THE RELATIONSHIP BETWEEN HAND DOMINANCE AND OCULAR DOMINANCE VIA PUTTING SIMULATIONS

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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 2014

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Has been approved

May, 2013

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Ferris State University
Doctor of Optometry Senior Paper
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ABSTRACT

Background: This research study investigates the relationship between hand dominance and ocular dominance while putting and compares the success of cross-dominant and same-dominant participants. *Methods:* Participants attempted seven-foot putts using a putting simulation on an indoor-carpeted area. Putts were made binocularly and monocularly, right eye, then left eye. Putts for each condition were averaged based on the length to the hole (LTTH), measured in inches. LTTH measurements were taken after each putt from the leading edge of the golf ball to the closest edge of the hole for each putting simulation. A value of zero was given when the put went into the hole. Ocular dominance was determined with the Dolman Method. Hand dominance of the participants was attained via a questionnaire. *Results:* The data obtained includes ocular dominance, hand dominance and putting accuracy. The results yielded non-significant data for the success of a binocular putt compared to the putt attempted monocularly with the dominant eye only. Non-significant data was also revealed for the success of those who are cross-dominant compared to those who are same-dominant. When comparing success of the binocular putt compared to the monocular dominate eye putt, there was no statistically significant difference in length to the hole. Putting success for cross-dominate and same-dominate also showed no statistically significant difference in length to the hole. *Conclusion:* The relationship between hand dominance and ocular dominance while putting was evaluated by comparison of the performance measured by LTTH averages for three different scenarios,

binocular putting, dominant eye putt, and the non-dominant eye putt for each participant. Unfortunately, the data collected yielded no clinical significance and further investigation with an increased number of participants is required.

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CHAPTER 1

INTRODUCTION OF CORRELATION BETWEEN OCULAR DOMINANCE AND HAND DOMINANCE.

The link between eye dominance and its correlation to hand dominance has been studied in recent times. A correlation has been looked at between the differences in laterality in eye dominance and hand dominance. While many in society believe that dominance is due to cultural upbringing and is a learned trait, scientists believe it is due to specializations in the left hemisphere[1]. Also, two theories exist on topic of eye dominance. The ocular dominance theory proposes that one eye is favored over the other when viewing a relative object. The cyclopean eye theory suggests that objects are seen from a central point between both eyes. In this study, we will be considering the ocular dominance theory.

Right-handed preference is exhibited by about 90% of the population whereas right eye dominance is exhibited by about 70% of population when viewing tasks that require selecting one eye or another[2]. Eye dominance refers to prominence of selecting either the right or left eye under monocular viewing conditions when carrying out monocular based tasks. Evidence suggests that eye preference is determined from hand preference. For example, left eye preference increases to about 60% in left handed people whereas it is only 20% right-handed people[1]. Studies show that people who are right handed are more likely to be right eye dominant and vice versa.

A study by Khan and Crawford examined whether eye dominance is related to eccentricity of gaze. They conducted experiments looking to see what eye was

chosen as the dominant eye in center fixation as well as horizontal eccentric fixation. Their studies showed that most individuals when fixating straight ahead were right eye dominant. However, when fixation was moved towards the left, people became left eye dominant. Similarly when left eye dominant people were fixating to the right they became right eye dominant[3]. This makes eye dominance a function of proprioception[4]. This provides a possible link between the eye and the hand. If one fixates on something to the left, they use left eye dominance. So if one is to perform a task with their left hand in the left hemi field of vision, they are using left eye dominance and vice versa. In this study, the correlation between these theories will be expanded on by researching the correlation of golf performance and how it relates to users who are cross dominant or same sided dominance. Cross dominant refers to individuals who measure as either right or left eye dominance and have opposite hand dominance. People that have same sided dominance use the same side for both eye and hand dominance.

As people perform the game of putting, they are aligned using opposite laterality depending on if they are right handed or left handed. For example, a person that is right handed will line up to putt a golf ball with their left foot to the left of the ball and the right foot to the right of the ball. Their left foot will be proximal to the hole. A left handed putter will also line up with their left foot to the left of the ball and their right foot to the right of the ball. However, their right foot will be proximal to the hole. According to Khan and Crawford's study, people use eye dominance according to eye fixation. Therefore we should be able to apply this to the game of putting. If a right-handed person putts they are aligning their putt

with fixation to the hole on their left side. Therefore, they would sight with their left eye. The same reasoning should be applied to left-handed putters. Left-handed putters align their putt to the hole on their right side. Therefore they would be sighting with the right eye. In this study, we question whether or not putting performance is affected in a random individual of varying golfing ability in three putting scenarios: right eye occluded, left eye occluded, and binocularly as a control. We examine whether or not eye dominance is correlated with putting performance in an individuals who are cross dominant and same-dominant. While talent is a difficult standard to quantify, this has possible implications for training techniques in order to improve one's putting skills. If putting ability and eye/hand dominance can be correlated, one could be trained to use a certain eye when putting. It is possible that a simple head turn could be detrimental to improving one's ability on the putting green.

CHAPTER 2

METHODS

Study Population

Participants were chosen at random from the population of the Michigan College of Optometry at Ferris State University in Big Rapids, Michigan. We evaluated sixteen participants between May and August of 2013. Participants who maintained a best corrected Snellen visual acuity of 20/20 or better and were between the ages of 18 and 40 years old were included.

Materials

Every participant used the same Odyssey White Hot Pro #7 putter and Callaway HX Tour Standard Service golf balls.

Determination of Eligibility

Visual acuity was measure using a Snellen chart with a test distance of 20 feet. Acuities for the right eye, left eye and both eyes were attained using this method. A short questionnaire was given to each participant. It included inquiry of subject age, gender, golf experience (in years), handedness, and self-assessed putting ability (a 1-5 scale, with 1 being no putting ability and 5 being excellent putting ability).

Pre-Putting Procedures

Ocular dominance was determined using the Dolman Method. Patients are instructed to view a distance Snellen 20/200 letter with binocular viewing. Subjects were then instructed to extend their arms and produce a small opening with both hands. Ocular dominance was determined based on the eye that was able the view the target through the opening in the hands under monocular context.

Putting Procedures

The putting scenario was simulated with painters tape on a flat, carpeted area within the atrium of the optometry building at Ferris State University. The putt distance was seven feet and was performed indoors to prevent weather variability, control lighting conditions and eliminate distractions. The participants first attempted the putt binocularly. They then attempted the putt monocularly with first the right eye followed by the left eye. The participants attempted each putt a

single time. The initial binocular putt served as a control to compare performance of the dominant eye putt and the non-dominant eye putt.

Putting success was determined by the total distance, in inches, remaining between the leading edge of the golf ball and the closest edge of the hole for each putting simulation and was labeled length to the hole (LTTH).

Statistical Analysis of Results

Data was evaluated with a paired two-tailed T-test that assumed unequal variances and a single factor Analysis of Variance (ANOVA).

CHAPTER 3

RESULTS

Seventeen people participated in the putting simulation. Each participant started with a binocular putt, followed by a right-eye monocular putt and ended with a left-eye monocular putt. The participants varied in golf experience, putting ability and age. Based on each participants' self-assessed putting ability on a scale of one to five. Most participants had little to no golf experience (47.1%), some had minimal golf experience (35.2%), few had a moderate amount of experience (5.9%) and only a select group had a high amount of experience (11.8%). The average putting ability subjectively assigned on a 1-4 scale (where 1 was a minimal score and 4 was a maximum score) was a 1.176. The average participant was between the age of 25 and 30. Nine females and eight males were evaluated.

A paired two-tailed T-test was used to evaluate the difference in the success of the dominant eye putt compared to the binocular putt. The results showed no significance with a p-value of 0.48601.

The T-test was also used to evaluate the difference in putting success between cross-dominant participants and same-dominant participants. Again, the resultant analysis determined no significance with a p-value of 0.74819.

The T-test was used to analyze all crossed putts independent of whether the participant was cross-dominant or same-dominant. This data also revealed no significance with a p-value of 0.39053.

Cross-dominant putts were compared to same-dominant putts and binocular putts using ANOVA. These results also yielded no significance with a p-value of less than 0.426.

There were many confounding variables such as varying golf experience and putting skill levels. Additionally, there were very few participants. Perhaps with an increased number of participants at a specific experience level would yield a study that provides more useful information.

CHAPTER 4:

DISCUSSION

Many researchers in the past have attempted to correlate hand dominance and eye dominance. Many factors are involved when it relates to gross motor activity. In this study, we tried to isolate the visual system and relate eye dominance and hand dominance. Most individuals who are right eye dominant are right hand dominant and vice versa. Eccentricity of gaze also has an effect on eye dominance. During the game of golf, a right handed person will have a different position of gaze when lining up the ball to the hole than a left hand person. Therefore, when a person uses his or her right hand for golf they are most likely using left eye dominance when aiming

towards the hole. So it is questioned that if people are cross dominant between eye and hand, they should benefit when putting in the game of golf. This study was designed to isolate that phenomena. Subjects were subjectively questioned on their golf ability and hand dominance. Their eye dominance was objectively evaluated using the Dolman method. Comparisons were made statistically using ANOVA testing to see if there was a correlation. Subjects were compared based on if they were ipsilateral hand-eye dominant or cross hand-eye dominant. ANOVA testing yielded no statistically significant results.

There were many limitations to this study. It is difficult to compare putting ability when experience and gross motor ability cannot be controlled from individual to individual. It is hard to measure or standardize someone's putting ability to another. In this study, a questionnaire was used to evaluate ability and experience. However, an individual's response may be skewed or biased. If this were to be controlled, a more accurate study could be performed. With a larger sample size, a difference between novice and expert groups could be isolated. Another component to consider is the effect of interpupillary distance and level of stereopsis when performing these tasks. In a study by Aslankurt et al, a correlation was found between interpupillary distance and level of stereopsis[5]. They also determined that right or left handedness has no effect on stereopsis. Complex neurological studies can be considered as well. Expertise, performance time, and the link between action and imagery can be considered. A study by Beilock and Gonso revealed that manipulating actual execution time and imagined execution time impacted the performance of novice and expert golfers. Levels of experience have been studied

and related based on aiming ability. A study by van Lier et al found that novice putters showed a rightward putting error whereas expert players did not[6]. The study showed that skill related differences impact the process of recalibration when lining up the ball for a putt. A few things that were controlled in this study were visual acuity and eye dominance. Every individual maintained vision better than 20/25 both monocular and binocular and individuals could only be right or left eye dominant. Other areas of the study that were controlled were the putting scenario and equipment. Each individual performed under the same scenario. There were very few participants in this study. A larger sample size could possibly reduce some of this variability. A sample size of 30 or more was recommended but recruitment was low for the study. Other limitations include sizing of golf clubs based on the individual's size as well as the putter style preference. A single putter was used to eliminate variability but one individual may benefit more from one putter to the next. The question still remains as to whether cross dominant individuals benefit in the game of golf compared to ipsilateral dominant individuals specifically at different levels of golf experience. More research is needed with a different design to isolate proper results.

APPENDIX A

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APPENDIX B

IRB APPROVAL FORM

Ferris State University

Institutional Review Board (FSU - IRB)

Chair
820 Campus Drive
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To: Dr. Alison Jenerou, Christina Marsman and Ryan Isaacson

From: Dr. John Pole, Interim IRB Chair

Re: IRB Application #130407 (Title: *Relationship Between Hand Dominance and Ocular Dominance via Putting Simulations*)

Date: May 8, 2013

The Ferris State University Institutional Review Board (IRB) has reviewed your application for using human subjects in the study, "*Relationship Between Hand Dominance and Ocular Dominance via Putting Simulations*" (#130407) and approved it as *expedited – 2D.* This approval has an expiration date of one year from the date of this letter. As such, you may collect data according to procedures in your application until May 8, 2014. It is your obligation to inform the IRB of any changes in your research protocol that would substantially alter the methods and procedures reviewed and approved by the IRB in this application. Your application has been assigned a project number (#130407) which you should refer to in future applications involving the same research procedure.

We also wish to inform researchers that the IRB requires follow-up reports for all research protocols as mandated by Title 45 Code of Federal Regulations, Part 46 (45 CFR 46) for using human subjects in research. We will send a one-year reminder to complete the final report or note the continuation of this study. The final-report form is available on the IRB homepage. Thank you for your compliance with these guidelines and best wishes for a successful research endeavor. Please let us know if the IRB can be of any future assistance.