

CROSS EYE-HAND DOMINANCE AND READING ABILITY
IN SECOND GRADE CHILDREN

by

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This paper is submitted in partial fulfillment of the
requirements for the degree of

Doctor of Optometry

Ferris State University
Michigan College of Optometry
May, 2011

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Has been approved

May, 2011


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Faculty Course Supervisor

Ferris State University
Doctor of Optometry Senior Paper
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4-28-11

Date

ABSTRACT

Background: Previous studies have shown that approximately 30% of people are crossed eye-hand dominant, meaning they are right eye dominant and left handed or vice versa. Some clinicians suspect there is a correlation between cross dominance and poor reading ability. This study investigated this topic further by evaluating a group of 2nd grade children. *Methods:* The experiment was conducted in five 2nd grade classrooms, totaling approximately 60 students. The experiment began by measuring ocular dominance in each child. More than one means of determining ocular dominance was used to make sure the child was consistent. Handedness was determined by asking the subject to pick up a writing utensil and write his or her name. To evaluate reading performance, the classroom teachers supplied information showing whether the student's reading ability was above average, average, or below average for their grade level. *Results:* It was found that 56.25% of the below average students were cross dominant. On the other hand, only 44% of the above average students were not cross dominant. *Conclusions:* This study did show a small correlation between crossed eye-hand dominance and delayed reading ability; however, the correlation was not strong enough to be statistically significant.

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INTRODUCTION

According to one study, 1 in 5 children have difficulty learning to read. It is very important to identify the children with reading disabilities as soon as possible because children who do not receive proper intervention by the third grade, have a 75% chance of continuing to struggle with reading into their high school years (1). Optometrists are often the first health care professionals that parents reach out to for help when their child falls behind in reading. During a comprehensive eye exam an optometrist will assess with child's visual acuity, refractive status, accommodation, binocular vision and ocular motility. The child's ocular health is also evaluated. When indicated the optometrist can take the exam one step further and perform a Visual Information Processing Assessment (VIPA) which can pinpoint the specific areas of learning the child is struggling with (2). The VIPA is often used to create a vision therapy plan to get the child back on track. After more than 30 years of practicing optometry, a clinical instructor at the Michigan College of Optometry believes there is a correlation between crossed dominance in children and decreased reading ability. Crossed dominance simply means that a person is right eye dominant and left handed or vice versa. If there was a correlation between delayed reading ability and cross dominance it could give teachers and optometrist a clue as to which kids are at risk for falling behind in reading. This data could also lead to some interesting research regarding information processing and literacy. The purpose of this study was to see if children who were cross dominant were more likely to fall below the expected reading level for their grade. The research was performed on 56 second graders in 5 different elementary classes in two different schools. Their eye and hand dominance was determined with a few simple tests performed in the classroom. The teachers indicated whether each child was at, above, or below expected reading level for second graders midway through the school year.

METHODS

The goal of the experiment was to gather data about ocular dominance, handedness and reading performance. The first step was contacting elementary schools to request permission to conduct the experiment in 2nd grade classrooms. One researcher had family connections at more than one elementary school, therefore it was very easy to find classrooms to test. The teachers were very open to the idea and were eager to help. A permission slip was drafted for the students to take home and have a legal guardian sign, to be allowed to participate in the study. The permission slip detailed the purpose and goals of the research. It explained the simple tests that would be used and also emphasized participant anonymity.

Handedness was assessed by having the student pick up a pencil and draw a shape or write his or her name on a piece of paper. The utensil was placed on the table for the student to pick up on his or her own. This way the correct hand would be used, rather than handing the pencil to the student which would be less consistent.

Ocular dominance was tested using the Dolman method, which requires the subject to look through a hole in a piece of paper held in both hands (3). The subject then looks through the hole at a distant object. The observer can then tell which eye the subject is using to sight with. After holding the paper at arms length to sight a distance object, the subjects were asked to hold the paper up to one eye and look at the examiners nose. Two techniques were used to establish reliability of the students for the test. The Dolman method was used because of its simplicity and efficiency. It also allowed for objective and subjective testing. Other tests exist for ocular dominance, but they require more complicated instruction, knowledge of the patient's refractive status and/or current visual acuity level.

After handedness and ocular dominance data were recorded, the record sheet was provided to the teacher. The teacher recorded the students' reading ability as above average, average or below average based on the most recent literacy testing. This concluded the data gathering.

RESULTS

A total of 56 students returned their signed permission slips on time and were able to participate in the study. Of these 56 students, 31 were right eye dominant and 24 were left eye dominant. One subject did not have an eye preference. Also, 50 out of 56 students were right handed, while only 5 were left handed. Lastly, 26 out of 56 subjects were cross dominant, which again means the subject is right eye dominant and left handed, or vice versa.

<i>Table 1- Handedness and Ocular Dominance</i>					
Total Subjects	Right Eye Dominant	Left Eye Dominant	Right Handed	Left Handed	Cross Dominant
56	31	24	50	6	26

Approximately 55% of the test subjects were found to be right eye dominant, leaving 45% as left eye dominant. Nearly 90% of the subjects were determined to be right handed and just 10% were left handed. Comparing the results showed that 26 individuals, or 46.4%, were cross dominant. Of the cross dominant subjects, it was more common to be right handed and left eye dominant due to the fewer amount of individuals overall that were left handed, as is common in the general population. It has been cited that about 8% of the normal population is left handed (4), although there are mild difference between studies. The percentage of left handed subjects was 10.5%, which was expected and follows the normal trend.

The following figures are a graphical representation showing the distribution of reading level and eye-hand dominance in the tested individuals.

Figure 1

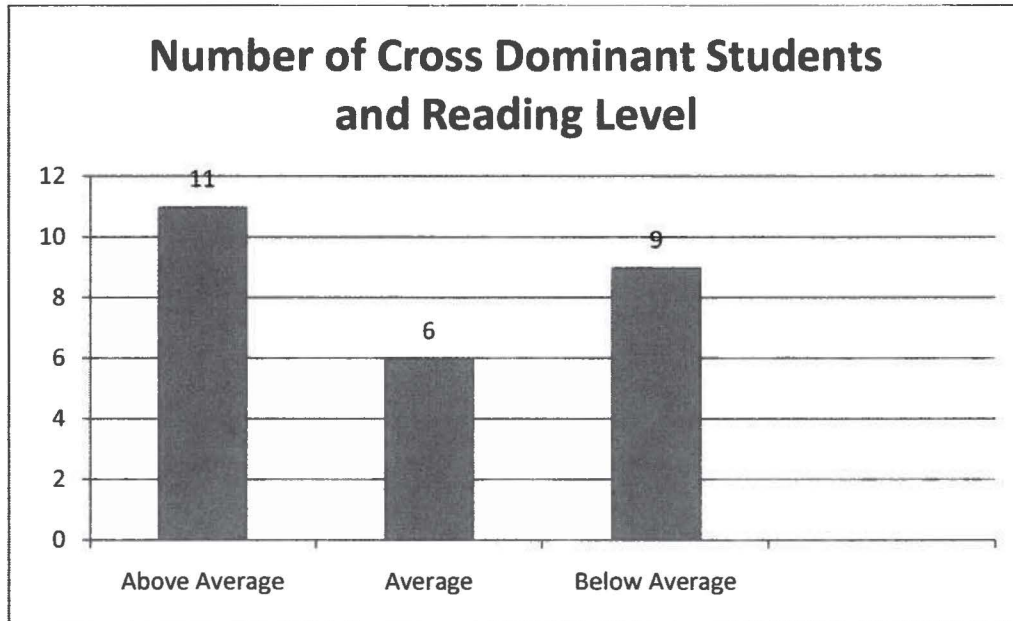
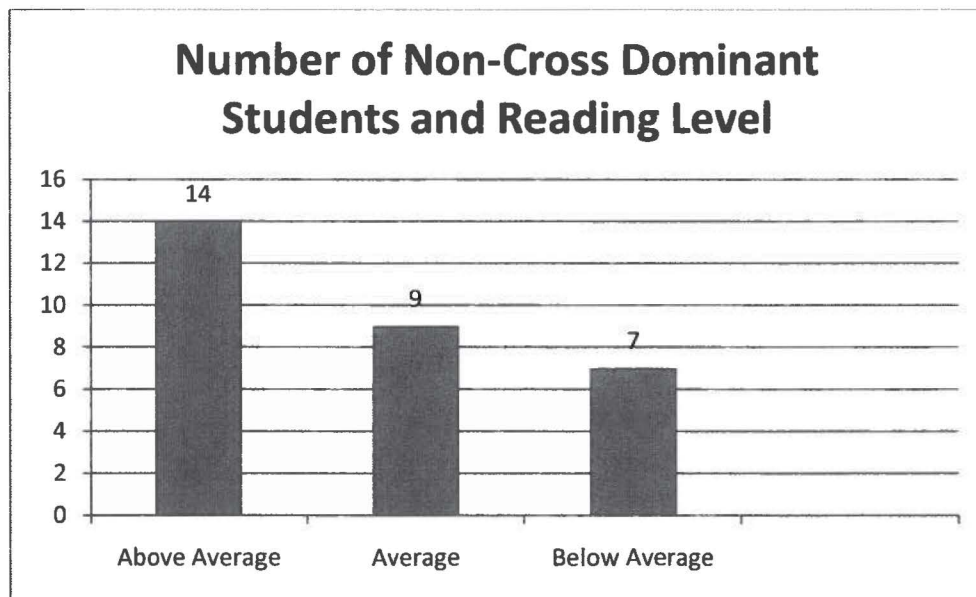


Figure 2



There was a slightly unequal distribution among the levels of reading performance. Twenty-five students, or 44.6%, were scored as above average readers. Fifteen students, or

26.8%, were scored as average readers. Sixteen students, or 28.6%, were scored as below average readers. It turned out that 56.25% of the below average students were cross dominant. On the other hand, only 44% of the above average students were not cross dominant. From these numbers, it appears that the cross dominant individuals were slightly more likely to be below average students than the non-cross dominant kids. This could also be said as the non-cross dominant children were slightly more likely to have above average reading ability. To determine if these numbers were statistically significant, the Chi Squared test was used to calculate a P value. The P value was calculated to be .6415. In general, a P value of $<.05$ means the result is statistically significant, or that the results from the study are significantly different than the result of pure coincidence. A lower P value indicates a lower chance of the result occurring at random (5). Therefore, the P value of .6415 shows a lack of statistically significant data obtained from this study. This can be attributed to several reasons which will be described later.

DISCUSSION

The purpose of this study was to investigate eye-hand dominance and reading ability in 2nd grade children. The original theory was proposed by an experienced clinician's observations over decades of optometric care. The theory was originally based on personal observations and, at this time, a solid physiological explanation has not been described by previous research. Early studies have shown conflicting results on this subject. An earlier study investigated lateral dominance in children with learning disabilities to see if these children were more likely to be cross dominant. The results of this study showed that learning disabled children did indeed have a higher chance of being cross dominant, but the results were also not statistically significant (6). This article is contradicted by other studies that found a significant relationship between cross

dominance and learning disabled children (7). This topic has limited previous research and varied results. There is a definite need for more research on this topic.

As mentioned before, our study did show a small correlation between crossed eye-hand dominance and delayed reading ability, however the correlation was not strong enough to be statistically significant. With a p value of .64, the results of the study must be attributed to coincidence. The original plan was to have a larger sample of students to include in the research, but the participation was lower than expected. The first step to increase the validity of this study would be to ensure a larger sample of students. Five classrooms were tested, however only about half of the students turned in their permission slips and were able to participate in the study. Ideally, more classrooms should have been involved to increase the total number of participants. More children may have strengthened the correlation and possibly lead to a more significant result.

Another factor affecting the outcome of the research was that the sample was not pure. Since the study involved children, permission slips signed and turned in by their guardians were required in order for the children to participate. It is likely that the kids who did not turn in their slips were, as a group, different from the group of kids who did turn in their permission slips. Excluding the kids that were not able to turn in the permission slip contaminated the results. It would have been better if 100% of the kids in each class were able to participate.

Other factors that potentially contaminated the research were ocular variables. The only test related to the student's eyes was ocular dominance testing. The initial study design did not include other ocular variables. Unequal visual acuity, uncorrected refractive error, amblyopia and different binocular vision disorders may have the ability to alter the results. It is difficult to

estimate what effects these variables would have on the outcome without doing any testing. To be more reliable, these factors would need to be considered in a larger scale study.

CONCLUSION

This study showed there is a possible correlation between crossed eye-hand dominance and impaired reading ability in 2nd grade children. The data initially supported the hypothesis; however, the sample size and results of this study were not significant from a statistical viewpoint. Hopefully there will be more research into this topic as the implications of a confirmed link could benefit many children who struggle with reading. If elementary school teachers were made aware of such a link, there could even be an increase in the number of children getting regular eye exams. Many children, parents, teachers and eyecare practitioners would benefit from additional research.

Statement of Informed Consent

Relationship between crossed ocular dominance and reading performance in 2nd graders

Explanation of study

You are being asked to allow your child to participate in a study conducted by students at the Michigan College of Optometry. The study will explore a possible relationship between crossed ocular dominance and reading performance in second grade students. The study will require that each child performs a few simple tasks and the results will be compared to his or her reading level.

The results will give eye care providers and educators important information on development of reading skills and may lead to improved diagnostic and teaching methods in the future. Permission for your child to participate would be greatly appreciated.

Questions

Any questions about the study can be directed to the study investigators, Troy Fox and Annah Nyblad at 906-281-1550 or via email at troylfox@gmail.com.

Confidentiality

All study records will be maintained with strict confidentiality. The Human Subjects Review Committee may inspect the investigators' records pertaining to your child as a participant in this study. The results of this study may be used for medical and/or scientific publications or meetings. In any event, your child's identity will not be disclosed in any manner.

I _____ (print name) have read the above information and have decided to allow my child _____ (print name) to participate in the described study.

Signature of parent or legal guardian

Date

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