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Association between the bias to the right visual half-field and reading difficulties in primary school first-graders

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Abstract

Introduction: The research data point to the association between reading difficulties and bias to the right side of the visual half-field in visual attention task performance in primary school children. Reading ability in these studies was assessed by the Rapid naming test or by using the teacher's evaluation of the pupil's reading ability. The current study was designed to extend data in this direction by directly evaluating reading in school first-graders.

Observation: Study participants performed pen and pencil Star cancellation tasks. The side of the first cancelation (left or right) and the number of targets canceled on the left and right sides were registered. In the reading assessment trial, participants were requested to read the text. The time allocated for this task was 5 min. Mistakes such as incorrectly read words, omission of words, and overruns in time were registered. The right-sided bias to the visual half-field in Star cancellation task performance was found to be associated with the mistakes in reading.

Conclusion: Some school first-graders demonstrate a bias to the right visual half-field in Star cancellation task performance. This bias is expressed in the prevailed target cancelations on the right side of the visual field. Bias to the right visual half-field is associated with reading difficulties, such as incorrect word reading and overruns of time allocated for reading

Keywords: Visual Spatial Attention; Bias to Visual Half-Field; Reading Quality; First-Graders; Star Cancellation Task

1. Introduction

Reading difficulties are rooted in problems with phonological awareness and rapid access to alphabetic knowledge. Researchers also view the deficit in non-verbal processes as a reason behind reading difficulties. One such view involves visual spatial attention [1,2]. The results of the studies, however, are contradictory [3], and this encourages further extension of the research data on the association between visual spatial attention and reading. We focus on the bias toward the right visual half-field as a possible reason behind reading difficulties in primary school first-graders. Bias to the visual half-field refers to the bias of healthy individuals to direct more attention to the left or right visual half-field. The attentional bias towards the left visual hemifield (BLV), known as "Pseudoneglect" [4], is expressed in most adults

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and children. However, some people are attentionally biased towards the right visual hemifield (BRV). Both BLV and BRV are considered normal. This phenomenon is studied by special tests on visual attention, mostly by line bisection and cancellation tests [5,6,7,8]. In the pen and pencil Star cancellation test, participants are instructed to cancel all bigger stars, dispersed between the smaller ones on paper. The side of the first cancellation (left or right) and the number of stars canceled on the left and right sides of the paper are calculated. Most people show BLV and some BRV, they cancel the first star and cancel more stars in total on the left and right sides respectively.

The research data determines our interest in the BLV and BRV, suggesting an association between individual differences in the visual half-field overestimation (BLV vs BRV) with reading ability. Several authors used Line bisection test to compare test performance in dyslexic and non-dyslexic children. Dyslexic children do not show the BLV characteristic of non-dyslexics [9], and dyslexics were found to demonstrate BRV [10,11]. Asberg Jonnels et al. [12] studied facial emotion recognition in non-dyslexic and dyslexic children. The authors presented faces with emotional load on the left vs right half-face and asked participants to recognize if the face had an emotional or neutral expression. The authors reported clear BLV in control participants, while BLV was absent in the dyslexic group. Moreover, the strength of the BLV (number of judgments based on left half-face in trials) was correlated with better word reading in the controls. In an earlier study [13], we asked school second graders to draw a human profile. It was assumed, that details such as eyes, nose, and chin, drawn in the left vs right visual half-field, demonstrate BLV vs BRV respectively. Teachers were asked about the reading skills of study participants. Teacher's better comments were associated with the profiles, drawn looking to the left. According to Hoyos et al. [14], successful reading in early elementary grades is associated with significant BLV in Line bisection task performance. Moreover, a farther distance from the true midpoint of a line predicted better performance on a Rapid automatized naming (RAN) test, which is considered a good predictor of reading ability.

The research data, discussed above, suggest an association between reading ability and BRV and BLV in primary school children. In particular, BRV is associated with dyslexia and with reading difficulties in non-dyslexics.

Reading ability in these studies was assessed by the RAN test or based on the teacher's evaluation of the pupil's reading ability. However, observation of the actual reading [15,16] in children with BLV and BRV is desirable for understanding the association between the bias to the visual half-field and reading difficulties.

2. Material and Methods

A total of 58 non-dyslexic first-graders, with normal or corrected to normal vision, of both sexes, right-handers, were recruited in the study. All participants spoke native Georgian. The study was conducted in schools attended by participants. Each participant was observed individually in a room reserved for this purpose. The study group was selected randomly from the list of first-graders. After selection, parents and teachers have been questioned about the handedness of selected participants. Questions referred to the preferential use of either the left or right hand in everyday activities and the forced use of the right hand. Inclusion criteria: right-hander, with no incidence of conversion. Parents of the study participants were informed about the study design and purpose and signed a written consent. Study of BLV and BRV: The paper and pencil version of the Star cancellation test (SCT) was used to study the bias towards the visual half-field. The test sample consisted of 52 large stars interspersed with 56 smaller stars. Study participants were seated at the table. The page was placed on the table, along the participant's body midline. In the beginning, instructors demonstrated how to cancel the stars. Two small stars in the center were used for demonstration. Study participants were requested to cross out all the small stars presented on paper. The time for SCT performance was limited to 10 sec. The sidedness, left or right, of the first mark was registered. The number of stars marked on the left and right sides was calculated. In the reading assessment trial, the text for reading, in native Georgian, was taken from the school textbook for first-graders. English translation of the text is as follows: "Giorgi is a pupil. Giorgi goes to school. Today, Giorgi and his classmates are going to the zoo. There are animals in the zoo, an elephant, a tiger, and a deer". Study participants were requested to read the text aloud. We registered the number of missed words and the number of incorrectly read words. The time allocated for reading was 5 min. The overrun of time allocated for reading was registered. The SPSS program was used for data analysis.

3. Results and Discussion

Based on the reading assessment results, study participants were divided into Groups A, B, and C. Group A consisted of 13 participants with no reading mistakes, Group B consisted of 20 participants who made 1 or 2 mistakes, and Group C consisted of 25 participants who made three or more mistakes. The main findings are presented in Table 1.

Table 1 Results of the SCT in Groups A, B, and C

Study participants	The number of stars canceled			The side of the first cancellation	
	Total	L	R	L	R
Group A	92	58 (63%)	34 (37%)	9 (69.2%)	4 (30.8%)
Group B	198	119 (60.1%)	79 (39.9%)	14 (70%)	6 (30%)
Group C	178	84 (47.2%)	94 (52.8%)	15 (60%)	10 (40%)

The side of the first cancellation was predominantly left in Groups A, B, and C, 69.2 %, 70 %, and 60% respectively. The percentage of right-sided cancelation is higher in Group C than in Groups A and B. No correlation between the side of the first cancellation and mistakes in reading was found.

As for the total number of stars canceled on the left and the right sides, left-sided cancellations were found to prevail in Groups A and B, 63% and 60.1% respectively, while right-sided cancellations were found to prevail in Group C, 52.8%. Results suggest the tendency of Group C to pay more attention to the right visual half-field in cancellation task performance,

The statistical analysis of the data is represented in Table 2.

Table 2 Comparison of Groups A, B, and C by the number of mistakes in reading

			Mistake_Group			Total
			No Mistake (A Group)	1-2 Mistake (B Group)	3 or more Mistakes (C Group)	
Side	Left Side	Count	58	119	84	261
		Expected Count	51.3	110.4	99.3	261.0
		% within Side	22.2%	45.6%	32.2%	100.0%
	Right Side	Count	34	79	94	207
		Expected Count	40.7	87.6	78.7	207.0
		% within Side	16.4%	38.2%	45.4%	100.0%
Total		Count	92	198	178	468
		Expected Count	92.0	198.0	178.0	468.0
		% within Side	19.7%	42.3%	38.0%	100.0%

Table 3 The caption to the Table 2. Chi-Square Test results for Groups A, B, and C by the number of mistakes

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.790[a]	2	0.012
Likelihood Ratio	8.788	2	0.012
Linear-by-Linear Association	7.676	1	0.006
N of Valid Cases	468		

0 cells (0.0%) have an expected count of less than 5. The minimum expected count is 40.69.

Table 4 The caption to the Table 2. Directional Measures for Groups A, B, and C by the number of mistakes

Directional Measures			
			Value
Nominal by Interval	Eta	Side Dependent	0.137
		Mistake_Group Dependent	0.128

The results revealed a statistically significant association between the preferential side of target cancellation and mistakes in reading, $\chi^2(2, N = 468) = 8.79$, $p = .012$. Examining the distribution, 22.2% of cases on the Left Side had no mistakes, 45.6% had 1–2 mistakes, and 32.2% had 3 or more mistakes. On the Right Side, 16.4% of cases had no mistakes, 38.2% had 1–2 mistakes, and 45.4% had 3 or more mistakes.

Results indicate that mistakes were more likely to occur on the right side, with a high proportion of participants making three or more mistakes than on the left. The linear-by-linear association was also significant, $p = .006$, suggesting a consistent trend between side and mistake frequency. Judging by the eta value .137, the relationship between these variables is statistically significant, however, the magnitude of the relationship is relatively weak.

In sum, the results suggest an association between the bias toward the right visual half-field and difficulties in reading.

4. Conclusion

Some school first-graders demonstrate a bias to the right visual half-field in Star cancellation task performance. This bias is expressed in the prevailed target cancelations on the right side of the visual field. Bias to the right visual half-field is associated with reading difficulties, such as incorrect word reading and overruns of time allocated for reading. However, further research is necessary due to the study's limitations, such as the small number of participants.

Compliance with ethical standards

Disclosure of conflict of interest

There is no conflict of interest to be declared

Statement of ethical approval

Ethics Committee of the I. Beritashvili Centre of Experimental Biomedicine approved the study method and data publication N02/17.02.2025.

Statement of informed consent

Informed consent was obtained from the parents of individual participants.

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