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Multiple distance dynamic retinoscopy

Abstract

Multiple distance dynamic retinoscopy

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

Harold M. Haynes

Subject Categories

Optometry

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MULTIPLE DISTANCE

DYNAMIC RETINOSCOPY

Original Research
Presented to the Faculty
of the
College of Optometry
Pacific University

In Partial Fulfillment of the Requirements for the
Degree of Doctor of Optometry

May 25, 1964

by: Timothy L. Gallagher
Richard H. Dohrn

75569

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INTRODUCTION

The initial use of the dynamic retinoscopic techniques was to measure the amplitude of accommodation in patients where it could not be determined subjectively. However, this method gained little prominence until Cross developed his system of dynamic skiametry and its relation to the prescription at far and near. It was his assumption that the accommodative system would make a response equal to the meter angles of convergence. If there was any difference in the postures of the two systems he assumed that this indicated a latent error. The method which he evolved was the use of an increase in plus lenses while the patient fixated a target held in the same plane as the retinoscope, until a point of reversal was determined. (1)

With the use of Cross's method it was found that there was a prescription of excessive plus power. As a result of Sheard's work, a normal lag of accommodation was found to exist at the near point. This lag, when measured retinoscopically, would range between .50 and .75 diopters. However, his technique was somewhat different from Cross's in that he added plus lenses until a point of neutrality was reached. Sheard felt that Cross's method was actually an objective measure of the negative relative amplitude. (2)

---

1. Cross, A.J., "Dynamic Skiametry in Theory and Practice"
2. Sheard, Charles, "Dynamic Skiametry"

Another approach to the use of the dynamic retinoscopic finding was evolved by Tait. It was his contention that a relationship existed between the retinoscopic finding at near and the amount of phoria displayed. His method of determining the retinoscopic finding was with the use of a fogging lens, in which the magnitude of the plus lens was reduced until a point of neutrality was first reached. (3) As a result of the conflicting methods of determining a point of neutrality, Pascal named two points. The point of high neutral would be that as found by the techniques of Tait and Cross and the low neutral would be that as found by the work of Sheard. (4)

More recently, as a result of work with children, Getman and others have developed a technique of dynamic retinoscopy which they refer to as book retinoscopy. Haynes contends that their work involves too many uncontrolled optical variables, and it was from this starting point that he evolved the monocular estimate method. (5) In this method the motion of the reflex is estimated and then a lens is momentarily introduced before the subject's eye to confirm this estimate. The purpose of this method is to measure the "true" dynamics of the accommodative system under various task demands, and have as little effect as possible upon the response.

---

3. Tait, E.F., "A Quantitative System of Dynamic Skiametry"
4. Pascal, J.I., "Selected Studies in Visual Optics"
5. Haynes, H.M., "Clinical Observations with Dynamic Retinoscopy"

Each of the methods measures the response of accommodation under different stimulus conditions, and it will be the purpose of this investigation to compare this difference between the high neutral, low neutral, and monocular estimate method. Professor Haynes, in his lectures, has discussed each method's use in the prediction of the far retinoscopic finding when taken at multiple distances; and this shall be the basis for a further comparison.

THE PROBLEM

The main purpose of this investigation is to compare three techniques of dynamic retinoscopy; the high neutral, the low neutral, and the monocular estimate method.

SUBJECTS

The population was composed of 30 subjects voluntarily selected from the Forest Grove Community. Each subject had to be between 15 and 35 years of age; have 20/20 visual acuity at 16 inches; and have no gross binocular problems as determined by a cover test.

EQUIPMENT

The equipment utilized in this study was as follows:

B&L Green's Phoropter

Hand Retinoscope - either Welsh Allen or American Optical

Trial Lenses

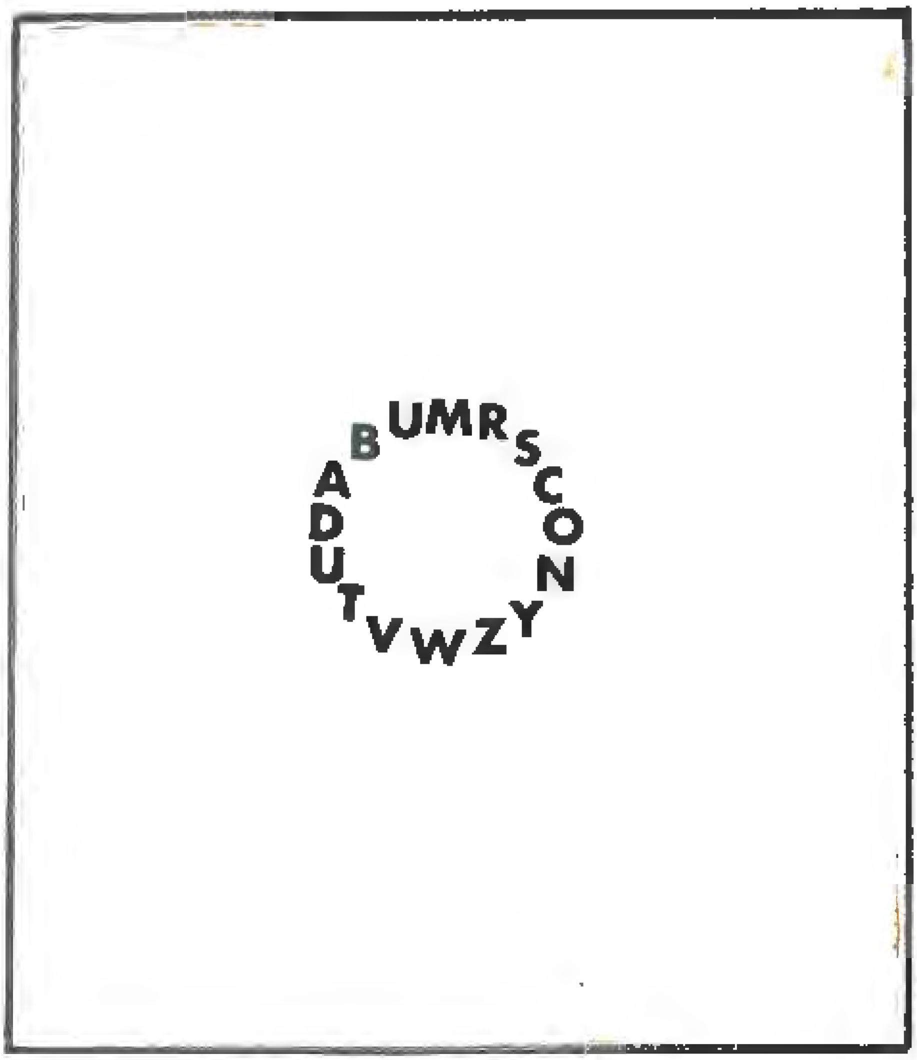
White Plastic Occluder

Reduced Snellen Card

Jaeger Near Point Card

Test Cards - These cards were made with 20/100 acuity letters for each of the three testing distances. The letters were of the block variety (Letraset # 108) and were arranged in a circular fashion around the hole in the retinoscopic card. The cards were designed so that the letters did not subtend and angle larger than 5.7 degrees with the retinoscopic aperature at each testing distance.

EXAMPLE OF A 26" TARGET



EXAMPLE OF A 16" TARGET

EXAMPLE OF A 13" TARGET

PROCEDURE

The visual acuities of each subject were taken at 16" with a reduced Snellen Card. If this test was passed, he was given a cover test at 16" to determine if there were any gross binocular problems. Once the subject had passed these two preliminary tests, his interpupillary distance (PD) was measured for 20 feet and 16 inches. Following this the OEP static retinoscopy finding (#4) was taken in the conventional manner. The three retinoscopic findings were taken at three distances: (26", 16", and 13"). At the beginning of each testing procedure at each distance, the subject was asked how many targets he observed; a response of one allowed us to assume that he was viewing the target binocularly. He was then instructed to read the letters out loud as well as in a clockwise fashion around the circle.

The three techniques were performed in the same sequence: beginning with the monocular estimate method (MEM, followed by the low neutral (LN), and finishing with the high neutral (HN). The MEM test involved the introduction of trial lenses before one eye, and it was done in such an expedient manner that we assumed it had a minimal effect upon the functioning of the system or its postural position. The value recorded on the data sheet was that point at which we first observed a neutral reflex and it was equal to the dioptric value of the inserted trial lens. The LN finding was obtained by increasing plus above our #4 finding until we first recognized a neutral reflex. The lens power in the phoropter was recorded as our gross finding. The HN finding was started with the #4 finding plus the reciprocal of the working distance in the phoropter, and the lens power was reduced in the minus direction until a neutral reflex was noted. The value recorded was the gross lens power in the phoropter.

Following the high neutral technique at each distance the subject was instructed to read .62M Jaeger type for one minute. In this respect we hoped to minimize the effect of the forced posture in the high neutral finding. At the end of this one minute period a new sequence of tests was begun at a new testing distance. At the completion of the total testing sequence the subject was allowed to relax for one hour and the total sequence was again repeated.

ILLUMINATION

A constant illumination of 2 ft. candles was maintained in the examination room at all times. The illumination on the test cards was 9 ft. candles.

ANALYSIS OF DATA

The data was analyzed for the following relationships: the repeatability of the tests; the linearity of the accommodative response slopes; the difference in behavior of the accommodative response under the HN, LN, and MEM test; the estimation of the #4 finding.

Repeatability of the Tests

To determine the repeatability between sequence one and sequence two, we ran correlation coefficients (Pearsons r) between the first and second sequences. The HN, LN, and MEM at 26" and 13" for the first sequence were correlated with the corresponding findings of the second sequence. The correlation coefficients between the findings on sequence one and sequence two were as follows:

	MEM	LN	HN
26"	.76	.83	.84
13"	.90	.86	.89

It was noted that a high correlation existed between the findings of the same tests at 26" and 13" distances, and then assumed that a high correlation would also exist between the 16" findings. From the high correlation coefficients it was concluded that the sequence of tests can be repeated at different times and yet obtain nearly the same findings.

A second approach to determine the repeatability of the two sequences was to plot a graph of the frequency distribution for the dioptric differences between the findings obtained in exam sequence one and sequence two. The frequency distribution of the dioptric difference between sequence one and sequence two for the MEM at 26", 16", and 13"; and for the LN at 26", 16", and 13"; and for the HN at 26", 16", and 13", can be observed on the frequency distribution graphs on page 14. A frequency distribution of the dioptric difference between each finding in sequence one and sequence two showed that about 87% of the findings were within a quarter diopter difference. This we considered good because the measuring devices used in multiple distance dynamic retinoscopy are only calibrated to the quarter diopter.

The graphs for the frequency distribution of the dioptric differences and the correlations between the same tests conducted at different times points directly to the fact that the HN, LN, and MEM tests at the 26", 16", and 13" distances are highly repeatable.

FREQUENCY DISTRIBUTION OF THE DIOPTRIC
DIFFERENCE BETWEEN FIRST AND SECOND FINDINGS

	MEM at 26"	MEM at 16"	MEM at 13"
pl	XXXXXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXXXXXX
.12	XXXXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXX
.25	XXX	XXXXXXX	XXXX
.37		X	X
.50			
.62			
.75			

r = .76　　　　r = .9

FREQUENCY DISTRIBUTION OF THE DIOPTRIC
DIFFERENCE BETWEEN FIRST AND SECOND FINDINGS

	LN at 26"	LN at 16"	LN at 13"
pl	XXXXXXXXXXXX	XXXXXXXX	XXXXXXXXX
.12	XXX	XXXXXX	XXXX
.25	XXXXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXXXXX
.37			XX
.50	X	XXXX	XX
.62			
.75			

r = .83　　　　r = .86

FREQUENCY DISTRIBUTION OF THE DIOPTRIC
DIFFERENCE BETWEEN FIRST AND SECOND FINDINGS

	HN at 26"	HN at 16"	HN at 13"
pl	XXXX	XXXXXXXXXX	XXXXXXXXXXX
.12	XXXXXXXXX	XXXX	XXXXXXX
.25	XXXXXXXXXXXX	XXXXXXXXXXX	XXXXXXX
.37	X	X	X
.50	XXXX	X	XX
.62			
.75		XXX	XX

r = .84　　　　r = .89

The Linearity of the Accommodative Response Slopes

The data was studied to determine if the accommodative response slopes (S_r) of the multiple distance dynamic retinoscopy tests were linear. We calculated the mean posture of accommodation for each test (MEM, LN, and HN) at each distance (26", 16", and 13"). The means and variances for the lag of accommodation on each test at each distance were as follows:

	MEM		LN		HN	
	mean;	variance	mean;	variance	mean;	variance
26"	.43	.06	.65	.11	.87	.40
16"	.61	.08	.84	.11	1.50	.28
13"	.76	.11	1.22	.44	1.87	.81

The mean postures of accommodation were then plotted graphically (refer to graph on page 18), and it was found that the HN, LN, and MEM tests are linear when conducted at multiple distances of 26", 16", and 13".

In calculating the S_r for the MEM, LN, and HN, we treated each series of tests for each subject independently. * Ie: For sequence one for subject A, we determined the S_r of the MEM on the basis of the 26" and 13" findings and we also determined the S_r on the basis of the 26" and 13" findings. This procedure was repeated for sequence two on subject A. The 26" and 16" slopes for the two tests were averaged and the 26" and 13" slopes were averaged. The averages of the S_r for sequence one and sequence two based on the 26" and 16" findings and S_r for sequence one and sequence two of the

* The slope of accommodative response (S_r) was calculated by dividing the accommodative response by the accommodative stimulus or by dividing the change of the accommodative response by the change of accommodative stimulus.

26" and 13" findings were then averaged to determine the S_r for the MEM of subject A. This procedure was then repeated for each test (LN, HN, and MEM) and for each subject. The mean and variance for the calculated S_r of LN, HN, and MEM are as follows:

MEM S_r		LN S_r		HN S_r	
mean	variance	mean	variance	mean	variance
.80	.03	.66	.04	.35	.06

The S_r for the HN, LN, and MEM taken from the mean lag for MEM, LN, and HN (refer to graph - page 18) are as follows:

MEM S_r	LN S_r	HN S_r
.75	.60	.37

In one case the slopes were calculated from individual findings on individual subjects and in the other case the slopes were calculated from the mean lags for MEM, LN, and HN, but in both ways of calculation the slopes of the MEM, LN, and HN are about the same.

MEM SLOPE OF RESPONSE

+1.0	X X X X X X
+.9	X X X X X X X X X
+.8	X X X X X
+.7	X X X
+.6	X X X X
+.5	X X
+.4	X
+.3	
+.2	
+.1	
0	

.800	mean
.850	median
.o30	variance
.170	standard deviation

LN SLOPE OF RESPONSE

+1.0	X X X
+.9	X X
+.8	X X X X X
+.7	X X X X X
+.6	X X X X X
+.5	X X X X X X X
+.4	X
+.3	X
+.2	X
+.1	
0	
-.1	

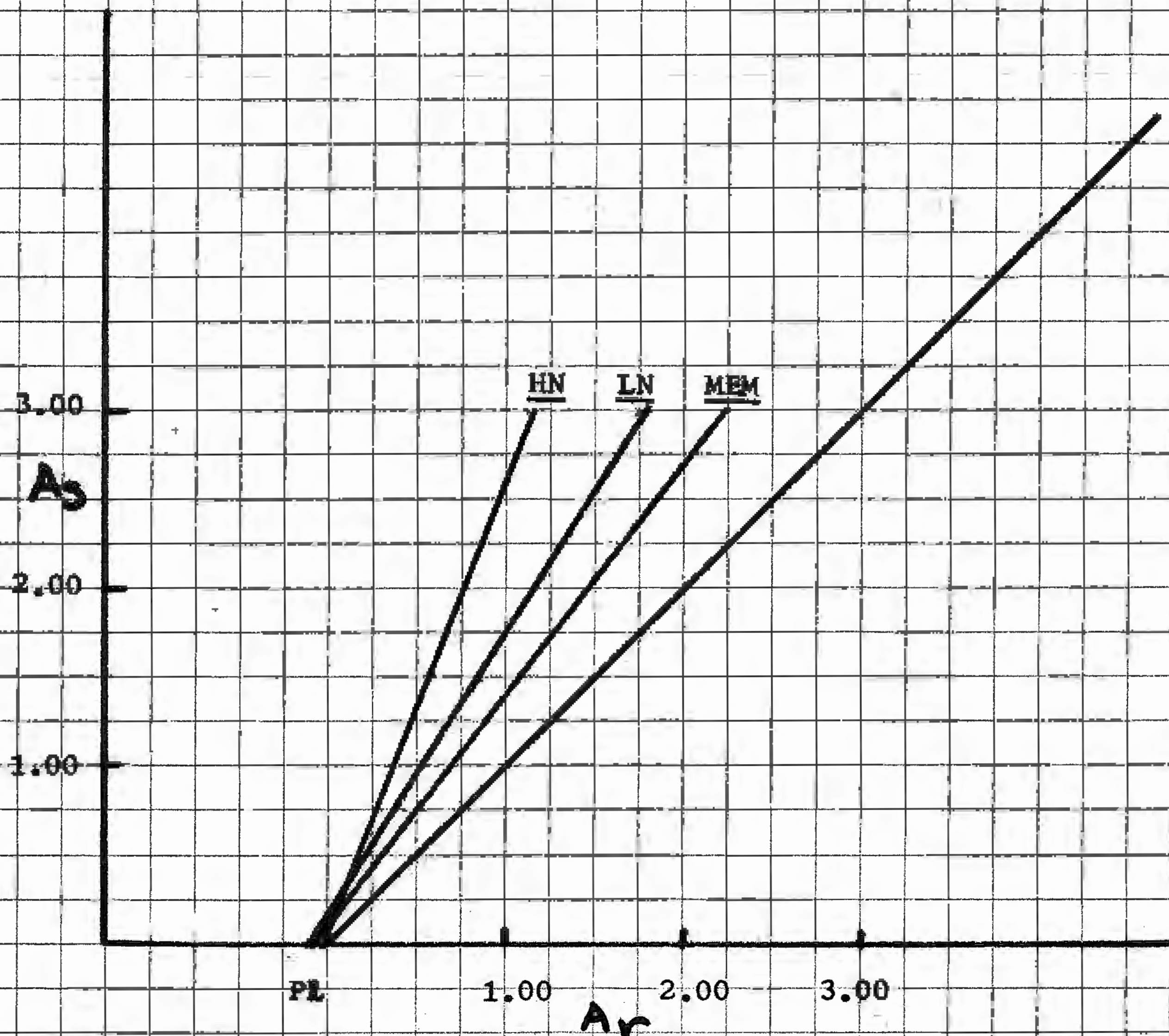
.657	mean
.650	median
.04	variance
.20	standard deviation

HN SLOPE OF RESPONSE

+1.0	
+.9	X
+.8	X
+.7	X X
+.6	X X X X X
+.5	X
+.4	X X X
+.3	X X X X X
+.2	X X X X X
+.1	X X X X
0	X X
-.1	X

.354	mean
.310	median
.06	variance
.24	standard deviation

PLOT OF THE MEAN POSTURES FOR MEM, LN, HN.



MEM	LN	HN
26" = +.425	26" = +.654	26" = +.870
16" = +.612	16" = +.840	16" = +1.50
13" = +.761	13" = +1.22	13" = +1.87

SLOPES

MEM = .75
LN = .60
HN = .37

FREQUENCY DISTRIBUTION OF
THE MEASUREMENTS OF DYNAMIC RETINOSCOPY

MEM at 26"

```
-.12 pl      XXXXXXX
+.12 +.25    XXXXXXXXX
+.37 +.50    XXXXXXXXXXXXXXXXXXXXXXXXXXXX
+.62 +.75    XXXXXXXXXXXXXX
+.87 +1.00 XX
+1.12 +1.25
```

.425	mean
.43	Median
.062	variance
.24	standard deviation

LN at 26"

```
-.12 pl      XXXXX
+.12 +.25    XXXXXXX
+.37 +.50    XXXXXXXXXX
+.62 +.75    XXXXXXXXXXXXXXXXXXXXX
+.87 +1.00 XXXXXXXXXXXXX
+1.12 +1.25XXX
+1.37 +1.50
```

.654	mean
.66	median
.107	variance
.32	standard deviation

HN at 26"

```
-.12 pl       XX
+.12 +.25     XXXXXXX
+.37 +.50     XXX
+.62 +.75     XXXXXXXXXXXX
+.87 +1.00    XXXXXXXXXXXXXXXXXXXXXX
+1.12 +1.25 XXXXXX
+1.37 +1.50 XXXXXXX
+1.62 +1.75 X
```

.87	mean
.82	median
.16	variance
.40	standard deviation

(+) denotes with motion or accommodative response less than the accommodative stimulus

(-) denotes against motion or accommodative response more than the accommodative stimulus

FREQUENCY DISTRIBUTION OF THE MEASUREMENTS OF DYNAMIC RETINOSCOPY

MEM at 16"

-.12 pl	X		
+.12 +.25	XXXXXXXX		
+.37 +.50	XXXXXXXXXXXXXXXXXX		
+.62 +.75	XXXXXXXXXXXXXXXXXXX		
+.87 +1.00	XXXXXXXXXX		
+1.12 +1.25	XXX		
+1.37 +1.50		.612	mean
+1.62 +1.75		.60	median
+1.87 +2.00		.084	variance
+2.12 +2.25		.28	standard deviation

LN at 16"

-.12 pl	X		
+.12 +.25	XXXXXX		
+.37 +.50	XXXXX		
+.62 +.75	XXXX		
+.87 +1.00	XXXXXXXXXXXXXXXXXXX		
+1.12 +1.25	XXXXXXXXXXXXXXXXXX		
+1.37 +1.50	XXXXXXX	.840	mean
+1.62 +1.75	X	1.01	median
+1.87 +2.00		.114	variance
+2.12 +2.25		.33	standard deviation

HN at 16"

-.12 pl	X		
+.12 +.25	XX		
+.37 +.50	XXX		
+.62 +.75	XX		
+.87 +1.00	XX		
+1.12 +1.25	XXXXXXXXXX		
+1.37 +1.50	XXXXXXXXXX	1.50	mean
+1.62 +1.75	XXXXXXXXXX	1.56	median
+1.87 +2.00	XXXXXXXXXXXXXXXXXX	.28	variance
+2.12 +2.25	XX	.53	standard deviation

FREQUENCY DISTRIBUTION OF THE
MEASUREMENTS OF DYNAMIC RETINOSCOPY

MEM at 13"

-.12	pl	
+.12	+.25	XXXXXXXX
+.37	+.50	XXXXXXXXXX
+.62	+.75	XXXXXXXXXXXX
+.87	+1.00	XXXXXXXXXXXXXXXXXXXX
+1.12	+1.25	XXXXXXXXX
+1.37	+1.50	X
+1.62	+1.75	
+1.87	+2.00	
+2.12	+2.25	
+2.37	+2.50	
+2.62	+2.75	

.761 mean
.81 median
.109 variance
.33 standard deviation

LN at 13"

-.12	pl	X
+.12	+.25	XXX
+.37	+.50	XXXXX
+.62	+.75	XXXX
+.87	+1.00	XXXXXXX
+1.12	+1.25	XXXXXXXXXXXXXXX
+1.37	+1.50	XXXXXXXXX
+1.62	+1.75	XXXXXXXXXXXXXX
+1.87	+2.00	XX
+2.12	+2.25	
+2.37	+2.50	
+2.62	+2.75	

1.22 mean
1.22 median
.440 variance
.68 standard deviation

HN at 13"

-.12	pl	
+.12	+.25	XXXX
+.37	+.50	
+.62	+.75	XXXX
+.87	+1.00	XX
+1.12	+1.25	XXX
+1.37	+1.50	XXXXXXXXX
+1.62	+1.75	XXX
+1.87	+2.00	XXXXXXXXX
+2.12	+2.25	XXXXXXXXXXXX
+2.37	+2.50	XXXXXXXXX
+2.62	+2.75	XXXXX

1.87 mean
1.98 median
.66 variance
.81 standard deviation

Difference in Behavior of Accommodative Response under HN, LN, and MEM Tests

We assumed that the behavior under HN, LN, and MEM constituted three different parameters of accommodative response (A_r). This assumption was tested in two ways. The test indicated that the A_r at 26", 16" and 13" for the MEM, LN, and HN were significantly different at better than the 5% level of confidence. In all cases the slopes of the HN, LN, and MEM maintained a constant relationship. The MEM slope was always greater than the LN slope, and the LN slope was always greater than the HN slope. This statement can be observed in the correlation between the MEM and LN which is +.75 and the correlation between the LN and HN which is +.69 and the correlation between the MEM and the HN which is +.35, as well as in the group graphs which indicate the accommodative slopes.

Estimation of the #4 Finding

The fourth consideration was to determine if multiple distance dynamic retinoscopy could be used to accurately estimate the far retinoscopic finding (4e). The #4e was calculated for each subject on the basis of the MEM, LN and HN slope and the posture at 16". For each subject these three estimations of the #4 were averaged to obtain another estimation. The frequency distribution of the differences between the #4 and the #4e (refer to graph on page 24) showed that, 90% of the time or better, the #4e was within + or - .37 diopters of the #4. Therefore, we have concluded that either the MEM, LN, or HN can be used to estimate the #4, but an average of all three methods gives a more reliable estimation. Graph on page 25, graph on page 26, graph on page 27, respectively, represent the mean postures and probable error of measurement of the MEM, LN, and HN. These three graphs, when projected, approximate within a quarter diopter the #4. Therefore, one may conclude that even though the MEM, LN, and HN are three independent tests, each may be used to estimate the #4.

The estimation of the #4 by the slope of the HN, LN, and MEM shows that the slopes are linear and measure A_r in such a manner that the slopes converge upon the end point of A_r which is the #4. However, it must be kept in mind that each sequence of tests was started with the #4 in place.

FREQUENCY DISTRIBUTION OF THE DIFFERENCES BETWEEN THE #4 AND THE PREDICTED #4E ON THE BASIS OF THE MEM SLOPE

```
 pl   XXXXXXX
.12   XXXXXXXX
.25   XXXXX
.37   X
.50   XXXXXXXX
.62   X
.75
```

FREQUENCY DISTRIBUTION OF THE DIFFERENCES BETWEEN THE #4 AND THE PREDICTED #4 ON THE BASIS OF THE LN SLOPE

```
 pl   XXXXXX
.12   XXXX
.25   XXXXXX
.37   XXXXXXX
.50   XXXX
.62   X
.75
.87   XX
1.00
```

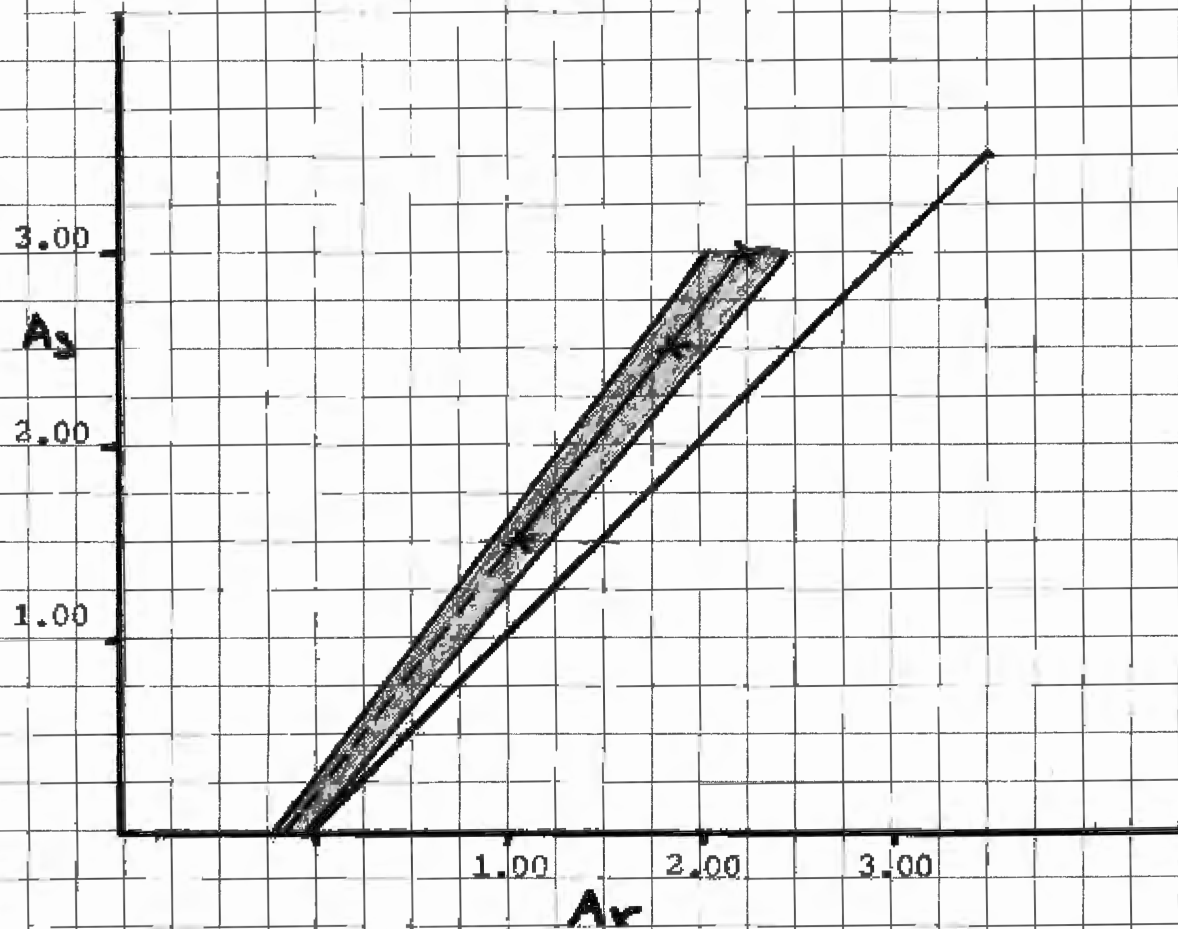
FREQUENCY DISTRIBUTION OF THE DIFFERENCES BETWEEN THE #4 AND THE PREDICTED #4 ON THE BASIS OF THE HN SLOPE

```
 pl   XXX
.12   XXXXXX
.25   XXXXXX
.37   XXXXXXX
.50   XXX
.62   XX
.75   XX
.87
1.00  X
```

FREQUENCY DISTRIBUTION OF THE DIFFERENCES BETWEEN THE #4 AND THE AVERAGE PREDICTED #4 ON THE BASIS OF THE MEM, LN, HN SLOPES.

```
 pl   XXXXXXX
.12   XXXXXXX
.25   XXXXXX
.37   XXXXX
.50   XXX
.62   XX
.75
.87
1.00
```

AVERAGE NET POSTURE OF MBM
WITH PROBABLE ERROR IN SHADED AREA



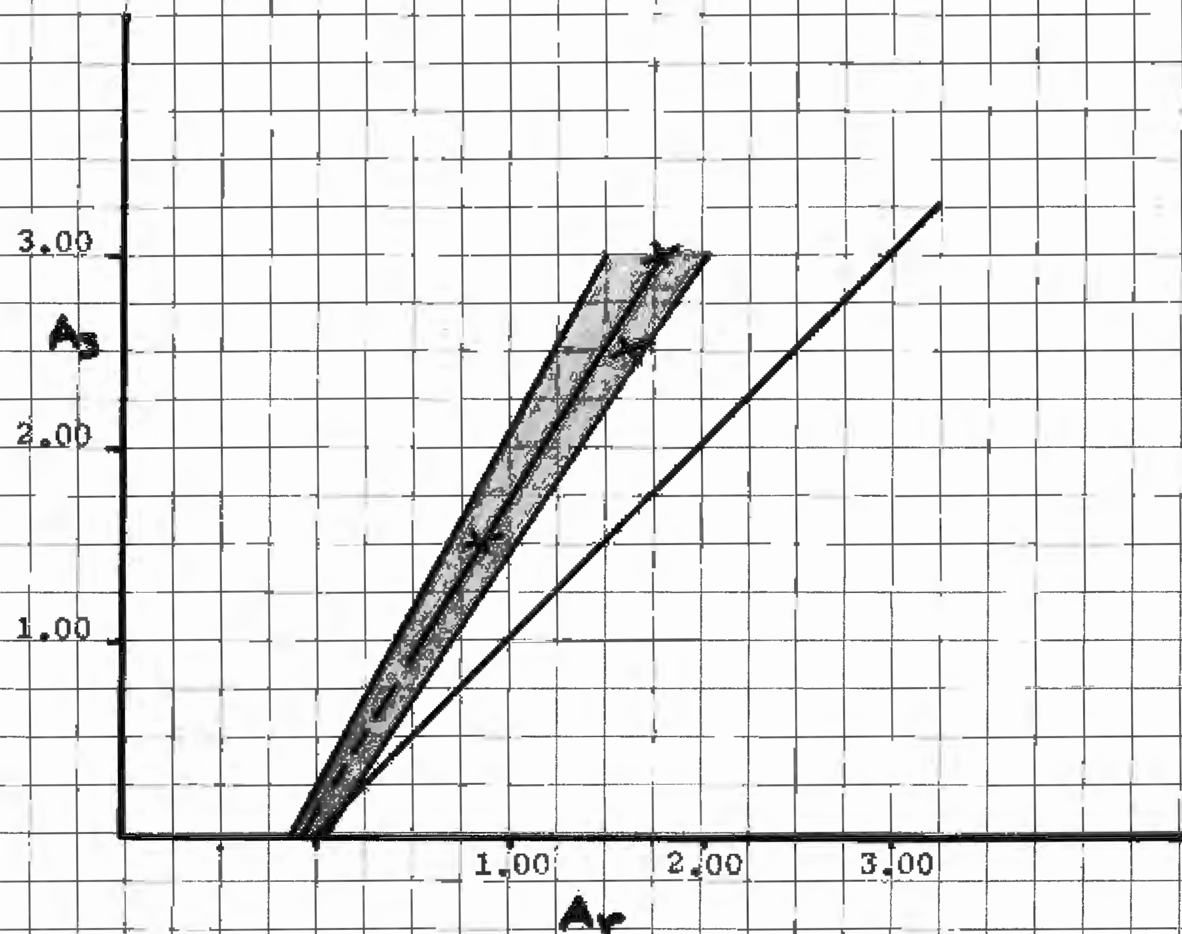
Average Net Posture of MBM

26"	=	+.43
16"	=	+.61
13"	=	+.76

Probable Error of MBM

26"	=	+or-	.16
16"	=	+or-	.18
13"	=	+or-	.22

AVERAGE NET POSTURE OF LN
WITH PROBABLE ERROR IN SHADED AREA



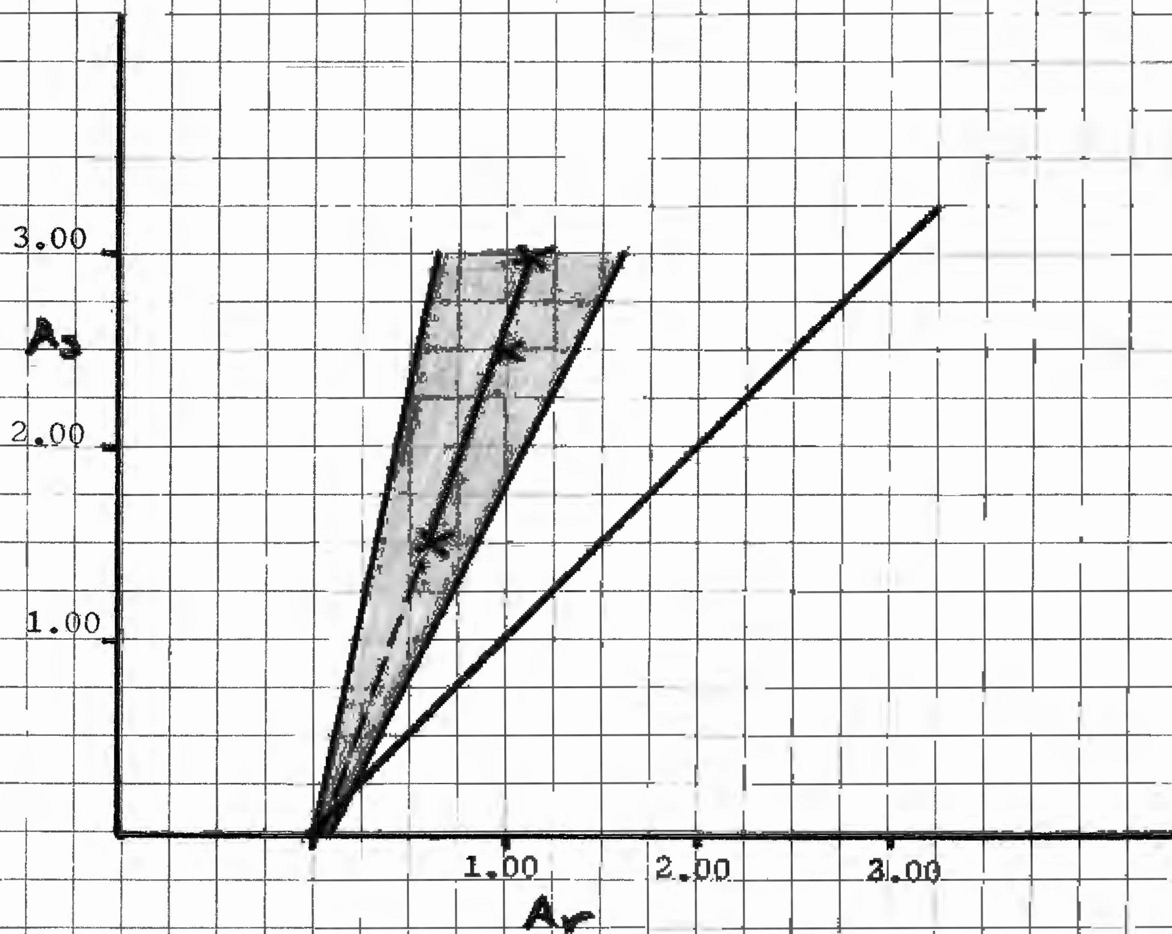
Average Net Posture of LN

26" = +.65
16" = +.84
13" = +1.22

Probable Error of LN

26" = +or- .22
16" = +or- .22
13" = +or- .26

AVERAGE NET POSTURE OF HN
WITH PROBABLE ERROR IN SHADED AREA



Average Net Posture of HN

26" = +.87
16" = +1.50
13" = +1.87

Probable Error of HN

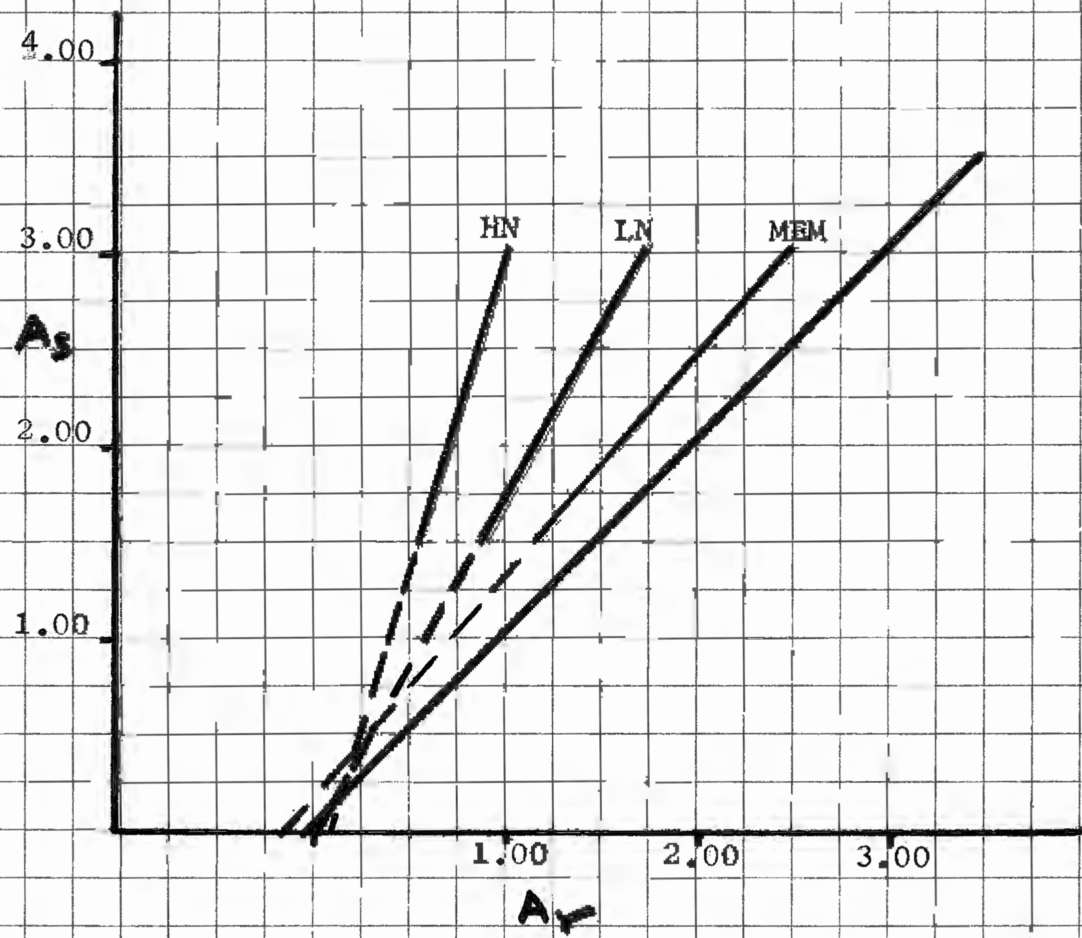
26" = +or- .26
16" = +or- .36
13" = +or- .54

INDIVIDUAL PATTERNS

Group conclusions cannot, without exception, be applied to the individual cases. With respect to this, three definite patterns were found: the individual in which the tests closely approximated the group data; the individual in which each test closely approximates the other; and the individual in which a greater degree of difference was found between the tests.

EXAMPLE OF

TYPICAL PATTERN



Subject; Ted Thonstad
age 21

Average Net Posture

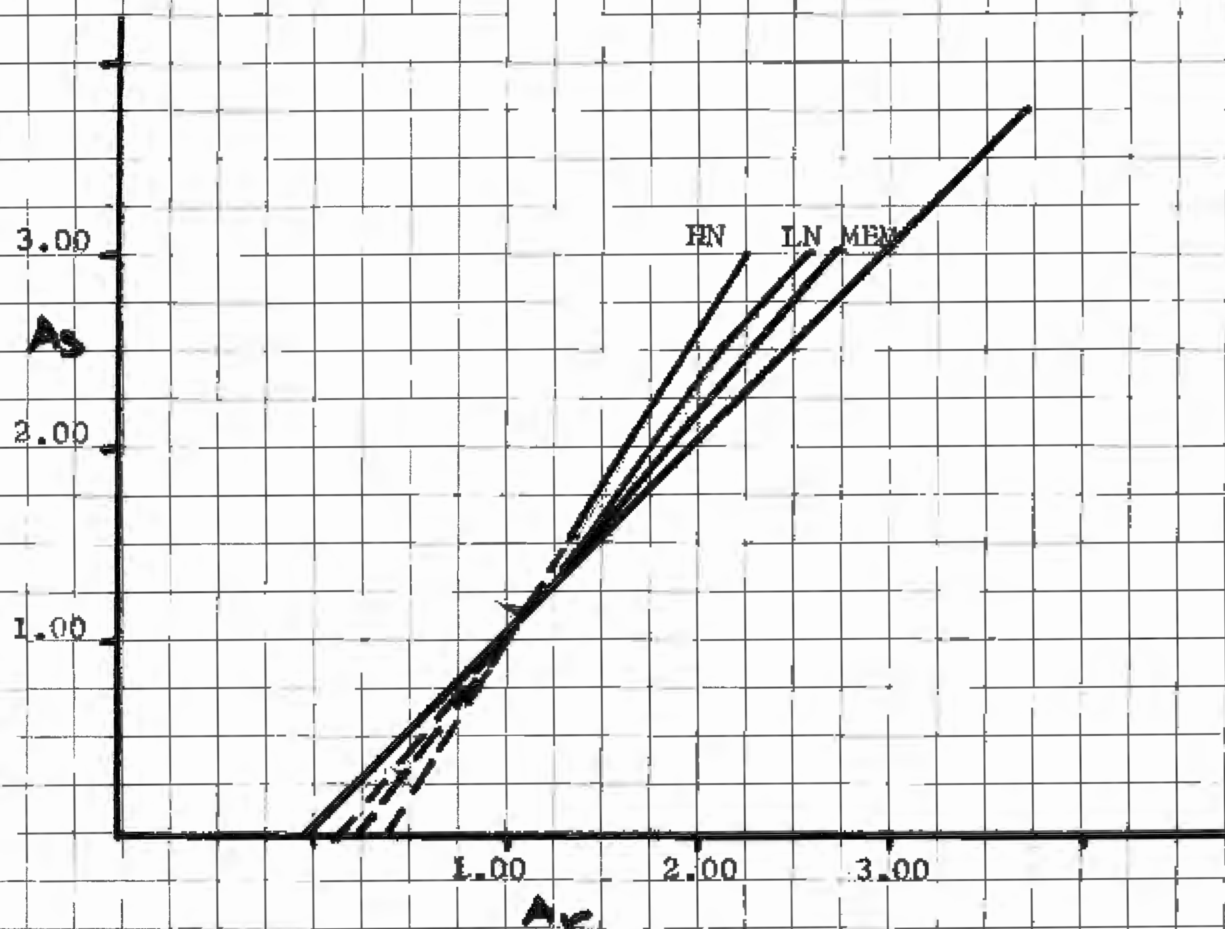
	MEM	LN	HN
26"	+.31	+.56	+.93
16"	+.41	+1.00	+1.56
13"	+.50	+1.25	+2.00

Average slope

MEM = .86
LN = .55
HN = .30

EXAMPLE OF

EXCESSIVE ACCOMMODATIVE RESPONSE PATTERN



Subject: Gerald Goodrich
age 32

Average Net Posture

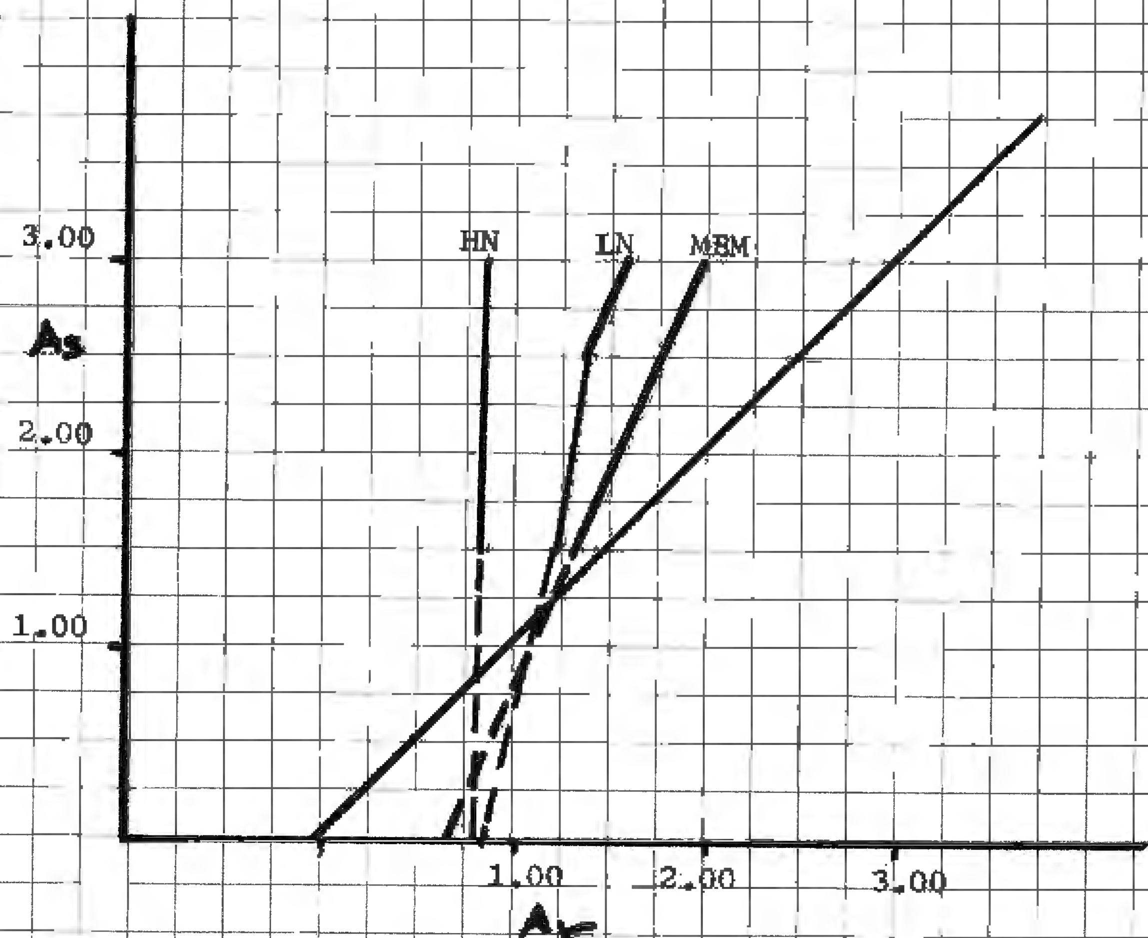
	MEM	LN	HN
26"	pl	pl	+.12
16"	+.25	+.37	+.50
13"	+.25	+.37	+.75

Average Slope

MEM = .80
LN = .70
HN = .65

EXAMPLE OF

EXCESSIVE ACCOMMODATIVE LAG PATTERN



Subject; John Russell
age 24

Average Net Posture

	MBM	LN	HN
26"	+.12	+.25	+.62
16"	+.75	+1.12	+1.62
13"	+.93	+1.37	+212

Average Slope S_r

MBM = .41
LN = .19
HN = .0

CLINICAL IMPLICATIONS

From the group data which we have obtained in this study, we have come to the following conclusions:

1. Each test is significant with respect to the accommodative response that it measures.
2. Each test is repeatable at any one specific distance.
3. Each test has a slope which is approximately linear.
4. Each test varies significantly with respect to posture and slope that one should not be substituted for the other.
5. Each test, when used as a predictor of the far retinoscopic finding with respect to the average slope and a specific posture, is a significant predictor within + or - .37 diopters.
6. Each test, if taken at only two distances, will give a good approximation of the accommodative slope. The greater the difference of the dioptric magnitude between these two testing distances, the more reliable the approximation.
7. Each test tends to indicate that the far retinoscopic finding is the end point of the accommodative system.

SUGGESTIONS FOR FURTHER STUDY

Since this is a preliminary study and the results tend to indicate a definite relation between the three techniques, there should be further study made.

1. Since the sample was drawn without respect to refractive error, there should be a study done upon uncorrected myopes, hyperopes, and astigmats to see how these factors affect multiple distance dynamic retinoscopy.
2. In the design of our experiment, all of the findings were taken with the far retinoscopic finding in place, and this may have accounted for the closeness in the approximation of this finding on the basis of the group data. It would be our suggestion that in an additional study that these three tests be run without the far retinoscopic finding in place and only after completion of the testing sequence should this finding be determined. For the purpose of conducting the tests, the habitual Rx might be used in the same way the #4 was used in this project.
3. The targets which were used in this experiment subtended an angle of 25 minutes of arc and would constitute a rather gross stimulus to accommodation. In any future investigations a target of a greater demand upon the discriminative ability of accommodation might be used. It is our feeling that some of the variance

found in the individual test was a result of the accommodative systems free posturing in which some individuals are always close to the task demand and other individuals, when not called upon to discriminate, will assume a posture at a more distant point (greater lag of accommodation).

4. A further study could be made with respect to the type of material used as the stimulus to accommodation. With this in mind a differentiation could be made between the accommodative response under acuity demands as against the individual being required to gain symbolic "meaning". A study of this nature may be valuable in the eventual diagnosis of reading problems as found in children.

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