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# A comparison study between the Von Graefe and Maddox rod phoria techniques at far and near

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# A comparison study between the Von Graefe and Maddox rod phoria techniques at far and near

**Abstract**

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**Degree Type**

Thesis

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A COMPARISON STUDY BETWEEN THE VON GRAEFE  
AND MADDOX ROD PHORIA TECHNIQUES AT FAR  
AND NEAR

CLINICAL YEAR THESIS

JANUARY 1960

BY

Donald Harrier

and

AlVerne S. Kautz

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Pacific University College of Optometry.

D.H.

A.K.

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## INTRODUCTION

This is a comparison study between the phoria findings of the von Graefe and Maddox rod techniques at far and near through the habitually worn lens. This information may be valuable to enable the clinician to change from one technique to the other or to use them interchangeably.

## RELATED STUDIES

Scobee<sup>1</sup>, Hirsch and Bing<sup>2</sup>, Hirsch<sup>3</sup>, and others have published findings concerning norms and expecteds using either one or both of the before mentioned techniques without complete descriptions of methods of testing and/or the statistical data necessary for acceptable clinical usage.

The reliability of each of the methods in this study has been established by Barnett and Sedway<sup>4</sup>, in their clinical study. Their study shows the levels of significance at .05 at near and far for the von Graefe and Maddox rod phoria techniques.

. . . . .

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
2. 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
3. Hirsch, Monroe - Clinical Investigation of a Method of Testing Phoria at Forty Centimeters; Amer. J. of Optometry. October, 1948
4. Barnett, J.P., Sedway, M.M. - A Comparison of the Reliabilities of the Maddox rod and von Graefe Phoria Techniques: Optometry Thesis June 1954



As one of the conclusions of the publication Phoria Norms<sup>5</sup>, it was suggested that the Maddox rod tends to indicate more esophoria than the von Graefe method. The conclusion is based on tests at far and cites many investigators who presented data taken under varying conditions. No concrete data is available for near point Maddox rod values or comparisons.

. . . . .

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

## APPARATUS

American Optical 'Rx Master' refractor

Bausch and Lomb projector

Reduced Snellen Chart

Near Maddox rod target

Interpupillary distance millimeter rule

Light meter

## PROCEDURE

The investigators worked with fifty two subjects, most of whom were clinicians at Pacific University Optometric Clinic. Each subject was instructed to wear his habitual prescription during the testing, in case of a near add, the power of the add was put in the refractor for near tests. Each subject in this study was required to have 20/20 binocular acuity at far and near through his habitual prescription.

### I. von Graefe Diplopia technique

A. At far - Target projected seventeen feet three inches from subject.

O.D. - Prism base in

O.S. - Prism base down

Target - Snellen Chart, 20/20

Room illumination - full

Target illumination - 12 c.p.

B. At near - Target at sixteen inches from subject.

O.D. - Prism base in

O.S. - Prism base down

Target - Reduced Snellen Chart, bottom line of 20/20 letters.

Room illumination - full

Target illumination - full

## II. Maddox rod technique

A. At far - Target projected seventeen feet three inches.

O.D. - Risley prism

O.S. - White Maddox rod, axis 180 degrees to give a vertical line.

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. - Risley prism

O.S. - White Maddox rod axis 180 degrees to give a vertical line.

Target - 2.5 mm. frosted glass pinhole illuminated from behind to give white dot and white vertical line.

Room illumination - Dim

Target illumination - 12 c.p.

## INSTRUCTIONS TO SUBJECTS

### I. von Graefe Technique

Far - "Please read the top line of letters to yourself and tell me when the bottom line of letters passes directly underneath".

Near - "Please read the bottom line of the top target to yourself and tell me when the bottom target passes directly underneath".

## II. Maddox Rod Technique

Far and Near - "Please look at the white line and tell me when the white spot is directly on top of the line".

It was necessary to use different room illumination levels for the two techniques. Full room illumination was used for the von Graefe technique to duplicate present clinical methods. Dim room illumination was required for the Maddox rod technique to provide a visible vertical line.

Three readings were taken from excessive base-in and three readings were taken from excessive base-out using each technique at each distance. The subjects were allowed to regain binocularity between techniques at each distance in an attempt to eliminate any effects of time of dissociation. The same examiner did all measuring to eliminate errors of examiner technique.

## ORGANIZATION OF THE DATA

Each subject's group of three findings was averaged to the nearest one-half prism diopter for each technique at far and near. The mean of these averages was then calculated as was the median, the mode and the standard deviation.

The frequency distribution values were graphed in one-half prism diopter intervals at far and near.

## STATISTICAL METHODS

### Key

- $\sigma$  equals standard deviation  
 X equals value of the variable  
 $\bar{X}$  equals arithmetic mean  
 Mdn. equals median  
 Mode equals mode  
 N equals 52 subjects

### Formulae

$$1. \sigma = \sqrt{\frac{\sum (X - \bar{X})^2}{N}}$$

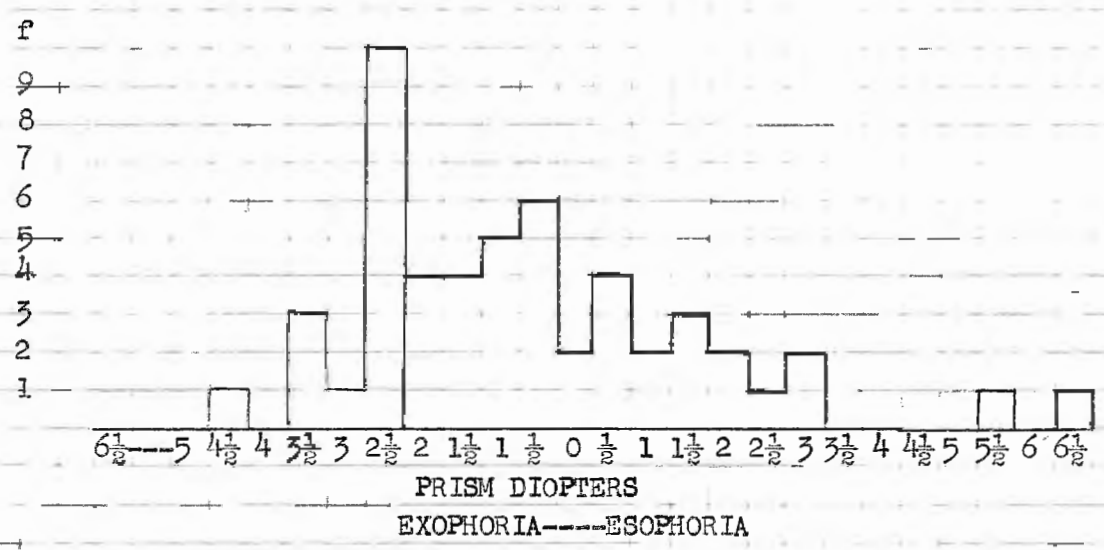
$$2. \bar{X} = \frac{\sum X}{N}$$

## FINDINGS

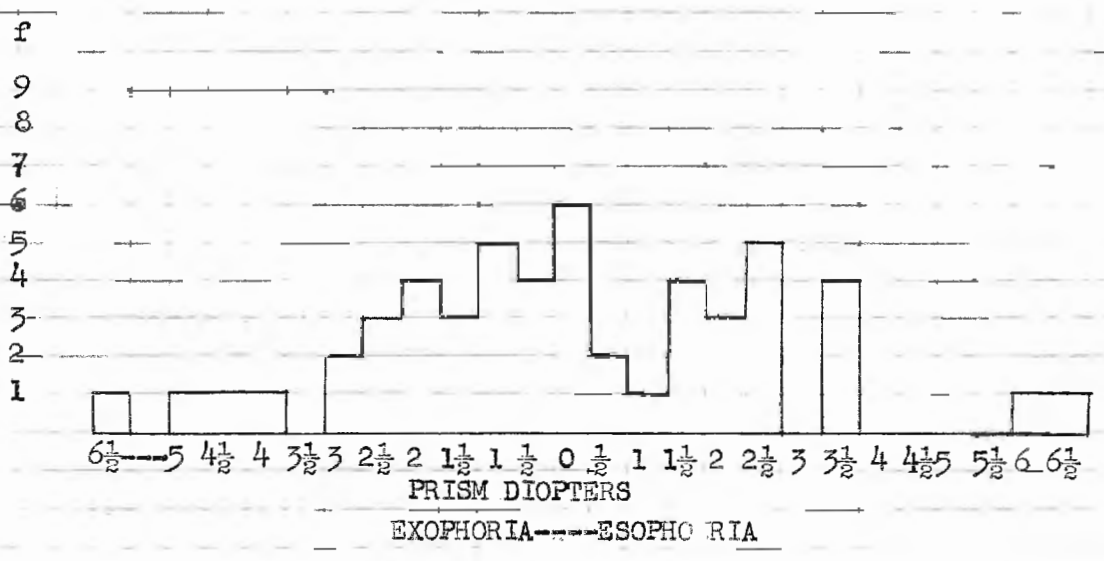
All subject data used can be found on Table I.

FAR FREQUENCY DISTRIBUTIONS

VON GRAEFE FROM EXCESSIVE BASE IN

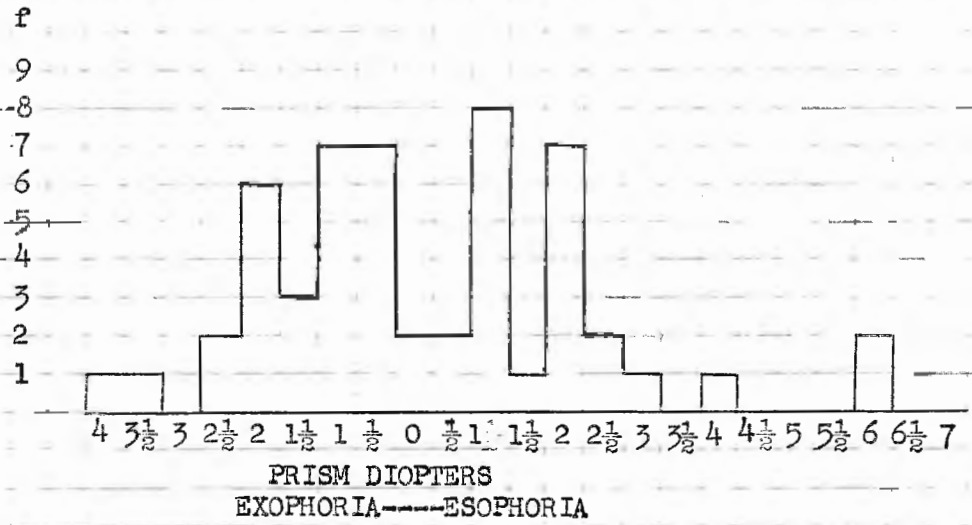


MADDOX ROD FROM EXCESSIVE BASE IN

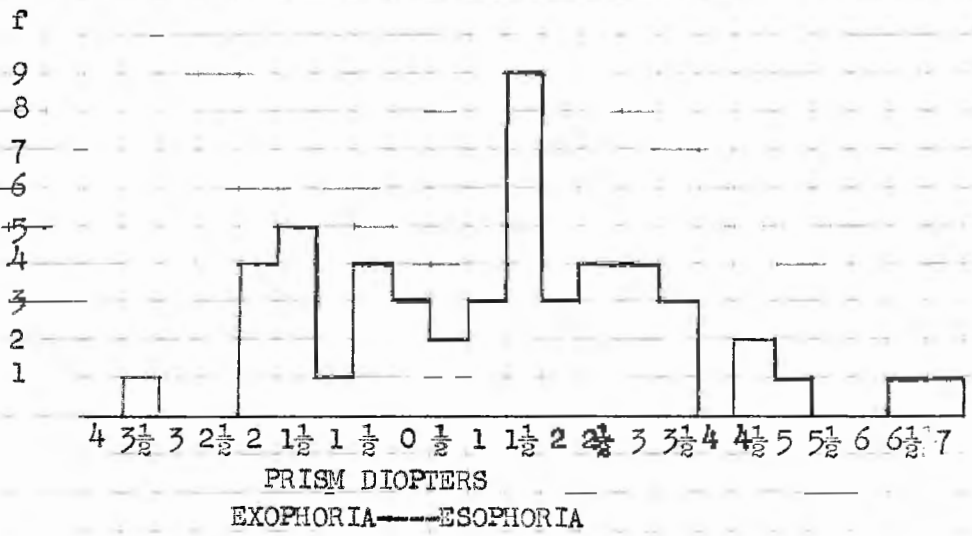


FAR FREQUENCY DISTRIBUTIONS

VON GRAEFE FROM EXCESSIVE BASE OUT



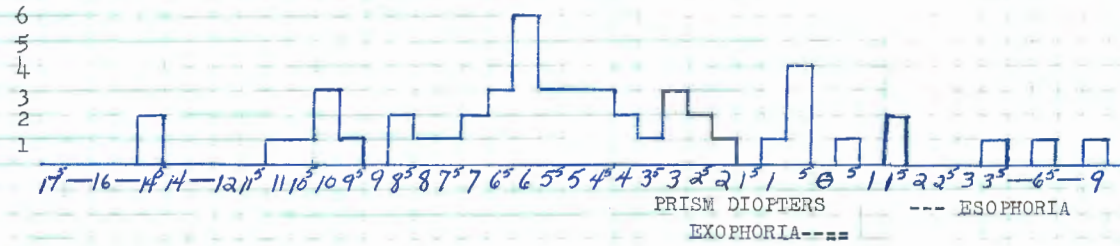
MADDOX ROD FROM EXCESSIVE BASE OUT



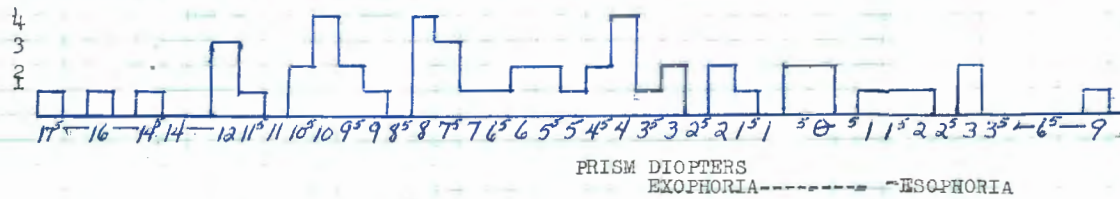


NEAR FREQUENCY DISTRIBUTIONS

VON GRAEFE FROM EXCESSIVE BASE IN

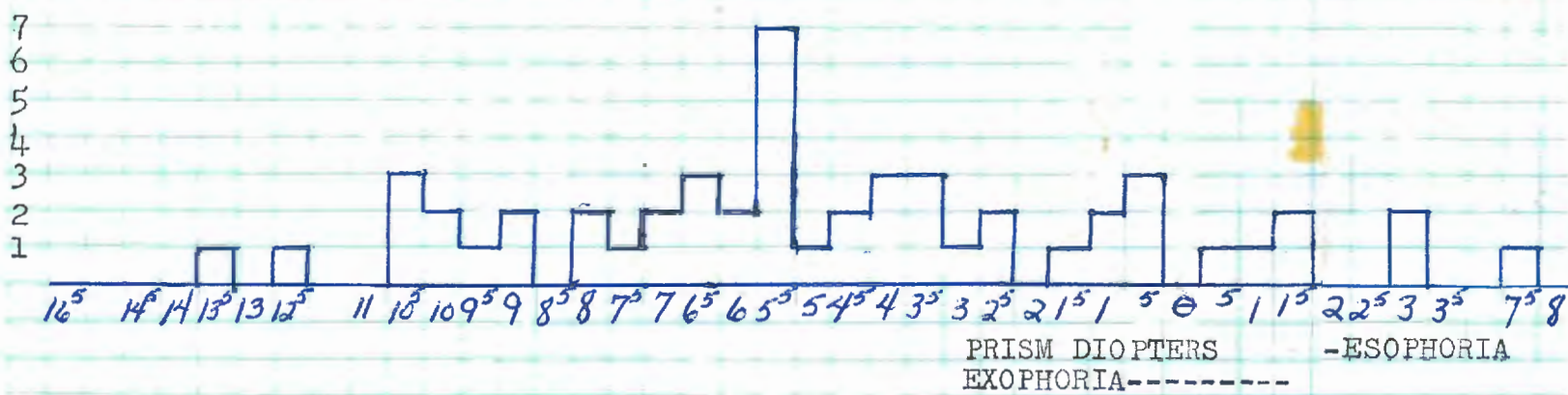


MADDOX ROD FROM EXCESSIVE BASE IN



NEAR FREQUENCY DISTRIBUTIONS

VON GRAEFE FROM EXCESSIVE BASE OUT



MADDOX ROD FROM EXCESSIVE BASE OUT

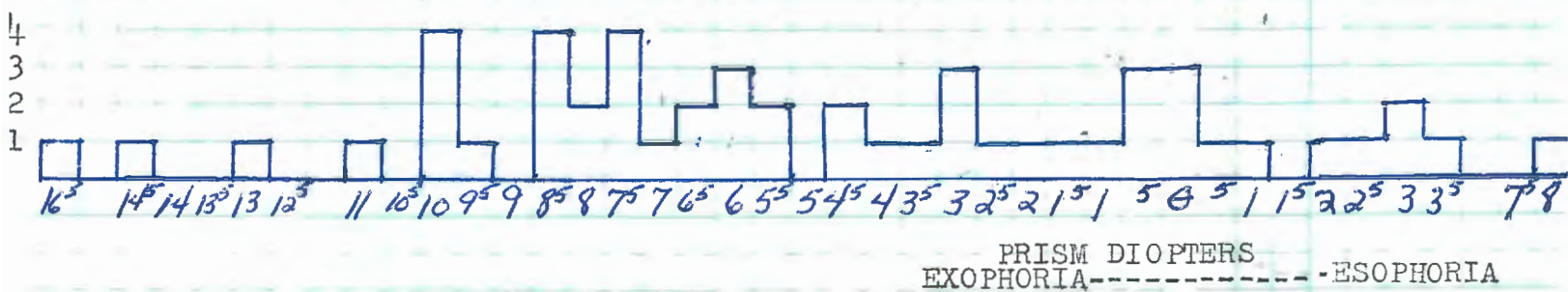


TABLE 1

	FAR		FAR		NEAR		NEAR	
	MADDOX BI	ROD BO	VON BI	GRAEFÉ BO	MADDOX BI	ROD BO	VON BI	GRAEFÉ BO
1.	2.5eso	4.5eso	2.0exo	.5exo	1.5eso	3.5eso	5.5exo	1.5exo
2.	0.0	0.0	1.0exo	.5eso	9.5exo	8.5exo	8.0exo	7.5exo
3.	5.0exo	3.5exo	2.5exo	2.0exo	9.0exo	8.5exo	7.0exo	6.5exo
4.	3.5eso	3.5eso	2.5eso	2.5eso	8.0exo	7.5exo	6.0exo	6.0exo
5.	2.5eso	3.0eso	1.5eso	2.0eso	.5exo	.5exo	2.5exo	2.5exo
6.	1.0exo	1.5eso	2.5exo	1.0exo	4.0exo	1.0exo	5.0exo	4.0exo
7.	1.5eso	1.5eso	0.0	1.0eso	6.5exo	6.0exo	4.5exo	5.5exo
8.	2.0exo	1.5exo	3.5exo	2.5exo	10.0exo	10.0exo	10.0exo	10.5exo
9.	2.0exo	1.5exo	2.0exo	2.0exo	10.5exo	8.5exo	11.0exo	10.5exo
10.	2.5eso	3.0eso	1.5eso	2.0eso	7.5exo	8.0exo	6.5exo	6.5exo
11.	.5eso	1.0eso	.5exo	.5exo	2.0exo	2.0exo	5.5exo	6.5exo
12.	3.5exo	3.5eso	2.0eso	2.5eso	8.0exo	7.5exo	9.0exo	8.0exo
13.	4.5exo	2.0exo	4.5exo	4.0exo	14.5exo	13.0exo	14.0exo	13.5exo
14.	6.5eso	7.0eso	5.5eso	6.0eso	1.0eso	0.0	.5eso	.5eso
15.	2.5eso	2.5eso	3.0eso	4.0eso	4.0exo	.5exo	1.0exo	.5exo
16.	2.5exo	2.0exo	2.5exo	2.0exo	17.5exo	16.5exo	14.0exo	12.5exo
17.	1.5eso	2.0eso	.5exo	0.0	9.0eso	8.0eso	6.5eso	7.5eso
18.	4.0exo	.5exo	2.5exo	.5eso	7.5exo	5.5exo	6.0exo	4.5exo
19.	1.0exo	2.0eso	2.5exo	1.5exo	11.5exo	10.0exo	10.5exo	10.5exo
20.	0.0	2.0eso	2.0exo	1.5eso	4.5exo	1.0eso	3.0exo	2.5exo
21.	0.0	.5eso	.5eso	1.0eso	10.0exo	9.5exo	4.0exo	3.5exo
22.	0.0	1.5eso	.5exo	.5exo	8.0exo	4.5exo	7.5exo	8.0exo
23.	1.5exo	0.0	1.0exo	0.0	12.0exo	10.0exo	10.0exo	10.0exo

TABLE 1 (continued)

	FAR		FAR		NEAR		NEAR	
	MADDOX ROD		VON GRAEFE		MADDOX ROD		VON GRAEFE	
	BI	BO	BI	BO	BI	BO	BI	BO
24.	3.0exo	2.0exo	2.5exo	2.0exo	.5exo	0.0	4.5exo	5.5exo
25.	.5exo	0.0	.5exo	.5exo	5.5exo	4.5exo	2.5exo	1.0exo
26.	2.5exo	1.5exo	3.5exo	2.5exo	3.0exo	2.5exo	5.0exo	3.5exo
27.	0.0	1.5eso	.5eso	1.0eso	3.5exo	.5exo	1.5eso	3.0eso
28.	3.5eso	3.5eso	.5exo	1.0eso	4.0exo	3.5exo	3.5exo	4.0exo
29.	2.0eso	2.5eso	.5eso	1.0eso	4.5exo	3.0exo	.5exo	1.0exo
30.	0.0	1.5eso	0.0	1.0eso	6.0exo	6.0exo	4.5exo	4.5exo
31.	.5exo	1.0eso	1.0exo	.5exo	10.0exo	10.0exo	6.0exo	7.0exo
32.	.5exo	.5eso	1.5exo	1.0exo	3.0eso	3.0eso	5.0exo	5.0exo
33.	.5exo	1.5eso	1.5exo	1.5exo	3.0exo	1.5exo	6.5exo	5.5exo
34.	3.0exo	1.5exo	1.0exo	.5exo	9.5exo	7.5exo	8.5exo	9.0exo
35.	1.5eso	3.0eso	1.0eso	1.0eso	1.5exo	.5exo	1.5eso	1.5eso
36.	1.5eso	2.5eso	1.5eso	2.0eso	10.0exo	8.5exo	6.5exo	6.0exo
37.	1.0exo	0.0	3.0exo	1.0exo	10.5exo	8.0exo	7.0exo	7.0exo
38.	1.0exo	0.0	2.5exo	1.0exo	6.0exo	6.5exo	6.0exo	5.5exo
39.	6.0eso	6.5eso	6.5eso	6.0eso	3.0eso	3.0eso	3.5eso	3.0eso
40.	2.0eso	3.0eso	2.0eso	2.0eso	4.0exo	3.0exo	3.0exo	3.5exo
41.	.5eso	.5eso	2.0exo	1.0exo	7.0exo	7.0exo	5.5exo	5.5exo
42.	2.0exo	1.5exo	3.5exo	3.5exo	12.5exo	11.0exo	6.0exo	5.5exo
43.	1.0eso	2.5eso	.5exo	1.5eso	5.0exo	4.0exo	.5exo	.5exo
44.	2.5eso	4.5eso	.5eso	1.0eso	0.0	0.0	2.0exo	1.5eso
45.	1.0exo	1.5eso	1.0exo	1.0exo	2.0exo	3.0exo	3.0exo	4.0exo
46.	1.5exo	.5exo	1.5exo	1.0exo	8.0exo	6.0exo	4.0exo	3.0exo

TABLE 1 (continued)

	FAR		FAR		NEAR		NEAR	
	MADDOX ROD		VON GRAEFE		MADDOX ROD		VON GRAEFE	
	BI	BO	BI	BO	BI	BO	BI	BO
47.	1.5exo	1.0exo	2.5exo	1.0exo	5.5exo	5.5exo	6.0exo	5.5exo
48.	2.0exo	.5exo	1.5exo	1.5exo	7.5exo	6.5exo	8.5exo	9.0exo
49.	3.5eso	5.0eso	3.0eso	3.0eso	0.0	2.5eso	.5exo	.5exo
50.	6.5exo	.5exo	3.5exo	2.0exo	12.0exo	7.5exo	9.5exo	9.5exo
51.	2.0eso	2.0eso	1.0exo	1.0eso	2.0eso	2.0eso	.5eso	1.0eso
52.	2.5exo	2.0exo	2.5exo	2.0exo	16.0exo	14.5exo	10.0exo	10.0exo

## STATISTICAL RESULTS

von Graefe from excessive base in at far:

$\bar{X} = .615^A \text{exo.}$   
Mdn. =  $.75^A \text{exo}$  to  $1.5^A \text{exo.}$   
Mode =  $1.75^A \text{exo}$  to  $2.50^A \text{exo.}$   
 $\sigma = 1.98$

Maddox rod from excessive base in at far:

$\bar{X} = .1058^A \text{eso.}$   
Mdn. =  $.50^A \text{eso}$  to  $.50^A \text{exo.}$   
Mode =  $1.50^A \text{eso}$  to  $.50^A \text{exo.}$   
 $\sigma = 2.36$

von Graefe from excessive base out at far:

$\bar{X} = .1058^A \text{eso.}$   
Mdn. =  $.50^A \text{eso}$  to  $.50^A \text{exo.}$   
Mode, bimodal =  $.75^A \text{eso}$  to  $1.50^A \text{eso}$ ;  $.75^A \text{exo}$  to  $1.50^A \text{exo.}$   
 $\sigma = 1.95^A$

Maddox rod from excessive base out at far:

$\bar{X} = 1.135^A \text{eso}$   
Mdn =  $.75^A \text{eso}$  to  $1.5^A \text{eso.}$   
Mode =  $.50^A \text{eso}$  to  $.50^A \text{exo}$   
 $\sigma = 2.11^A$

von Graefe from excessive base in at near:

$\bar{X} = 5.030 \text{exo}$   
Mdn. =  $5.25^A \text{exo}$  to  $7.0^A \text{exo.}$   
Mode =  $5.25^A \text{exo}$  to  $7.0^A \text{exo.}$   
 $\sigma = 3.82$

Maddox from excessive base in at near:

$$\bar{X} = 5.701^{\Delta} \text{ exo.}$$

$$\text{Mdn} = 5.25^{\Delta} \text{ exo to } 7.0^{\Delta} \text{ exo.}$$

$$\text{Mode, trimodal} = 3.0^{\Delta} \text{ to } 5.0^{\Delta} \text{ exo; } 7.0^{\Delta} \text{ to } 9.0^{\Delta} \text{ exo; } 9.0^{\Delta} \text{ to } 11.0^{\Delta} \text{ exo}$$

$$\sigma = 5.16$$

von Graefe from excessive base out at near

$$\bar{X} = 4.6408^{\Delta} \text{ exo.}$$

$$\text{Mdn} = 5.25^{\Delta} \text{ to } 7.00^{\Delta} \text{ exo.}$$

$$\text{Mode} = 5.25^{\Delta} \text{ to } 7.00^{\Delta} \text{ exo.}$$

$$\sigma = 4.12$$

Maddox from excessive base out at near:

$$\bar{X} = 4.0^{\Delta} \text{ exo.}$$

$$\text{Mdn.} = 5.25^{\Delta} \text{ exo to } 7.0^{\Delta} \text{ exo.}$$

$$\text{Mode} = 7.25^{\Delta} \text{ exo to } 9.0^{\Delta} \text{ exo.}$$

$$\sigma = 4.80$$

## SUMMARY

The results of this study indicate that the far Maddox rod from base in phoria is .10 prism diopters eso, standard deviation plus or minus 2.36 prism diopters. The far von Graefe from base in phoria norm is .615 prism diopters exo, standard deviation plus or minus 1.98 prism diopters.

The far Maddox rod from base out phoria norm is 1.14 prism diopters eso, standard deviation plus or minus 2.11 prism diopters. The far von Graefe from base out phoria norm is .106 prism diopters eso, standard deviation plus or minus 1.95 prism diopters.

At near the Maddox rod from base in phoria norm is 5.70 prism diopters exo, standard deviation plus or minus 5.16 prism diopters. The near von Graefe from base in phoria norm is 5.03 prism diopters exo, standard deviation plus or minus 3.82 prism diopters.

The near Maddox rod from base out phoria norm is 4.00 prism diopters exo, standard deviation plus or minus 4.80 prism diopters. The near von Graefe from base out phoria norm is 4.64 prism diopters exo, standard deviation plus or minus 4.12 prism diopters.

It is the authors' opinion that there is little or no clinically significant difference between the von Graefe phoria findings and those phorias taken with the Maddox rod --- at far or near.

This study indicates that the use of acuity material at near to posture convergence closer to the plane of regard is apparently not accomplished by use of the reduced Snellen. It was not in the scope of this study to suggest changes of standard target designs now in use, but it is now mentioned as an area of investigation.

The authors' suggest that further study be made with the Maddox rod phorias at the near cross cylinder levels and at the recovery levels of the positive and negative relative accommodation findings.



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