive processing, but in simultaneous processing, the groups have no significant differences. Hence, the results indicate that there is more deficits in the development of nonverbal successive processing among the learning disabled students than verbal successive processing.

The review of some prior studies (Swanson, 1987; Kirby & Robinson, 1987; Kirby et al., 1996; Chow & Skuy, 1999; Mahapatra et al., 2010) pointed out that normal and learning disabled students do not develop the information processing abilities related to PASS model in similar ways; but the exact nature of development of these skills have not been adequately explained. The present study sought to compare the simultaneous and successive processing skills between normal and learning disabled children.

Objectives

Thus the objectives of the present study were as follows:

(i) To compare the performance of normal and Learning disabled children in respect of simultaneous and successive processing skills.

(ii) To find out the relative difficulty of simultaneous and successive processing for learning disabled children

Hypotheses

(i) Learning disabled children would have poor skills in simultaneous processing compared to normal children.

(ii) Learning disabled children would have poor skills in successive processing compared to normal children.

Method of Study

Sample

The sample for the study consisted of 30 students each from normal and learning disabled groups. The two groups were matched for non-verbal intelligence, age and grade. Tests of both simultaneous and successive processing were administered on each of the participants. Figure memory, Tokens test, and Block designs were used as measures of simultaneous processing. Successive ordering, Digit span, and Serial recall were used as measures of successive processing.

Measures of Simultaneous processing

Figure memory: The test consists of 20 simple straight line designs which the child is shown one at a time for 5 seconds each. The child's task is to reproduce from memory each of the 20 designs. Each drawing is scored as '1' for a correct reproduction and '0' for a wrong reproduction of the figures. The maximum score in the test is 20.

Tokens test: The test consists of 4 round and 4 squared pieces from each of the blue, yellow, white and black colours. The task of the child was to use the concepts of shape and colour in various combination responding to 23 items. For example in an item, the subject is asked, "put a black round one on a yellow square piece to the left of a blue square." Each correct response was scored '1' and wrong response as '0'. The maximum score in the test was 23.

Block design: This is a subject of WISC-R in which the child was given colored cube and then shown a particular design on a paper and was asked to create the design in the cube. Time was recorded for scoring of each item and maximum time allowed was 5 minutes for each of 10 tasks. Total time taken indicates the score of the child having less time considered as better performance. The maximum score in the test was 50 minutes.

Measures of Successive Processing

Successive ordering: In this test, the child's task was to replicate the order in which the figures of animals are placed before him by the investigator. The task consists of presenting 3 figures to 8 figures. The presentation was stopped when a particular sequence is 3 times failed by the child. The score of the child was the numbers of cards which he or she has correctly placed. The maximum score in the test was 18 (6x3)

Digit span: This is a successive marker test abstracted directly from WISC-R. In the test, the experimenter reads out a series of digits in increasing length beginning with 3 digits to a maximum of 9 digits. The score was the maximum number of digits which the child was able to repeat back. The maximum score in the test was 9.

Serial recall: In this test words are verbally presented to the child, which he or she has to repeat back. There were 4 lists for each of four-, five- and six-word series. The child gets a score of 1 for each correct recall in its position resulting in a maximum score of 60 (4x4+5x4+6x4= 60).

Results and Discussion

The means, standard deviations, t-values and Cohen's d (Effect size) were computed for each of the measures of simultaneous and successive processing for comparing the performances of normal and learning disabled children. The results are reported in Table 1. Further, to present the results visually, three figures are plotted. Figure 1 presents the comparison of means for simultaneous processing measures, Figure 2 for successive processing measures, and Figure 3 shows the comparison of average effect size of 't' test for simultaneous and successive measures.

The results showed that normal children had significantly higher means in Figure memory ('t'=5.21, df=58, p<.001); and in Token's test ('t'=6.58, df=58, p<.001) compared to learning disabled children. Further, normal children also took significantly less time in Block design test ('t'=4.78, df=58, p<.001) compared to learning disabled children. Hence, the results of the study clearly supported the hypothesis that learning disabled children are weak in simultaneous processing of information compared to normal children. Figure 1 also shows the trend of difference between normal and learning disabled children in simultaneous processing measures.

With regard to successive processing measures, normal children have also significantly higher means compared to learning disabled children. In the Successive Ordering test, the means are 12.80 and 9.36 ('t'=4.44, df=58, p<.001) respectively for normal and learning disabled children. Similarly, for Digit Span, means are 6.50 and 5.20 ('t'=4.79, df=58, p<.001) and for Serial Recall, means are 40.62 and 28.86 ('t'=11.31, df=58, p<.001). Hence the results pointed out that learning disabled children are also poor in successive processing of information compared to normal children. Figure 2 also shows the trend of difference between normal and learning disabled children in simultaneous processing measures.

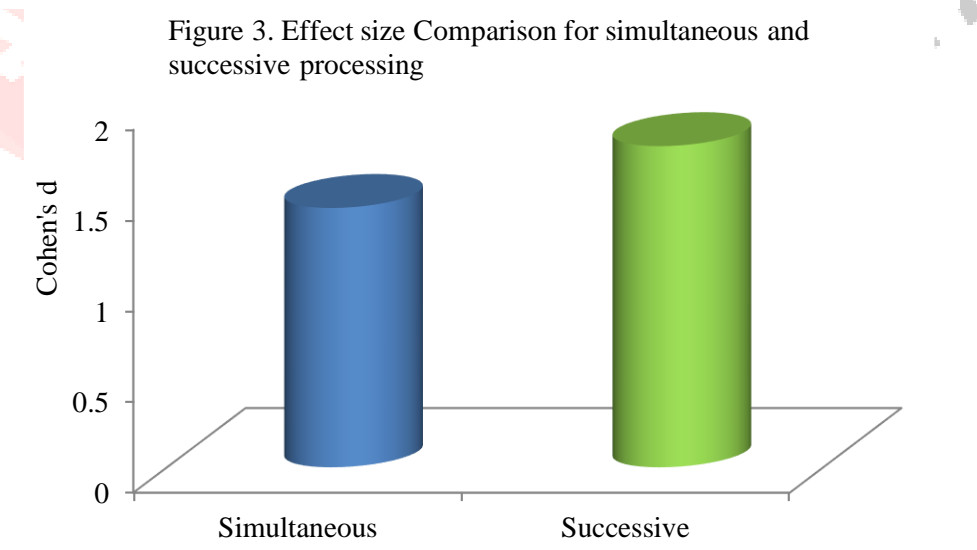
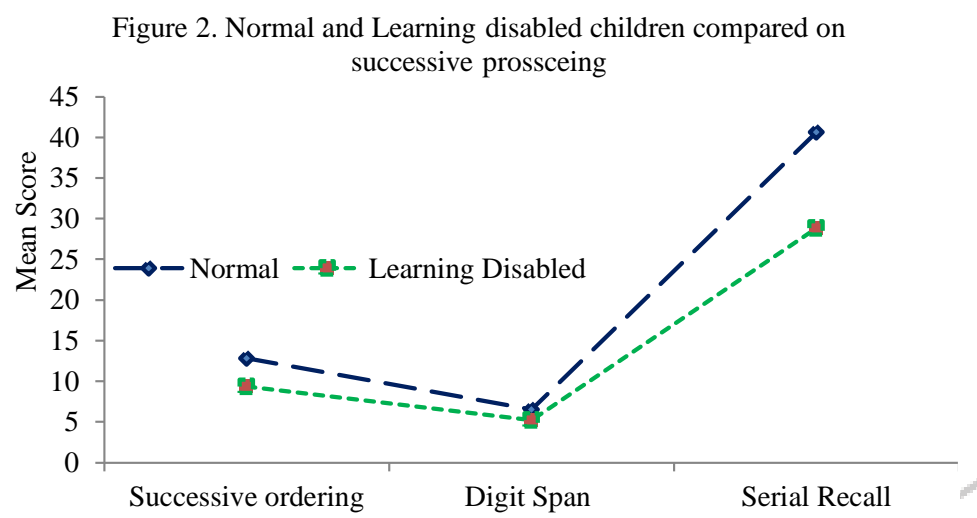
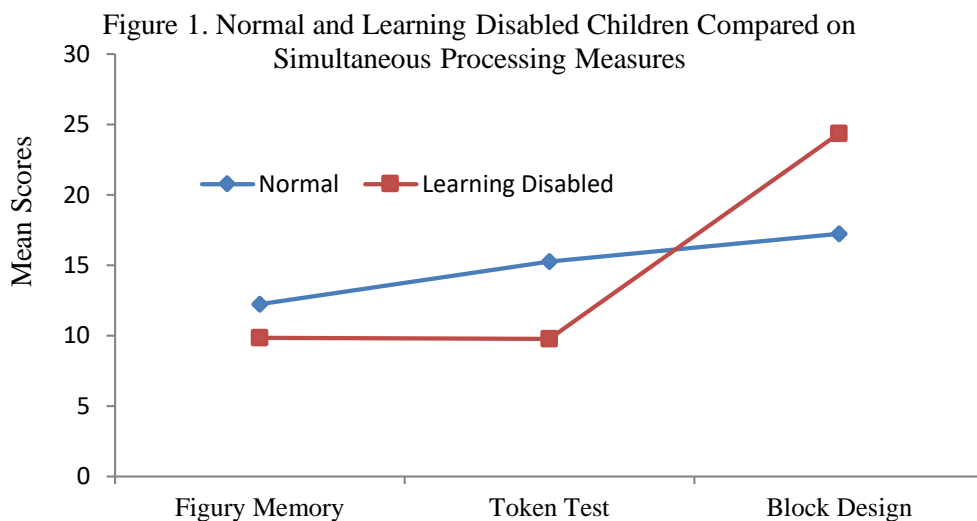
In order to further authenticate the differences in information between normal and learning disabled children, effect size measure of Cohen's 'd' for each of the 't' test was computed. All the measures of Cohen's 'd' are very large suggesting that more than 90% of the learning disabled population fall below the mean of the normal population in respect of all the measures of simultaneous and successive processing. Further, the results also point out that serial recall is the most difficult task (Cohen's d=2.92) for learning disabled children.

Finally, the average of Cohen's d for the 3 simultaneous and 3 successive measures are presented in Figure 3 which shows that the ability difference between normal and learning disabled children is higher in successive processing than in simultaneous processing.

Table 1

Mean, SD, t-value, and Cohen's d for each of the measures of simultaneous and successive processing relating to normal and learning disabled children (N=30 in each group)

Processing Method	Tests & Measures	Normal	Learning Disabled	't' value	Cohen's d	
Simultaneous Processing	Figure memory	Mean	12.2	9.85	5.21; p<.001	1.34
		SD	1.91	1.57		
	Token's test	Mean	15.25	9.76	6.58; p<.001	1.70
		SD	3.54	2.89		
	Block Design	Mean	17.20	24.35	4.78; p<.001	1.24
		SD	6.71	4.69		
Successive processing	Successive ordering	Mean	12.80	9.36	4.44; p<.001	1.15
		SD	2.87	3.12		
	Digit span	Mean	6.50	5.20	4.79; p<.001	1.24
		SD	1.19	0.89		
	Serial Recall	Mean	40.62	28.86	11.31; p<.001	2.92
		SD	4.68	3.24		



Conclusion

The following conclusions are derived from the findings of the study:

- (1) Learning disabled children are poor in simultaneous processing skills compared to normal children.
- (2) Learning disabled children are also poor in successive processing skills compared to normal children
- (3) Successive processing are more difficult for learning disabled children than simultaneous processing.

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