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A study of various task reading distances

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by

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We wish to acknowledge certain people who have made this thesis possible. The original work of Dr. Darrel B. Harmon was the incentive stimulus for this study and without the help and direction of Dr. Jane B. Carmichael this study may have never reached completion. The Optometric Dame's Club of Pacific University should be congratulated for its program of aid to thesis research, which has been beneficial to Optometric research in the past and will continue in the future. Finally, we wish to thank Mrs. Linda Wold for her help in the preparation of our final thesis.

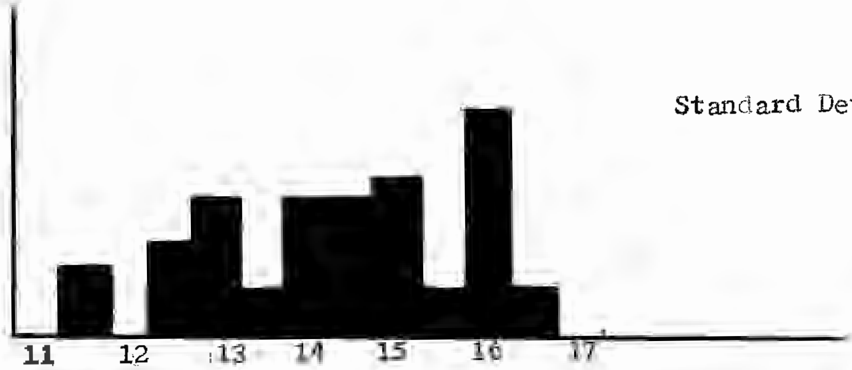
The purpose of this study is to compare various task reading distances with the anatomically determined reading distance presented by Dr. Darell Boyd Harmon in his monograph "The Co-ordinated Classroom". Secondly, the accommodative response as measured by the Optometric Extension Program method of determining the sixteen inch fused cross-cylinder findings, then both the Harmon distance and seated reading distance will be correlated with the accommodative response at the standard sixteen inch reading distance. We hope to therefore determine the validity of the use of the sixteen inch testing distance on a critical nearpoint oriented sample.

The subjects, totaling twenty-four, for this study were comprised of nine males and fifteen females between the ages of eighteen and twenty-five. It was our thinking that these college age students have possibly the greatest nearpoint demand of any age group, and, therefore require the most exacting nearpoint refraction. Concerning a breakdown of refractive errors, we have classified them as following; eight as being emmetropes having a distant refraction of plano ± .25 Diopter with no cylinder over .25 Diopter; nine as being myopic with a distant refraction of greater than -.25 Diopter again without a cylindrical component of over .25 Diopter; seven as hyperopes witha distant refraction of greater than +.25 Diopter without greater than .25 Diopter of cylinder; and five astigmats with over -.25 Diopter of cylinder. Contact lens wearers and subjects with past visual training, organic or dental disorders were eliminated from the study.

All of the subjects were tested with the following procedure. The Harmon distance was measured from the olecranon process of the ulna bone to the head of the 3rd. metacarpal. Three specific reading distances were then measured. The first was taken with the patient seated at a standard size desk, reading an article on geology. This will be referred to as reading distance No. 1. The second was taken while the subject was seated on one of the reception room couches reading a popular periodical. This will be referred to as reading distance No. 2. The subject was then seated at the desk once again and requested to write a short essay on the article he had read. This measurement will be referred to as reading distance No. 3. A series of measurements were taken during each task situation and a single figure as recorded after three consecutive measurements were taken. We had to eliminate three of the subjects' measurements from the study due to a lack of consistancy in the findings.

Each subject was then given a distance refraction to determine the maximum correction for the best visual acuity. A standard O.E.P. monocular and fused cross-cylinder followed at the sixteen inch distance. Using the same technique the testing was completed with monocular and fused cross-cylinder tests at the Harmon distance and at the measured reading distance when the subject was seated at the desk. One subject had to be eliminated due to a lack of response to the test at the Harmon distance. All other subjects responded well and were incorporated in the study.

A comparison of the various distances measured can be found in Figure I. It can be easily seen that the means of the Harmon distance



Standard Deviation 1.36

Median 14.5

Mean 14.44

Mode 16.0

A. Measurement of Harmon's Distance in inches

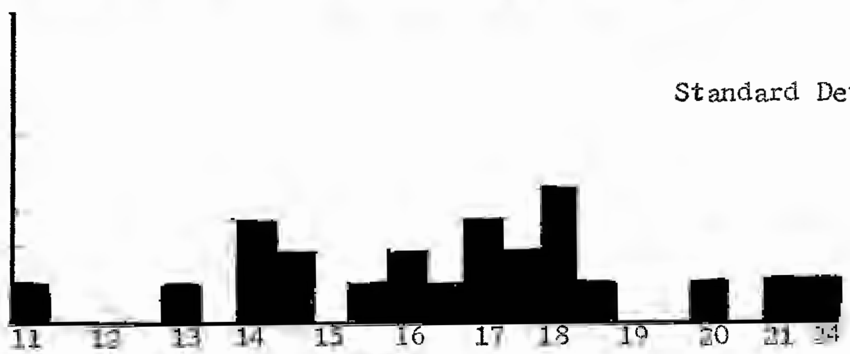
Standard Deviation 1.73

Median 15.0

Mean 14.85

Mode 17.0

B. Measurement of Reading Distance 1 in inches



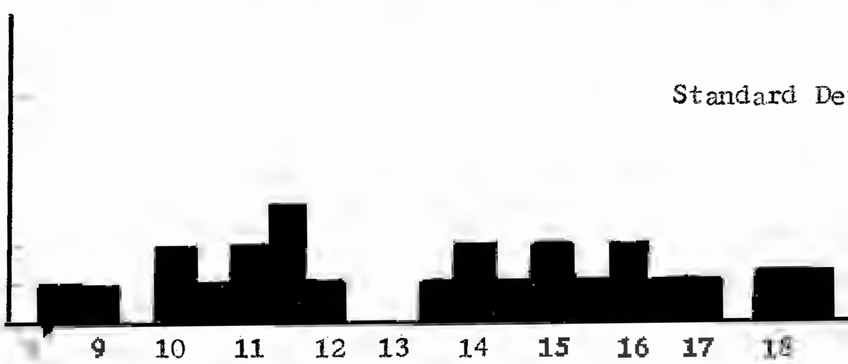
Standard Deviation 2.7

Median 16.5

Mean 16.69

Mode 18.0

C. Measurement of Reading Distance 2 in inches



Standard Deviation 2.9

Median 14.0

Mean 13.27

Mode 11.5

D. Measurement of Reading Distance 3 in inches and reading distance No. 1 correspond quite closely, while the reading distance No. 2 was a larger distance and the reading distance No. 3 a shorter distance. The standard deviation of the Harmon distance (1.36) and the reading distance No. 1 (1.73) were much lower than reading distance No. 2 and No. 3, which were 2.7 and 2.9 respectively. The correlations of all three reading distances and their average (shown in the appendix) were all very low and not significant. Harmon's distance correlated .34 to reading distance No. 1; .19 to reading distance No. 2; .08 to reading distance No. 3; and .26 to the average of the three.

Figure II deals with the actual difference between the Harmon distance and each measured reading distance on each patient in respect to sex and refractive error. These differences are listed in terms of plus being less than the Harmon distance and minus signifying a greater distance. Great variations were found within the three measurements on individual patients, as shown in Figure III, although the variation itself was very consistent. We, therefore, found it very hard to predict a

	H.D. - #1		H.D. - #2		H.D. - #3	
	Numerical Value*	%**	Numerical Value*	%**	Numerical Value*	%**
Hyperope	-0.7	14	-3.8	0	+0.2	29
Myope	-1.2	22	-3.3	11	+0.44	0
Emmetrope	+0.8	25	-0.75	25	+2.6	25
Astigmat	-0.1	60	-2.2	0	-1.1	20
Males	+0.5	22	-0.83	22	+3.3	11
Females	-1.0	20	-3.1	6	-0.2	20
Total	-0.4	21	-2.25	12.5	+1.1	16.5

Figure II.

Comparison of Measurements of Harmon's Distance and Various Reading Distances in inches

* Numerical Value of Harmon's Distance Minus Reading Distance
**Percent of subjects within .5 inches of Harmon Distance

	Mean Variation of three Reading Distances Measured	Mean Distance		Mean Distance	
		H.D.	#1	#2	#3
Hyperope	4.7	13.88	14.38	17.06	13.25
Myope	4.3	14.3	14.9	16.6	13.3
Astigmat	4.2	14.2	14.3	16.4	12.9
Males	4.3	15.6	15.22	16.55	12.44
Females	4.2	14.3	14.65	16.65	13.87
Total	4.25	14.9	14.85	16.69	13.27

Figure III.

Means of Various Reading Distances broken down into Groups and Total Deviation in Inches specific reading distance of an individual subject using only sex or refractive error as our criteria.

A percentage of each indiwidual group that executed each of the nearpoint tasks within one-half inch of his Harmon's distance is also shown in Figure II. Only seventeen per cent of the total measurements fell within this range, and no single subject meet this criteria on all three measurements. Of the twenty-four subjects only one had all three measurements fell within a two inch variance proving the variability of chosen distance on different nearpoint tasks of the individual subject.

The accommodative response at the sixteen inch, Harmon; and seated reading distances were computed from the cross-cylinder finding by the following procedure. The distance refraction (7A) was subtracted from the fused cross-cylinder finding (14B), and this total was subtracted from the reciprocal of the working distance in meters.

When analysing these findings we find a correlation of .66 between the sixteen

Breakdown of Subjects	Total Variation	Variation in Harmon Distance and 16 inch. Acc. Response	Variation in Reading Distance and 16 inch. Acc. Response
Total	.35	.30	.19
Myopes	.28	.22	.21
Hyperopes	.41	.36	.14
Emmetropes	.37	.36	.20
Astigmats	.57	.52	.40
Male	.17	.08	.17
Females	.45	.42	.20

Figure IV.

Means of Variation in Accommodative Response at the 16 inch, Harmon and Seated Reading Distances interms of Diopters.

Deviation	Total	Variation between Harmon Distance and 16 inch Accom. Response	Variation between Seated Readind Di Distance and 16 inch Accom. Response
0 - .12	11	13	16
.25 - .37	6	5	3
.50 - .62	2	2	3
.75 - .87	2	1	1
1.00 - 1.12	1	1	0
1.25 - 1.37	1	1	0
1.50 - 1.62	0	0	0
Total	23	23	23
Percent within .12	48	57	70
Percent greater.37	26	22	17

Figure V.

Variation of Accommodation Response at the 16 inch, Harmon and Seated Reading Distances inch and Harmon's distance and .85 between sixteen inches and the seated reading distance. The individual variations of these measured distances from the Harmon distance are shown in Figure V. There we see that seventy per cent of the subjects had an agreement within .12 Diopters of their measured accommodative response at the seated reading distance when compared with that at sixteen inches, while only fifty-seven per cent had a similar agreement between the Harmon distance and sixteen inches. At the other end only seventeen per cent has a disparity of .50 Diopters or greater between the seated reading distance and sixteen inches, with a twenty-two per cent deviant group when considering the Harmon distance and sixteen inches.

In regard to sex, the males showed a much lessened variation in accommodative response, and the myope the least among the various refractive groups. The astigmat showed the greatest, while the hyperope and emmetrope were fairly equal and consistent. Once again the same subject was shown to have a significant deviation in accommodative response at one distance, but not at another. The amount of variation in accommodative response at a certain distance was not dependant upon the deviation of that distance from the standard sixteen inch testing distance.

In conclusion, we have shown that there is a great individual variation in reading distance on various tasks. The Harmon measurement compared quite closely with the seated desk reading distance but the other reading distances showed great variation. Reading a popular periodical while seated on the reception room couch compared most closely to the standard sixteen inch testing distance, while the other three tasks were all done at a closer distance. The standard deviation was found to be much greater for writing and couch task distance when compared to the Harmon and seated desk distance, which were comparable. Sex and refractive error were not found to be significant determinations of any individual task distance. The correlation of the various task distances to the standard sixteen inch testing distance were very low indicating that they can definitely not be predicted or used interchangably.

Variations in the accommodative response at the different distances did not vary as greatly as the task distances, but did show significant deviation. The correlation of accommodative response at the desk reading distance and sixteen inches was a significant .85, while the correlation of the Harmon distance and sixteen inches was a less significant .66. Seventy per cent of the subjects at the desk reading distance and fifty-six per cent at Harmon's distance show less than .25 Diopter variation in accommodative response from the sixteen inch distance. A more important seventeen per cent and twenty-two per cent of the subjects at the desk reading and Harmon distances, respectively, have a variation of .50 Diopters or greater. This last group leads to the possible assumption that a significant portion of this college age group might receive a faulty near prescription based strictly, upon the standard sixteen inch cross-cylinder testing distance. The correlation of the desk reading distance was closer to the sixteen inch distance than Harmon's distance in respect to accommodative response; but these two distances (reading distance No. 1 and Harmon's) correlate very closely to each other (.89). Therefore either of these two measurements will give a more truly accurate measure of the accommodative system than the standard sixteen inch test distance.