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A comparison of the reliabilities of the Von Greafe and Maddox rod techniques of phoria measurements

John P. Barnett
Pacific University

Marvin M. Sedway
Pacific University

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Abstract

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A COMPARISON OF THE RELIABILITIES
OF THE VON GREAFE AND MADDOX ROD TECHNIQUES
OF PHORIA MEASUREMENT

Original research
presented to the faculty of the
College of Optometry
Pacific University

in partial fulfillment
of the requirements for the degree
Doctor of Optometry

by

John F. Barnett

and

Marvin M. Sedway

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A COMPARISON OF THE RELIABILITIES
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TECHNIQUES OF PHORIA MEASUREMENT

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Marvin W. Sedway

Introduction

The possibility that a variation in technique might lead to a variation in phoria measurement has been discussed and tested for many years. Our present literature has pointed up to the fact that the Maddox Rod technique of phoria determination will lead us to a more esophoric response. However, we have found sadly lacking any amount of literature on the reliabilities of the various methods of testing a phoria.

Subsequently the present authors felt it would be of value to investigate the comparative reliabilities of the Maddox Rod and the Von Graefe phoria measurement techniques.

The most comprehensive work found in phoria measurement problems was done by Scobee¹ whose investigation covered two hundred subjects. He showed statistically that the Maddox Rod technique of phoria measurement

1. Scobee, R.G. and Green, E.L. - Tests for Heterophoria-Reliability of the Tests, Comparison Between Tests and Effect of Changing Testing Conditions; Trans. Amer. Acad. of Ophthalmology and Otol., 1947

gave a more esophoric response than that elicited by the Von Graefe method. However there was no statistical evidence concerning the reliabilities of the two major techniques. Scobee, then, although covering an important point, did not give us any information concerning the confidence level of the reliabilities at which the two techniques operated.

In the publication Phoria Norms,² a like report is found, which gives us no statistical data to apply to the reliability problem.

The work of Hirsch and Bing³ at Ohio State University on the difference in testing methods of phorias at the nearpoint seemed to be of most significance in relation to the stated problem. The article consisted of the tabulated results and accompanying statistical evidence showing the difference in results obtained from the five methods of phoria measurement tested. The only conclusion pertinent to the present paper, reached by Hirsch and Bing, was that all methods of phoria measurement tested were reliable.

It will be seen, therefore, that no concrete evidence or statistical data has been published up to this date relevant to the reliabilities of these two methods of

2. Bureau of Visual Science - Phoria Norms, American Optical Company, 1941

3. Hirsch, Monroe and Bing, Lois - The Effect of Testing Methods On Values Obtained For Phoria at Forty Centimeters; Amer. J. of Optometry and Arch. of Amer. Acad. of Optometry, Sept., 1948

phoria determination both at near-point and at far-point testing distances.

Therefore, it was with this in mind, that the present authors have undertaken this project, specifically to investigate the reliabilities of the Maddox Rod technique and the Von Graefe technique and determine if there is a significant variation in reliability between the two.

Procedure

Each investigator worked with ten different subjects, all of whom were senior clinicians at the University Optometry Clinic. The subjects were instructed to wear their habitual prescription during the testing, in order that some uniformity of visual performance might be expected without actually determining it by running a complete optometric examination upon each of our subjects.

1. Von Graefe Diplopia Technique:

- a. At Far - Target projected seventeen feet
three inches from subject.

O.D. - Prism Base In

O.S. - Prism Base Up

Target - Snellen chart, bottom line 20/20
letters

Room Illumination - Dim

Target Illumination - 12 c.p.

- b. At Near - Target at sixteen inches from
subject.

O.D. - Prism Base In

O.S. - Prism Base Up

Target - Reduced Snellen chart, bottom line
20/20 letters.

Room Illumination - Dim

Target Illumination - 12 c.p.

2. Maddox Rod Technique:

- a. At Far - Target projected seventeen feet
three inches from subject.

O.D. - White Maddox Rod, axis at 180 degrees,
giving a vertical line.

O.S. - Risley Prism

Target - Projected white dot and vertical
white line

Room Illumination - Dim

Target Illumination - 12 c.p.

- b. At Near - Target sixteen inches from subject.

O.D. - White Maddox Rod, axis at 180 degrees,
giving a vertical line.

O.S. - Risley Prism

Target - Because there has been no satisfactory target devised to take a Maddox Rod Phoria at near, the authors devised an apparatus for this purpose. This will be discussed and diagrammed in the next section under the title "Apparatus."

Room Illumination - Dim

Target Illumination - 12 c.p.

Three readings were taken from excessive base-in and three readings were taken from excessive base-out and these figures averaged for each reading.

Instructions To Subjects

1. Von Graefe Technique:

Far and Near - " Please fixate the bottom line of the lower chart and tell me when the two targets are lined up, one exactly above the other."

2. Maddox Rod Technique:

Far and near - " Please fixate the center of the vertical line and tell me when the white dot appears to be centered in the vertical line."

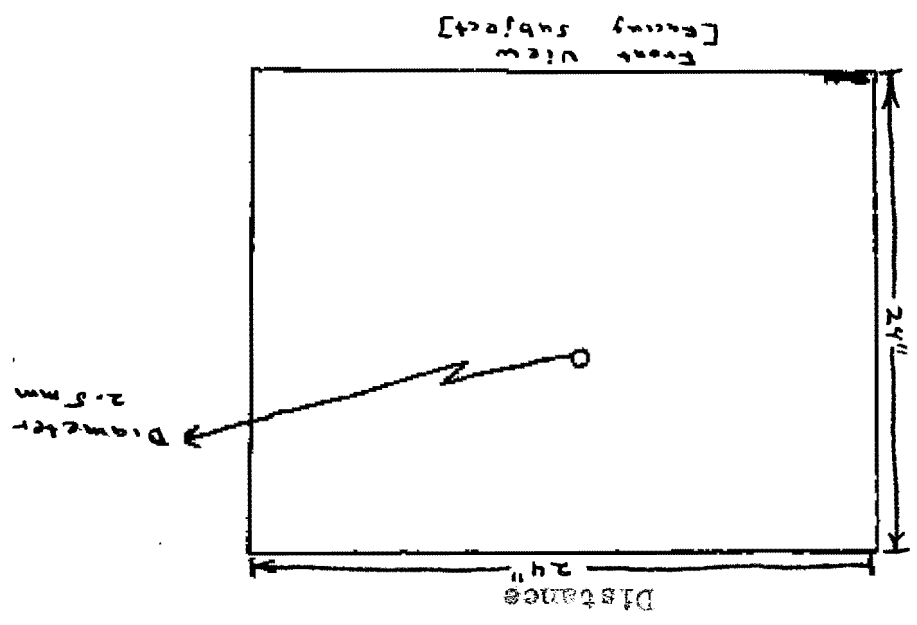
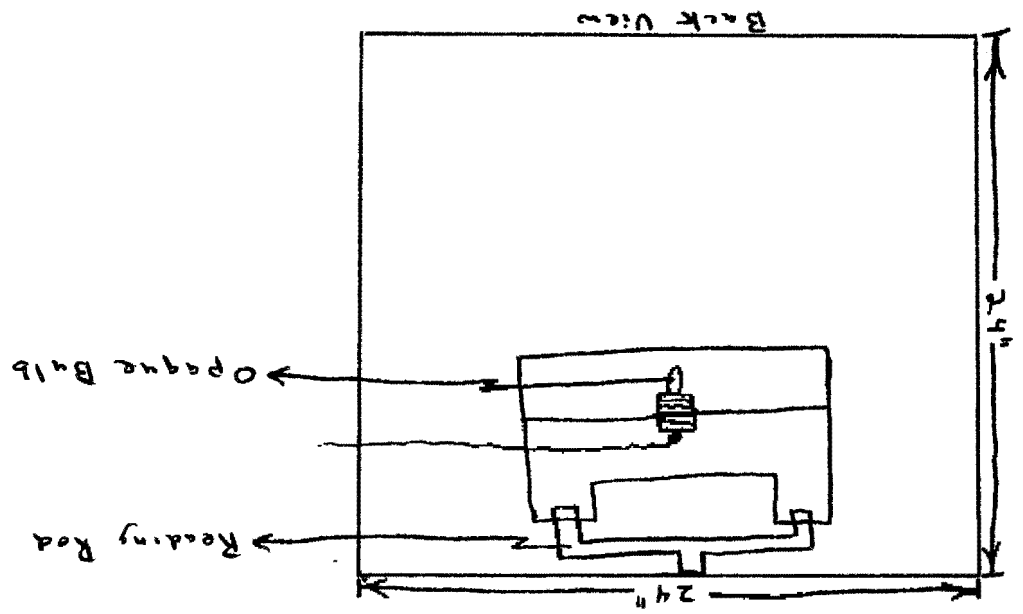
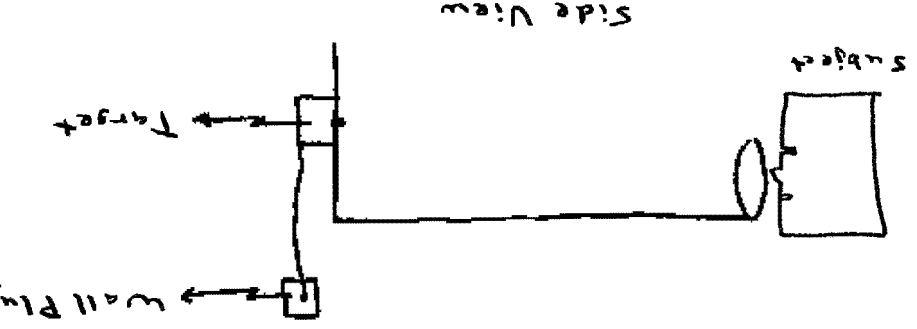
These four different tests which would approximate the #3 and #13A of the O.E.P. analytical examination were repeated on the aforementioned twenty subjects on ten different occasions. We feel that although this is a low number, it is sufficiently large enough for us to investigate the reliability of the two techniques at the two different distances. We are not attempting to pass judgement on the validity of the techniques in question. This is a problem which lies outside the scope of this research.

We have kept the following variables as closely controlled as possible:

1. We used the white maddox rod, instead of the red, in order that at both near and far the targets would be black and white.

2. At near, our target was superimposed on a black background simulating that at far.
3. The diameter of the spot of light at near-point was such as to subtend the same visual angle as the spot of light projected on the screen at the far-point.
4. The prisms and the maddox rods were always set before the eyes in the same positions, so that a consistent procedure in this respect was used by both examiners.
5. The illumination in the testing rooms was kept at the same level for all tests.
6. The illumination of the targets were kept the same for all tests.

The original statistical calculations and the raw data sheets are in the possession of the authors for the inspection of those interested in them. The compiled statistical data which follow are devised therefrom.



Maddox Rod Phoria Device For Use At A Near Test

APPARATUS

Post von Gräber DISTANCE - MEAS

\bar{x}	\bar{y}	$d^2 = (x - \bar{x})^2$	$d^2 = (y - \bar{y})^2$
1.	3.3	.4	.16
2.	3.5	.6	.36
3.	5.3	2.4	4.76
4.	2.7	.2	.04
5.	0.9	2.9	4.09
6.	3.3	.4	.16
7.	3.3	.4	.16
8.	2.3	2.9	.36
9.	2.3	2.9	.36
10.	2.3	2.9	.36
11.	5.1	2.2	4.84
12.	0.4	2.9	6.25
13.	0.8	2.9	4.41
14.	0.9	2.9	4.09
15.	2.2	2.9	4.41
16.	5.7	2.9	8.04
17.	2.3	2.9	.36
18.	1.2	2.9	2.89
19.	4.9	2.9	1.21
20.	6.8	2.9	15.21

Total $d^2 = 58.42$
 $s^2 = 3.1$

Test MADDOX ROD DISTANCE - NEAR

	$X(\text{Scores} - s^2)$	$\bar{X}(\text{Mean of } s^2)$	$(X - \bar{X})$	$(X - \bar{X})^2$
1.	1.8	3.1	1.3	1.69
2.	3.6	3.1	.5	.25
3.	3.3	3.1	.2	.04
4.	9.4	3.1	6.3	39.69
5.	1.9	3.1	1.2	1.44
6.	4.9	3.1	1.8	3.24
7.	2.2	3.1	-.9	.81
8.	3.6	3.1	.5	.25
9.	1.2	3.1	1.9	3.61
10.	2.9	3.1	.3	.09
11.	4.1	3.1	1.0	1.00
12.	1.4	3.2	1.6	2.56
13.	3.6	3.2	.5	.25
14.	0.8	3.2	2.3	5.29
15.	3.9	3.1	.8	.64
16.	2.7	3.1	.4	.16
17.	2.3	3.1	.8	.64
18.	1.8	3.1	1.3	1.69
19.	1.4	3.1	1.6	2.56
20.	5.0	3.1	2.7	7.29

Total $d^2=73.19$ $s^2=3.9$

Test VON GRAFFE DISTANCE - FAR

	$X(\text{Scores} - s^2)$	$\bar{X}(\text{Mean of } s^2)$	$(X - \bar{X})$	$(X - \bar{X})^2$
1.	0.9	1.2	.3	.09
2.	1.2	1.2	0	0
3.	4.2	1.2	3	9.00
4.	0.9	1.2	.3	.09
5.	1.3	1.2	.1	.01
6.	1.6	1.2	.4	.16
7.	1.3	1.2	.1	.01
8.	0.5	1.2	.7	.49
9.	0.1	1.2	1.1	1.21
10.	0.9	1.2	.3	.09
11.	0.5	1.2	.7	.49
12.	1.5	1.2	.3	.09
13.	0.8	1.2	.4	.16
14.	1.6	1.2	.4	.16
15.	2.1	1.2	.9	.81
16.	0.1	1.2	1.1	1.21
17.	0.2	1.2	1.0	1.00
18.	1.5	1.2	.3	.09
19.	0.6	1.2	.6	.36
20.	2.0	1.2	.8	.64

Total $d^2=16.24$ $s^2=0.9$

Test MADDOX ROD DISTANCE - FAR

	$X(\text{Scores} - S^2)$	$\bar{X}(\text{Mean of } S^2)$	$(X - \bar{X})$	$(X - \bar{X})^2$
1.	1.2	1.0	0.2	.04
2.	0.4	1.0	.6	.36
3.	1.3	1.0	.3	.09
4.	2.5	1.0	1.5	2.25
5.	1.4	1.0	.4	.16
6.	0.6	1.0	.4	.16
7.	0.7	1.0	.3	.09
8.	0.9	1.0	.1	.01
9.	0.7	1.0	.3	.09
10.	0.5	1.0	.5	.25
11.	1.2	1.0	.2	.04
12.	1.4	1.0	.4	.16
13.	0.6	1.0	.4	.16
14.	1.3	1.0	.3	.09
15.	2.0	1.0	1.0	1.00
16.	0.1	1.0	.9	.81
17.	0.0	1.0	.4	.16
18.	0.1	1.0	.9	.81
19.	0.4	1.0	.6	.36
20.	2.5	1.0	1.5	2.25

Total $d^2=9.34$ $s^2=0.49$ or 0.5

9 - Near:

$$F = \frac{S^2(\text{von Grefte})}{S^2(\text{Maddox Rod})}$$

$$F = \frac{3.1}{3.9}$$

$$F = 0.794$$

$P > .05$ Level of Significance

9 - Far:

$$F = \frac{S^2(\text{von Grefte})}{S^2(\text{Maddox Rod})}$$

$$F = \frac{0.49}{0.90}$$

$$F = 0.544$$

$P > .05$ Level of Significance

SUMMARY

1. There was no statistically significant difference in terms of reliability between the Maddox Rod Technique of phoria measurement and the Von Graefe technique of phoria measurement as obtained in this investigation.

2. Both the Maddox Rod and the Von Graefe techniques proved to be equally reliable and either test, from this standpoint at least, might be included in an analytical routine.

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