6-1-1965

A study on predicting cycles per minute with changes in prism magnitude

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Abstract
This paper is a study to determine the possibility of predicting the number of cycles per minute in the Prism Rock Test as a function of changes in magnitude of prism.

Degree Type
Thesis

A STUDY ON PREDICTING CYCLES PER MINUTE WITH CHANGES IN PRISM MAGNITUDE

A THESIS

PRESENTED TO THE FACULTY

OF

PACIFIC UNIVERSITY

BY

Kenneth I. Cameron

Lyman N. Yoshimura

IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE

DOCTOR OF OPTOMETRY

JUNE 1965

DEDICATED

to Dr. H. M. Haynes
for his invaluable
advice and contributions

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STATEMENT OF PROBLEM

This paper is a study to determine the possibility of predicting the number of cycles per minute in the Prism Rock Test as a function of changes in magnitude of prism.

INTRODUCTION

A review of the Optometric literature offers a limited amount of material with respect to the Prism Rock Test. This test was first presented at a visual training conference at San Jose in 1960 by Dr. H.M. Haynes.[1] The thesis files of Pacific University reveal two further studies on the subject. In 1958, Yandle and Turk presented a thesis on "The effect of base out and base in prism training."[2] Berreth and Smith, 1960, presented "A normative study of the Prism Rock Test" which standardized the test, using eight prism diopters in both base in and base out directions.[3]

The values of the Prism Rock Test are recorded in number of cycles observed per minute. The cycle is defined as the starting with the prism in the up position moving to the down position and returning to the up position. The test is a clinical reaction time test for measuring relative convergence and divergence performance.

Extensive studies on the reaction time of the convergence and divergence functions can be found in the Ophthalmological and Optometrical literature. The method of studying this property if approached in many different fashions. The experiments presented by Westheimer and Mitchell, were specifically designed to ascertain the time characteristics of eye movements elicited by presentation of the visual stimulus in horizontal disparity.[4] It was concluded in their studies that convergence relaxation required a longer period of time for both the reaction and the response durations as compared with that required for convergence. A historical survey by Merrill J. Allen presented in the American Journal of Optometry gave a list of men who have carried on studies

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1 Haynes, San Jose V. T. Conference transcript, 1960.

2 Yandle and Turk, The effect of base out and base in prism training, Pacific University Thesis Files, 1958.

3 Berreth and Smith, Normative study of the prism rock test, using eight prism diopters in both base out and base in directions, Pacific University Thesis files, 1960.

4 Westheimer, PhD. and Mitchell, M. Sc., Eye movement responses to convergence stimuli, Archives of Ophthalmology, Vol. 55, Jan.-June, 1956, p. 848.

Introduction con't

in this area, and included a brief description of their methods and results.[5]

We know of no studies of the reaction time as a function of varying stimuli for purposes of prediction. It is our attempt to present a graph for such purposes, using the techniques described in the Prism Rock Test.

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5 Allen, Merrill, An investigation of the time characteristics of accommodation and convergence of the eyes, American Journal of Optometry and Archives of American Academy of Optometry, Vol. 30, 1953, p. 78.

EXPERIMENTAL PROCEDURE

APPARATUS

1. Instrument- Keystone Van Orden Flipper
2. Prism magnitudes- 2 - 4 - 8 - 12 - 16 B.O. & B.I.
3. Timing Device

TESTING

We have tried to standardize the testing techniques to eliminate as many variables as possible. The subjects were tested under the following identical conditions:

1. Distance- 16 inches
2. Target- Reduced Snellen Chart
3. Refractive Status- Corrected to 20/20 at 16 inches
4. Time- One minute

A randomized technique was employed with respect to the sequence of stimulus presentation.

SUBJECTS

1. Number tested- 50
   a. Persons subjected to training within the last year were excluded from this study.
2. Age level- College

TESTING PROCEDURE

1. The instrument was adjusted on a table to a comfortable viewing height with elbows of the subject resting on the table and the thumb and index finger of both hands on the flipper knobs.
2. The distance from the reduced snellen slide to the subject's eye was adjusted for 16".
3. The instrument was then set for the appropriate inter-pupillary distance.
4. The appropriate round prism was then inserted into the flipper device.
5. Each patient was instructed and demonstrated the procedure until both were understood completely.

INSTRUCTIONS

1. "How many charts do you see?" (If the answer is "One Chart," proceed.)
2. "Can you read all the letters in the bottom row?"
3. "Read the letters aloud to me."
4. Flip the prisms into place.
5. "How many charts do you see?"
6. If one chart is reported, ask "Did you see two charts before you saw one?"
7. "Can you read all the letters in the bottom line?" (Optional: Ask for oral reading of letters if deemed necessary.)

INSTRUCTIONS (con't)

8. "The purpose of this test is to see how many times a minute you can flip the lenses in and out while reading all the letters on the bottom line."
9. "As soon after each flip as you can see one chart and read all the letters in the bottom line, flip the lenses again."
10. "Remember, do not flip the lenses until after you can see one chart and can read all the letters on the bottom line."
11. "Continue flipping the lenses until you are told to stop."

RESULTS

Our data in the following histograms have been presented in two forms. The first consists of separate presentations of the male and female populations and the second consists of the combined data which is of primary interest in our study.

The data representing the combined group can be summarized as follows:

PRISM	MEAN C/M	MEDIAN	STD. DEV.
2 BO	35	36	7.18
4	30	32	7.66
8	24	28	7.02
12	19	19	5.21
16	19	22	5.02
2 BI	34	35	7.14
4	28	32	5.83
8	20	22	5.36
12	15	18	5.29
16	15	19	3.99

These figures have been presented graphically in Fig. 4. The following table was obtained from the same graph.

TABLE FOR PREDICTION

PRISM	BI CYCLES/MIN	BO CYCLES/MIN
2	34	35
4	28	30
6	23.5	26.5
8	20	24
10	17.5	21.5
12	15	19
14	15	19
16	15*	19*

Figures followed by (*) represent what we felt were unreliable data. Out of the total population of 50 subjects only 11 responded to the magnitude of 16 prism diopters in the BI direction and 41 to the

RESULTS (con't)

BO direction. Of the 41 that did respond to the 16 delta BO stimulus, 21 had responses equal to or greater than that of the 12 prism diopter stimulus. In the BI direction 4 out of 11 subjects reported responses of such nature. The following table was obtained by excluding those subjects that did report equal to or greater responses than that recorded at the 12 delta level.

PRISM	BI CYCLES/MIN	BO CYCLES/MIN
2	34	35
4	28	30
6	23.5	26.5
8	20	24
10	17.5	21.5
12	15	19
14	14.5	17.5
16	14	16.5

A comparative study of the male and female population can be summarized in the following table of mean cycles per minute.

PRISM	BI MALE/FEMALE	BO MALE/FEMALE
2	34/34	34/35
4	29/26	31/28
8	21/20	26/23
12	17/14	20/19
16	14/22	21/17

GRAPHICAL PRESENTATIONS OF RESULTS

Fig. 1a- 5 histograms (prisms 2,4,8,12 and 16) showing the distribution of cycles per minute to prism magnitudes in the BO direction.
Subjects: Female Number: 25

Fig. 1b- 5 histograms (prisms 2,4,8,12 and 16) showing the distribution of cycles per minute to prism magnitudes in the BI direction.
Subjects: Female Number: 25

Fig. 2a- 5 histograms (prisms 2,4,8,12 and 16) showing the distribution of cycles per minute to prism magnitudes in the BO direction.
Subjects: Male Number: 25

Fig. 2b- 5 histograms (prisms 2,4,8,12 and 16) showing the distribution of cycles per minute to prism magnitudes in the BI direction.
Subjects: Male Number: 25

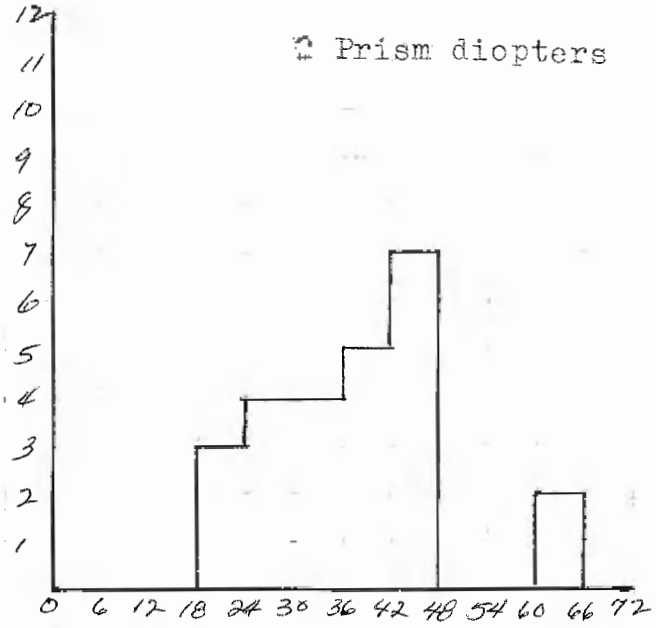
Fig. 3a- 5 histograms of the combined population in the BO direction.

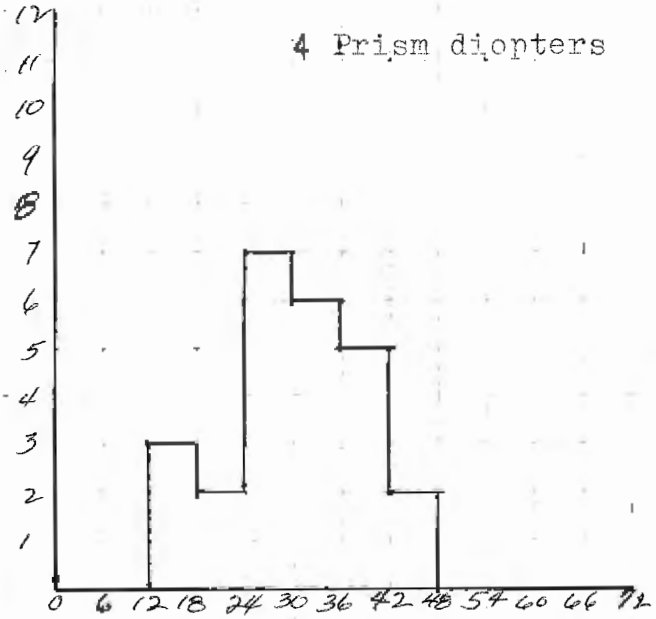
Fig. 3b- 5 histograms of the combined population in the BI direction.

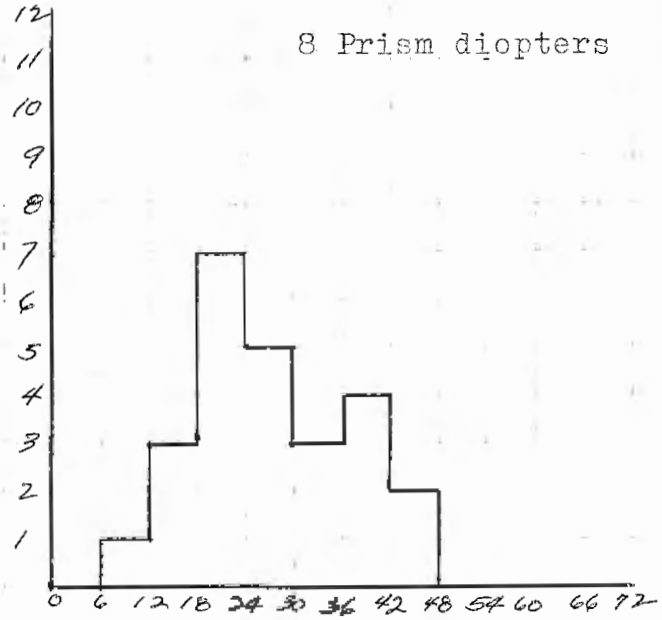
Fig. 4 - Graphical presentation of the mean distributions with their respective standard deviations plotted in dotted lines.

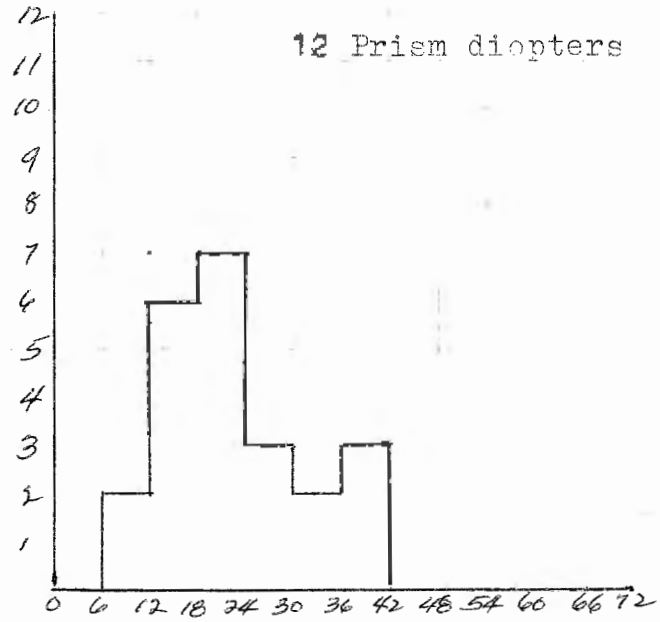
Fig. 5 - 2 graphs showing the individual response differences to BI and BO stimuli.

Fig. 1a- Histograms showing the distribution of cycles per minute to different prism magnitudes in the B.O. direction.
Subjects: Female
Number: 25
Abscissa: Cycles/Minute
Ordinate: Frequency









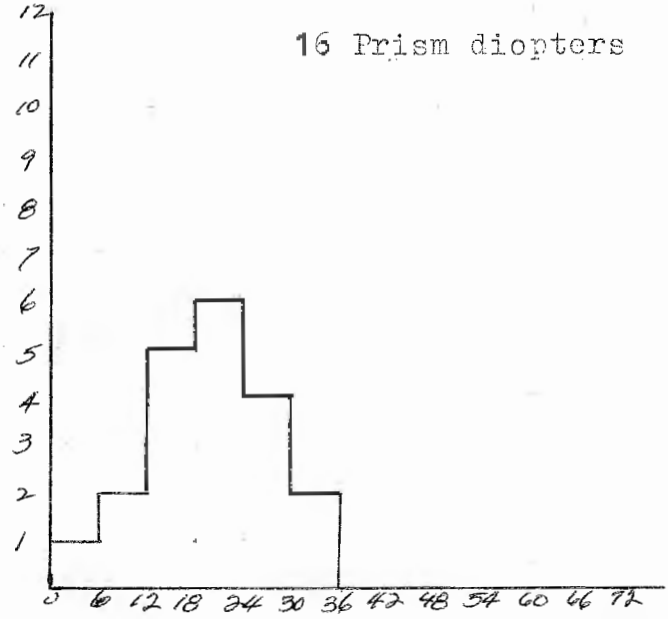
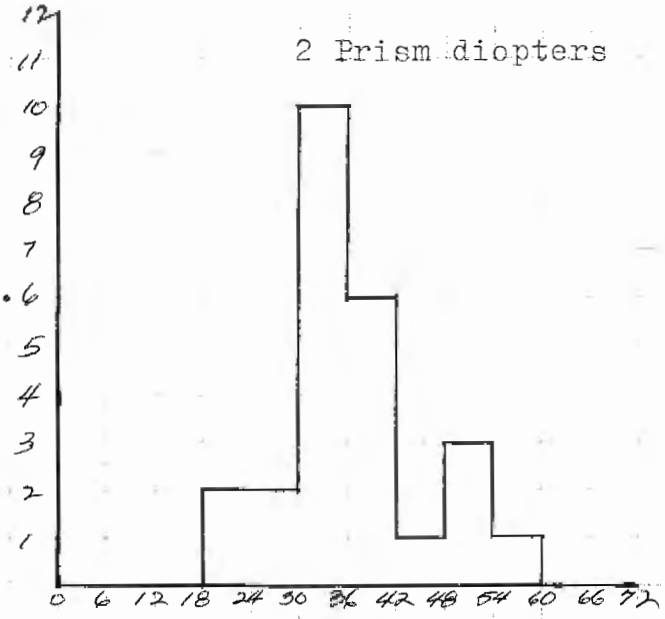
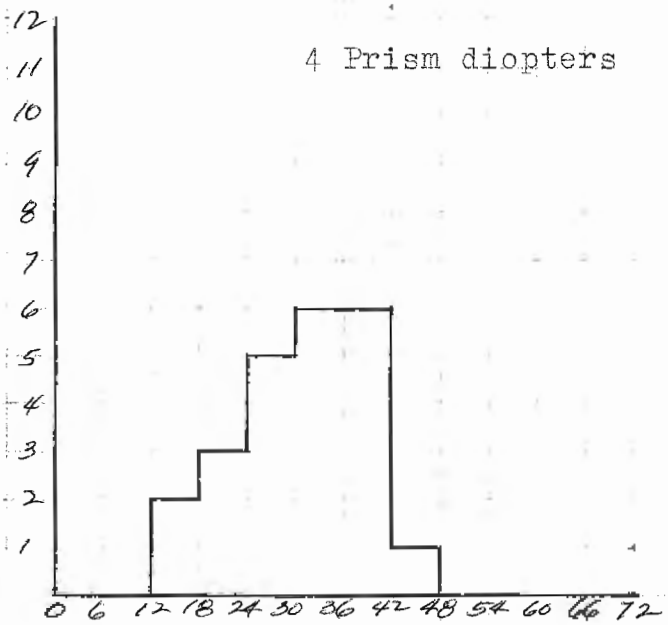
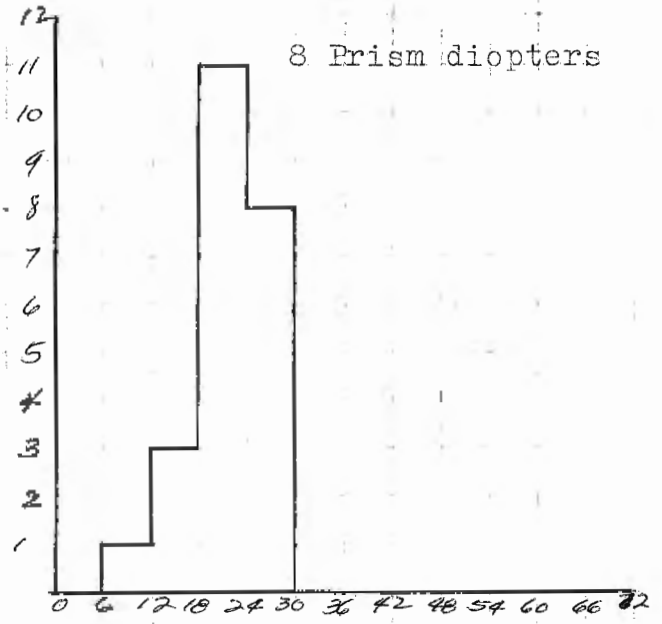
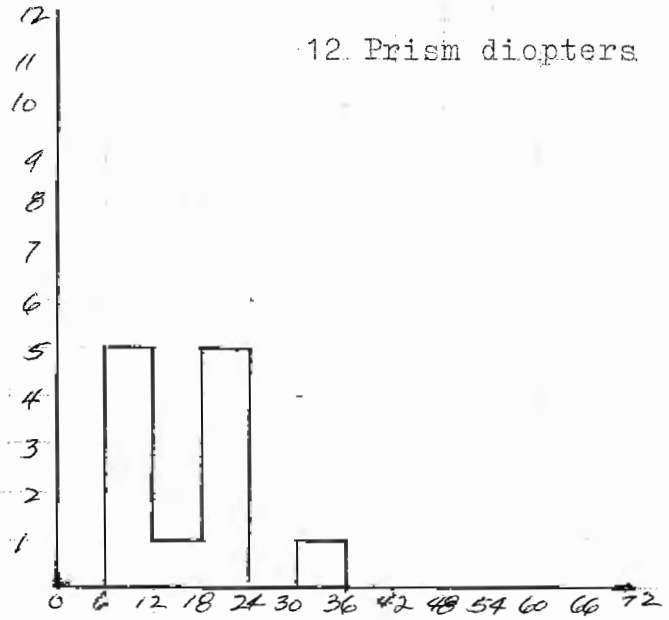


Fig. 1b- Histograms showing the distribution of cycles per minute to different prism magnitudes in the B.I. direction.
Subjects: Female
Number: 25
Abscissa: Cycles/Minute
Ordinate: Frequency









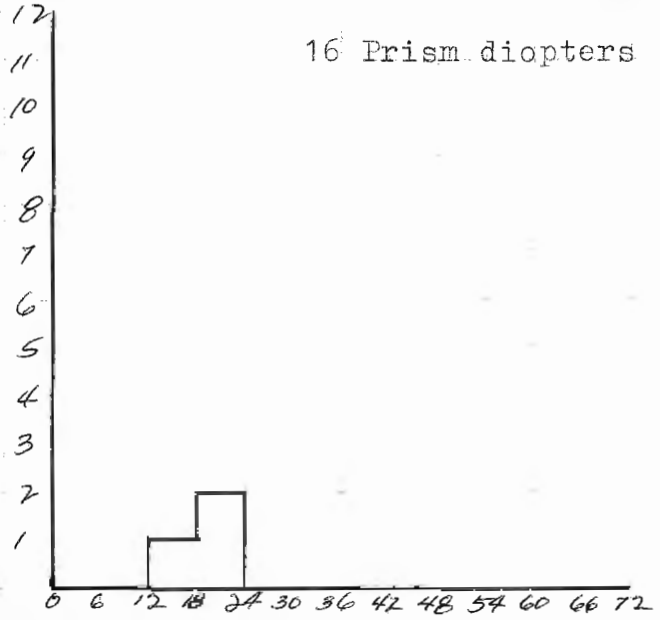
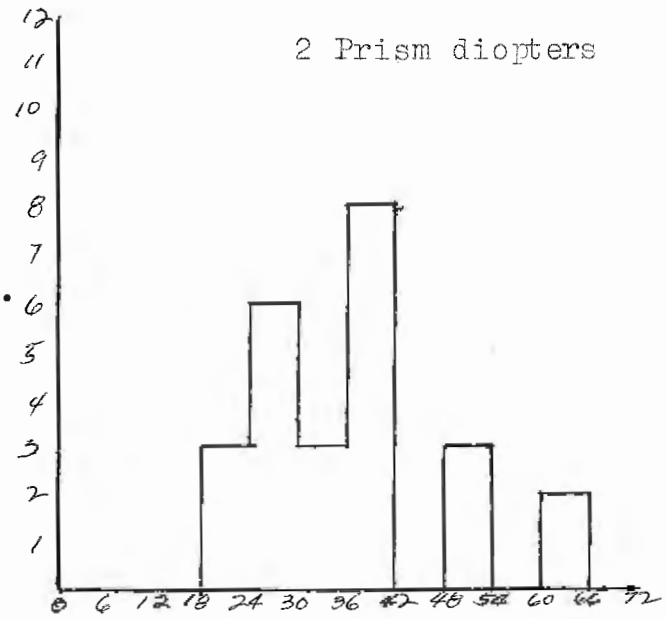
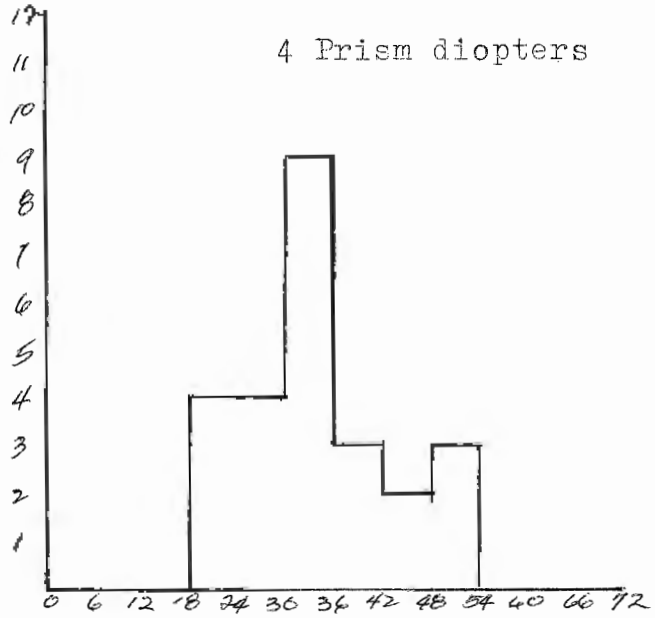
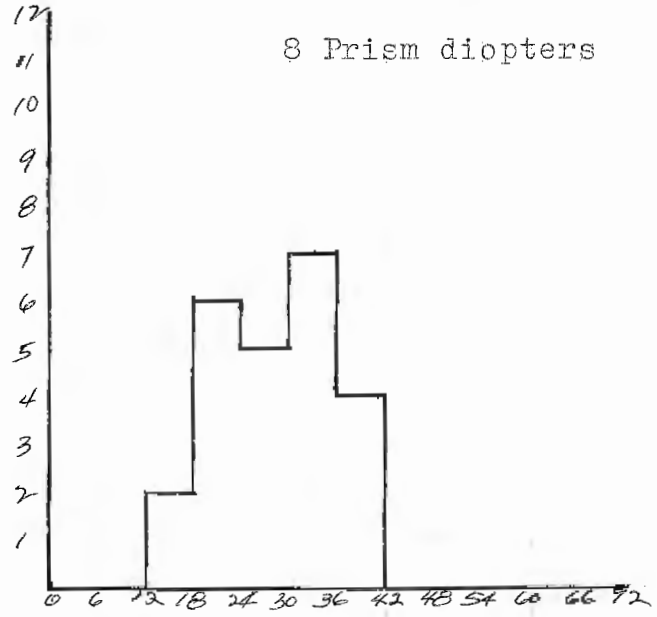
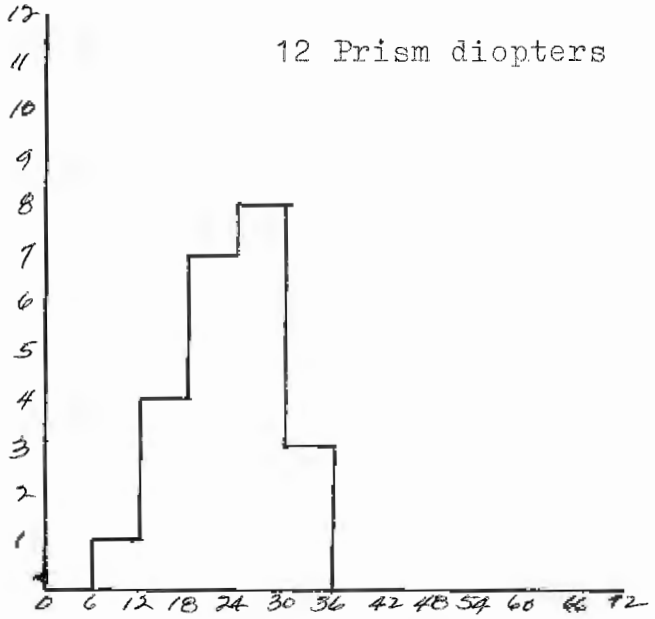


Fig. 2a- Histograms showing the distribution of cycles per minute to different prism magnitudes in the B.O. Direction.
Subjects: Male
Number 25
Abscissa: Cycles/Minute
Ordinate: Frequency









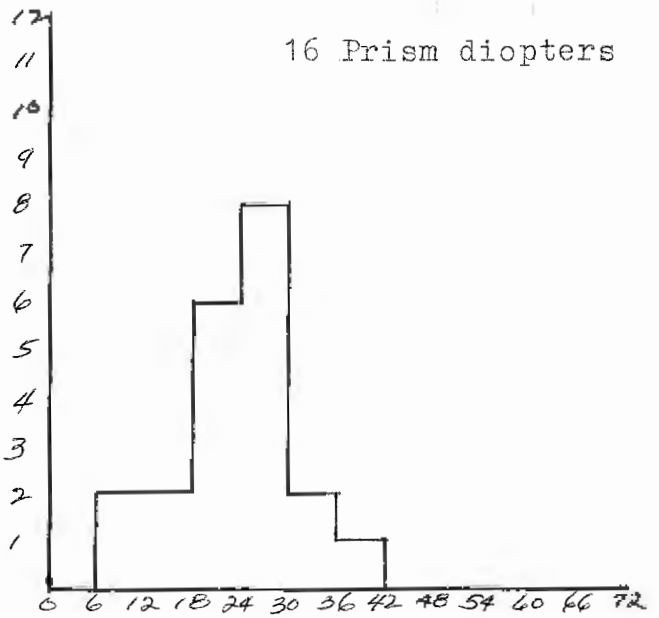
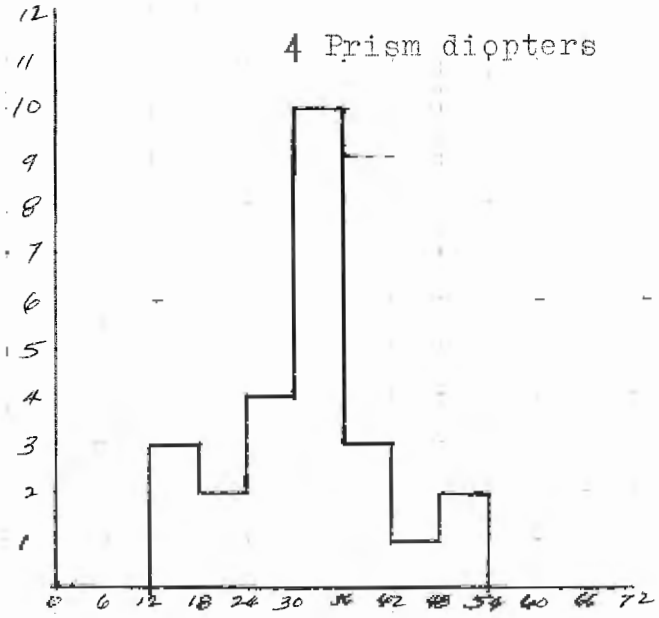
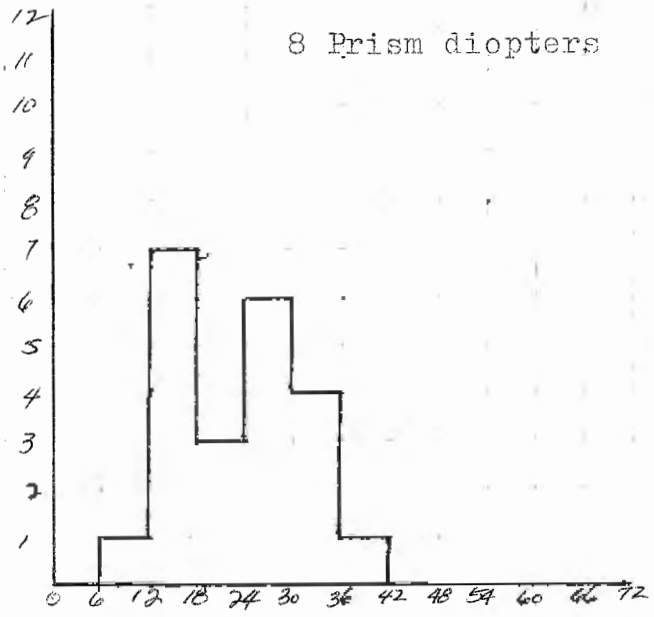
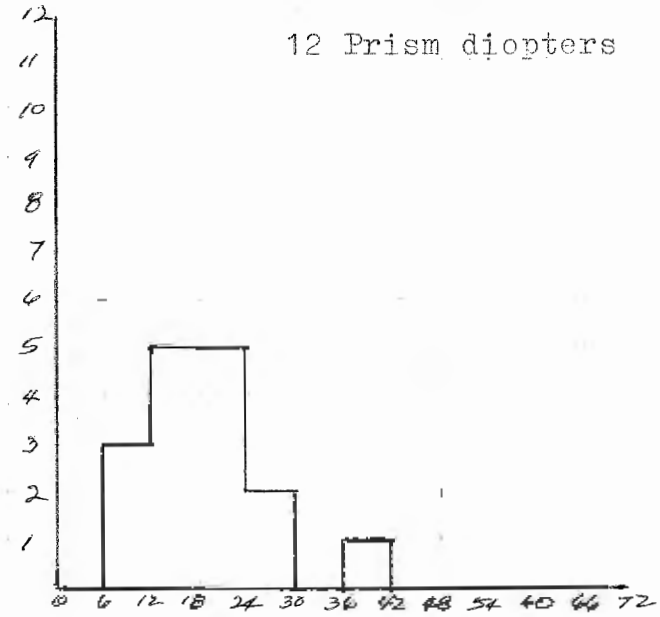


Fig. 2b- Histograms showing the distribution of cycles per minute to different prism magnitudes in the B.I. direction.
Subjects: Male
Number: 25
Abscissa: Cycles/Minute
Ordinate: Frequency







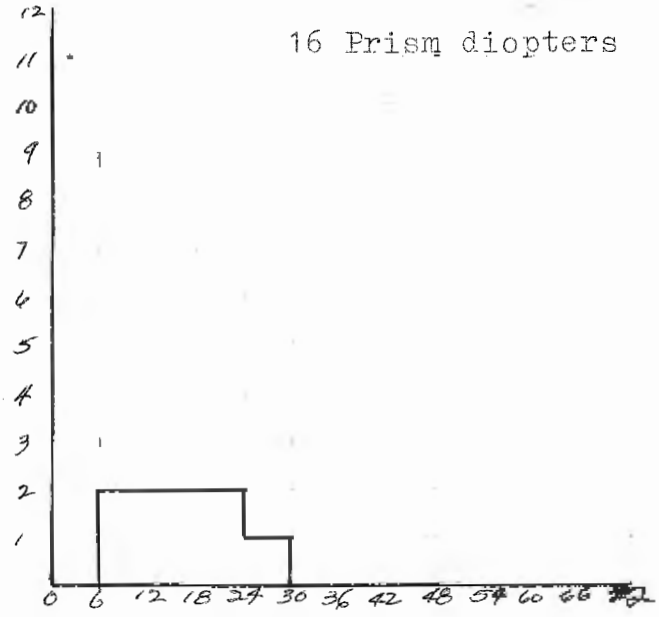
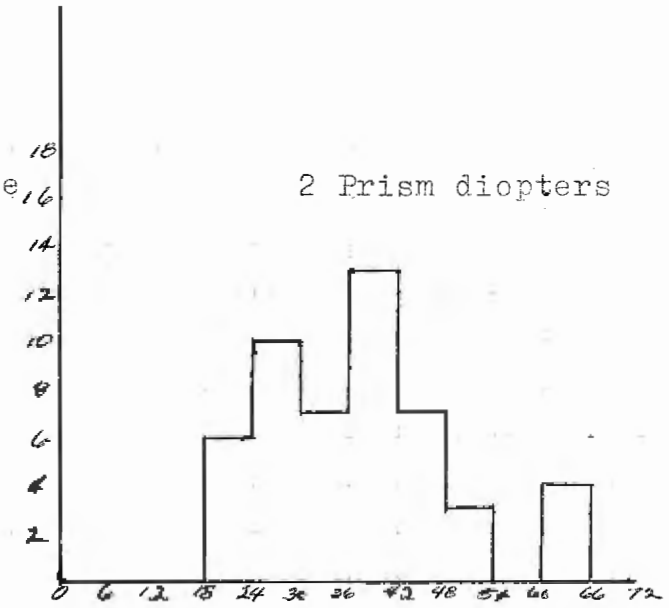
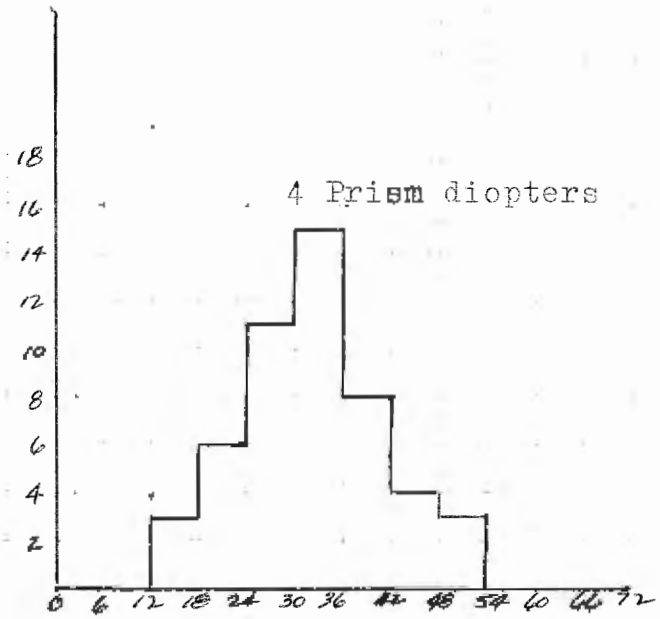
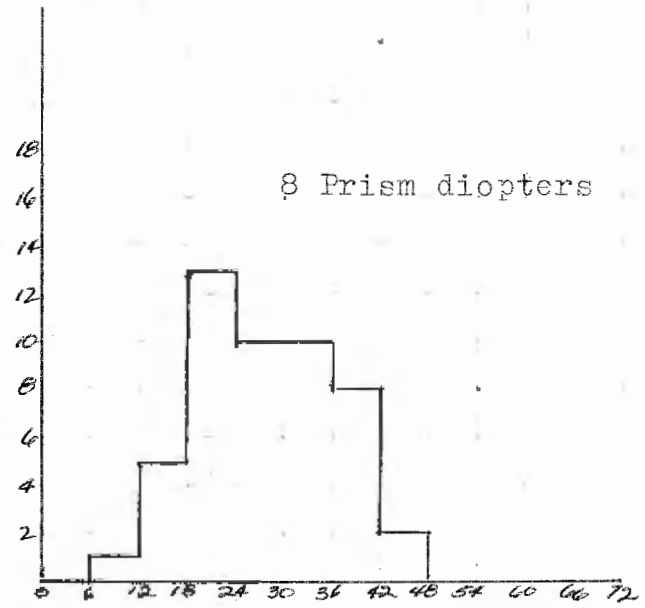
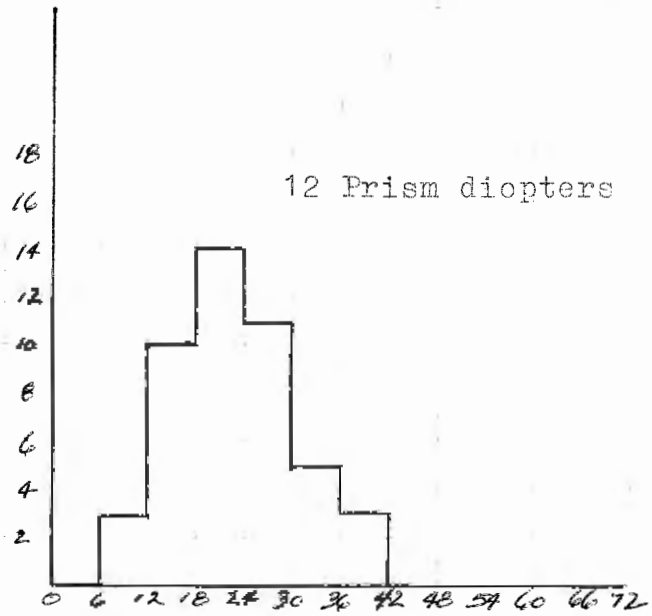


Fig. 3a- Histograms showing the distribution of cycles per minute to different prism magnitudes in the B.C. direction of the combined population.
Number: 50
Abscissa: Cycles/Minute
Ordinate: Frequency









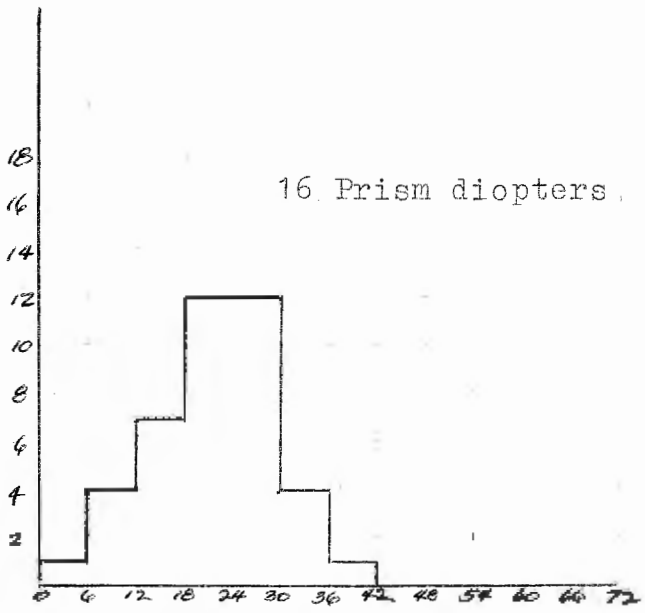
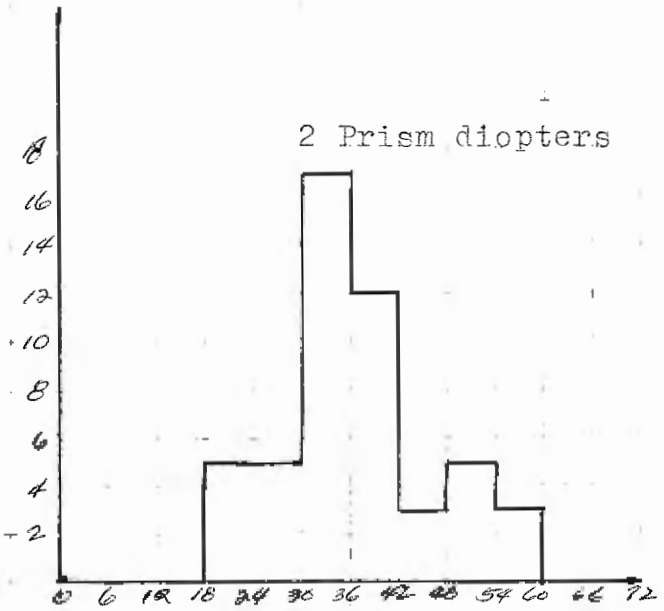
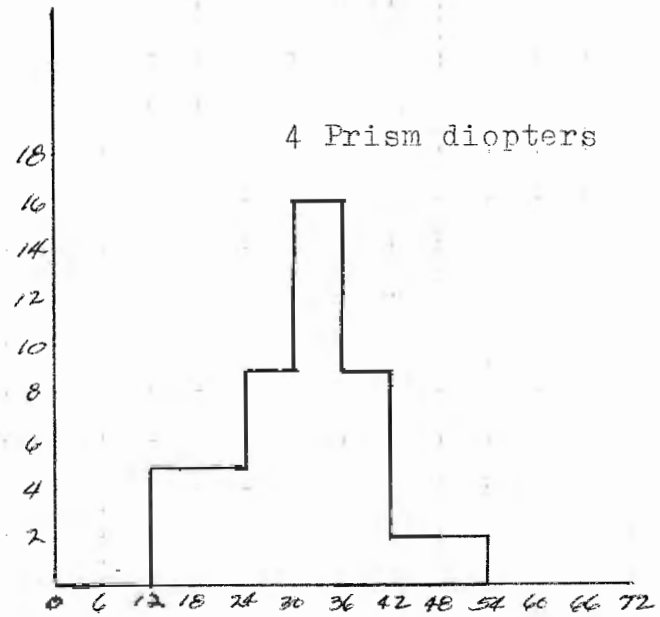
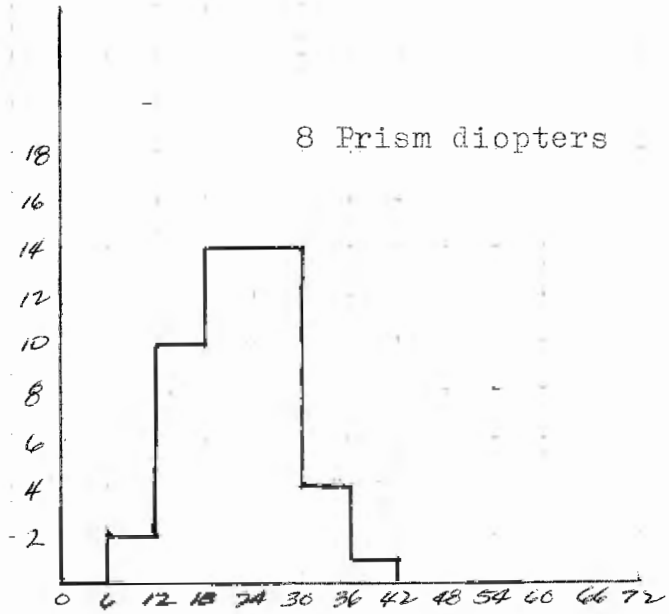
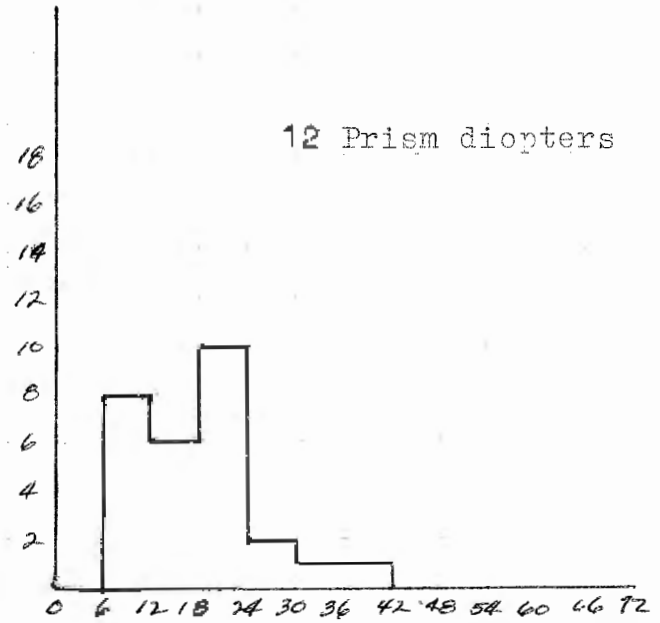


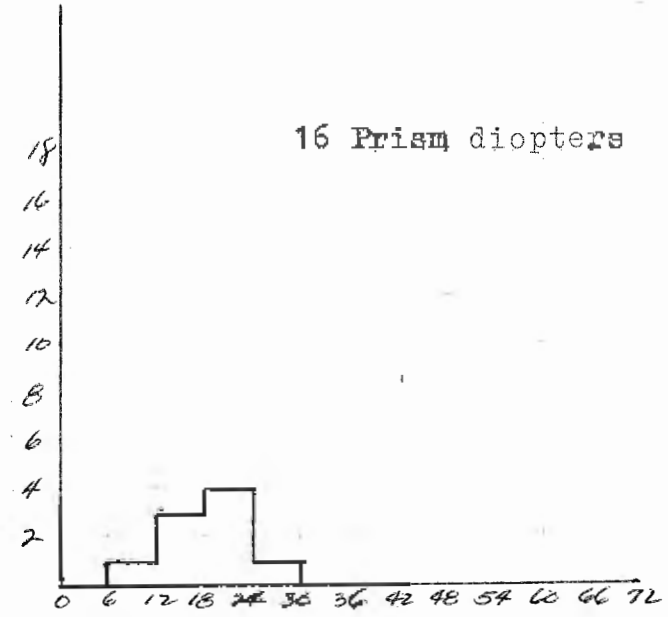
Fig. 3b- Histograms showing the distribution of cycles per minute to different prism magnitudes in the B.I. direction of the combined population.
Number: 50
Abscissa: Cycles/Minute
Ordinate: Frequency











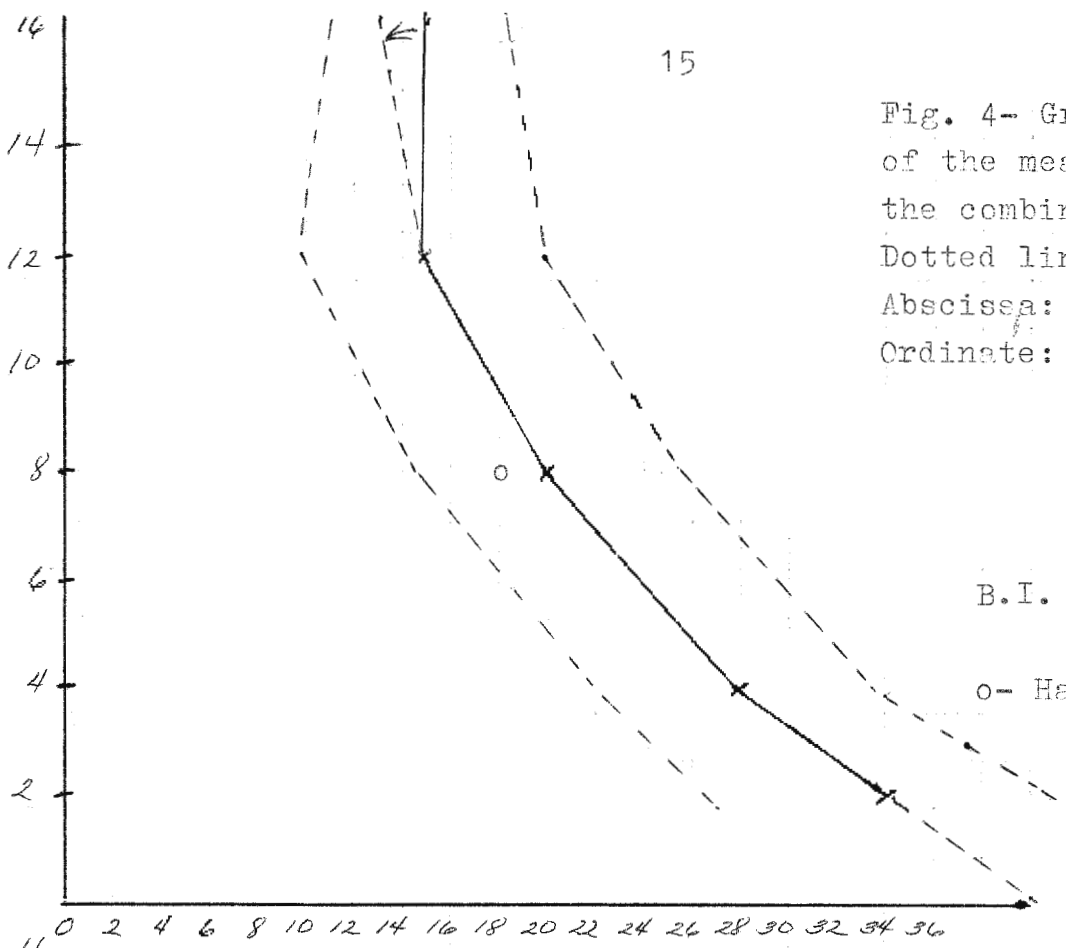
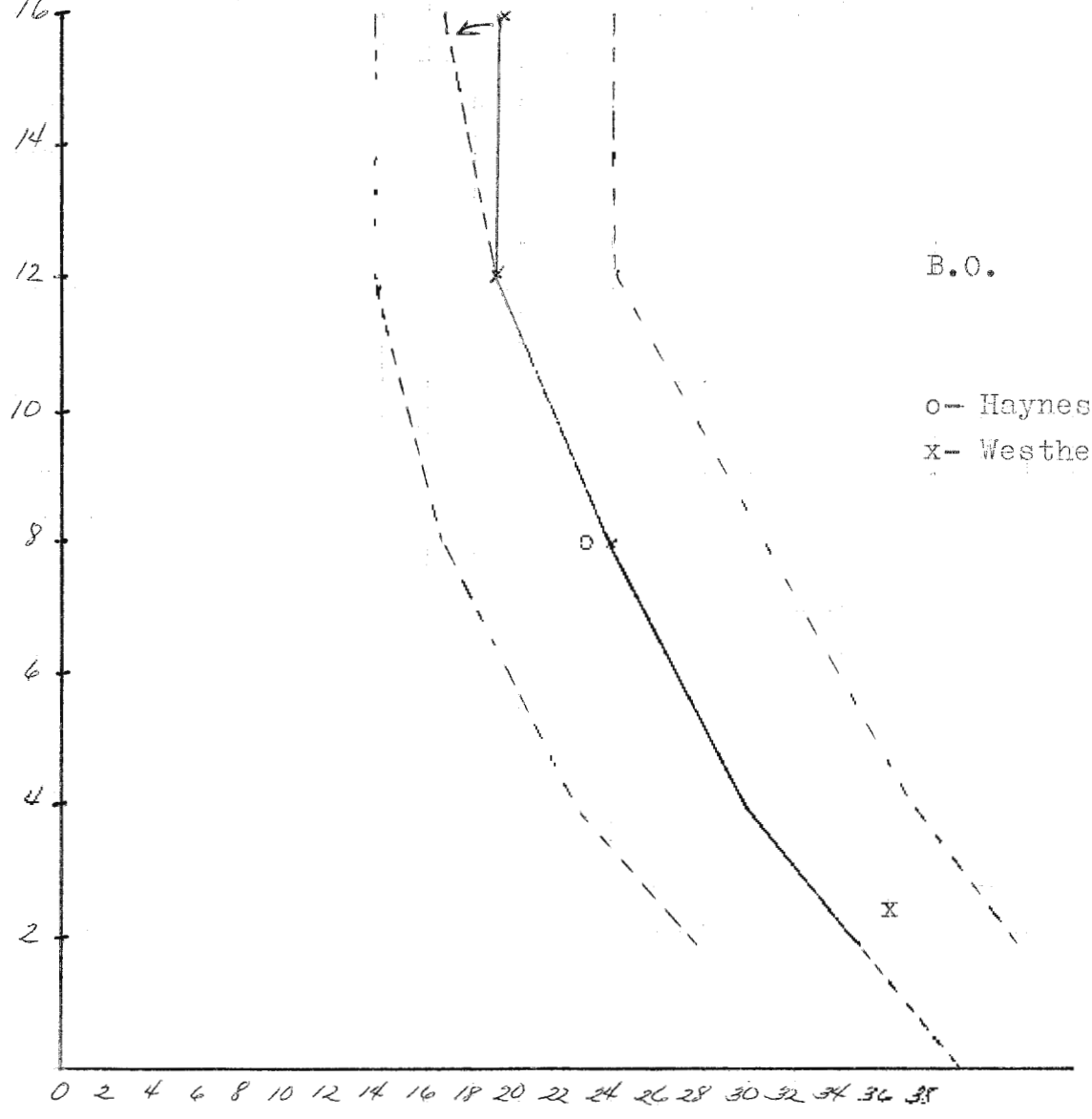


Fig. 4- Graphical presentation of the mean distributions for the combined group.
Dotted lines: Std. dev.
Abscissa: Cycles/Minute
Ordinate: Prism Magnitude

B.I.

o- Haynes' data



B.O.

o- Haynes' data
x- Westheimer's data

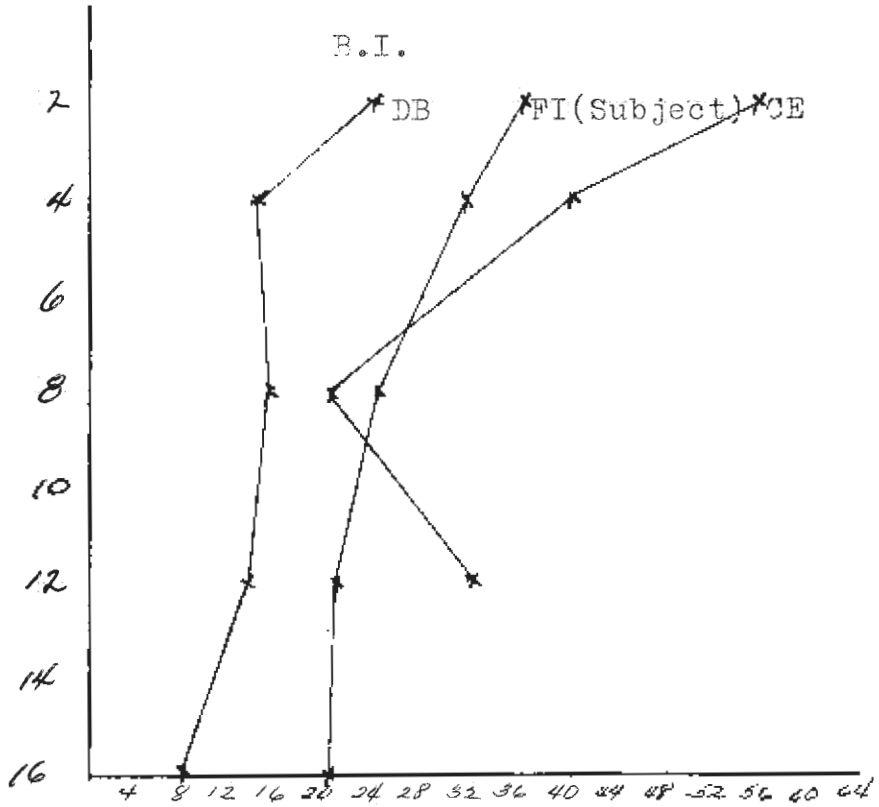
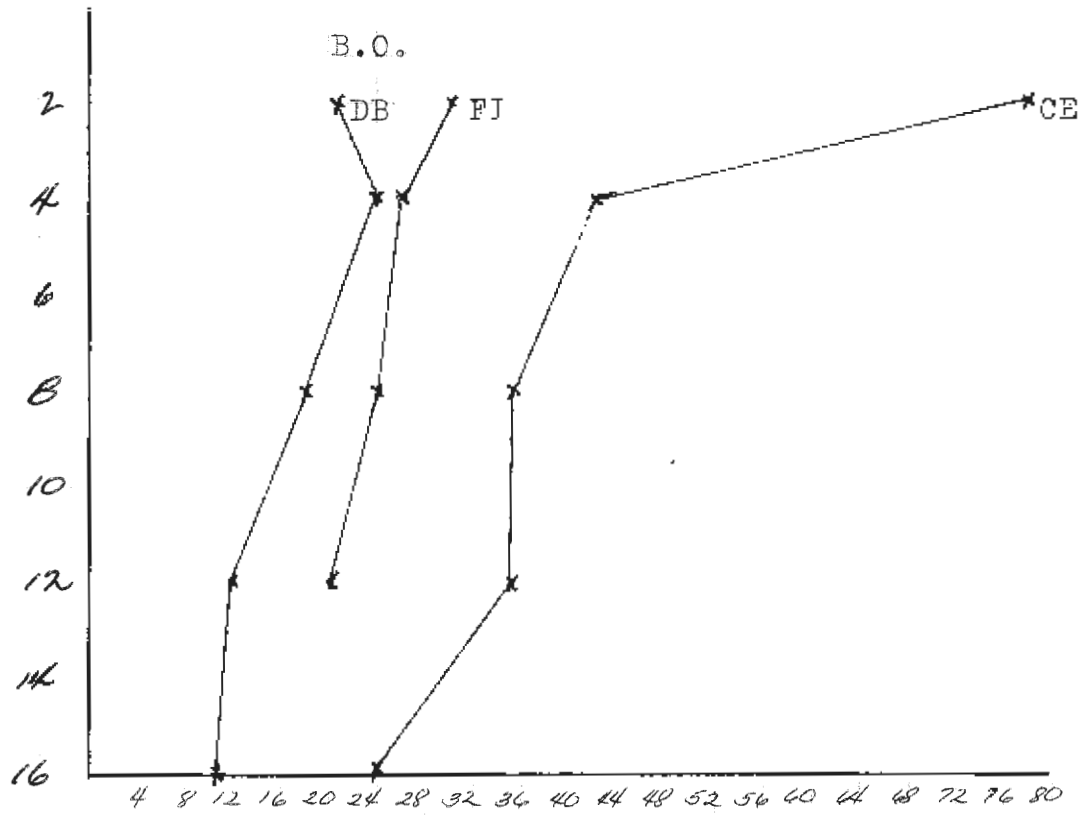


Fig. 5- 2 Graphs showing 3 individual response differences to B.I. and B.O. stimuli.
Abscissa: Cycles/Minute
Ordinate: Prism Magnitude



CONCLUSION

Definite agreement can be seen between our data and that of Haynes and also with that of Westheimer and Mitchell. Haynes, summarizing the prism rock data from the Pacific University studies, reported an average of 18 cycles per minute in the BI direction and 23 cycles per minute in the BO direction using a stimulus of eight prism diopters. Our data revealed 20 cycles per minute and 24 cycles per minute respectively with no significant difference found between the male and female populations.

Westheimer and Mitchell in their study on the "Eye movement response to convergence stimuli," reported that positive convergence reacted faster than negative convergence which he labeled convergence relaxation. Our data was again in harmony with their study as indicated by our slope approximations showing a value of 1.2 for the BI direction and 2.15 for the BO direction. A glance at our slope graph in Fig. 4, shows a displacement of 3 cycles between our data and that of Westheimer and Mitchell. This could easily have been due to the instrumentation that we used. According to the lectures given by Haynes, manual dexterity does not become involved until a level of 120 cycles per minute.

It is therefore felt that our data can be used clinically for predicting purposes.

SUMMARY

It was our purpose to determine the possibility of predicting the number of cycles per minute in the Prism Rock Test as a function of changes in magnitude of prism. Our data indicates that this is possible. Prediction values can be obtained from the graph in Fig. 4, or from the table presentation.

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