National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Association between cross-dominance and visual memory – A cross-sectional study

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Received: September 27, 2019; **Accepted:** December 18, 2019

ABSTRACT

Background: Ocular dominance plays an important role in visual memory. Although many studies are done to find the relationship between cross-dominance and their performance in sports, little was known about the effect of cross-dominance in visual memory. **Aim and Objective:** The present study was aimed to find if there exists an association between cross-dominance and visual memory. **Materials and Methods:** In this study, 40 above average subjects in the age group 18–30 years of both genders with cross-dominance is taken as study group and 40 above average subjects with complete lateral dominance who are age and sex matched is taken as control. A detailed history of the subjects was collected and they are subjected to complete ophthalmological and neurological examination to rule out any neurological deficits. Dominant eye was found using miles test and visual memory was evaluated using Benton's visual retention test. **Results:** In this study, it was found that though cross dominant subjects had less score than complete lateral dominant subjects, the difference is statistically insignificant. **Conclusion:** There is no significant difference in visual memory between the complete lateral dominance and cross dominant subjects.

KEY WORDS: Cross-dominance; Visual Memory; Miles Test; Benton Visual Retention Test

INTRODUCTION

A completely organized child will have a dominant hand and eye on the same side. If there is no complete dominance, it shows a degree of neurological disorganization. Subjects with cross-dominance (when the eye and hand dominance of a subject does not match up, e.g., having left eye dominance with the right hand dominance) will not be able to process the information as they lack organization. When presented with a task, they cannot take in information, assimilate it, process it, and bring it out again due to a lack of firm pathways in the brain. Such subjects will have problem in visual memory resulting in learning disabilities. Although many studies have compared the association between intelligence and cross-dominance, there was no proper study explaining the association between cross-dominance and visual memory. Hence, our study is to find whether their exists any association between visual memory and cross-dominance.

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2020.10.0933118122019	

Visual memory describes the relationship between perceptual processing and encoding, storage, and retrieval of resulting neural representation. The visual information regarding color, shape, movement reaches the primary visual cortex (area 17) in the occipital lobe. The interblob cells which surround the color-sensitive blob cells process the information of orientation and location and are used in perception, discrimination, learning, and memory. The information from interblob cells are sent through ventral

stream to inferior temporal visual association cortex (area 20, 37, and 39) to process information about objects color and form which help us to recognize objects and colors, read text and learn and remember visual objects. The V1 interblob cells exhibit ocular dominance (i.e., respond best to stimulation of preferred eye).[1]

Laterality as a component of the psychomotor development is an important aspect to learning skills evolutions. It is defined as preference on using symmetrical body parts: Hand, eye, ear, and leg.[2] It is crossed when there is disagreement such as writing with the right hand and seeing with the left eye. The establishment of lateral dominance occurs around 6 years of age.[3]

Visual memory, in an academic environment, entails work with pictures, symbols, numbers, letters, and especially words. Students must be able to look at a word, form an image of that word in their minds, and be able to recall the appearance of the word later. Children who have not developed their visual memory skills cannot readily reproduce a sequence of visual stimuli. They frequently experience difficulty in remembering the overall visual appearance of words or the letter sequence of words for reading and spelling.[4] The visual retention test is a task that involves the interaction of visuoperceptive, visuomotor, and visual memory factors. Consequently, failure under administration A BVRT (Benton visual retention test) raises the question as to whether visuoperceptive or visuoconstructive disability is the basis of the failure.

More specifically, the left brain hemisphere controls the right side of the body and the right brain hemisphere leads the way to corporal left half; this dominance is fundamental for cerebral function efficiency. Each brain hemisphere operates with high precision and complexity which allows speech, writing, and cognitive thinking, dependents of their own cooperation and combined work. For that to happen, the body bilateral integration must be structured and automatized, otherwise learning and memory are affected as a consequence of impairment in the quality of relationship and interaction among several brain functional units.[5]

MATERIALS AND METHODS

In this study, 40 above average subjects (above 60% marks in all subjects in past 3 years), in the age group 18–30 years of both genders with cross-dominance is taken as study group and 40 above average subjects with normal dominance who are age and sex matched is taken as control. The study subjects were recruited from the student group of Akash Institute of Medical Sciences and Research Centre (AIMS and RC) and staff members. A detailed history of the subjects was collected and they are subjected to complete ophthalmological and neurological examination to rule out any neurological deficits. Subjects with any neurological deficit were excluded from the study. All subjects have undergone the following test.

Miles Test

In 1928, Miles established that the basis for how eye dominance is determined.[6,7] It is easy to determine which eye is the dominant or sighting eye by doing the simple test called Miles test. The following method is simple and accurate way to check eye dominance for both adults and children.

- Extend both arms forward of your body and place the hands together making a small triangle (approximately 1/2" to 3/4" per side) between your thumbs and the first knuckle
- With both eyes open look through the triangle and center something such as doorknob or the bull's eye of a target in the triangle
- Close your left eye – if the object remains in view, you are right eye dominant. If your hands appear to move off the object and move to the left, then you are left eye dominant
- To validate the first test, look through the triangle and center the object again with both eyes open
- Close your right eye – if the object remains in view, you are left eye dominant. If your hands appear to move off the object and move to the right, then you are right eye dominant.

Benton Visual Retention Test (BVRT)

The BVRT is an individually administered test for people aged from 8 years to adulthood that measures visual perception and visual memory. It is used to identify learning disabilities among other afflictions that might affect an individual memory.

The individual examined is shown 10 designs (Form C), one at a time for 10 s and asked to reproduce each one as exactly as possible on plain paper (Type A). The test is untimed and the results are professionally scored by form, shape, pattern, and arrangement on the paper.

The test can be scored two ways. The number correct score is calculated based on an all-or-nothing approach; points are awarded if the reproduction of the design matches the original. The number error score, on the other hand, is calculated based on the number and type of errors made for each design. The major categories for these errors are omissions, distortions, perseverations, rotations, misplacements, and size errors.[8] These scores are then be compared to several sets of normative data available in the manual, each representing different demographic characteristics, and conclusions can be drawn by the examiner.[9] The two different methods of scoring allow for both quantitative and qualitative analysis of an individual's test.[10]

Table 1: Descriptive statistics

Score	*n*	Mean	Standard deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
	80	8.01	1.185	5	10	7.00	8.00	9.00

Table 2: Test statistics*

Variables	Score
Mann–Whitney U	681.500
Wilcoxon W	1501.500
Z	−1.180
Asymp. Sig. (2-tailed)	0.238

*Grouping variable: Dominance

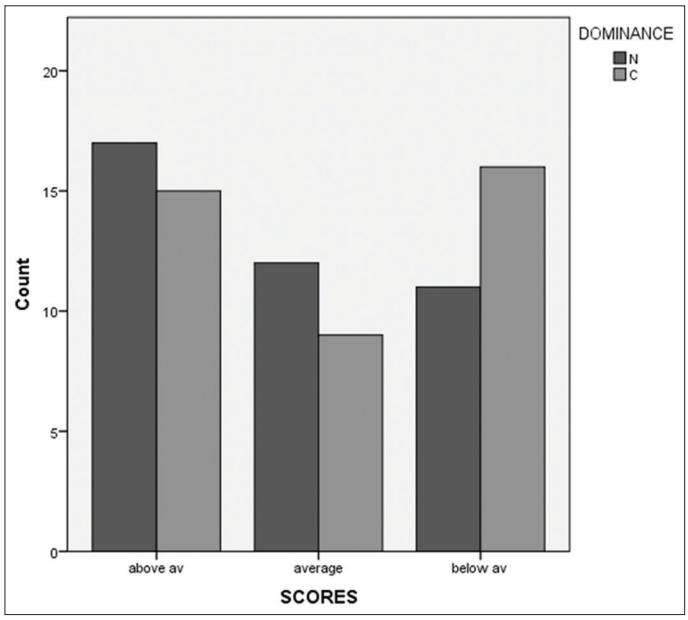

Figure 1: Benton visual retention test score

Interpretation of subject performance is based on expected score appropriate for age and intellectual endowment.

Ethical Clearance

It obtained from the ethical committee of AIMS and RC.

Statistical Analysis

The study is analyzed using independent sample *t*-test, applying the Mann–Whitney test to compare visual dominance among complete lateral dominance and cross-dominance subjects. According to the test, the difference in visual memory between complete lateral dominance and cross-dominance is statistically insignificant ($P = 0.238$).

RESULTS

This study shows that there is no significant difference in the visual memory of complete lateral dominance and cross dominant subjects. Distortion and rotation type of error is more common among both complete lateral dominance and cross dominant subjects [Tables 1 and 2 and Figure 1].

DISCUSSION

Our study concludes that there exists no association between cross-dominance and visual memory. The results were similar to Sulzbacher *et al*., who proved in his study that there is no relationship between cross-dominance and intelligence and academic achievements.[11] Goss also had compared the eye dominance and baseball and concluded that there is no relationship between eye dominance and baseball performance.[12] However, Neto had confirmed in his study that children with crossed laterality underperform in reading and writing compared to children with complete lateral dominance.[13] Jones 3rd *et al*., in his study, proved that rifle marksmanship is influenced by eye dominance. He concluded that cross dominant subjects do not learn marksmanship skills as readily as individual who have complete lateral dominance.[14] Hence, few studies prove the existence and few prove the nonexistence of relationship between cross-dominance and intelligence and sports. Since very few studies were done in this field, it is very difficult to conclude. Hence, I wish more studies to be done on this field to find the real existence of relationship between cross-dominance and visual memory, intelligence, and sports.

CONCLUSION

We conclude that though cross dominant subject scores less in BVRT than the complete lateral dominance subjects, the difference is statistically insignificant and so there is no much relationship between cross-dominance and visual memory and furthermore studies are needed in this field to prove the same.

ACKNOWLEDGMENT

I would like to thank our principal, Dr. H S Somashekar, AIMS and RC, Devanahalli, for supporting me in this study. I express my thanks and gratitude to all participants who cooperated to undergo the study.

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How to cite this article: Arrthy S, Saravanan S, Atha A. Association between cross-dominance and visual memory – A cross-sectional study. Natl J Physiol Pharm Pharmacol 2020;10(02):164-167.

Source of Support: Nil, **Conflicts of Interest:** None declared.