

VIRTUAL REALITY'S IMPACT ON PHORIC POSTURE IN THE POPULATION

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, 2019

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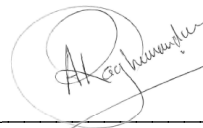
15th January, 2019

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Faculty Advisor: Alison Jenerou

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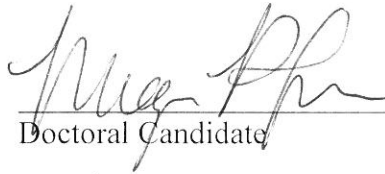


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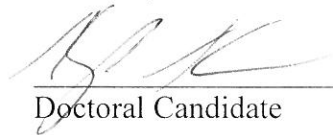
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VIRTUAL REALITY'S IMPACY ON PHORIC POSTURE

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ABSTRACT

Background: In 2016, virtual reality (VR) became mainstream and consumer affordable with the release of the Oculus Rift, Playstation VR, and Samsung Gear VR. With new technology comes new concerns and in the field of optometry, one of these concerns is the impact that virtual reality devices could have on the development of pediatric patient's binocular system. Since these devices come with preset interpupillary distance (PD) measurements, it can be assumed that children using these devices would not be altering the settings to match their own PD without instruction. This study examined whether or not an overestimated PD will produce measurable effects on a subject's binocular system and whether this could have the potential to impact pediatric binocular development. **Methods:** This study examined 7 subjects ranging from 21-26 years old. The subject's near phoria was measured before 20 minutes of VR play with the correct PD. Then the near phoria was measured again after playing. This was repeated with the PD set larger than our subjects' PD (10 mm larger). Subjects were alternated with whether they played with an appropriate PD or larger PD first. Following both VR sessions, subjects were then given a symptom survey where a score was calculated based on what symptoms they experienced while playing. **Results:** The results of the study determined that an incorrect interpupillary distance of 10 mm did not provide a statistical significance for an affect on the subject's near phoria with a p-value of 0.3296. The high p-value supports the null hypothesis that an incorrect PD of 10 mm will not cause an individual's phoric posture to become significantly more exophoric than with the correct PD. **Conclusions:** The clinical significance of this project could be widespread for

clinicians, as well as patients. What the results have shown is that no statistical significance can be observed between playing with a correct PD or incorrect PD. Symptom survey results showed the exactly the same amount of symptoms displayed between the two groups.

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	vii
CHAPTER	
1 INTRODUCTION.....	1
2 METHODS.....	2
3 RESULTS.....	3
4 DISCUSSION.....	5
APPENDIX	
A. IRB APPROVAL LETTER.....	8

LIST OF TABLES

Table	Page
1. Data Collection	4
2. Data Analysis	4

CHAPTER 1

INTRODUCTION OF VIRTUAL REALITY'S IMPACTS

On March 28th of 2016, a virtual reality headset was released by a division of Facebook which would change the video game industry. The Oculus Rift was one of the first virtual reality devices to draw mainstream attention to itself, quickly followed by the first console virtual reality device, the Playstation VR. With the release of these devices, new uses were brought to eye care like vision therapy. However, with these new devices also rose questions for many eye care professionals. How would these devices affect the eyes, specifically eye development in children? In 2017, a study performed by Turnbull and Phillips examined the relationship between virtual reality gaming use and binocular vision status. The study concluded that if the interpupillary distance (PD) was correct, no measurable changes were observed in the binocular vision system of individuals (Turnbull, Phillips 2017). There were no significant changes in distance or near phoria, stereopsis, amplitude of accommodation or fixation disparity. The only notable changes observed were changes in choroidal thickness. These changes in choroidal thickness were hypothesized to be caused by the environment the headsets created, resulting in the potential for a lead of accommodation.

This study examined the impact that varying the interpupillary distance had on near phoria by simulating an environment that an individual might experience when using a virtual reality headset with the incorrect interpupillary distance. Symptoms that each subject experienced while playing under each condition were also recorded since motion sickness is a known side effect of virtual reality (Hartnagel D., Taffou M., Sandor P.M. (2017).

CHAPTER 2

METHODS

Participants in this study included 7 students and faculty at the Michigan College of Optometry by method of convenience sampling. Patients ages ranged from 21 to 26 years old. Informed consent forms were provided, explained, and signed by all participants prior to any involvement in the study. The participant's interpupillary distance (in millimeters) and near phoric posture (in prism diopters) were measured prior to any virtual reality game play. The interpupillary distance was measured with a pupillometer and the near phoric posture was measured using the Modified Thorington technique. Subjects were then randomized into two categories: VR game play with correct PD and with an incorrect (larger) PD. Each group answered a short symptom survey before playing 20 minutes of the 'Job Simulator' game. The subjects then repeated the survey and near phoria measurements after playing. Subjects then participated in the other category of play, such that each subject participated in each type of play and played for a total of 40 minutes. Interpupillary distances were altered by 10 mm. This alteration was based on a 7-year old female patient's average PD of 51.775 mm and a 7-year old male patient's average PD of 53.335 mm (MacLachlan, C. & Howland, H. C. 2002). The Playstation VR has a default PD of 62 mm, which is on average about 10 mm greater than the expected averages for 7-year old patients.

CHAPTER 3

RESULTS

The results of the study determined that an incorrect interpupillary distance of 10 mm did not provide a statistical significance for an affect on the subject's near phoria with a p-value of 0.3296. The high p-value supports the null hypothesis that an incorrect PD of 10 mm will not cause an individual's phoric posture to become significantly more exophoric than with the correct PD. Data concluded that with the correct PD in place, 85.7% of the subject's phoric posture became more exophoric and 14.3% of the subject's phoric posture became more esophoric. Data concluded that with the incorrect PD in place, 57.1% of subject's phoric posture became more exophoric, 28.6% of subject's phoric posture did not change and 14.3% of subject's phoric posture became more esophoric. The results determined that the average change in the individual's phoric posture was actually greater with the subject's correct pupillary distance at 1.2857 prism diopters than with the incorrect (larger) pupillary distance at 0.6429 prism diopters after 20 minutes of virtual reality game play. Results also concluded that an incorrect (larger) pupillary distance of 10 mm did not cause subjects to become symptomatic for eye strain as the average symptom survey score for the correct and incorrect interpupillary distance were equal.

Participant #	Posture before Simulation	Phoria steady or unsteady	Randomization (Key 1= incorrect PD first, 0=correct PD first)	Posture after VR simulation with incorrect PD	Phoria steady or unsteady	Symptom Survey score following incorrect PD play	Posture after VR simulation with correct PD	Phoria steady or unsteady	Symptom Survey score following correct PD play
1	4 exo	steady	1	4.5 exo	steady	1	4.5 exo	steady	1
2	3 exo	steady	1	5 exo	steady	1	4 exo	steady	0
3	ortho	steady	0	1 eso	steady	1	3 eso	steady	1
4	2 eso	steady	1	2 eso	steady	1	1 eso	steady	1
5	2 exo	steady	0	2 exo	steady	1	1 exo	steady	1
6	1 eso	steady	1	0.5 eso	steady	1	0.5 eso	steady	1
7	2 exo	steady	0	2.5 exo	steady	0	4 exo	steady	1

Table 1 illustrates the data collection of phoric postures with correct and incorrect interpupillary distance along, steadiness of phoric posture, and symptom survey scores

	Average Change in Phoria	Average Symptom Survey Score	P-value
Correct PD	1.2857	0.8571	0.3317
Incorrect PD	0.6429	0.8571	0.3296

Table 2 illustrates the average change in phoria, the average symptom survey scores, and the p-values for both correct and incorrect interpupillary distances

CHAPTER 4

DISCUSSION

When this study was first created, the original hypothesis was that if the pupillary distance was increased by 10mm that it would induce a significant increase in exophoric posture. This theory was due to the thought that the eyes would have to sustain divergence in order to fuse the images provided in the oculars. However, the data collected in this study did not support that hypothesis. The data shows that no statistical significance is noted due to the high p-values obtained. These results ultimately concluded that the changes made in pupillary distance did not impact the phoric posture under these specific conditions. It is possible that greater changes in pupillary distance or longer periods of gameplay could result in a change in phoric posture which is an avenue that could be explored with future studies. It is difficult to determine if significant divergence was necessary for subjects to fuse the ocular images. The optics of the virtual reality ocular lenses could certainly play a role in this, as they likely induce prism based on how they are positioned on each individual. Although, we attempted to control this factor to reduce error, the possibility cannot be ruled out. An additional possibility for the binocular system to be affected by the optics of the virtual reality system is through proximal accommodation. Proximal accommodation is defined as the difference in accommodation in a real target at optical infinity compared to a near target virtually simulating optical infinity (Jones, Ronald 1993). Since we know that the ocular lenses are in close proximity to the eyes and the gameplay is simulating optical infinity, it can be inferred that proximal accommodation is likely having an effect. We also know that

accommodation is closely tied into the binocular vision system, and therefore it will likely be impacted by this.

When examining the symptom survey scores for the population of this study, the results are clear. Both groups ended with identical symptom survey scores. This result indicates that symptoms did not vary between correct or incorrect pupillary distances. The most common complaint was motion sickness, noted by every subject at some point in their gameplay. Motion sickness is a well known side effect of virtual reality gameplay, but how this could tie into the binocular vision system and the resulting phoria is unclear. It would likely be dependent on the duration and severity of motion sickness, which could be explored in future studies.

As cell phones, tablets, and other electronic devices have proven to have an impact on the population's binocular vision system over the last decade, it is possible that optometrists will see more complaints regarding binocular vision discomfort due to virtual reality gaming. Therefore, it is important to keep up-to-date on technology and its relation to eye care.

REFERENCES

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4. Turnbull, P. & Phillips, J. Ocular Effects of Virtual Reality Headset Wear in Young Adults. *Scientific Reports*, 7: 16172 (2017).

APPENDIX H
IRB APPROVAL FORM

Institutional Review Board (FSU - IRB)

Gregory Wellman, R.Ph, Ph.D, IRB Chair
820 Campus Drive
Ferris State University
Big Rapids. MI 49307
(231) 591-2759
IRB@ferris.edu

Date: January 15, 2019

To: Alison Jenerou

From: Gregory Wellman, R.Ph, Ph.D, IRB Chair

Re: IRB Application *IRB-FY17-18-189 Virtual Reality's Impacts on Phoric Posture in the Population*

The Ferris State University Institutional Review Board (IRB) has reviewed your application for using human subjects in the study, "*Virtual Reality's Impacts on Phoric Posture in the Population*" (*IRB-FY17-18-189*) and Approved this project under Federal Regulations Expedited Review 4. Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing. (Studies intended to evaluate the safety and effectiveness of the medical device are not generally eligible for expedited review, including studies of cleared medical devices for new indications.)

Approval has an expiration date of one year from the date of this letter . **As such, you may collect data according to the procedures outlined in your application until January 15, 2020** . Should additional time be needed to conduct your approved study, a request for extension must be submitted to the IRB a month prior to its expiration.

Your protocol has been assigned project number IRB-FY17-18-189. Approval mandates that you follow all University policy and procedures, in addition to applicable governmental regulations. Approval applies only to the activities described in the protocol submission; should revisions need to be made, all materials must be reviewed and approved by the IRB prior to initiation. In addition, the IRB must be made aware of any serious and unexpected and/or unanticipated adverse events as well as complaints and non-compliance issues.

Understand that informed consent is a process beginning with a description of the study and participant rights with assurance of participant understanding, followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document and investigators maintain consent records for a minimum of three years.

As mandated by Title 45 Code of Federal Regulations, Part 46 (45 CFR 46) the IRB requires submission of annual reviews during the life of the research project and a Final Report Form upon study completion. 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.

Regards,

A handwritten signature in cursive script, appearing to read "Gregory Wellman".

Gregory Wellman, R.Ph, Ph.D, IRB Chair
Ferris State University Institutional Review Board