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A study of vision screening for kindergarteners

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Abstract
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A STUDY OF VISION SCREENING
FOR KINDERGARTENERS

A Thesis

Presented to

the Faculty of the School of Optometry

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In Partial Fulfillment

of the Requirements for the Degree

Doctor of Optometry

by

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_______________ Director of thesis

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The completion of a study of this kind depends upon the assistance and cooperation of many persons. The authors wish to thank the administrators and kindergarten teachers of the Forest Grove school district for their time and consideration. We are especially grateful for the guidance and encouragement received from Pacific University faculty members during the course of the study.

We also wish to express our thanks to those optometry students who assisted in the gathering of data.

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CHAPTER I

INTRODUCTION

Educators and those in the health professions agree that efficient vision is vitally important for children entering elementary school. The ideal vision care program would include a complete visual examination for each of these children prior to entering the school situation. However, for reasons of time, cost, and available personnel, this goal is far from being obtainable today. Therefore, an effective vision screening is needed to bring visual deficiencies to the early attention of parents and schools.

A vision screening is merely a vision test or group of tests which can be administered to many subjects in a relatively short time. Its purpose is to identify those who have probable visual problems and refer them for further professional attention.

Screening has the advantages of being inexpensive, it can be accomplished with relatively few personnel, and when well designed, it holds the potential for detecting a very high percentage of children with visual disorders. The limitations of screening must also be defined and understood. A screening does not, and can not, thoroughly explore all facets of the visual system, and does not pretend to do so. There will be individuals with visual problems who are able to pass a screening. These individuals are under-referrals, or "false negatives". A screening may also produce over-referrals in the form of "false positives". These are children who for some reason fail the screening, but when subsequently given complete examinations, are not found to require treatment.

The most dangerous of these incorrect referrals is the under-referral, and it is to this problem that this paper will address itself. Existing screening programs are not designed specifically for the pre-schooler; moreover, they appear to be deficient in testing accommodation and convergence performance, and thus they yield under-referrals.

Our purposes were: 1) to determine how existing screening batteries would compare to a complete clinical examination in detecting abnormalities of accommodation and convergence; 2) to determine normative performance for kindergarteners on selected tests of accommodation and convergence; and 3) to determine whether an augmented screening battery could be designed to uncover visual problems not detected by the existing battery alone.

CHAPTER II

REVIEW OF LITERATURE

The most comprehensive study of vision screening methods to date is The Orinda Study. Over one thousand children in an elementary school district were tested in three successive years. Six different screening methods were used and the results of screenings were compared with clinical evaluations done at the University of California, School of Optometry, and the Stanford University, Department of Ophthalmology. The six screening methods used were: the Massachusetts Vision Kit; the Keystone Telebinocular test; the California State recommended procedure[1]; school nurse observation; teacher observation; and a Modified Clinical Technique (MCT). The MCT was concluded to be the most effective in terms of discovering children with visual abnormalities while at the same time keeping the number of over-referrals to a minimum.

The MCT is based on a sampling of four visual criteria: distance visual acuity, refractive error, coordination, and organic problems. The following are procedures for administering the MCT

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[1]California State recommended procedure: teacher tests with Snellen "E" first unaided, and then through +1.50 and +2.00 diopter spheres; cover test; teacher positives and doubtfuls are retested by school nurse, who makes decisions for referral.

as recommended in The Crinda Study.

1. Visual Acuity. This is measured with a table model projector type instrument (e.g. American Optical Company Projectochart Model 1217) and appropriate slides for both letters and illiterate "E" charts projected on a screen at twenty feet.

2. Cover Test. With the above projector, showing a single threshold letter on the screen, and an occluder, both the cover-uncover and alternate cover tests at a distance of twenty feet are performed. A loose prism of 5 prism diopters may be used for accurate determination of coordination at the cut-off point. With a single threshold letter held at 16 inches and with 6 prism diopter and 10 prism diopter loose prisms, the coordination at the near point is determined by the cover test.

3. Skiametry. The equipment required includes a small movie projector and screen, a retinoscope, 2 pairs of +1.50 D.S. lenses in trial frames, and a test lens bar. The child being tested observes a cartoon film projected on a screen at a distance of twenty feet through a pair of +1.50 D.S. lenses. Since it is desirable to have the child look through the lenses for at least one minute before the test is made, the lenses can be placed before the child's eyes and he can observe the film while the examiner performs test 1 and test 2 on the next child. When the retinoscopy test is being performed, the lens bar containing lenses of -0.75, +0.75, +1.50, +2.25 D.S. is held in front of the lenses in the trial frame. The best estimates of the total refractive error for the vertical and horizontal meridians are recorded separately. Only if there is a marked oblique astigmatism are other meridians reported. To reduce recording errors, the vertical meridian should always be reported first.

4. Organic problems. With a hand magnifier and ophthalmoscope, external and internal organic problems are checked for.[2]

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[2] Henrik Blum, Henry Peters, and Jerome Bettman, Vision Screening for Elementary Schools--The Orinda Study

Table I lists the referral criteria used with the Modified Clinical Technique as recommended in The Orinda Study.

A study by Harold M. Haynes, published in 1958[3], described testing done on a kindergarten population. Haynes' routine included a complete analytical series with distance refraction, visual acuity, ocular health, and standard optometric near point tests, in addition to tests for unification, stereopsis, and manipulatory skills.

He concluded that for school referrals, measure of refractive error, visual acuity, accommodative tests, and convergence tests were most necessary and that the number of tests could be greatly lessened without decreasing the effectivity of the sequence.

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[3]Harold M. Haynes, O.D., "A Report of the Forest Grove Preschool Study", Journal of American Optometric Association, XXIX (No. 9, April, 1958), pp. 573-578.

TABLE I

THE ORINDA REFERRAL CRITERIA FOR MCT

Modified Clinical Technique	Criteria for referral	
Visual Acuity	20/40 or poorer with either eye	
Refractive error		
Hyperopia	+1.50 D.S. or more	
Myopia	- .50 D.S. or more	
Astigmatism	1.00 D.C. or more	
Anisometropia	1.00 D. or more	
Coordination	Distance	Near
Tropia	Any	Any
Esophoria	5$^{\Delta}$ or more	6$^{\Delta}$ or more
Exophoria	5$^{\Delta}$ or more	10$^{\Delta}$ or more
Hyperphoria	2$^{\Delta}$ or more	2$^{\Delta}$ or more
Organic	Any pathology or medical anomaly of the eye and/or adnexa	

CHAPTER III

PRELIMINARY RESEARCH

The case findings for 166 children tested at the Pacific University Optometry Clinic in a 1968 Kindergarten Project were made available to us for study. In this testing program a rather complete examination was given each child, but the results were used to classify into refer or non-refer categories on the basis of clinical judgement. A list of the findings taken is given in Table II. Those findings marked by asterisk are tests common to the MCT screening bettery.

We compared those subjects who were categorized by the clinical examinations as being in need of visual care to those who would have failed the MCT by The Orinda Study criteria. This comparison is illustrated in Table III.

The difference in numbers of clinical failures and MCT referrals by refractive error and visual acuity were due only to differences in pass-fail criteria, (i.e., the arbitrary levels of hyperopia, myopia, astigmatism, anismetropia, and reduced acuity that are considered tolerable). The MCT would have been as effective as the clinical examination in the detection of strabismus. Eight subjects out of the population of 166 were judged to have accommodative dysfunction by the clinical examination. This area of visual performance is not sampled by the MCT. In evaluation of convergence performance, the MCT would have failed to refer four subjects who had subnormal amplitudes of convergence.

The two subjects with excessive heterophorias would have been correctly determined by both clinical and MCT criteria; however, even if we rule out "missed" referrals due to the less stringent fail criteria of the MCT, the MCT would also have missed 12 additional subjects having visual abnormalities, and so would have correctly referred only 60% of subjects requiring professional attention in all areas tested by the clinical examination.

The Crinda Study showed that optometrists tend to consider smaller deviations to be of more clinical significance than do ophthalmologists. Since both optometric and ophthalmological evaluations were involved in determining the pass-fail criteria of the MCT, it is not particularly surprising that the above differences in referrals exist here. The 1968 study cited above involved judgements by optometric evaluations only, and so could be expected to yield a higher overall referral rate. Nevertheless, these factors alone do not completely account for the discrepancies, as we will attempt to show.

In order for a screening battery to be maximally effective, we feel it should include, in addition to the MCT, tests in two other areas of performance, viz., accommodation and amplitude of convergence.

TABLE II

TESTS ADMINISTERED IN PACIFIC UNIVERSITY KINDERGARTEN PROJECT

Case history	Subjective refraction
*Visual acuity	Lateral and vertical phorias at 20 feet and 16 inches
Monocular light fixation	Lateral and vertical ductions at 20 feet and 16 inches
Binocular versions and rotations	Relative accommodative ranges
Binocular motor field	Accommodative rock
Tracking skills	Cross cylinder tests at 10 and 16 inches
NPC	*Static distance retinoscopy
*Cover tests at 20 feet, 16 inches, and 8 inches	Dynamic retinoscopy tests (MEM, monocular high neutral, binocular high neutral at 16 inches)
Stereo pointing	
Eye dominance	
*Internal-external ocular examination	

(Asterisk indicates MCT test)

TABLE III

COMPARISON OF PACIFIC UNIVERSITY KINDERGARTEN AND MCT REFERRALS

Category	Clinical Failures	MCT Referrals
Dist. Refr. & V.A.	12	9
Strabismus	6	6
Accommodation	8	none
Convergence	6	2
Totals	32	17

CHAPTER IV

DESCRIPTION OF RESEARCH

To determine the validity of our conviction that a more effective screening is possible, we decided to design a program and carry out a screening study of kindergarten children.

In designing a screening battery, tests of the following areas of vision were deemed necessary: visual acuity, refractive error, ocular health, eye coordination, accommodation, and amplitude of convergence. The MCT encompasses the first four of these areas, and therefore it was chosen to be used in conjunction with our additional tests.

In considering a test for accommodative performance it was felt that some type of dynamic retinoscopy would best fit the qualifications of a screening test. The Monocular Estimate Method (MEM), as described by Haynes[4], was chosen. It is completely objective, quick, and requires a minimum amount of instrumentation (retinoscope, testing card, and two or three trial lenses). Haynes'[5] studies have shown that this test correlates highly with the binocular near cross cylinder (#14B) and can directly measure the accommodative response under normal seeing conditions.

[4,5] Harold M. Haynes, "Clinical Observations with Dynamic Retinoscopy", The Optometric Weekly, (October 27, 1960 and November 3, 1960), pp. 2243-2246 and 2306-2380.

The MEM testing card, which is mounted at the plane of the retinoscope mirror, is approximately five inches square and has four animal pictures around the observation hole. This test is performed, as are the other tests of the MCT, with correction in place if one is worn and without if no correction is worn. The child being tested is asked to name the animals while the examiner estimates the amount of "with" motion of the retinoscope reflex. This measurement is recorded as the estimated amount of plus lens which would be required to neutralize the "with" motion in the horizontal meridian, and is called the gross MEM value. The child is then asked to tell the examiner what color eyes each of the animals has. The purpose of this is to force the child to make a maximal accommodative response to fine detail. The amount of "with" motion is checked by placing a plus lens quickly before the eye at the exact moment that the retinoscope streak is flashed across the pupil.

The Near Point of Convergence test (NPC) was chosen to supplement the near cover test in an effort to screen the convergence system. In this test, the subject is instructed to look at a small fixation light held at a distance of about 16 inches from his face. The examiner notes the position of the corneal light reflexes to insure binocular fixation. The subject is then told to watch the fixation light while it is moved slowly toward the bridge of his nose. When the examiner observes the deviation of one of the eyes he notes the distances and asks the patient how many lights he sees at that instant. If the patient reports diplopia, he is instructed to tell the examiner when he sees only one light again. The fixation target is withdrawn until the patient reports singleness or the examiner notes binocular recovery. In the event the subject does not report diplopia, the break and recovery are determined objectively. The NPC break and recovery are recorded in inches from the bridge of the patient's nose.

We decided to do our screening "cafeteria style", with the children moving from one examiner to the next until they had completed the entire battery. It was decided that visual acuity would be taken first, followed by cover test, NPC, ocular health, distance retinoscopy, and MEM, in that order.

The referral criteria for MCT tests would be those recommended by the Orinda Study (Table I). No initial referrals were to be made on the basis of the MEM or NPC until all data were taken and evaluated statistically. Then a clinical examination would be administered to the small group which passed all MCT tests but showed significant deviation from normative performances on MEM and NPC.

The kindergarten children to be studied were those of Forest Grove Public Schools, District # 15, Forest Grove, Oregon, and were comprised of predominantly white, rural and suburban children between the ages of five years six months and six years four months. Several steps were taken in the organization of the screening. We first met with the superintendant of the school district and discussed the objectives of our study and what the screening project would entail. Later, the principals of each of the five schools were contacted to go over the procedures for handling the results of the screening and informing parents of referrals. A conference was also arranged with each of the teachers of the kindergarten classes. In these conferences we asked the teachers to note any unusual behavior of a child which she thought might be due to visual difficulties. (A form was provided for this). She was also asked to instruct her class in making hand signals to correspond with the "tumble E's" of the acuity chart. (Three fingers pointing in the direction of the E). The authors were assisted by other sixth year optometry students; however, we alone ran the MEM and NPC tests and any retests that were performed.

CHAPTER V

RESULTS

Prior to making out referral lists for each of the schools, we evaluated the data for MEM and NPC. Those children falling two standard deviations or more on the high side of the NPC break and/or recovery means were tentatively determined to be significantly aberrant performers. On MEM, those falling above two standard deviations on the greater "with-motion" side of the mean were deemed significantly variant. In other words the "fail" levels were NPC break greater than 4 inches, recovery greater than 7 inches, MEM gross greater than 1.75D "with" motion, fine detail greater than 1.00D "with" motion.

By the above criteria and those of Table I, a total of 56, or 20% of N, would be referred for further visual analysis. A breakdown of the causes of referral is given in Table IV.

Our data show that 18% were referred by the MCT tests. Ten children (4% of total tested) in addition to failing the MCT criteria also failed the NPC or MEM. Seven (2%) failed by NPC or MEM alone.

TABLE IV

DATA OBTAINED FROM TEST RESULTS

Number of tests failed	Test titles	Number of children who failed test
One	Visual Acuity	3
	Dist. Retinoscopy	14
	Cover test	12
	N.P.C.	5
	M.E.M.	2
	Ocular health	1
Two	Ret. and M.E.M.	3
	Visual Acuity and Ret.	4
	Cover and M.E.M.	1
	Cover and Ret.	2
	Cover and Visual Acuity	1
Three	Ret., Visual Acuity, Cover	2
	Ret., Visual Acuity, N.P.C.	2
	Ret., Visual Acuity, M.E.M.	3
	Ret., N.P.C., M.E.M.	1

Data for the MEM dynamic retinoscopy is shown in Figure 1. The curve for the gross target shows a positive skewness at 0.87D of with motion. The mean is 1.00D with motion and the S.D. for the data is 0.35D. For fine discrimination the curve shows a similar skewness at 0.37D, mean accommodative lag of 0.42D, with a S.D. of 0.27D.

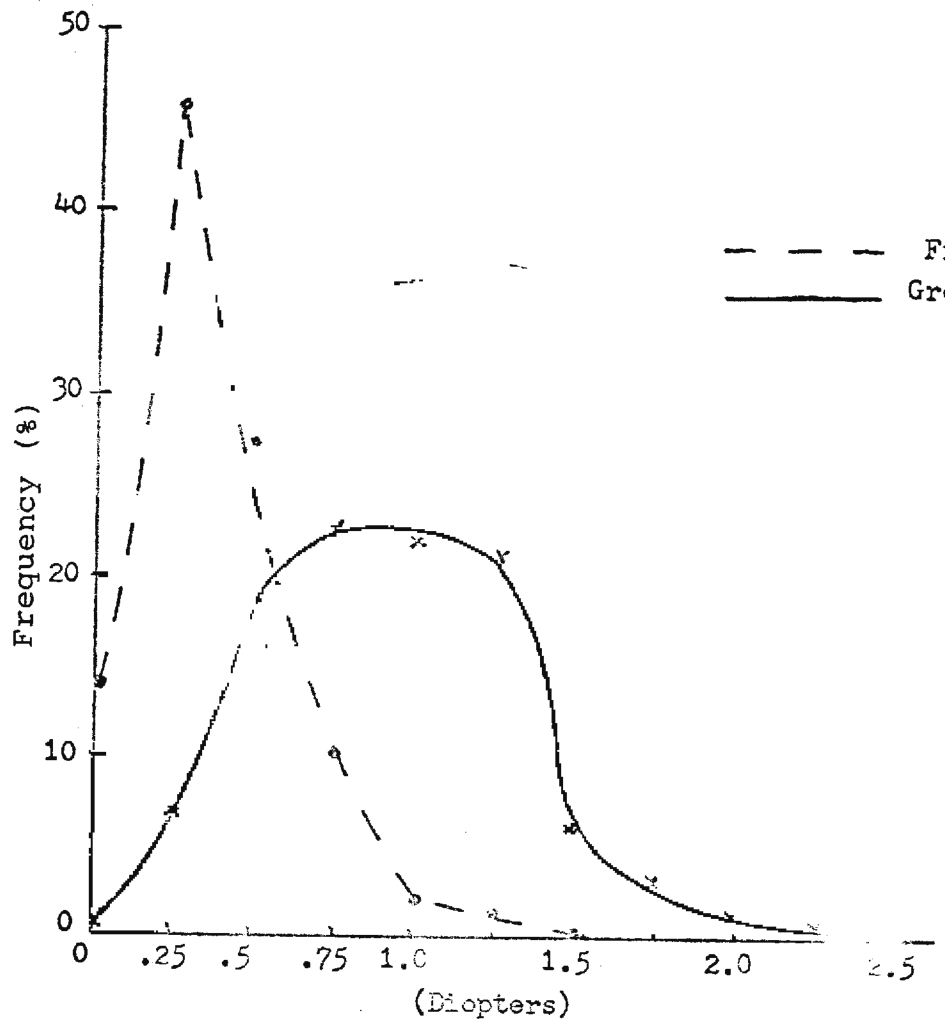

Figure 1. Frequency distribution of accommodative lag (MEM method) for kindergarten children (N=256).

Near point of convergence data show a mean Break/Recovery of 1.6 inches/3.1 inches. The Break curve in Figure 2 is leptokurtotic and skewed positively at one inch. The Recovery curve shows greater variability, extending to 14 inches.

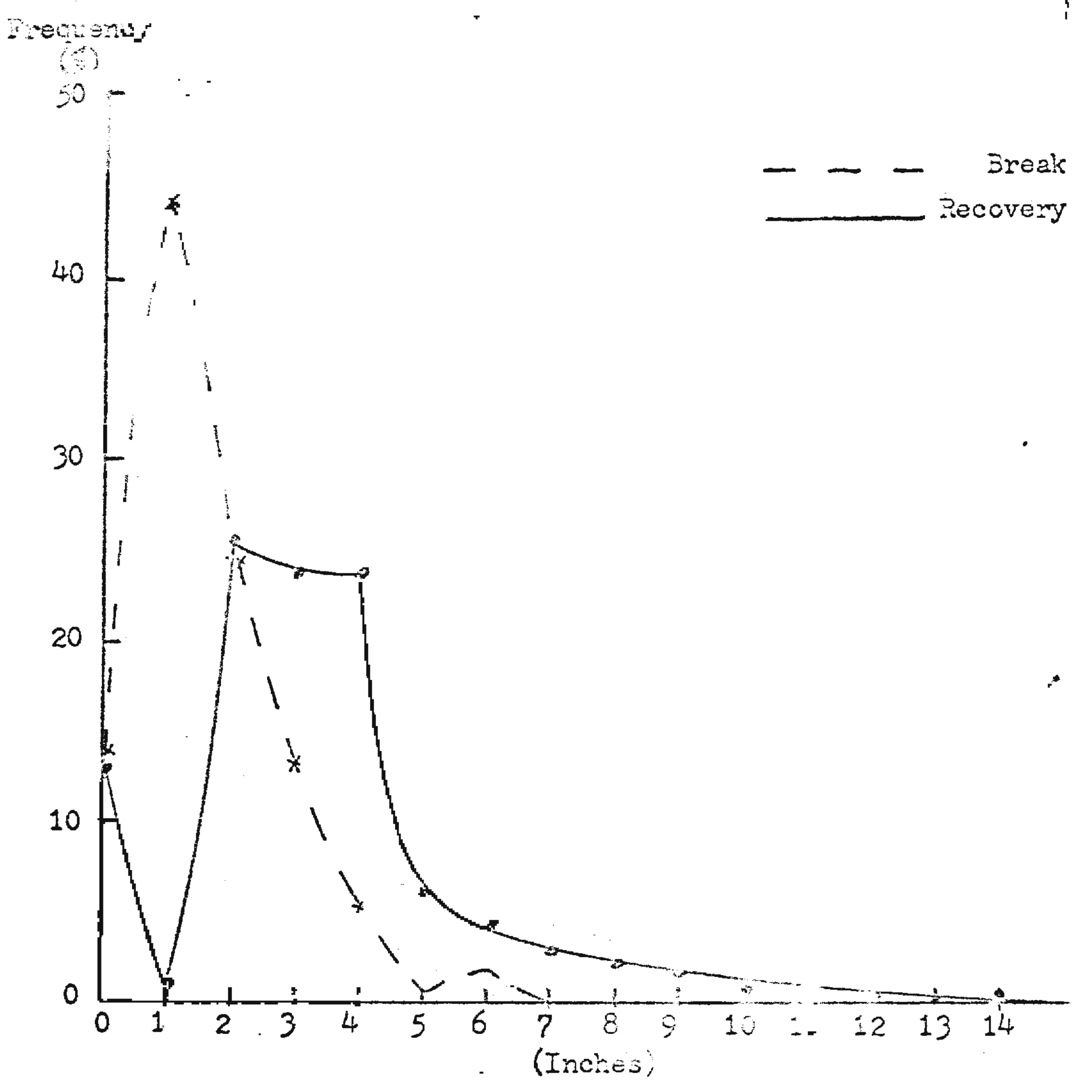

Figure 2. Frequency distribution of NPC Break and Recovery for kindergarten children (N=256).

The distribution of refractive error in Figure 3 below shows a leptokurtosis, and nearly symmetrical distribution. The mean refractive error of this population was found to be 0.62D hyperopic, with S.D. of 0.47D. 88.8% of the subjects were found to be hyperopic, 5.8% emmetropic, and 5.4% myopic.

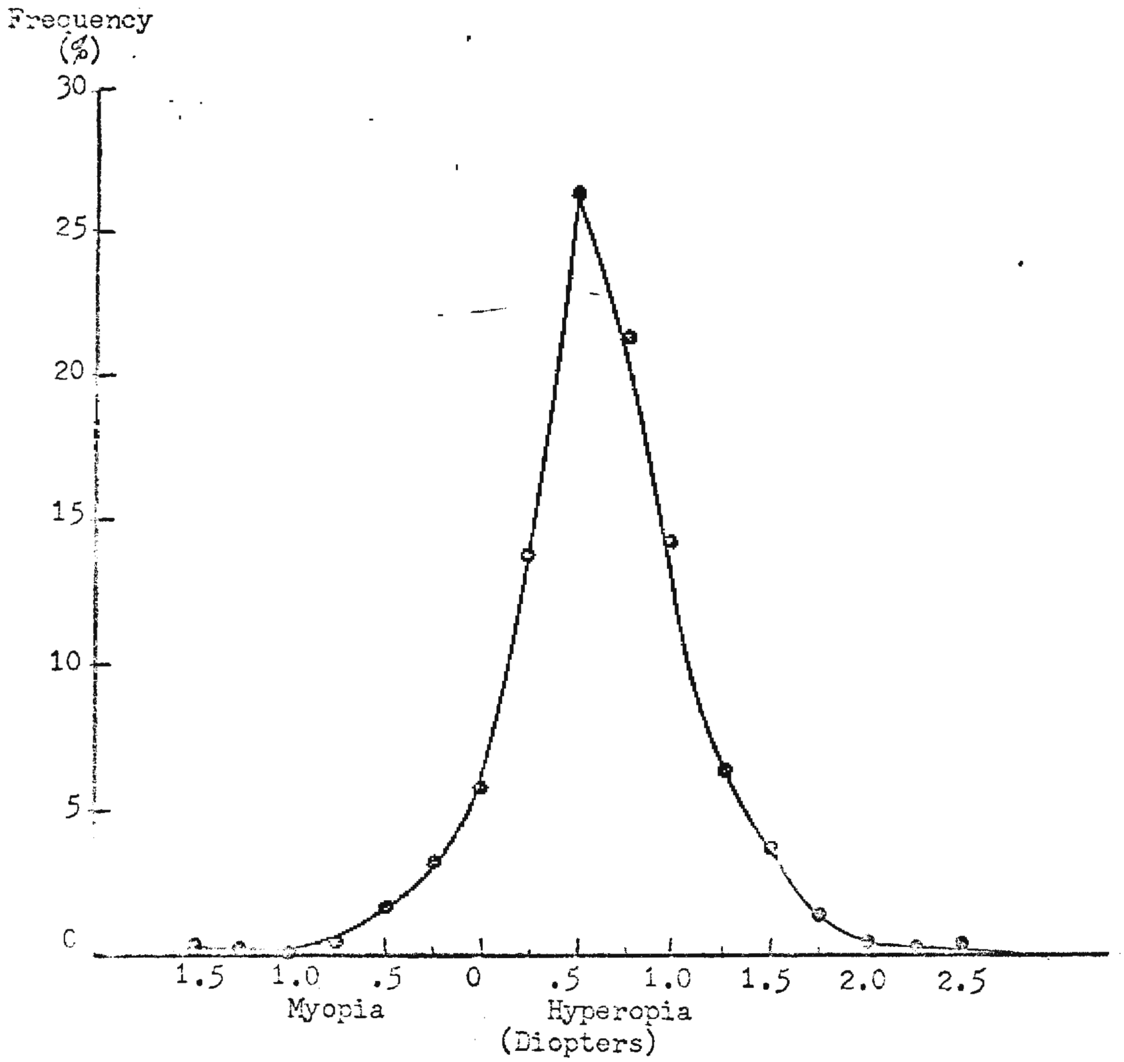

Figure 3. Frequency distribution of refractive error of kindergarten children. (N=512 eyes).

Figure 4 shows the distribution of astigmatic errors. 67.4% of the eyes were found to have less than 0.25D, 28.3% had between 0.25 and 0.50D of astigmatism, and only 4.2% had astigmatism greater than 0.50D. 1.2% of the population had astigmatism of 1.00D or greater and would be failed by the MCT criteria.

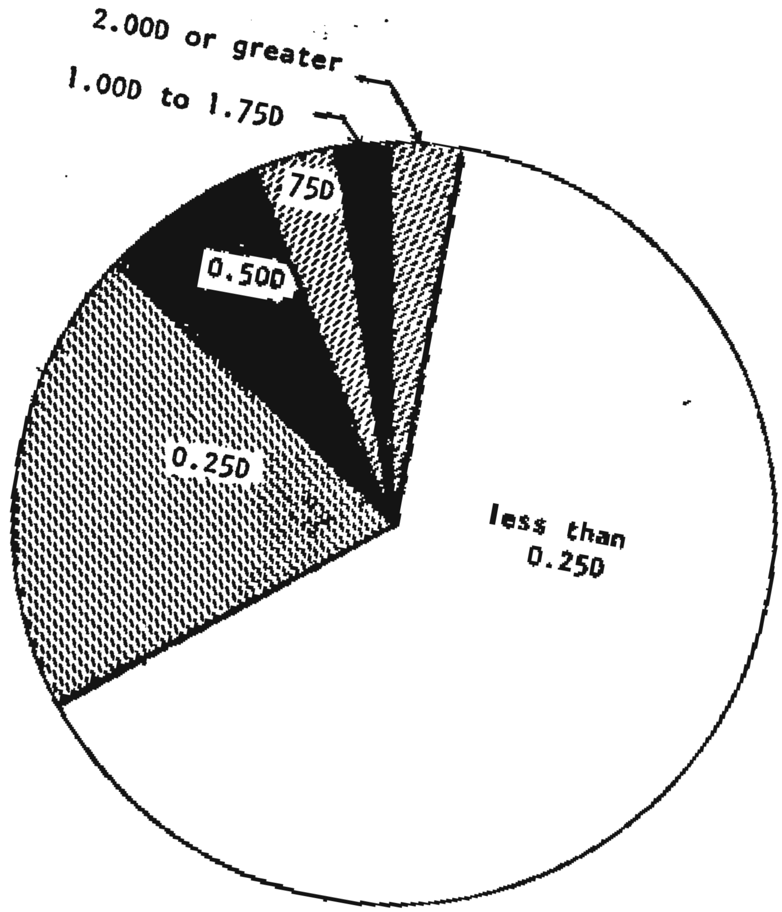

Figure 4. Diagram and distribution of astigmatic errors (N=512 eyes).

Figure 5 shows the distribution of anisometropia. 55.5% of the eyes were found to have less than 0.25D of anisometropia. 41.3% had between 0.25 and 0.50D, and 3.6% had anisometropia of greater than 0.50D. 1.2% of the eyes had anisometropia of 1.00D or greater and were failed by the MCT criteria.

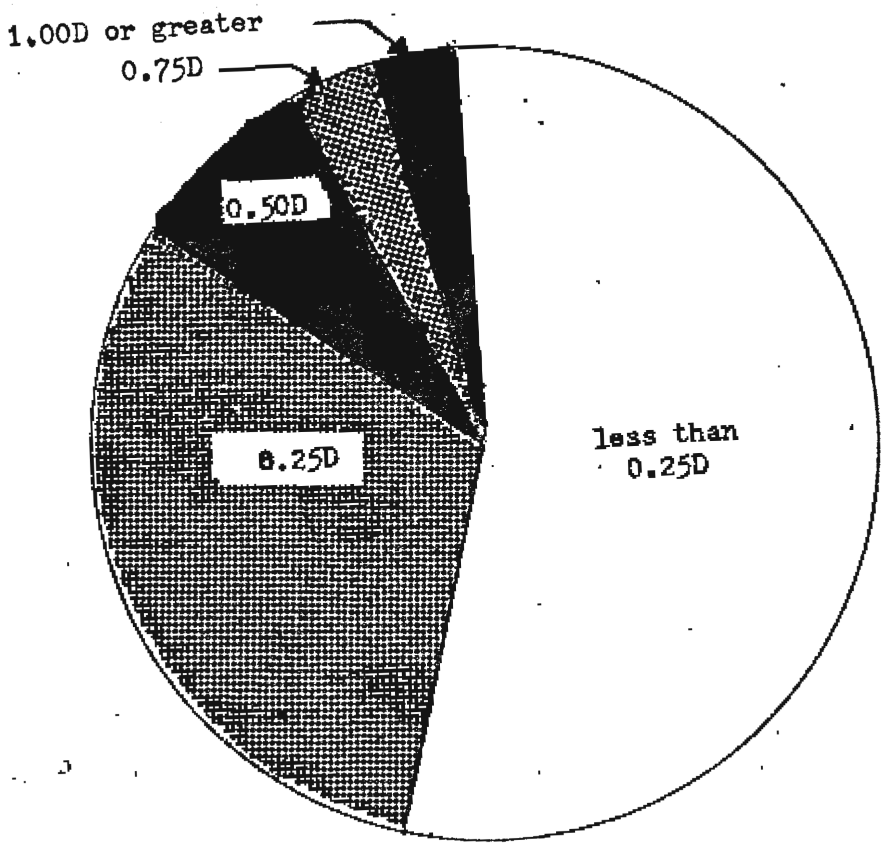

Figure 5. Diagram and distribution of anisometropia (N=256).

Results of Cover Test data are given in Tables V and VI. 95.3% of the children were found to be non-strabismic. 2.0% of these individuals were found to have excessive lateral heterophorias by MCT criteria and were referred. 4.3% of the population was classified as strabismic. One case of latent nystagmus was uncovered.

Clinical examination of the two children who passed all MCT tests but whose MEM values fell outside our established criteria (Gross MEM of 1.75D and Fine of 1.00D) showed highly aberrant accommodative performance when subsequently tested clinically. (Refer to appendix for results of clinical examinations). This was evidenced by low accommodative responses on near cross cylinder tests and dynamic retinoscopy tests showing accommodative response of .50D at 16 inches. Also, both subjects showed restricted relative accommodative ranges.

Of the six who failed on the basis of NPC alone, two were not available for clinical testing. The four who were examined all showed convergence problems. Poor manipulatory skills and low relative vergences were common to all four tested. Characteristic of the manipulatory skills were unsteady pursuits, inaccurate saccades, and low relative vergences in both base out and base in directions.

TABLE V

PHORIC POSTURE OF KINDERGARTEN CHILDREN
AS MEASURED BY COVER TEST
(N=256)

Magnitude of phoria	Percentage At 20 feet	Percentage At 14 inches
Less than 5^{Δ} eso	.4%	1.6%
Greater than 2^{Δ} eso	2.4	9.9
2^{Δ} eso to 2^{Δ} exo	88.0	22.5
Greater than 2^{Δ} exo	4.5	45.0
Greater than 5^{Δ} exo	0.0	15.9
Greater than 10^{Δ} exo	0.0	.4
Total	95.3%	95.3%

TABLE VI

INCIDENCE OF SQUINT IN KINDERGARTEN CHILDREN (N=256)

Type of squint	Frequency	Percentage
Esotrophia (constant)	2	.8%
Exotrophia (constant)	5	1.9
(periodic)	3	1.2
Hypertropia	1	.4
Total	11	4.3%

CHAPTER VI

DISCUSSION

Many studies have been done on refractive status of children. The majority of these studies are either on a large spectrum of ages or of later age groups. Few, if any, studies have reported the refractive status of a narrow band of age groups. Hence, the authors feel that the data of this nature, gathered in this study, should be of special importance.

The distribution of refractive error (Figure 2) shows a leptokurtosis but lacks the positive skewness reported by other investigators. Instead it approximates the symmetrical curve of the nine to ten year age group reported by Hirsch.

The mean refractive error of this population was found to be .62D hyperopia. For a similar population, Hirsch reports the mean refractive error to be approximately 1.00 hyperopic. The difference in refractive error could possibly be due to the broader spectrum of age in the Hirsch study. The difference however, cannot be explained in terms of methods of recording refractive error, for we chose the most hyperopic meridian for statistical purposes.

5.4% of the kindergarten children were found to be myopic. In contrast, Hirsch found 1.6% myopes. This threefold difference in percentage of myopes may be one of the factors influencing the difference of the mean refractive error between the two studies.

From a statistical standpoint, it appears that the MCT criteria for astigmatism may be too permissive. Only those at the 98.8 percentile and above would be failed by the MCT criteria. If the 96th percentile level were used, subjects having greater than .50D astigmatism would be failed.

Again, as for astigmatism, the MCT criteria for anisometropia seem to be too permissive from a statistical point of view. The MCT fail criteria lie at the 98.8 percentile level. If the 96 percentile were used, those subjects having greater than .50D of anissometropia would be failed.

The incidence of strabismus reported in the literature (2-3%) is slightly lower than was found in this study. This may be partially explained by the fact that 1.2% were periodic in nature, and secondly, the figure cited in the literature is for all age groups.

In the Orinda Study, for the 6 to 8 year olds, 16% were referred by MCT. We found for kindergarten children that the referral rate was 2% higher by the MCT criteria. In addition, 2% failed the NPC or MEM tests alone.

Clinical testing of those subjects that failed the MEM indicated poor accommodative performance as judged by the authors. Furthermore, those subjects who failed the NPC showed poor convergence and manipulatory performance when clinically tested. This leads the authors to believe that a receded NPC may be an indicator of poor convergence and poor eye-motor skills. We are also inclined to believe that a child with these deficiencies should not be allowed to pass a vision screening.

CHAPTER VII

CONCLUSIONS

From the results of the preliminary research run on the 1968 kindergarten project, we conclude that existing screening programs are not as effective in detecting abnormalities of convergence as is a complete clinical examination. Moreover, accommodative performances have been completely neglected in the most widely publicized screening batteries.

The referrals made on the basis of the MEM and NPC were judged to be correct referrals when the results of our clinical examinations were analyzed. Out of the population of 256, 56 were referred. Using only the criteria of the MCT, 48 would have been considered for referral. 14% of the kindergarten children needing visual attention, by our criteria, would not have been referred by MCT.

In terms of accommodative performance as measured by the MEM, the normative accommodative lag was found to be 1.00D for gross discrimination and 0.42D for fine discrimination. The convergence amplitude as measured by the NPC was found to be 1.6"/3.1" for this age group.

Until the availability of economic and manpower resources makes the full clinical examination of all preschool children feasible, it will be necessary to rely upon screening to identify those children having vision problems. We feel that our study shows that the MCT could be made significantly more effective by the addition of two simple tests, the MEM and NPC, in catching deficiencies in accommodation and convergence.

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APPENDIX A:

RECORDING FORM FOR SCREENING

VISION SCREENING

NAME________________________ AGE_____ SEX_______School______________

Wears glasses? Yes No Full time? Near only? Distance only? Today?

Remarks.

Pass	Fail			
			Habitual V.A. @ 20'	OD ________ OS ________
			Cover Test	20' ________ 16" ________
			N.P.C.	____/____
		Distance Retinoscopy	#1 OD ______ @ ____ OS ______ @ ____	[redacted] OD ______ @ ____ OS ______ @ ____
			M.E.M	Birds OD ________ OS ________ EYES OD ________ OS ________

OCULAR HEALTH

Right eye	Left eye
Pass Fail	Pass Fail
Remarks	Remarks

APPENDIX B:

CLINICAL FINDINGS AND MEM AND NPC FAILS

Patient: R.G. (Failed NPC)
Visual acuity: 20/20 (Far) & 20/30+ (Near)
Cover test: Ortho @ 20'
5 exo @ 16"
NPC: 6"/9"
Manipulatory skills: Poor
Ocular health: Negative
#3) 4/2 eso
13A) 4 exo
4) OD +.50-.50 x 180
OS +.50DS
VA = 20/20 OD,OS,OU
5) OD +2.50-.50 x 180
HN (monoc) at 13" = OD +3.50D
HN (monoc) at 20" = OD +2.75D
7) +1.00D
+ .75D
7A) +.25D
Plano
VA = 20/20 OD OD,OS,OU
8) 1 eso
9) X
10) 16/3
11) 23/0
12) Negative
13B) 6 exo
14A) OD +2.50D
15A) 12 exo
14B) OD +1.50D
15B) 7 exo
16A) X
16B) 16/0
17A) X
17B) 16/12
20 Gross) -4.25/-4.00D
20 Ø) 8 eso
21 Gross) +3.00/+2.25D
21 Ø) 10 exo
Stereo Fly: Positive stereo response

Patient: G.C. (Failed NPC)
Visual acuity: 20/20 @ Far & $20/30^{+}$ @ Near
Cover test: ortho @ 20'
3 eso @ 16"
NPC: 3"/8"
Manipulatory skills: Poor
Ocular health: Negative
#3) Ø/5 eso
13A) 9 eso
4) OD +1.25 -.50 x 90
OS +1.25 -.25 x 90 VA = 20/20 OD,OS,OU
5) OD +2.50D
LN) OD +2.50D
LN @ 10") OD +3.25D
7) +1.25 -.25 x 90
+1.00 -.25 x 90
7A) +.75 -.25 x 90
+.50 -.25 x 90 VA = 20/20 OD,OS,OU
8) 4/9 eso
9) X
10) 19/5
11) 6/1
12) Negative
13B) 7 eso
14A) OD +2.00 -.25 x 90
15A) 6/8 eso
14B) OD +1.25 -.25 x 90
15B) 10 eso
16A) X
16B) 30/12
17A) X
17B) 18/-4
20 Gross) -3.25/-3.00D
20 Ø) 21 eso
21 Gross) +3.50/+3.25D
21 Ø) 2 exo
Stereo Fly: Positive stereo response

Patient: W.B. (Failed NPC)
Visual acuity: 20/20 (Far) 20/30 (Near)
Cover test: Ortho @ 20"
6 exo @ 16"
N.P.C.: 8"/12"
Manipulatory skills: Poor
Ocular Health: Negative
#3) ortho
13A) 3 exo
4) OD +.75D.S. VA = 20/20
OS +.25-.25 x 180 VA = 20/20
5) OD +2.00
HN (monocular) at 20" = OD +2.00D
HN (monoc) at 10" = OD +2.50D
LN (16") = OD +1.75D
LN (10") = OD +1.00D
MEM (14") = .87/.37 with motion
7) +1.00 VA = 20/20
+ .50 VA = 20/20
7A) +.25D
-.25D
8) 3 eso
9) X
10) 7/3
11) 6/4
12) Negative
13B) 6 exo
14A) +1.50D (OD)
15A) 6 exo
14B) +.50D (OD)
15B) 5 exo
16A) X
16B) 10/2
17A) X
17B) 12/6
20 & 21) No response
Stereo Fly: Positive stereo response

Patient: S.C. (Failed NPC)
Visual acuity: 20/20 @ Far & 20/30 @ Near
Cover test: 2 exo @ 20'
6/8 exo @ 16"
Manipulatory skills: Poor
NPC: 3"/11"
Ocular Health: Negative
4) +.25 -.25 x 180 VA = 20/20 OD,OS,OU
+.25 -.25 x 180
5) +1.75 -.25 x 180
+1.75 -.25 x 180
HN (monoc) @ 20" OD = +2.25D
HN (monoc) @ 13" OD = 3.25D
LN @ 20" OD = +1.25D
LN @ 13" OD = +2.25D
MEM @ 13" = 1.00/.75D
8) 2 exo - 2 eso
9) X
10) 16/2
11) 12/8
14B) OD +1.00D
16A) X
16B) 20/10
17A) X
17B) 30/12

Patient: K.R. (Failed MEM)
Visual acuity: 20/20 @ Far & 20/30 (slow) @ Near
Cover test: Ortho @ 20'
5 exo @ 16"
NPC: 3"/4"
Manipulatory skills: Fair
Ocular health: Negative
#3) Ortho
13A) 2 exo
4) OD +.75 -.50 x 180 VA = 20/20 OD,OS,OU
OS +.50DS
5) +2.50D
HN (monoc) @ 20" = OD +2.25D
HN (monoc) @ 13" = OD +3.25D
LN) OD +2.50D
LN @ 10" = OD +2.75D
MEM @ 16" = 1.50/1.00D
MEM @ 10" = 1.50/1.37D
7) +1.00 -.50 x 180 VA = 20/20-
+ .75DS
7A) +.50 -.50 x 180 VA = 20/20 OD,OS,OU
+.25DS
8) Ortho
9) X
10) 15/5
11) 9/1
12) Negative
13B) 2 exo
14A) OD +3.00 -.50 x 180
15A) 10 exo
14B) OD +2.50 w/c
15B) 6 exo
14B @ 10" OD = +3.00
16A) X
16B) 32/7
17A) X
17B) 24/12
20) Gross -.25/+.25D
20 Ø) 2 eso
21) Gross +2.00/+150D
21 Ø) 5 exo
Stereo Fly: Positive stereo response

Patient: T.S. (Failed MEM)
Visual acuity: 20/20 @ Far & 20/30 @ Near
Cover test: Ortho @ 20'
4 exo @ 16"
NPC: 3"/4"
Manipulatory skills: Good
Ocular health: Negative
#3) Ortho
13A) 4 exo
4) OD +1.00 -.50 x 180 VA = 20/20 OD,OS,OU
OS + .75 -.25 x 180
5) OD +2.00 w/c
HN (monoc) OD +3.25D
HN (monoc) @ 10" = OD +3.25D
LN OD +2.75D
LN @ 10" = +2.50
MEM @ 16") 2.25/1.25D
MEM @ 10") 1.75/1.75D
7) +1.25 -.50 x 180 VA = 20/20 OD,OS,OU
+1.00 -.25 x 180
7a) +.75 w/c
+.50 w/c
8) Ortho
13B) 8 exo
Stereo Fly: Positive stereo response