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Effects of instructional set variations on the Bichrome Test and comparison of the continuous and flash phoria techniques

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Abstract

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Effects of Instructional Set Variations on the Bichrome Test

and

Comparison of the Continuous and Flash Phoria Techniques

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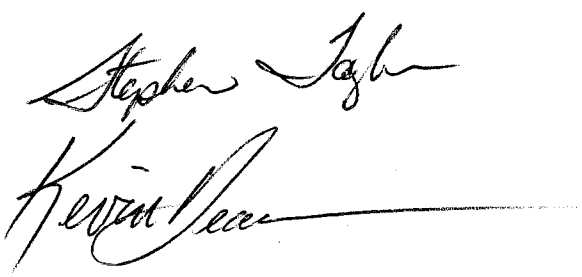

INTRODUCTION

Early in optometric education heavy emphasis is placed upon clinical testing procedures that maximize interclinician data repeatability. The aim of this study was to investigate how the bichrome test is affected by instructional set modification. At the same time we compared data based on two different methods of estimating phoric posture.

The bichrome test is used to estimate the best spherical correction as a preset to cylinder testing. The test has a second application when balancing spherical refractive correction between two eyes. The spherical correction and balancing are accomplished by utilizing the differences between the refractive indices for red and green light. Given an emmetropic eye and based on the refractive indices, the red focus would fall behind the retina and the green focus in front of the retina in such a way that the blur circles due to each focus are equal in size. At this point both sides of the projected chart will look equally clear. For a patient with a refractive error the clinician need only change spherical lens values until a subjective response of, equal is obtained. This lens power estimate is the patients spherical equivalent correction. This study is designed to test for possibly significant data changes occurring with an altered bichrome instruction set.

The phoria test is employed to find the tonic position of the eye at rest. This is normally accomplished by dissociating the eyes using vertical and horizontal prisms. The most common procedure for estimating phoric posture is the "continuous method". Throughout the duration of this test both images are seen simultaneously. An alternative procedure often used when patients have trouble responding to the continuous method is the "flash phoria" technique. In contrast to the continuous method the flash phoria technique allows simultaneous viewing only for an instant. In this study we compared the two phoria test methods by observing whether differences between the data obtained with each eye are statistically significant.

METHOD

The subjects participating in this study were chosen from the population of Pacific University students. Optometry students in their third and fourth year were not chosen since they are considered trained responders. Participants were accepted on the basis that they have one eye with 20/20 Snellen acuity. Those unable to distinguish the correct colors of the bichrome test target were considered ineligible, but could remain in the study as subjects for the phoria testing.

A total of forty-two subjects were chosen for both studies of which two were eliminated from the bichrome test. Each member of the bichrome group was given two sets of instructions. Examiner bias was eliminated by developing two sets of instructions (appendix 1) that would be presented identically to each of the subjects. In the non-specific instruction set the subjects based their clarity decision on a casual observation of the testing target. The second instruction set requires subjects to direct their attention to the green half of the bichrome chart and make a clarity decision. Random order of presentation was not performed because if given the specific set of instructions first, the subjects may find it more difficult to casually observe the chart without bias to the green side. Subjects read the non-specific instructions before entering the exam room. Subjects wore their habitual prescription and were monocularly fogged to 20/30 before darkening the room. This spherical value was used as a preset for each of three trials. Participants were then verbally given the specific instruction set, three additional trials were taken, and the data was recorded.

The phoria testing used forty-two subjects. The ability to read 20/20 with each eye was the only requirement for this part of the study. The eyes were dissociated using eight prism diopters base up OS (left eye) and twelve prism diopters base in OD (right eye). This was the preset used for all individuals unless a more substantial dissociation was necessary to eliminate fusion. To be considered a valid phoria measurement, each trial had to be consistent to within plus or minus two prism diopters. If a person had inconsistencies over that amount then the trial was repeated until a consistent reading occurred. Verbal instruction sets were used for both continuous and flash phoria methods (appendix 2). The continuous method was always used before the flash method as this was the most common order in a practitioner's exam. The data was recorded for three trials with each method.

DATA ANALYSIS AND DISCUSSION

Upon the completion of testing, data from the three trials were averaged and prepared for statistical analysis. When comparing the specific to the non-specific instruction set bichrome data it was revealed that when given the specific instruction set, nineteen subjects showed an ave .25 D acceptance of plus, thirteen subjects showed an ave .19 D acceptance of minus and five subjects showed no change in spherical power.

In comparing the difference between the continuous and flash phoria data it was revealed that twenty-two subjects showed an average increase of 1.4 prism diopters of esophoric posture using the flash phoria technique. Fourteen subjects showed an average increase of 1.1 prism diopters of exophoric posture usin the flash phoria technique and six subjects showed no change in phoric posture.

A two-tailed t-test for related measures statistical work up at the .05 significance level was performed on each data set (appendix 3). It was concluded via statistical analysis that the diffences in both the bichrome and phoria portions of the research were insignificant.

Though the data was deemed statistically insignificant, there were worthwhile observations noted in both portions of the research. As the bichrome research progressed it became evident that the untrained observer found it difficult to distinquish between image clarity and background brightness. To be more specific, some observers could not recognise the 20/40 letters on the bichrome chart with the R/G filter in place. The chart image was so blurred that the clarity decision was then based on the perceived chart brightness, not image clarity as was intended. This problem might be due to a small retinal image size. Once the 20/40 letters of the bichrome chart are blurred beyond recognition the observer has no choice but to make his decision based on perceived brightness. Subjects who had difficulty with the standard bichrome chart found it much easier to make a clarity choice when the 20/400 letter was used. Even though the spherical fogging was the same, the 20/400 letter was never blurred beyond recognition, so the perceived brightness of the red and green was not as much a factor in the subjects decision.

As the phoria research progressed it was recognised that when compared to the flash technique, the continuous technique required several more attempts to arrive at three valid trials. An explanation for this phenomenon is the concept of fusion lock. The continuous phoria method dissociates the target and images are viewed constantly. Once the images are bought into alignment, the two eyes attempt to fuse them. This results in a wide range of prismatic values in which the images appear aligned. The flash phoria method allows only momentary viewing of the

images and breaks any fusional attempt each time the examiner covers an eye. In this study the continuous phoria inconsistencies were not a statistical factor since repeated measurements were performed until a valid trial was obtained. Most optometrists do not repeat the continuous phoria until a repeatable value is obtained so reliability and validity of data are compromised.

The purpose of research is not always to test a given hypothesis but to generate new ideas for further research. Results of this study, though statistically insignificant, lead to statements about both portions of the research: 1) instruction sets generally do not make major changes to bichrome spherical results and 2) the continuous phoria method, with consistent data, gives results that are comparable with those of the flash phoria method. It would be interesting to see continued bichrome research in the areas of image size and perceived brightness as it relates to monochromatic light. Further phoria test research could deal with how inconsistencies might be controlled with specific instruction sets.

APPENDIX I

NON-SPECIFIC INSTRUCTION SET - to be read by subject

This test is an estimate of your refractive error. It is not meant to evaluate your present Rx or ocular health.

The letters on the Red/Green chart will be clearer on one side than the other. When asked by the testor, tell him which side you perceive the letters as clearer and more distinct (Red or Green). Each time the testor changes the lens you will tell him which letters you perceive as clearer and more distinct.

SPECIFIC INSTRUCTION SET - verbally given to patient

Now, I am going to make the instructions for this test more specific. I want you to concentrate on the green side and only glance at the red side. Which side do you perceive the letters as being clearer and more distinct? Remember, concentrate on the green and only glance at the red.

APPENDIX II

CONTINUOUS PHORIA VERBAL INSTRUCTIONS

Set prisms to preset values.

1. How many strips of letters do you see? (TWO)
2. Is the top strip up and to the right? If no vary prism until this situation is created.
3. I would like you to concentrate on the bottom strip of letters and say "now" when the top strip comes over and lines up directly over the bottom.
4. Do you understand the instructions? (If not, the instructions are repeated.)

FLASH PHORIA VERBAL INSTRUCTIONS

Return prisms to preset values.

1. I am now going to change the test slightly. Instead of viewing the strips of letters continuously I will only flash the upper strip of letters for an instant (Demonstrate to patient).
2. As I uncover the top strip of letters you will tell me whether the top target is to the right, to the left, or above the bottom strip of letters.
3. Do you understand the instructions? (If not, the instructions are repeated.)

APPENDIX III

DATA AND STATISTICAL ANALYSIS

Red/Green Data:

	Ave. of trials Non specific	Ave. of trials Specific	(D) Difference	$(D)^2$ $(Difference)^2$
1.	-.166	- .25	-.083	.00689
2.	+.083	+ .083	0	0
3.	-.416	- .50	-.083	.00689
4.	-.583	- .75	-.167	.02789
5.	-.166	- .166	0	0
6.	+.166	+ .083	-.083	.0625
7.	-.25	- .416	-.166	.02789
8.	+.333	+ .416	+.083	.00689
9.	+.083	+ .333	+.25	.0625
10.	-.75	- .75	0	0
11.	-.166	- .25	-.083	.00689
12.	+.166	+ .25	+.083	.00689
13.	-.25	0.00	+.25	.0625
14.	-.583	- .416	+.167	.02789
15.	-.583	- .75	-.167	.02789
16.	-.333	- .25	+.083	.00689
17.	+.333	+ .50	+.167	.02789
18.	+.417	+ .33	-.083	.00689
19.	+.25	+ .25	0	0
20.	-.25	+ .333	+.583	.3399
21.	-.833	- .583	+.25	.0625
22.	+1.00	+1.25	+.25	.0625
23.	-.667	- .417	+.25	.0625
24.	0	0.00	0	0
25.	-2.25	- 1.50	+.75	.5625
26.	-.50	- .583	-.083	.00689
27.	+.08	+ .08	0	0
28.	-1.5	- .917	+.583	.3399
29.	-1.417	-1.33	+.087	.00757
30.	-.583	-1.33	-.747	.5580
31.	+.50	+ .50	0	0
32.	-.50	- .667	-.167	.02789
33.	-.083	0.00	+.087	.00689
34.	+.583	+ .50	-.083	.00689
35.	-.25	- .167	+.083	.00689
36.	-.25	+ .167	+.417	.1739
37.	-.417	- .25	+.167	.02789
38.	-.25	- .188	+.062	.00384
39.	+.333	+ .333	0	0
40.	-.333	- .583	-.25	.0625
sum	18.66	18.42	2.24	2.69

$\bar{x}$= .056

Std. Dev.= .25

Phoria Data:

	Ave. of trials Continous	Ave. of trials Flash	(D) Difference	$(D)^2$ $(Difference)^2$
1.	8.33so	9.33so	+1.00	1.00
2.	4xo	0	+4.00	16.00
3.	11xo	9xo	+2.00	4.00
4.	15xo	11.3xo	+3.70	13.70
5.	4.66xo	2.66xo	+2.00	4.00
6.	6.33xo	5.66xo	+ .67	.45
7.	3xo	5.3xo	-2.30	5.40
8.	4xo	4.3xo	- .33	.11
9.	3.33xo	4xo	- .67	.45
10.	2.66xo	4xo	-1.34	1.79
11.	3.3xo	3.66xo	- .33	.11
12.	5xo	3xo	+2.00	4.00
13.	1.33xo	1xo	+ .33	.11
14.	2xo	.33xo	+1.67	2.78
15.	0	2.33so	+2.30	5.43
16.	.33xo	1so	+1.33	1.77
17.	1so	1.7so	- .70	.49
18.	2xo	2xo	0.00	0.00
19.	.67	0	+ .67	.45
20.	2so	2xo	-4.00	16.00
21.	3.33xo	3xo	+ .33	.11
22.	.7xo	.7xo	0.00	0.00
23.	2so	2.33so	+ .33	.11
24.	4.67xo	4.5xo	+ .17	.03
25.	6so	6.3so	+ .30	.09
26.	0	.5xo	- .50	.25
27.	2xo	2.33	- .33	.11
28.	1.3xo	1.3xo	0.00	0.00
29.	14xo	14.3xo	- .30	.09
30.	1.33xo	1xo	+ .33	.11
31.	4xo	3.33xo	+ .66	.44
32.	4.7xo	4.7xo	0.00	0.00
33.	2xo	2.67xo	- .67	.45
34.	1.33xo	1.67xo	- .34	.12
35.	0	1xo	-1.00	1.00
36.	4xo	2.67xo	+1.33	1.77
37.	4so	2so	-2.00	4.00
38.	0	1.33xo	-1.33	1.77
39.	4.67xo	2.67xo	-2.00	4.00
40.	6xo	6xo	0.00	0.00
41.	6so	8.67so	+2.67	7.13
42.	2xo	2xo	0.00	0.00
sum	153.97	147.53	+15.01	99.57

$\bar{x}$= .342

Std. Dev.= 1.51

Both sets of data were statistically analyzed using the related measures t-test. The formula for which is given below.

$$t = \frac{\bar{X} - \bar{Y}}{\sqrt{\text{Sum } D^2 - \frac{(\text{Sum } D)^2}{N}}}$$

N= #of subjects

Results of Red/Green data analysis:

t= .123

At .05 significance for a two-tailed test the Red/Green t score must be 2.021 or greater. Since this was not the case, the data was statistically insignificant.

Results of Continuous and Flash phoria data:

t= .66

At .05 significance for a two-tailed test the phoric posture t score must be 2.021 or greater. Since this was not the case, the data was statistically insignificant.

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