Original Research Article

Object Perception in Specific Learning Difficulty: An Experimental Approach

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ABSTRACT

The past literature shows inconsistent findings regarding object perception skills in children having specific learning difficulty. The present study investigates object perception, in terms of object constancy, object categorisation and object assimilation, in specific learning difficulty. A total of 73 children (age 7-16 years, both gender) were taken. Among them 53 were diagnosed as having specific learning problem and were classified into three groups: difficulty in reading and writing (n= 21), difficulty in reading, writing and calculation (n=16) and attention deficit problem (n=16) along with a normal control group (n=20). Screening was done by NIMHANS Battery for SLD and MISIC. Sample was collected from different clinics and schools by incidental sampling technique. Stimulus was prepared in direct RT software. A pilot study was conducted for fixing the difficulty level. Response accuracy and latency were recorded. A repeated measure ANOVA was performed. The result suggests deficient performance of all the groups having specific learning difficulty in comparison to the normal control group.

Key words: object perception, object assimilation, learning disability, learning.

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INTRODUCTION

Specific Learning Disability (SLD) is a condition of deficient performance in reading, writing, spelling, or arithmetic skill despite having no deficiency in intellectual capacity, sociocultural and educational opportunity and intact sensory abilities [1-2]. According to DSM V, the level of the academic difficulty is a matter of degree, i.e., the difficulty ranges from mild to severe.

A number of previous research have indicated that SLD is associated with deficient object perception skill. The identification and recognition processes are said to be distinct and impaired in SLD. Sigurdardottir [3] noted that reading a Western alphabet involves few basic cognitive processes such as analysis of the shape letters and words, the discrimination of visual stimuli from one another, and finally recognition of specific written units and linking them to semantic information. Alexander and Money [4] postulated that reading requires two principles to the law of object constancy: directional constancy and form constancy. For directional constancy by which one can differentiate the letters having similar shapes by the directional cues e.g., b and d. In case of form constancy, individuals use the subtle difference in form even if the two shapes are very close to each other, e.g., e and c. People having dyslexia or reading difficulty fail to use these two laws of object constancy successfully during reading. The resulting effect is difficulty in letter recognition, inaccurate word identification, slow reading, guessing, and fumbling. Alexander and his colleagues [4] further explained that these difficulties route generally from specific neurocognitive deficit, which was also termed as 'space-form blindness', is the inability to recognize slight changes in the shape of the object. A reader who is space- form blind gets confused between letters of similar form. On the other hand, if a reader

has problems in directional orientation faces difficulty in differentiating the reversed image of the letter and words for example 'p & q', 't and f' and 'pot & top'.

A number of researchers have agreed with the fact that reading processes involve an identical neural mechanism as that of all visual object perception. This object recognition process relies a large extent on ventral visual stream [5-7]. Reading difficulty results when there is any disruption of these steps. Behrmann and his colleagues [8] found that pure alexia patients show deficient recognition skill only in case of print stimulus. Later on, this idea has been countered by Behrmann [9] by saying that these patients are also impaired in face matching tasks. The same result has been documented by [10] in identification of real object from fragmented line drawing in children having reading difficulty. Similarly, Friedman and his colleague [11] noted the same trend for visually complex objects. Thus, the literature suggests that alexia patients have problem in processing both lexicon and non- lexicon stimulus.

A few researchers have focused on discovering the underlying neural path, responsible for this deficit and majority of them found out the left ventral visual stream, particularly the adjacent area of left fusiform gyrus [12-14]. Richlan and others [15] compared the functional abnormalities in younger and older individuals with dyslexia and found consistent hypoactivity. As the area is predominantly visual in nature, it is not much connected with semantics [16-17]. Binder and others [19] added that visual word form area (VWFA) is sensitive only to the orthographic visual stimuli. Intact VWFA area helps to form efficient reading strategies through parallel processing of multiple letters [18]. Dysfunction in this area might cause slow laborious and dysfluent reading.

Another increasing concern of the recent researchers is whether the area is only sensitive to lexical stimuli, and its nature is more general [19-20]. The recent literature showed that VWFA selectively responds to several visual objects other than words, e.g., in meaningful symbol, tools and faces [21-22]. Its activation helps in object discrimination which requires discrimination of fine shapes [23] and memory retrieval for words and non-word objects [24].

However, controversy in the past literature shows that more research is required to show the relationship of specific learning problem and object perception. The present research purports to see whether people having different manifestation of learning problem is associated with object constancy, object categorization and object assimilation. Here, object constancy refers to ability to identify a specific stimulus in its different forms. Object categorization is designed to classify objects in terms of its use and external features. In object assimilation the underlying reasoning to assimilate each small unit of objects into a larger whole is measured. Lastly, how each of the object perception task is performed by different groups of individuals with different manifestation learning disability problem is to be found out.

METHODOLOGY

Participants:

73 children (mean age= 11 years, age range= 7-16 years), both genders participated in the study, among them 53 were diagnosed (following DSM V) as having specific learning disorder by psychologists and 20 were taken as normal control group. The children with SLD were further subdivided into three groups based on manifested learning problems. Finally, the three obtained groups are: difficulty in reading and writing (n= 21), reading, writing and calculation (n=16) attention deficit problem (n=16) along with a normal control group (n=20). All participants were engaged in formal schooling, had normal vision and were free from any other psychiatric disorder. The sample having specific learning disorder was collected from different clinics and schools of Kolkata metropolis. Incidental sampling technique was used. Screening was done on the basis of case history, behavioral observation, academic record and behavioral report from the teacher or parents and administration of relevant psychological tests.

Assessment and Screening Tools

Malin's Intelligence Scale for Indian Children (MISIC): It is an adapted version of the original Wechsler Intelligence Scale for Children by Malin (1969) on Indian population. The age range of the Indian adaptation is from 6 to 15.11 years.

NIMHANS Index for Specific Learning Disability: The Battery was developed by Kapur and colleagues [26], which is used for identification of academic backwardness. The subtests are for Attention (number cancellation), Language (Reading, writing, spelling and comprehension), arithmetic (Addition, Subtraction, Multiplication, Division and Fractions), Visuo- motor Skills and Memory. The responses of the participants on this test have also been checked against case history and behavioral observation of each participant. The criteria for diagnosis of SLD are at least two grade below performance in academic skills than that of expected from his actual age.

For the present study the SLD groups have been subdivided into two groups based on the manifested deficiency in specific academic skills: deficit in reading and writing, and deficit in reading, writing and arithmetic skills.

Object Perception Tasks: All the three levels of object perception tasks were designed in Direct RT software. Three tasks were based on object constancy, object categorization and object assimilation. Each task contained 9-12 trials. Each stimulus was colored and the colors used represented the original color of that stimuli. Each time, response of the participants was recorded in terms of accuracy (number of correct response) and latency (reaction time). Each set of stimuli was purported to measure each kind of object perception tasks. Below is a brief description of the task. The subject was instructed to respond by pressing the computer key. All the stimuli were presented in a LCD screen.

- **Object Constancy Task:** The subject was shown a target object i.e. a picture of a specific bird: parrot. Later, in the successive trials the subject was to discriminate any image of parrot from other birds. The participants were instructed to respond by pressing 'z' key for the target (parrot) and '/' for non-targets.
- **Object Categorization:** The subjects were presented 3 different images at a time: two were of same class and another was supposed to belong in different class. All three images were numbered on the screen. The subject was instructed to respond by pressing the number key of the image which is the 'odd-man-out', i.e., which cannot form a homogeneous unit with other
- **Object Assimilation:** Two or three objects were wrongly assimilated on the screen. The subject had to explain the absurdity seen in the picture and suggest the correct option among the given options. The subject needed to press the number keys against which the correct answer is given.

Stimulus Preparation and Standardization

A pilot study purports to fix the difficulty levels of the tasks used in the study.

Fixing Difficulty Levels: Three different difficulty levels of varied exposure time were fixed. 10 children without learning problems, (age 8-16 years) were taken, and they were exposed to the task of moderate difficulty level. Assuming the children with SLD might have greater difficulty in task performances a cutoff point was fixed at 75 to 100% correct response by the 75% of the group. But if more than 50% of cases reach 100% of score then the difficulty level of that item was increased by reducing the exposure time. When it was ensured that less than 50% of the normal children attained the full score and at least 75% of the children attained 75-100% score, the particular task was retained with its existing difficulty level. After the preparation of each task the entire software program was administered to five children who were diagnosed (by Psychologists) learning difficulty to investigate whether the task is too difficult or too easy to them. The response ranges from 32- 100% among all the three pattern recognition tasks.

Procedure

At first the screening tools (case history, intelligence test and tests for specific learning disability) were administered to screen the participants for the purpose of diagnosis and categorization of the participants. The normal control group, having a sound scholastic record and no complaint of intellectual deficit was selected from different schools of Kolkata. A separate room was arranged for testing and data collection. Before the data collection 10 practice trials were given to each participant. The technique of randomization was followed in selecting the experimental levels for each participant.

Scoring rule: Correct and incorrect responses were scored as 1 and 0 respectively.

RESULT

For analysis of data, we computed Mean, SD and repeated measure ANOVA for both accuracy (percentage of correct response) and latency (reaction time) measures to see the effect of types of specific learning disability on various Object perception task performances. The necessary post hoc analysis was also performed, and the result was interpreted.

Table 1: Mean, SD and F value for percentage of correct response by the groups having specific learning disability.

		Mean	SD	F
Object constancy	Attention déficits	97.56	5.15	
	Reading and Writing	89.32	18.86	F (group) = **5.348****
	Reading, writing and arithmetic	90.48	16.64	
	Normal	98.72	4.42	
Object Categorization	Attention déficits	82.94	16.56	
	Reading and Writing	76.73	24.13	F (object perception) = **48.76****
	Reading, writing and arithmetic	72.15	23.13	
	Normal	89.65	9.26	
Object Assimilation	Attention déficits	65.31	18.61	F (int)=1.516
	Reading and Writing	62.95	24.04	
	Reading, writing and arithmetic	70.18	19.73	
	Normal	84.45	14.73	

$p > 0.01^{**}$, $p > 0.05^{**}$

Table 1 shows group difference as well as cognitive task difference was significance at .01 level in terms of accuracy score.

Table 2: Mean, SD and F value for reaction time scores by the groups having specific learning disability.

		Mean	SD	F
Object constancy	Attention déficit	2816.5	473.45792	F(group) = **29.116****
	Reading and Writing	3346.65	933.62690	
	Reading, writing and arithmetic	4394.8	1234.01801	
	Normal	2384.4	376.01587	
Object categorization	Attention déficit	3177.5634	1078.32111	F (object perception) = **31.564****
	Reading and Writing	3252.375	777.67799	
	Reading, writing and arithmetic	4065.9	1123.05762	
	Normal	5122.1333	998.10498	
Object Assimilation	Attention déficit	2909.2	666.31805	F (int)= 0.371
	Reading and Writing	3779.8873	1217.09799	
	Reading, writing and arithmetic	3481.6250	1020.45440	
	Normal	4185.0	898.36676	

$p > 0.01^{**}$, $p > 0.05^{**}$

Table 2 shows group difference as well as cognitive task difference was significance at .01 level in terms of response latency.

Table 3: Pair wise comparison of the mean differences among groups in percentage of correct response

Groups		Significance Levels
Attention Deficit	Reading and Writing	0.545
	Reading, writing and arithmetic	0.769
	Normal	0.158
Reading + Writing	Reading, writing and arithmetic	0.990
	Normal	**0.002**
Reading + Writing + arithmetic	Normal	**0.013**

Table 3 shows the post hoc analysis in terms of object perception scores. The result suggests that group difference is significant only between normal control and difficulty in reading and writing (0.01) as well as between normal control and learning difficulty in reading, writing and arithmetic (0.05).

Table 4: Pair wise comparison of the mean differences among groups in Reaction Time scores

Groups		Significance Levels
Attention Deficit	Reading and Writing	**0.023**
	Reading, writing and arithmetic	**0.000**
	Normal	0.540
Reading + Writing	Reading, writing and arithmetic	**0.000**
	Normal	**0.000**
Reading + Writing + arithmetic	Normal	**0.000**

Table 4 reflects that all the pair wise comparisons are statically significant except the attention deficit group and normal control when the latency score for the cognitive performance is taken into consideration.

DISCUSSION

The result shows that the group having difficulty in all the three academic skill areas scored lowest in most of the Object perception tasks. This group also had delayed reaction time for Object constancy. The result also reveals that the groups having learning difficulty responded faster than the normal control and the difference is significant at 0.01 level (Table 2). But the scores of percentages of correct responses show the reversed finding, i.e., the learning difficulty groups scored less than the normal control group and the difference is significant at 0.01 level (Table 1). Combining these two observations we get the fact that children with learning difficulty had a tendency to respond faster but they fail to generate the accurate answer. One reason of this might be that they actually use guesswork and without getting deeper into the cognitive process they have a tendency to finish the task as soon as possible. It was also validated during the behavioral observation that a group of children with learning disability generally use guess and avoid the active process of cognition.

However, the accuracy scores show that people with difficulty in all academic skill areas get affected most in object perception task performance. The result can easily be interpreted by the theory of impaired activation in ventral visual stream in people with dyslexia [6, 27-28]. Studies have also concluded that the same neural substrate is present for recognition of both lexical and non-lexical material. The Visual Word Form Area responded to a number of recognition tasks including faces [22], tools [21], words [17], shape [23] etc. Thus, the same visual recognition area is responsible for impairment in objects perception, recognition and reasoning behind it. Another adjacent area, namely Fusiform Face Area which was thought to be activated during recognition of faces primarily, now is known for its important role in other object recognition process also, for example different kinds of birds or different kind of cars [29].

The present result also reveals that the overall performance of all the experimental groups is somewhat deficient in object assimilation task which required creative reasoning to assimilate different objects and the rules of assimilation. The difference came to be significant at .01 level also.

The post-hoc comparison shows that for the percentage of correct response scores only the two groups of SLD differ significantly from the normal control (Table 3), supporting the notion of visual ventral stream damage in SLD. However, the multiple comparison among the groups for reaction times scores shows all the groups differs significantly from each other except normal control and attention deficit group, again supporting the fact that these two groups need not use guess work much which results in high accuracy scores and low reaction time scores (Table 4).

Thus, the present research findings support the neurocognitive deficit theory in Visual Word Form Area in the visual ventral processing stream which causes deficient processing in both lexical and non-lexical stimulus materials. In order to provide a cognitive remedial technique for the group of learning disability training for object recognition will be beneficial.

Limitation of the Study

Firstly, during data collection it was observed that sometimes participants responded randomly, especially when there were confusions. We have only analysed the correct responses. the wrong answers were not considered for analysis. If we analyze the incorrect responses also it would be helpful to analyze guessing behavior in different groups. Secondly, participants were not matched in terms of their technological exposure. Participants who are in habit of playing video games might be having greater probability of better performance.

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