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Vision Test Validation Study for the Health Examination Survey Among Youths 12-17 Years

Validation of selected parts of the vision test battery used in the Health Examination Survey of 1966-70 among youths 12-17 years of age against a standard clinical ophthalmological examination for distance visual acuity and eye muscle imbalance.

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COOPERATION OF THE BUREAU OF THE CENSUS

In accordance with specifications established by the National Health Survey, the Bureau of the Census, under a contractual agreement, participated in the design and selection of the sample, and carried out the first stage of the field interviewing and certain parts of the statistical processing.

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VISION TEST VALIDATION STUDY
FOR THE HEALTH EXAMINATION SURVEY AMONG YOUTHS

Jean Roberts, *Division of Health Examination Statistics*

INTRODUCTION

Vision tests were included in the standardized examination given the national probability samples of children and youths in the Health Examination Surveys of 1963-65 and 1966-70, which focused primarily on health factors related to growth and development, as previously described. [1,2]

In the survey among children 6-11 years of age, visual acuity and the degree of eye muscle imbalance were determined using selected Armed Forces Vision-Tester targets in Master Ortho-Rater instruments under carefully controlled conditions, as shown in the first vision and eye examination reports from that study. [3,4] Children were tested only without glasses or other corrective lenses.

Because of the reported substantial increase in the incidence of myopia at or around puberty, the vision test battery for the study of youths 12-17 years of age was expanded beyond that for children to include visual acuity tests with their usual refractive lenses and a set of trial lenses used to determine the presence and severity of myopia. Lensometer readings of the prescriptions used in the youths' present glasses or contact lenses were also obtained.

The new vision test battery for the youth study was developed primarily by ophthalmologists Dr. J. Theodore Schwartz of the National Eye Institute and Dr. Herbert A. Urweider of George Washington University School of Medicine. A feasibility test of the new battery was made, under the guidance of Dr. Urweider, in collaboration with Dr. Lawrence E. Van Kirk, Health Examination Survey Dental Advisor, by the two initial survey dental examiners who would be giving both the dental and vision test parts of the survey examination.

Since essentially no information was available on the comparability of results from two parts of the vision battery as they were being administered in the survey—the trial lens test for myopia or the phoria (eye muscle imbalance) tests—with those from the usual clinical ophthalmologic examination, a validation study planned with the advisory group and arranged by the author of this report was carried out under Dr. Urweider's direction in collaboration with Dr. Van Kirk. The study was conducted during July and August 1968 in Chicago, Illinois, immediately following completion of the regular survey examinations at the two locations of the mobile examination centers in that city. Dr. Mary Dahl, Illinois-licensed ophthalmologist, performed the clinical examinations with the assistance of Mr. John Petroff of Dr. Urweider's staff, who was the field manager for the clinical part of the validation study. Health Examination Survey field management and field representative staff made arrangements for the return of the youths who met the study criteria for these additional examinations.

It was recognized at the outset that three factors would affect to an unknown extent the comparability of results between survey tests and the clinical examination. The first and most critical of these was that in the clinical examination the best corrected acuity was obtained under cycloplegia (with the pupils dilated), while in the survey only an approximation to this best corrected acuity could be obtained with the

simple lens and without the use of cycloplegics. A second factor was the fundamental difference between the Ortho-Rater instruments and commonly used clinical tests. Only in the former does the optical distance of both distance and near test targets differ from their actual distance. The targets in the Ortho-Raters used to test phoria and visual acuity in the survey were actually only 13 inches from the eyes, and the desired relaxation of accommodation was produced by means of plus lenses before the eyes.[5] The third factor was that both acuity and degree of eye muscle imbalance are known to be affected by the individual's physical condition, in particular, bodily fatigue.[6] No attempt was made to determine or to control for any such changes in an individual youth's condition by the time of his reexamination which was scheduled a week or more after his survey tests.

STUDY PLAN

The vision test validation study for the Health Examination Survey among youths was designed to determine the degree of correspondence, with respect to myopia and lateral heterophoria, between actual survey test results and those obtained in the usual clinical examination by an ophthalmologist.

The study was conducted in Chicago, Illionois, during July and August 1968 immediately following completion of the regular survey examinations at the two locations of the mobile center in that city. Youths were given their regular standard survey examination, then a sample was selected for the validation study which was to include all of those with abnormal and one-third of those with normal vision test findings.

Criteria for the abnormal group were as follows:

1. Distance acuity of less than 20/20 (Snellen ratio) in either eye, and/or
2. Distance lateral phoria outside the range of scores of 6-16 where a score of 11 shows no heterophoria, and/or

Table A. Visually normal and abnormal youths 12-17 years of age from the Chicago area (stand 25) selected and reexamined in the special vision study: July-August 1968

Vision test results	All Chicago area examinees		Study sample selected		Reexamined in special study	
	Number	Percent of examinees	Number	Percent of examinees in study sample	Number	Percent of study sample reexamined
Total	210	100.0	148	70.5	98	66.2
Normal	92	43.8	30	14.3	29	19.6
Abnormal	118	56.2	118	56.2	69	46.6
Type of vision abnormality:[1]						
Acuity	106	50.5	106	50.5	59	39.9
Phoria	55	26.2	55	26.2	33	22.3

[1] Includes duplication— 43 youths had both types of abnormality.

3. Near lateral phoria outside the range of scores of 8-18 where 13 is the position of no lateral misalignment in binocular vision.

Of the 254 youths in the sample draw for the Chicago area, 210 were examined as part of the regular survey. Vision test results for them showed 92 as normal and 118 as abnormal under the special study criteria. At the time arrangements were made for the regular examinations, the Health Examination Survey representative had described the purpose of the additional special vision study and had obtained consent from the parents for the youths' participation in this later study, should they be selected. Arrangements were made to transport those youths to be returned to the special study center which was in the Public Health Service Outpatient Clinic.

Approximately two-thirds of those selected—98 out of 148—returned for the special vision study. These included 29 out of the 30 selected systematically from the normal group and 69 of the 118 visually abnormal group. Original survey examination findings for the visually abnormal group who were and were not reexamined are shown in table A. Vacations and work interfered with the return of the remaining 50 youths despite substantial followup effort by the Health Examination Survey representatives and the field manager for the clinical part of this study.

REGULAR SURVEY EXAMINATION

The test results from the regular survey examination that are compared in this report with the findings for the youths in the subsequent special vision study, with and without their glasses, include: lateral phoria at distance and near and monocular visual acuity at distance; the axis deviation and the power of the spherical and cylindrical lens correction in the youths' own glasses; and the findings from the trial lens test for myopia. To preserve the independence of the subsequent clinical examination findings, the survey test results were not made available to the special study ophthalmologist prior to the special study.

Monocular visual acuity was tested in the regular survey examination using specially designed targets in the Bausch and Lombe Master Ortho-Rater as described in the report, "Visual Acuity of Youths, United States."[7] Special care was taken to keep the youths from squinting and hence reaching a spuriously high acuity level during the test.

Lateral phoria of youths was also tested with and without correction in the regular survey examination using the appropriate plates for distance and near in the Bausch and Lombe Master Ortho-Rater in the same manner as the corresponding tests among children described in the report "Eye Examination Findings Among Children, United States."[4] For this part of the survey examination the targets permitted measuring the degree of lateral phoria in single prism diopters ($^{\Delta}$) at distance up to 11^{Δ} of esophoria and 11^{Δ} of exophoria and at near up to 13^{Δ} of esophoria and 21^{Δ} of exophoria.

The regular survey examination included a trial lens test for myopia for all youths whose distance acuity in either eye was less than 20/20 (Snellen). The power in diopters (D) of the seven spherical trial lenses used in the test were: 0, -1, -1.5, -2, -3, -4, and -5. The trial lens test, which was always started first with the 0 diopter lens, was given without cycloplegia. No attempt was made to determine the extent of cylindrical correction or axis deviation for those with some astigmatism or to test with positive lenses for those with hyperopia. Hence this trial lens test was intended to give only an indication of the presence or absence of myopia and a crude measure of the best spherical equivalent correction for myopia.

A lensometer was used in the survey examination to measure the power of the spherical and cylindrical lens corrections and the degree of axis deviation between the two in the present glasses of the examined youths. The recording forms used in the survey are included in the appendix.

CLINICAL EXAMINATION

At the start of the subsequent clinical examination each youth in the special study was first tested without, then with, his own glasses (if he had glasses) for the degree of lateral phoria at distance and near. The special study

ophthalmologist used the alternate cover technique, employing prism bars for the quantitative determinations which permitted measurements in single prism diopter units ranging up to 25^{Δ} of esophoria and 30^{Δ} of exophoria at distance and up to 30^{Δ} of esophoria and 35^{Δ} of exophoria at near.

A standard dosage of cycloplegic (2 drops of 1% Mydriacil 5 minutes apart) was administered. Twenty minutes after the last drop of Mydriacil was given, the study ophthalmologist performed a retinoscopic examination and determined the best possible correction for the youths at distance. The power of the spherical and cylindrical correction in each of these lenses was recorded to the nearest 0.25 diopter and the axis deviation to the nearest degree. The monocular acuity with this maximum correction was also obtained. Results were recorded on examination forms shown in the appendix.

The clinical examination was given from 1 to 4 weeks after the regular survey testing for each youth was completed.

FINDINGS

Phoria Tests

For youths in the special study, lateral phoria test results without glasses from the survey and later clinical examination were in better agreement on distance than on near tests among both the abnormal and normal control groups. At near, agreement was better on these tests among normal than abnormal subjects. Since the range in degree of lateral heterophoria was similar at distance and near but substantially greater among abnormal than normal subjects, the extent of agreement or lack of it between the survey and clinical tests does not appear to be a function of the severity of heterophoria.

The proportion of youths for whom comparable survey-clinical test results differed by no more than 1 prism diopter was highest for normal subjects at distance without glasses (41 percent) and lowest for abnormal subjects at near without glasses (10 percent), as shown in tables B and 1-4.

Table B. Extent of agreement between phoria test results on survey and clinical examination of youths 12-17 years of age: Chicago Special Vision Study, 1968

Group and test	Number of youths given both tests	Difference between survey and clinical scores in prism diopters			
		0^{Δ}	1^{Δ} or less	2^{Δ} or less	3^{Δ} or more
		Percent of examinees			
Abnormal group					
Distance:					
Uncorrected	47	6.4	31.9	57.4	42.6
With correction[1]	37	5.4	24.3	37.8	62.2
Near:					
Uncorrected	60	1.7	10.0	16.7	83.3
With correction[1]	37	13.5	27.0	29.7	70.3
Normal group					
Distance:					
Uncorrected	29	20.7	41.4	65.5	34.5
Near:					
Uncorrected	28	10.7	21.4	39.3	60.7

[1] With own glasses or contact lenses.

On these tests without glasses, the proportion for whom survey and clinical phoria test findings differed by 3 prism diopters or more was significantly greater on near than distance tests among both normal subjects (61 percent compared with 34 percent) and abnormal subjects (83 percent compared with 43 percent). The respective near-distance differences in these proportions are statistically significant at the 5-percent probability level or lower. The proportion showing this degree of difference on clinical retest (3 prism diopters or more) without glasses is also significantly greater on near, but not distance, tests among the abnormal than the normal group (83 percent compared with 61 percent). Findings with respect to the agreement between clinical and survey phoria tests with glasses among abnormal subjects are inconclusive; the respective proportions of substantial disagreement (3 prism diopters or more) do not differ significantly from those found between survey-clinical test results among normal subjects.

Survey tests generally tended to rate the subjects as having a greater degree of lateral heterophoria than did the clinical tests. More than half of the normal and abnormal subjects scored lower on the clinical than on the corresponding survey test for all but the normal group when tested at near. The proportions with lower clinical than survey scores ranged from 64 percent for the abnormal group at distance without correction to 58 percent among normal subjects at distance but dropped to 46 percent for normal subjects when tested at near. For the remainder whose clinical score was not lower than their survey test, the clinical score was substantially more likely to have exceeded than to have been the same as the survey score among abnormal subjects on three of the four tests—at distance without correction and at near without and with correction—and among normal subjects at near.

When the type of heterophoria in any degree was considered, substantially more youths were rated as having 1 prism diopter or more of esophoria at distance on survey than on clinical tests, the proportions ranging from 69 to 78 percent for the abnormal group with and without correction and for the normal group on the survey compared with 3 to 6 percent on the respective clinical tests, as shown in table C. At near, the survey test results with respect to some degree of esophoria are less consistent than those at distance, but for two of the three groups or tests—abnormals with correction and normals—proportionately more than twice as many were rated as esophoric in the survey than in the clinical examination. At near, the proportion rated as exophoric (1 prism diopter or more deviation) was similar on survey and clinical examinations for all three groups or tests—abnormals without and with correction and the normals. However, at distance, significantly more (proportionately two to three times as many) were found to have some degree of exophoria (1 prism diopter or more) on the clinical than the survey examination.

The survey tests at distance were substantially more likely to show lateral eye muscle imbalance than were the clinical tests: the three survey tests showed only 8-21 percent as normal or orthophoric (0 prism diopters of deviation) compared with 54-76 percent for the corresponding clinical tests. At near, this pattern was also found among abnormal subjects when tested with correction (but not without) and among normal subjects.

The degree of association as measured by the correlation coefficient between clinical and survey phoria test results among abnormal subjects is significant and slightly higher for tests without glasses at distance than near (r =+.55 and +.44, respectively). A significant association also may be seen on tests with glasses and for normal subjects where the chi-square test for independence shows a relationship or lack of independence significant at the 1-percent probability level or lower (tables 1-4).

Since it is the purpose of the survey tests to identify and determine the extent of significant esophoria or exophoria rather than to give a precise measure or distribution of the degree of imbalance in the youth population, the extent of agreement between survey and clinical examination on this basis is of primary interest here. The critical levels of significant heterophoria most frequently recommended in standards for referring children for further study and care are 5 prism diopters or more of esophoria or exophoria at distance and at near 6 prism diopters

Table C. Consistency of phoria ratings on clinical and survey tests of youths 12-17 years of age: Chicago Special Vision Study, 1968

Group and test	Esophoria (1^{Δ} or more)		Orthophoria (0^{Δ})		Exophoria (1^{Δ} or more)		Clinical-survey agreement on essential orthophoria[1]
	Clinical test	Survey test	Clinical test	Survey test	Clinical test	Survey test	
	Percent of examinees						
Abnormal group							
Distance:							
Uncorrected	6.4	72.3	57.4	12.8	36.2	14.9	95.1
With correction[2]	5.4	78.4	54.1	8.1	40.5	13.5	90.6
Near:							
Uncorrected	20.0	11.7	10.0	10.0	70.0	78.3	71.4
With correction[2]	24.3	56.8	43.3	2.7	32.4	40.5	72.7
Normal group							
Distance:							
Uncorrected	3.4	69.0	75.9	20.7	20.7	10.3	100.0
Near:							
Uncorrected	14.2	39.3	39.3	14.2	46.5	46.5	75.0

[1]Using critical levels: distance esophoria of 5^{Δ} or more, exophoria of 5^{Δ} or more, 0-4^{Δ} considered essentially orthophoric; near esophoria of 6^{Δ} or more, exophoria of 10^{Δ} or more, with remainder considered essentially orthophoric.[4,8,9]

[2]With own glasses or contact lenses.

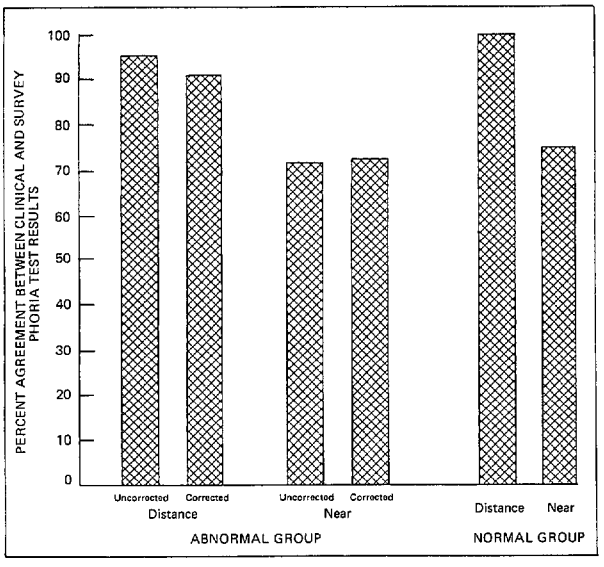

Figure 1. Percent agreement between clinical and survey tests among youths 12-17 years of age in identifying essential orthophoria: Chicago Special Vision Study, 1968.

or more of esophoria and 10 prism diopters or more of exophoria.[4,8,9] Considering the lesser degrees of heterophoria as orthophoria, on the basis of these broad groupings (significant esophoria, significant exophoria, and essentially normal or orthophoric), clinical and survey test results show a high level of agreement on essential orthophoria (table C and figure 1). The percentage with complete agreement between survey and clinical test results on this basis was slightly higher on distance than near tests (95, 91, and 100 percent at distance, respectively, for the abnormal subjects tested without and with correction and the normal controls, compared with the corresponding percentages of 71, 73, and 75 at near).

Refraction

From the survey and clinical examination findings for the youths in this study it was possible to determine the extent of agreement

among three measures of monocular distance acuity—the best corrected acuity as determined with cycloplegia in the refraction part of the clinical examination, the best level obtained with the trial lenses but without cycloplegia in the survey, and the level at which they could read with their present glasses.

As previously indicated, the trial lens test for myopia was given each youth in the survey who tested less than 20/20 in either eye without glasses. The failure to reach that level may have been due to simple myopia, astigmatism, or a combination of these or other conditions affecting acuity. It was the purpose of this special study to determine how accurately this crude screening device consisting of a plano lens and six simple negative spherical lenses ranging in power from 1 to 5 diopters could identify and roughly grade the degree of simple myopia. Obviously, the refraction done in the clinical examination with cycloplegia and that done at the time the youths were examined for their present glasses would have determined the best correction possible at those respective times and would not have been limited to just the negative spherical corrections of 5 diopters or less used in the survey tests.

The best apparent agreement among these three measures of corrected acuity (disregarding the strength of the correction needed) was between the level obtained with refraction in the clinical examination and that with present glasses at the time of the survey (tables D and 5). Agreement between acuity on the trial lens test and the refractive examination was slightly but not significantly less good, while the poorest agreement was that between results with the trial lens and those with present glasses both done at the time of the survey.

Complete agreement with respect to distance acuity level was reached on the survey tests with present glasses and with refraction on the clinical examination for 61 percent of the youths compared with 57 percent complete agreement between the survey trial lens test results and those from the refractive examination. Agreement within one acuity level was reached for 81 percent of the youths between their survey tests with glasses and their refractive examination compared with 74 percent between trial lens and refractive examination. Substantially less good agreement was found between acuity on the trial lens test and with their own glasses among these youths—only 43 percent reached the same acuity level on both types of tests while for 60 percent acuity differed by no more than one level. The poorer agreement between the trial lens test results and those with their present glasses reflects the fact that not all of the youths were reaching their best corrected acuity with their present glasses at the time of the survey.

Consideration of the acuity level reached on each of the three types of tests in relation to the spherical equivalence of the corrective lens used gives some further insight into the lack of

Table D. Extent of agreement on visual acuity level among findings from refraction in clinical examination, trial lens test in survey, and tests with present glasses in survey of youths 12-17 years of age: Chicago Special Vision Study, 1968

Tests for determining acuity	Number of tests	Difference in monocular acuity level			
		None	One	Two	Three or more
		Percent of tests			
Refraction vs. trial lens	103	57.2	16.6	8.8	17.4
Trial lens vs. present glasses	75	42.7	17.2	12.2	27.9
Present glasses vs. refraction	84	60.7	20.2	11.9	7.2

complete agreement in the measurement of acuity among these three tests. As used in this report, the spherical equivalence of a lens (system) is that described by Copeland (1928)[10] as the algebraic sum of the spherical power of the lens and half the power of the cylinder. This approximation of the strength of the lens has the effect of ignoring or omitting the astigmatic correction in compound lenses (those with both a spherical and cylindrical correction) to the extent described by Duke-Elder (1970).[11] In a simple spherical correction the power (the reciprocal of the focal length) and the spherical equivalency of the lens are identical. In the present study, when the strength of the lens in terms of its spherical equivalency was taken into account, agreement between the acuity on refraction and on the trial lens test was found to be better than that between acuity on the refractive examination and with their own glasses or between acuity test results with their glasses and with the trial lens (tables 6-8).

The proportion of youths in the study reaching at least the 20/25 level on each of the three acuity tests shows generally good agreement when a lens with spherical equivalency of -1 through -4 diopters was used, as may be seen in figure 2 and tables E, 9-11. The poor agreement evident at the extremes of the trial lens range—0 diopters or no correction and -5 diopters—reflects the limitations of this survey test. At the lower extreme are those whose visual problem is not one of simple myopia, while at the upper extreme are those needing a stronger corrective lens. About 3 percent of these youths were found on clinical examination to be hyperopic rather than myopic, so that no real improvement in acuity could be expected with a simple negative lens.

Seventeen percent of youths reached the same acuity level with the same spherical equivalency of lens on the refractive examination and trial lens test compared with 11 percent on the refractive examination and their own glasses and 12 percent on tests with their own glasses and those with the trial lens (tables 6-8). The better agreement is found only for those with a simple spherical correction (the respective percentages being 12 percent, 6 percent, and 5 percent), while youths with some degree of astigmatism

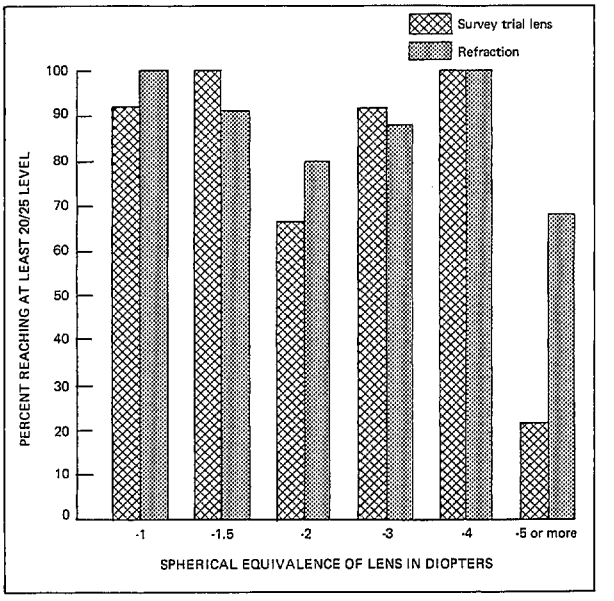

Figure 2. Proportion of monocular tests in which acuity of at least 20/25 was reached with trial lens test and refractive examination, by spherical equivalence of lens for those requiring correction of 1 to 5 diopters or more: Chicago Special Vision Study, 1968.

Table E. Proportion of tests in which acuity of at least 20/25 was obtained for youths 12-17 years of age with the refractive examination and the trial lens test, by the spherical equivalence of the corrective lens used: Chicago Special Vision Study, 1968

Spherical equivalence[1] in diopters	Percent of monocular tests with correction to at least 20/25 level		
	Trial lens test	Refraction	Present glasses
0	27.2	94.4	55.5
-1	92.0	100.0	100.0
-1.5	100.0	90.9	50.0
-2	66.7	80.0	66.7
-3	91.7	88.2	91.7
-4	100.0	100.0	75.0
-5 or more[2]	21.7	68.2	76.7

[1]Algebraic sum of the spherical and one-half of cylindrical lens power.

[2]Upper limit of spherical equivalence in trial lens test was -5 diopters.

requiring a complex lens correction show about the same level of agreement on all three comparisons (the respective percentages being 5 percent, 5 percent, and 7 percent).

The same level of acuity was reached more frequently with a weaker correction (spherical equivalence) on the refractive examination than either the trial lens test or tests with their own glasses (16 percent agreement in acuity with a stronger correction in the trial lens and 21 percent agreement in acuity with a stronger correction in their glasses), as might be expected since the refractive examination was given with the examinee's eyes in a relaxed condition under cycloplegics. A negligible proportion reached the same acuity level with a weaker correction in their glasses than with the trial lens.

Better acuity was reached with a stronger correction on the refractive examination than either the trial lens test or tests with their own glasses (22 percent reached better acuity with a stronger correction on refraction than that used in the trial lens test and 14 percent than that in their own glasses). If comparison is limited here to the possible range of the trial lens test, the former proportion is reduced to 12 percent. Substantially more youths reached better acuity with a stronger correction in their own glasses than that used in the trial lens—44 percent for the entire group or 20 percent if comparison is limited to the possible range of the trial lens test (less than 6 diopters).

For refraction in the clinical examination more than half of the visually abnormal youths (53 percent) required a complex lens with both spherical and cylindrical correction to compensate for astigmatism to reach their best corrected acuity (table 6). Hence the agreement between the clinical examination and trial lens test findings with respect to the power of the corrective lens needed and with respect to the best corrected acuity with that strength is substantially poorer among these subjects than among the remaining 47 percent where no cylinder in the lens was needed. For the latter group, with no astigmatism, 25 percent reached the same acuity level with the same lens spherical equivalence on both the clinical examination and trial lens test compared with 9 percent among those for whom a cylindrical correction was also needed. (The difference in these proportions is statistically significant at the 5-percent probability level.)

More than one-half of the results (52 percent) from the trial lens tests understated the best acuity attained on refraction with about 70 percent of this being due to the need for a stronger lens or cylinder or both in the correction.

Nearly 7 percent of the trial lens tests apparently overcorrected the acuity beyond that obtained in the clinical examination despite the fact that care was taken in the survey examination to keep the youths from squinting. Slightly but not significantly more of these were among youths requiring only a simple negative spherical lens correction, without a cylinder.

Comparison between the degree of refraction in the present glasses for these youths at the time of the survey and in the best correction for them at the time of the clinical examination is shown in tables 12-15. The degree of association or extent of agreement with respect to both the spherical equivalence and the spherical lens part in both corrections is very high ($r = +.84$ and $\chi^2_{870} = 1{,}155.53$, $p < .0001$). No significant association or agreement was found with respect to the power of the cylindrical correction or the axis deviation in the complex lenses (tables 13 and 14).

It is of interest to compare the acuity levels reached with the trial lens and with their present glasses for the youths in this special study, both tests done in the survey without dilation, but within a period of less than 20 minutes. The correlation here was of a very low order—+.05 for the entire group or +.20 if limited to those with simple spherical correction in their glasses. The correlation between acuity with their present glasses in the survey and that found on refraction (with cycloplegia) in the clinical examination was +.40 for the entire group but increased to +.70 when limited to the group with simple spherical lenses.

Thus on the basis of the Chicago study the trial lens test results from the survey would appear to differentiate myopia and to provide a slightly better estimate of the best corrected acuity level for the youth population than that obtained from test results with their present glasses within the limits of the strength of the trial lens test. The estimates will be better for

those youths who require only a simple correction of 6 diopters or less than those requiring a stronger lens or complex correction.

DISCUSSION

Previous studies have shown correlations between clinical and Ortho-Rater lateral phoria tests ranging from +.53 to +.94 at distance and +.64 to +.77 at near.[5,12-15] From these studies it is also evident that, as measured by the correlation coefficient, the association between machine tests (including the Ortho-Rater) and clinical tests is as close as that between the clinical tests themselves when given under controlled conditions with only a short timelag between the first test and the retest.

The findings with respect to agreement between clinical and survey (Ortho-Rater) phoria tests at distance in the present clinical study are within the range of the previous survey results (r =+.55), while at near they are somewhat lower (r =+.44). Considering the timelag between the survey and clinical examinations of from 1 to 4 weeks, these findings are remarkably consistent with those from previous, more closely controlled studies. Complete agreement for 70-90 percent on the various phoria tests was found when results were grouped into the three categories of significant esophoria, significant exophoria, and essential orthophoria. Hence the phoria findings among youths from the Health Examination Survey in 1966-70, of which this study group is a small segment, can be expected to give fairly accurate estimates of the prevalence of significant esophoria and exophoria among youths 12-17 years of age in the United States.

With respect to the measurement of visual acuity, the comparability of machine test and clinical test scores has been investigated in at least three studies, but these studies used instruments or targets differing somewhat from those in the present study.[13,16,17] The findings from these studies would indicate that the association between these machine and clinical tests are also as close as between the clinical tests themselves, ranging from correlations of +.70 to +.90 when both types of test are done without dilation.

Because of the limitation of the trial lens used in the survey, the timelag between the survey and clinical tests, and the fact that the best correction was obtained by refraction with cycloplegia in the clinical examination, it is to be expected that the agreement between the survey and clinical acuity tests will be lower than those from the studies cited above. The correlation between the acuity obtained on the survey trial lens test (without cycloplegia) and that obtained by refraction (with cycloplegia) in the clinical examination was +.29. However, if the comparison is limited to those 47 percent of the youths for whom only a spherical correction was needed (without any astigmatism requiring a cylindrical correction also), the correlation was increased to +.54.

SUMMARY

The validation study of the vision test battery used in the Health Examination Survey of 1966-70 among youths 12-17 years of age was conducted among a sample of youth examinees in that survey from the Chicago area in July-August 1968. The study was designed primarily to determine the degree of correspondence with respect to myopia and lateral heterophoria between actual survey test results and those obtained in the usual clinical examination by an ophthalmologist.

Following 1 to 4 weeks after their regular survey examination, a sample of 98 youths, including 69 who were judged visually abnormal by predetermined criteria and a control group of 29 normal youths, were given a standard clinical ophthalmological examination in which cycloplegics were used for the refractive examination.

Findings from the special study indicate that the survey test results for lateral phoria will give fairly reliable estimates of the prevalence of significant esophoria and exophoria among the youth population of the United States in the 1966-70 survey. The trial lens test for myopia will give a slightly better estimate of the best corrected acuity among the youth population than that obtained from test results with their present glasses when considered in relation to the strength of the correction needed. The estimates will be slightly better among those requiring only simple spherical lenses than those with astigmatism needing a more complex corrective lens.

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Table 1. Degree of binocular lateral phoria at distance without correction on survey test and clinical examination of youths 12-17 years of age: Chicago Special Vision Study, 1968

Findings on clinical examination	Total youths in study	Survey test results											
		Esophoria in prism diopters							0Δ	Exophoria in prism diopters			Target not visible
		10Δ	8Δ	5Δ	4Δ	3Δ	2Δ	1Δ		1Δ	2Δ	5Δ	
		Number of youths											
ABNORMAL ON SURVEY													
Total in study--	69	1	1	3	4	6	8	11	6	5	1	1	22
Esophoria													
25Δ	1	-	-	-	-	-	-	-	-	-	-	-	1
4Δ	1	1	-	-	-	-	-	-	-	-	-	-	-
2Δ	1	-	-	-	1	-	-	-	-	-	-	-	-
1Δ	1	-	-	-	-	1	-	-	-	-	-	-	-
0Δ	35	-	1	3	3	4	6	6	2	1	1	-	8
Exophoria													
1Δ	5	-	-	-	-	-	1	1	2	1	-	-	-
2Δ	13	-	-	-	-	-	1	3	2	2	-	-	5
4Δ	3	-	-	-	-	1	-	-	-	-	-	1	1
6Δ	3	-	-	-	-	-	-	1	-	1	-	-	1
8Δ	1	-	-	-	-	-	-	-	-	-	-	-	1
10Δ	1	-	-	-	-	-	-	-	-	-	-	-	1
12Δ	1	-	-	-	-	-	-	-	-	-	-	-	1
14Δ	1	-	-	-	-	-	-	-	-	-	-	-	1
16Δ	1	-	-	-	-	-	-	-	-	-	-	-	1
30Δ	1	-	-	-	-	-	-	-	-	-	-	-	1
NORMAL ON SURVEY													
Total in study--	29	-	-	2	-	4	8	6	6	2	1	-	-
Esophoria													
2Δ	1	-	-	-	-	-	-	1	-	-	-	-	-
0Δ	22	-	-	2	-	4	7	2	6	1	-	-	-
Exophoria													
1Δ	1	-	-	-	-	-	-	-	-	-	1	-	-
2Δ	4	-	-	-	-	-	1	2	-	1	-	-	-
4Δ	1	-	-	-	-	-	-	1	-	-	-	-	-

Table 2. Degree of binocular near lateral phoria without correction on survey test and clinical examination of youths 12-17 years of age: Chicago Special Vision Study, 1968

Findings on clinical examination	Total youths in study	Survey test results																								Target not visible
		Esophoria in prism diopters						0Δ	Exophoria in prism diopters																	
		7Δ	5Δ	4Δ	3Δ	2Δ	1Δ		1Δ	2Δ	3Δ	4Δ	5Δ	6Δ	7Δ	8Δ	9Δ	10Δ	12Δ	13Δ	14Δ	15Δ	16Δ	17Δ	
		Number of youths																								
ABNORMAL ON SURVEY																										
Total in study---	69	1	3	-	-	-	3	6	3	3	2	2	4	5	1	7	3	4	1	1	3	3	2	3	9
Esophoria																										
30Δ----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
10Δ----------	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8Δ----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
6Δ----------	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Δ----------	6	-	-	-	-	-	-	2	-	1	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-
2Δ----------	4	-	1	-	-	-	-	-	-	1	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-
0Δ----------	6	-	1	-	-	-	1	1	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Exophoria																										
1Δ----------	2	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
2Δ----------	7	-	-	-	-	-	-	-	1	-	1	-	1	1	-	2	-	-	-	-	-	1	-	-	-
4Δ----------	9	-	-	-	-	-	-	1	1	-	-	-	-	1	-	2	1	1	1	-	-	1	-	-	-
6Δ----------	8	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	1	1	-	-	1	-	2	-	1
8Δ----------	7	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	1	-	-	1	1	-	-	1
10Δ----------	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1
12Δ----------	8	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	-	1	-	-	2	1
14Δ----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
20Δ----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
30Δ----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
35Δ----------	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
NORMAL ON SURVEY																										
Total in study---	29	-	1	2	1	3	4	4	3	2	4	3	1	-	-	-	-	-	-	-	-	-	-	-	1
Esophoria																										
6Δ----------	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2Δ----------	2	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Δ----------	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0Δ----------	11	-	1	1	1	1	1	1	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exophoria																										
2Δ----------	5	-	-	-	-	1	1	-	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
4Δ----------	2	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
6Δ----------	3	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
8Δ----------	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
10Δ----------	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12Δ----------	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 3. Degree of binocular lateral phoria at distance with correction on survey test and clinical examination of youths 12-17 years of age: Chicago Special Vision Study, 1968

Findings on clinical examination	Total youths in study	Survey test results												
		Esophoria in prism diopters							0Δ	Exophoria in prism diopters			Target not visible
		8Δ	7Δ	6Δ	4Δ	3Δ	2Δ	1Δ		1Δ	4Δ	6Δ	
ABNORMAL ON SURVEY	Number of youths												
Total in study	42	2	1	2	3	7	7	11	3	3	1	1	1
Esophoria													
25Δ	1	-	-	-	-	-	-	-	1	-	-	-	-
4Δ	1	1	-	-	-	-	-	-	-	-	-	-	-
0Δ	20	-	1	1	3	5	2	6	2	-	-	-	-
Exophoria													
1Δ	2	-	-	-	-	-	-	2	-	-	-	-	-
2Δ	7	1	-	-	-	2	3	-	-	1	-	-	-
4Δ	3	-	-	-	-	-	-	1	-	2	-	-	-
8Δ	1	-	-	-	-	-	-	-	-	-	-	1	-
18Δ	1	-	-	-	-	-	-	-	-	-	1	-	-
25Δ	1	-	-	-	-	-	-	1	-	-	-	-	-
Not tested	5	-	-	1	-	-	2	1	-	-	-	-	1
NORMAL ON SURVEY													
Total in study	2	-	-	-	-	1	1	-	-	-	-	-	-
0Δ	-	-	-	-	-	-	1	-	-	-	-	-	-
Not tested	-	-	-	-	-	1	-	-	-	-	-	-	-

Table 4. Degree of binocular near lateral phoria with correction on survey test and clinical examination of youths 12-17 years of age: Chicago Special Vision Study, 1968

Findings on clinical examination	Total youths in study	Survey test results																						
		Esophoria in prism diopters											0^{Δ}	Exophoria in prism diopters										
		12^{Δ}	11^{Δ}	9^{Δ}	8^{Δ}	7^{Δ}	6^{Δ}	5^{Δ}	4^{Δ}	3^{Δ}	2^{Δ}	1^{Δ}		1^{Δ}	3^{Δ}	4^{Δ}	5^{Δ}	6^{Δ}	8^{Δ}	9^{Δ}	10^{Δ}	11^{Δ}	15^{Δ}	16^{Δ}
ABNORMAL ON SURVEY		Number of youths																						
Total in study----	42	3	2	2	1	1	3	2	4	3	1	1	3	2	4	1	-	2	2	1	1	1	1	1
Esophoria																								
30^{Δ}----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
20^{Δ}----------	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12^{Δ}----------	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8^{Δ}----------	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6^{Δ}----------	3	-	-	1	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
4^{Δ}----------	2	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0^{Δ}----------	16	1	1	1	1	1	-	1	2	-	1	1	1	1	1	-		-	1	1	1	-	-	-
Exophoria																								
2^{Δ}----------	2	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
4^{Δ}----------	3	1	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6^{Δ}----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
8^{Δ}----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
10^{Δ}----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
12^{Δ}----------	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	1	-	-
20^{Δ}----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Not tested----------	5	-	-	-	-	-	1	-	1	-	-	-	2	-	-	1	-	-	-	-	-	-	-	-
NORMAL ON SURVEY																								
Total in study----	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
Exophoria																								
2^{Δ}----------	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Not tested----------	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5. Number and percent of monocular visual acuity tests for youths 12-17 years of age, by the visual acuity level reached with trial lens and present glasses in survey and on refraction in clinical examination: Chicago Special Vision Study, 1968

Test for monocular acuity and acuity level	Total	Monocular acuity level						
		20/20 or better	20/25	20/30	20/40	20/50	20/60 to 20/70	20/100
Trial lens	Number of tests with refraction							
Total	103	65	24	9	4	-	1	-
20/20 or better	54	47	7	-	-	-	-	-
20/25	10	1	9	-	-	-	-	-
20/30	11	6	4	1	-	-	-	-
20/40	12	4	2	4	2	-	-	-
20/50	4	3	1	-	-	-	-	-
20/60 to 20/70	3	2	-	-	1	-	-	-
20/100	2	-	1	-	-	-	1	-
20/200	5	1	-	3	1	-	-	-
20/400	2	1	-	1	-	-	-	-
Trial lens	Number of tests with present glasses							
Total	75	43	9	10	5	2	3	3
20/20 or better	37	28	5	3	-	-	1	-
20/25	5	1	-	1	1	-	-	2
20/30	9	5	1	2	1	-	-	-
20/40	8	4	-	1	1	2	-	-
20/50	4	2	1	-	-	-	-	1
20/60 to 20/70	3	-	1	1	-	-	1	-
20/100	2	1	-	-	-	-	1	-
20/200	5	1	1	1	2	-	-	-
20/400	2	1	-	1	-	-	-	-
Present glasses	Number of tests with refraction							
Total	84	58	15	7	3	-	1	-
20/20 or better	50	43	7	-	-	-	-	-
20/25	10	5	3	2	-	-	-	-
20/30	10	6	2	2	-	-	-	-
20/40	5	1	1	1	2	-	-	-
20/50	2	-	-	2	-	-	-	-
20/60 to 20/70	4	2	-	-	1	-	1	-
20/100	3	1	2	-	-	-	-	-

Table 5. Number and percent of monocular visual acuity tests for youths 12-17 years of age, by the visual acuity level reached with trial lens and present glasses in survey and on refraction in clinical examination: Chicago Special Vision Study, 1968—Con.

Test for monocular acuity and acuity level	Total	Monocular acuity level						
		20/20 or better	20/25	20/30	20/40	20/50	20/60 to 20/70	20/100
Trial lens	Percent of tests with refraction							
Total	100.0	63.1	23.3	8.7	3.9	-	1.0	-
20/20 or better	52.4	45.6	6.8	-	-	-	-	-
20/25	9.7	1.0	8.7	-	-	-	-	-
20/30	10.7	5.8	3.9	1.0	-	-	-	-
20/40	11.7	3.9	2.0	3.9	1.9	-	-	-
20/50	3.9	2.9	1.0	-	-	-	-	-
20/60 to 20/70	2.9	1.9	-	-	1.0	-	-	-
20/100	1.9	-	0.9	-	-	-	1.0	-
20/200	4.8	1.0	-	2.8	1.0	-	-	-
20/400	1.9	0.9	-	1.0	-	-	-	-
Trial lens	Percent of tests with present glasses							
Total	100.0	57.3	12.0	13.3	6.7	2.7	4.0	4.0
20/20 or better	49.3	37.3	6.7	4.0	-	-	1.3	-
20/25	6.7	1.3	-	1.3	1.3	-	-	2.8
20/30	12.0	6.7	1.3	2.7	1.3	-	-	-
20/40	10.7	5.4	-	1.3	1.3	2.7	-	-
20/50	5.3	2.7	1.4	-	-	-	-	1.2
20/60 to 20/70	4.0	-	1.3	1.3	-	-	1.4	-
20/100	2.6	1.3	-	-	-	-	1.3	-
20/200	6.7	1.3	1.3	1.3	2.8	-	-	-
20/400	2.7	1.3	-	1.4	-	-	-	-
Present glasses	Percent of tests with refraction							
Total	100.0	69.0	17.9	8.3	3.6	-	1.2	-
20/20 or better	59.4	51.1	8.3	-	-	-	-	-
20/25	11.9	6.0	3.6	2.3	-	-	-	-
20/30	11.9	7.1	2.4	2.4	-	-	-	-
20/40	6.0	1.2	1.2	1.2	2.4	-	-	-
20/50	2.4	-	-	2.4	-	-	-	-
20/60 to 20/70	4.8	2.4	-	-	1.2	-	1.2	-
20/100	3.6	1.2	2.4	-	-	-	-	-

Table 6. Number and percent of monocular visual acuity tests for youths 12-17 years of age given the refractive examination in clinical examination and the trial lens test in survey, by the visual acuity level reached and the comparative strength of the lenses: Chicago Special Vision Study, 1968

Comparative strength[1] of refractive and trial lenses	Total eyes tested	Best acuity on refraction			Total eyes tested	Best acuity on refraction		
		Same as with trial lens	Better than with trial lens	Worse than with trial lens		Same as with trial lens	Better than with trial lens	Worse than with trial lens
	Number of tests				Percent of tests			
Spherical equivalence[2] of all lenses in refractive examination:								
Total	103	42	54	7	100.0	40.8	52.4	6.8
Same as trial lens	38	17	21	-	36.9	16.5	20.4	-
Stronger than trial lens but within trial lens range	22	8	12	2	21.3	7.8	11.6	1.9
Weaker than trial lens	32	17	10	5	31.1	16.5	9.7	4.9
Beyond trial lens range (6 diopters or more)	11	-	11	-	10.7	-	10.7	-
Spherical lens only used in refractive examination:								
Total	48	21	23	4	46.6	20.4	22.3	3.9
Power same as trial lens	20	12	8	-	19.4	11.7	7.7	-
Power stronger than trial lens but within trial lens range	6	2	3	1	5.8	1.9	2.9	1.0
Power weaker than trial lens	18	7	8	3	17.5	6.8	7.8	2.9
Power beyond trial lens range (6 diopters or more)	4	-	4	-	3.9	-	3.9	-
Spherical and cylindrical lenses used in refractive examination:								
Total	55	21	31	3	53.4	20.4	30.1	2.9
Power[3] same as trial lens	15	6	8	1	14.6	5.8	7.8	1.0
Power[3] stronger than trial lens but within trial lens range	20	8	11	1	19.4	7.8	10.6	1.0
Power[3] weaker than trial lens	9	7	1	1	8.7	6.8	1.0	0.9
Power[3] beyond trial lens range (6 diopters or more)	11	-	11	-	10.7	-	10.7	-
Spherical equivalence[4] same as trial lens	18	5	13	-	17.5	4.9	12.6	-
Spherical equivalence[4] stronger than trial lens but within trial lens range	16	6	9	1	15.5	5.8	8.7	1.0
Spherical equivalence[4] weaker than trial lens	14	10	2	2	13.6	9.8	1.9	1.9
Spherical equivalence[4] beyond trial lens range (6 diopters or more)	7	-	7	-	6.8	-	6.8	-

[1]Power and spherical equivalence.
[2]Spherical lens power in simple lens or algebraic sum of power of sphere and one-half power of cylinder in complex lens.
[3]Algebraic sum of power of sphere and cylinder in complex lens.
[4]Algebraic sum of power of sphere and one-half power of cylinder in complex lens.

Table 7. Number and percent of monocular visual acuity tests for youths 12-17 years of age given the refractive examination in clinical examination and tests with present glasses in survey, by the visual acuity level reached and the comparative strength of lenses: Chicago Special Vision Study, 1968

Comparative strength[1] of refractive lens and youth's own glasses	Total eyes tested	Best acuity on refraction			Total eyes tested	Best acuity on refraction		
		Same as with own glasses	Better than with own glasses	Worse than with own glasses		Same as with own glasses	Better than with own glasses	Worse than with own glasses
	Number of tests				Percent of tests			
Spherical equivalence[2] of all lenses in refractive examination:								
Total	84	31	28	25	100.0	36.9	33.3	29.8
Same as own glasses	19	9	4	6	22.6	10.7	4.8	7.1
Stronger than own glasses	17	4	12	1	20.2	4.8	14.2	1.2
Weaker than own glasses	48	18	12	18	57.2	21.4	14.3	21.5
Spherical lens only used in refractive examination:								
Total	39	16	10	13	46.4	19.0	11.9	15.5
Power same as own glasses	6	5	1	-	7.1	6.0	1.1	-
Power stronger than own glasses	5	1	4	-	6.0	1.2	4.8	-
Power weaker than own glasses	28	10	5	13	33.3	11.8	6.0	15.5
Spherical and cylindrical lenses used in refractive examination:								
Total	45	15	18	12	53.6	17.9	21.4	14.3
Power[3] same as own glasses	8	2	3	3	9.6	2.4	3.6	3.6
Power[3] stronger than own glasses	11	2	6	3	13.1	2.4	7.1	3.6
Power[3] weaker than own glasses	26	11	9	6	30.9	13.1	10.7	7.1
Spherical equivalence[4] same as own glasses	13	4	3	6	15.5	4.8	3.6	7.1
Spherical equivalence[4] stronger than own glasses	12	3	8	1	14.3	3.6	9.5	1.2
Spherical equivalence[4] weaker than own glasses	20	8	7	5	23.8	9.5	8.3	6.0

[1]Power and spherical equivalence.
[2]Spherical lens power in simple lens or algebraic sum of power of sphere and one-half power of cylinder in complex lens.
[3]Algebraic sum of power of sphere and cylinder in complex lens.
[4]Algebraic sum of power of sphere and one-half power of cylinder in complex lens.

Table 8. Number and percent of monocular visual acuity tests for youths 12-17 years of age given the trial lens test and tests with present glasses in survey, by the visual acuity level reached and the comparative strength of the lenses: Chicago Special Vision Study, 1968

Comparative strength[1] of youth's own glasses and trial lens	Total eyes tested	Actual acuity with own glasses			Total eyes tested	Actual acuity with own glasses		
		Same as with trial lens	Better than with trial lens	Worse than with trial lens		Same as with trial lens	Better than with trial lens	Worse than with trial lens
	Number of tests				Percent of tests			
Spherical equivalence[2] of own glasses:								
Total	75	19	39	17	100.0	25.3	52.0	22.7
Same as trial lens	19	9	6	4	25.3	12.0	8.0	5.3
Stronger than trial lens but within trial lens range	24	6	15	3	32.0	8.0	20.0	4.0
Weaker than trial lens	11	3	-	8	14.7	4.0	-	10.7
Beyond trial lens range (6 diopters or more)	21	1	18	2	28.0	1.3	24.0	2.7
Spherical lens only in own glasses:								
Total	34	8	18	8	45.4	10.7	24.0	10.7
Power same as trial lens	8	4	2	2	10.7	5.3	2.7	2.7
Power stronger than trial lens but within trial lens range	9	3	6	-	12.0	4.0	8.0	-
Power weaker than trial lens	5	-	-	5	6.7	-	-	6.7
Power beyond trial lens range (6 diopters or more)	12	1	10	1	16.0	1.4	13.3	1.3
Spherical and cylindrical lenses in own glasses:								
Total	41	11	21	9	54.6	14.7	28.0	11.9
Power[3] same as trial lens	4	-	3	1	5.3	-	4.0	1.3
Power[3] stronger than trial lens but within trial lens range	19	8	7	4	25.3	10.7	9.3	5.3
Power[3] weaker than trial lens	5	2	-	3	6.7	2.7	-	4.0
Power[3] beyond trial lens range (6 diopters or more)	13	1	11	1	17.3	1.3	14.7	1.3
Spherical equivalence[4] same as trial lens	11	5	4	2	14.7	6.7	5.3	2.7
Spherical equivalence[4] stronger than trial lens but within trial lens range	15	3	9	3	20.0	4.0	12.0	4.0
Spherical equivalence[4] weaker than trial lens	6	3	-	3	8.0	4.0	-	4.0
Spherical equivalence[4] beyond trial lens range (6 diopters or more)	9	-	8	1	12.0	-	10.7	1.3

[1]Power and spherical equivalence.
[2]Spherical lens power in simple lens or algebraic sum of power of sphere and one-half power of cylinder in complex lens.
[3]Algebraic sum of power of sphere and cylinder in complex lens.
[4]Algebraic sum of power of sphere and one-half power of cylinder in complex lens.

Table 9. Number and percent of monocular visual acuity tests for youths 12-17 years of age, by the visual acuity level reached and the strength of correction in trial lens and refraction: Chicago Special Vision Study, 1968

Test, power, and spherical equivalence of lens	Total[1]	Monocular acuity								
		20/20 or better	20/25	20/30	20/40	20/50	20/60 to 20/70	20/100	20/200	20/400
TRIAL LENS	Number of tests									
Total	103	54	10	11	12	4	3	2	5	2
Power[2]										
- 5 D	23	4	1	5	1	4	2	1	1	1
- 4 D	9	7	2	-	-	-	-	-	-	-
- 3 D	12	11	-	1	-	-	-	-	-	-
- 2 D	6	4	-	1	1	-	-	-	-	-
-1.5 D	6	5	1	-	-	-	-	-	-	-
- 1 D	25	23	-	-	1	-	-	1	1	-
0 D	22	-	6	4	9	-	1	-	-	1
REFRACTION										
Total	103	65	24	9	4	-	1	-	-	-
Lens power[2]										
-12 D	1	1	-	-	-	-	-	-	-	-
-10 D	1	-	-	1	-	-	-	-	-	-
- 9 D	2	1	-	1	-	-	-	-	-	-
- 8 D	2	-	-	2	-	-	-	-	-	-
- 7 D	1	-	-	-	-	-	1	-	-	-
- 6 D	8	5	1	-	2	-	-	-	-	-
- 5 D	7	5	2	-	-	-	-	-	-	-
- 4 D	11	8	3	-	-	-	-	-	-	-
- 3 D	17	11	4	2	-	-	-	-	-	-
- 2 D	10	6	2	2	-	-	-	-	-	-
-1.5 D	11	7	3	-	1	-	-	-	-	-
- 1 D	10	8	2	-	-	-	-	-	-	-
0 D	18	11	6	-	1	-	-	-	-	-
+ 1 D	3	2	1	-	-	-	-	-	-	-
+ 2 D	1	-	-	1	-	-	-	-	-	-
Spherical equivalence[3]										
-10 D	2	1	-	1	-	-	-	-	-	-
- 9 D	1	-	-	1	-	-	-	-	-	-
- 8 D	3	1	-	2	-	-	-	-	-	-
- 7 D	-	-	-	-	-	-	-	-	-	-
- 6 D	5	5	-	-	-	-	-	-	-	-
- 5 D	8	4	3	-	-	-	1	-	-	-
- 4 D	10	7	1	-	2	-	-	-	-	-
- 3 D	18	12	6	-	-	-	-	-	-	-
- 2 D	10	6	2	2	-	-	-	-	-	-
-1.5 D	10	6	2	2	-	-	-	-	-	-
- 1 D	11	9	1	-	1	-	-	-	-	-
0 D	23	14	8	-	1	-	-	-	-	-
+ 1 D	1	-	1	-	-	-	-	-	-	-
+ 2 D	1	-	-	1	-	-	-	-	-	-
TRIAL LENS	Percent of tests									
Total	100.0	52.4	9.7	10.7	11.7	3.9	2.9	1.9	4.8	1.9
Negative lens	78.6	52.4	3.9	6.8	3.0	3.9	1.9	1.9	4.8	0.9
0 power	21.4	-	5.8	3.9	8.7	-	1.0	-	-	1.0
REFRACTION (Spherical equivalence)										
Total	100.0	63.1	23.3	8.7	3.9	-	1.0	-	-	-
Negative lens	75.8	48.5	15.7	7.7	2.9	-	1.0	-	-	-
0 power	22.3	14.6	6.7	-	1.0	-	-	-	-	-
Positive lens	1.9	-	0.9	1.0	-	-	-	-	-	-

[1] With both types of test.
[2] Power of lens in diopters (D) = algebraic sum of spherical power and cylindrical power in the correction.
[3] Spherical equivalence of lens in diopters (D) = algebraic sum of spherical power and one-half power of cylinder in the correction.

Table 10. Number and percent of monocular visual acuity tests for youths 12-17 years of age, by the visual acuity level reached and the strength of correction in trial lens and in present glasses: Chicago Special Vision Study, 1968

Test, power, and spherical equivalence of lens	Total[1]	Monocular acuity								
		20/20 or better	20/25	20/30	20/40	20/50	20/70	20/100	20/200	20/400
	Number of tests									
TRIAL LENS										
Total	75	37	5	9	8	4	3	2	5	2
Power[2]										
- 5 D	23	4	1	5	1	4	2	1	4	1
- 4 D	9	7	2	-	-	-	-	-	-	-
- 3 D	11	10	-	1	-	-	-	-	-	-
- 2 D	5	3	-	1	1	-	-	-	-	-
-1.5 D	5	4	1	-	-	-	-	-	-	-
- 1 D	12	9	-	1	1	-	-	1	-	-
0 D	10	-	1	1	5	-	1	-	1	1
PRESENT GLASSES										
Total	75	43	9	10	5	2	3	3	-	-
Lens power[2]										
-18 D	2	-	1	1	-	-	-	-	-	-
-15 D	2	-	-	1	1	-	-	-	-	-
-14 D	-	-	-	-	-	-	-	-	-	-
-13 D	1	-	-	1	-	-	-	-	-	-
-12 D	3	2	1	-	-	-	-	-	-	-
-11 D	1	1	-	-	-	-	-	-	-	-
-10 D	4	3	-	1	-	-	-	-	-	-
- 9 D	4	2	1	-	-	-	-	1	-	-
- 8 D	5	4	1	-	-	-	-	-	-	-
- 7 D	7	5	-	1	-	-	1	-	-	-
- 6 D	3	2	1	-	-	-	-	-	-	-
- 5 D	3	3	-	-	-	-	-	-	-	-
- 4 D	9	6	1	2	-	-	-	-	-	-
- 3 D	9	3	2	-	2	-	2	-	-	-
- 2 D	10	7	1	-	-	-	-	2	-	-
-1.5 D	1	1	-	-	-	-	-	-	-	-
- 1 D	5	3	-	2	-	-	-	-	-	-
0 D	4	1	-	-	1	2	-	-	-	-
+ 1 D	-	-	-	-	-	-	-	-	-	-
+ 2 D	2	-	-	1	1	-	-	-	-	-
Spherical equivalence[3]										
-14 D	2	-	1	1	-	-	-	-	-	-
-13 D	-	-	-	-	-	-	-	-	-	-
-12 D	-	-	-	-	-	-	-	-	-	-
-11 D	2	-	-	1	1	-	-	-	-	-
-10 D	-	-	-	-	-	-	-	-	-	-
- 9 D	4	2	1	1	-	-	-	-	-	-
- 8 D	2	2	-	-	-	-	-	-	-	-
- 7 D	5	3	1	1	-	-	-	-	-	-
- 6 D	6	4	1	-	-	-	-	1	-	-
- 5 D	7	6	-	1	-	-	-	-	-	-
- 4 D	4	2	1	-	-	-	1	-	-	-
- 3 D	12	9	2	1	-	-	-	-	-	-
- 2 D	12	7	1	1	2	-	1	-	-	-
-1.5 D	6	3	-	-	-	-	1	2	-	-
- 1 D	4	3	1	-	-	-	-	-	-	-
0 D	5	2	-	2	1	-	-	-	-	-
+ 1 D	2	-	-	-	-	2	-	-	-	-
+ 2 D	2	-	-	1	1	-	-	-	-	-
	Percent of tests									
TRIAL LENS										
Total	100.0	49.3	6.7	12.0	10.7	5.3	4.0	2.7	6.7	2.7
Negative lens	86.7	49.3	5.4	10.7	4.0	5.3	2.7	2.7	5.4	1.4
0 power	13.3	-	1.3	1.3	6.7	-	1.3	-	1.3	1.3
PRESENT GLASSES (Spherical equivalence)										
Total	100.0	57.3	12.0	13.3	6.7	2.7	4.0	4.0	-	-
Negative lens	92.0	56.0	12.0	12.0	4.1	-	4.0	4.0	-	-
0 power	5.3	1.3	-	-	1.3	2.7	-	-	-	-
Positive lens	2.7	-	-	1.3	1.3	-	-	-	-	-

[1]With both types of test.
[2]Power of lens in diopters (D)= algebraic sum of spherical power and cylindrical power in the correction.
[3]Spherical equivalence of lens in diopters (D)= algebraic sum of spherical power and one-half power of cylinder in the correction.

Table 11. Number and percent of monocular visual acuity tests for youths 12-17 years of age, by the visual acuity level reached and the strength of correction on refraction and in present glasses: Chicago Special Vision Study, 1968

Test, power, and spherical equivalence of lens	Total[1]	Monocular acuity						
		20/20 or better	20/25	20/30	20/40	20/50	20/60 to 20/70	20/100
	Number of tests							
REFRACTION								
Total	84	58	15	7	3	-	1	-
Lens power[2]								
-12 D	1	1	-	-	-	-	-	-
-10 D	2	1	-	1	-	-	-	-
- 9 D	3	2	-	1	-	-	-	-
- 8 D	2	-	-	2	-	-	-	-
- 7 D	1	-	-	-	-	-	1	-
- 6 D	8	5	1	-	2	-	-	-
- 5 D	7	5	2	-	-	-	-	-
- 4 D	11	8	3	-	-	-	-	-
- 3 D	16	11	4	1	-	-	-	-
- 2 D	10	6	2	2	-	-	-	-
-1.5 D	8	5	2	-	1	-	-	-
- 1 D	5	4	1	-	-	-	-	-
0 D	8	8	-	-	-	-	-	-
+ 1 D	2	2	-	-	-	-	-	-
Spherical equivalence[3]								
-10 D	2	1	-	1	-	-	-	-
- 9 D	2	1	-	1	-	-	-	-
- 8 D	4	2	-	2	-	-	-	-
- 6 D	5	5	-	-	-	-	-	-
- 5 D	8	4	3	-	-	-	1	-
- 4 D	10	7	1	-	2	-	-	-
- 3 D	18	12	6	-	-	-	-	-
- 2 D	9	6	2	1	-	-	-	-
-1.5 D	8	4	2	2	-	-	-	-
- 1 D	6	5	-	-	1	-	-	-
0 D	12	11	1	-	-	-	-	-
PRESENT GLASSES								
Total	84	50	10	10	5	2	4	3
Lens power[2]								
-18 D	2	-	1	1	-	-	-	-
-15 D	2	-	-	1	1	-	-	-
-13 D	2	1	-	1	-	-	-	-
-12 D	3	2	1	-	-	-	-	-
-11 D	2	2	-	-	-	-	-	-
-10 D	4	3	-	1	-	-	-	-
- 9 D	4	2	1	-	-	-	-	1
- 8 D	5	4	1	-	-	-	-	-
- 7 D	9	5	-	1	-	-	1	2
- 6 D	3	2	1	-	-	-	-	-
- 5 D	3	3	-	-	-	-	-	-
- 4 D	9	6	1	2	-	-	-	-
- 3 D	9	3	2	-	2	-	2	-
- 2 D	8	7	1	-	-	-	-	-
-1.5 D	1	1	-	-	-	-	-	-
- 1 D	8	6	-	2	-	-	-	-
0 D	4	3	-	-	1	-	-	-
+ 1 D	2	-	-	-	-	2	-	-
+ 2 D	4	-	1	1	1	-	1	-

[1] With both types of test.

[2] Power of lens in diopters (D) = algebraic sum of spherical power and cylindrical power in the correction.

[3] Spherical equivalence of lens in diopters (D) = algebraic sum of spherical power and one-half power of cylinder in the correction.

Table 11. Number and percent of monocular visual acuity tests for youths 12-17 years of age, by the visual acuity level reached and the strength of correction on refraction and in present glasses: Chicago Special Vision Study, 1968—Con.

Test, power, and spherical equivalence of lens	Total[1]	Monocular acuity						
		20/20 or better	20/25	20/30	20/40	20/50	20/60 to 20/70	20/100
PRESENT GLASSES—Con.	Number of tests							
Spherical equivalence[3]								
-14 D	1	-	-	1	-	-	-	-
-13 D	1	-	1	-	-	-	-	-
-11 D	2	-	-	1	1	-	-	-
- 9 D	5	3	1	1	-	-	-	-
- 8 D	3	3	-	-	-	-	-	-
- 7 D	5	3	1	1	-	-	-	-
- 6 D	6	4	1	-	-	-	-	1
- 5 D	7	6	-	1	-	-	-	-
- 4 D	4	2	1	-	-	-	1	-
- 3 D	12	9	2	1	-	-	-	-
- 2 D	12	7	1	1	2	-	1	-
-1.5 D	6	3	-	-	-	-	1	2
- 1 D	6	5	1	-	-	-	-	-
0 D	9	5	-	2	1	-	1	-
+ 1 D	3	-	1	-	-	2	-	-
+ 2 D	2	-	-	1	1	-	-	-
REFRACTION	Percent of tests							
(Spherical equivalence)								
Total	100.0	69.0	17.9	8.3	3.6	-	1.2	-
Negative lens	85.7	55.9	16.7	8.3	3.6	-	1.2	-
0 power	14.3	13.1	1.2	-	-	-	-	-
Positive lens	-	-	-	-	-	-	-	-
PRESENT GLASSES								
(Spherical equivalence)								
Total	100.0	59.5	11.9	11.9	6.0	2.4	4.8	3.6
Negative lens	83.3	53.5	10.7	8.3	3.6	-	3.6	3.6
0 power	10.7	6.0	-	2.4	1.2	-	1.2	-
Positive lens	6.0	-	1.2	1.2	1.2	2.4	-	-

[1]With both types of test.
[2]Power of lens in diopters (D) = algebraic sum of spherical power and cylindrical power in the correction.
[3]Spherical equivalence of lens in diopters (D) = algebraic sum of spherical power and one-half power of cylinder in the correction.

Table 12. Spherical lens strength in best correction on refraction and in present glasses for youths 12-17 years of age: Chicago Special Vision Study, 1968

Spherical correction in present glasses in diopters	Total	Spherical correction on refraction in diopters																																						
		-9.50	-9.00	-8.50	-8.25	-8.00	-7.50	-7.25	-6.25	-6.00	-5.75	-5.50	-5.25	-5.00	-4.50	-4.25	-4.00	-3.75	-3.50	-3.25	-3.00	-2.75	-2.50	-2.25	-1.75	-1.50	-1.25	-1.00	-0.75	-0.50	-0.25	0	+0.25	+0.50						
	Number of lenses tested																																							
Total	88	1	1	1	1	2	1	1	1	1	4	3	0	3	2	3	3	3	6	1	6	5	4	2	2	6	4	4	3	4	2	5	1	2						
-9.75	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-9.00	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-7.75	2	-	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-6.00	2	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-5.75	3	-	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-5.50	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-5.25	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-5.00	5	-	-	1	-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-4.75	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-4.50	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-4.25	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-4.00	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-3.75	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-3.50	4	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-3.25	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-3.00	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-2.75	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
-2.50	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-						
-2.25	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	1	-	-	-	-	-	-	-	-	-	-						
-2.00	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-						
-1.75	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	1	-	1	2	1	-	-	-	-	-	-	-						
-1.50	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2	-	-	-	-	-	-	-						
-1.25	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-						
-1.00	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-						
-0.75	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-						
-0.50	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-	-						
-0.25	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	1	1	-	-						
0	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-						
+0.25	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-						
+0.50	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
+0.75	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-						
+1.00	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	-	-						
+1.25	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-						
+1.50	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-						
+1.75	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						

Table 13. Spherical equivalence in best correction on refraction and in present glasses for youths 12-17 years of age: Chicago Special Vision Study, 1968

Spherical equivalence[1] on refraction in diopters	Total	Spherical equivalence[1] of present glasses in diopters																																				
		-14.25	-13.75	-11.25	-9.25	-9.00	-8.50	-8.00	-7.75	-7.50	-7.25	-7.00	-6.75	-6.25	-5.75	-5.50	-5.25	-4.50	-4.25	-3.75	-3.50	-3.25	-3.00	-2.50	-2.25	-2.00	-1.75	-1.50	-1.25	-1.00	-0.75	-0.50	-0.25	+0.25	+1.25	+1.50	+1.75	+2.00
	Number of lenses for youths with both tests																																					
Total-	84	1	1	2	2	3	2	1	1	2	1	1	2	4	2	2	3	3	1	3	3	4	2	4	5	3	2	4	1	5	4	1	1	2	1	1	2	2
-10.25	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-10.00	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 9.25	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 9.00	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 8.75	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 8.00	3	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 6.50	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 6.00	4	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 5.75	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 5.50	3	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 5.00	4	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 4.75	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 4.50	3	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
- 4.25	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 4.00	4	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
- 3.75	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
- 3.50	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
- 3.25	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 3.00	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
- 2.75	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- 2.50	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	-	1	-	-	-	-	-	-	-	-	-
- 2.25	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
- 2.00	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
- 1.75	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
- 1.50	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	1	-	-	-	-	1	-	-	-	1	-	1	-
- 1.25	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	1	1	-	-	-	-	-	-	-
- 1.00	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
- 0.75	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	1	-	-	-	-	-	-
- 0.50	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
+ 0.25	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
+ 0.50	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	2

[1]The algebraic sum of the power of the spherical lens and one-half the power of the cylinder in a lens (system).

Table 14. Cylindrical lens strength in best correction on refraction and in present glasses for youths 12-17 years of age: Chicago Special Vision Study, 1968

Cylindrical correction in present glasses in diopters	Total	Cylindrical correction on refraction in diopters																		
		-4.00	-3.75	-3.50	-3.00	-2.25	-2.00	-1.75	-1.50	-1.25	-1.00	-0.75	-0.50	-0.25	0	+0.25	+0.50	+0.75	+1.00
	Number of lenses tested																		
Total	88	1	1	1	1	2	0	1	1	2	7	3	14	7	41	2	1	1	2
-9.75	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
-9.00	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
-8.25	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-7.25	3	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-
-7.00	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
-6.50	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
-6.00	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
-5.75	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
-5.50	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
-5.25	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-5.00	3	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-
-4.75	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
-4.50	3	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-
-4.25	2	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-
-4.00	2	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
-3.75	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
-3.50	3	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-
-3.25	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-3.00	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
-2.75	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
-2.50	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
-2.25	6	-	-	-	-	1	-	-	-	-	-	-	1	-	4	-	-	-	-
-2.00	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-
-1.75	4	-	1	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-
-1.50	4	-	-	-	-	-	-	-	-	1	-	1	-	2	-	-	-	-	-
-1.25	3	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-
-1.00	6	-	-	-	-	-	-	-	-	-	-	-	3	2	1	-	-	-	-
-0.75	4	-	-	-	-	-	-	-	-	-	1	-	-	-	3	-	-	-	-
-0.50	10	-	-	-	-	-	-	-	-	-	2	-	1	-	6	-	1	-	-
-0.25	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
0	4	-	-	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-	-
+0.75	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
+1.00	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2

Table 15. Degree of axis rotation for lenses in best correction on refraction and in present glasses for youths 12-17 years of age: Chicago Special Vision Study, 1968

Axis rotation in present glasses in degrees	Total	Axis rotation on refraction in degrees												
		0°	10°	30°	60°	65°	75°	80°	90°	95°	100°	105°	170°	180°
	Number of lenses tested													
Total	88	41	1	1	1	1	1	0	25	1	1	2	1	12
0°	41	25	-	-	-	-	-	-	12	-	-	-	-	4
1°	1	1	-	-	-	-	-	-	-	-	-	-	-	-
2°	2	-	-	-	-	-	-	-	2	-	-	-	-	-
3°	2	-	-	-	-	-	-	-	1	-	-	-	1	-
5°	1	-	-	-	-	-	-	-	-	-	-	-	-	1
6°	1	-	1	-	-	-	-	-	-	-	-	-	-	-
7°	1	-	-	-	-	-	-	-	-	-	-	-	-	1
8°	1	1	-	-	-	-	-	-	-	-	-	-	-	-
10°	3	1	-	-	-	-	-	-	-	-	-	1	-	1
11°	2	-	-	-	-	-	-	-	2	-	-	-	-	-
17°	1	-	-	-	-	-	-	-	-	-	1	-	-	-
19°	1	-	-	-	-	-	-	-	1	-	-	-	-	-
27°	1	1	-	-	-	-	-	-	-	-	-	-	-	-
29°	1	1	-	-	-	-	-	-	-	-	-	-	-	-
31°	1	-	-	-	-	-	-	-	-	-	-	1	-	-
32°	1	1	-	-	-	-	-	-	-	-	-	-	-	-
39°	1	1	-	-	-	-	-	-	-	-	-	-	-	-
42°	1	1	-	-	-	-	-	-	-	-	-	-	-	-
49°	1	-	-	1	-	-	-	-	-	-	-	-	-	-
135°	1	1	-	-	-	-	-	-	-	-	-	-	-	-
146°	1	-	-	-	1	-	-	-	-	-	-	-	-	-
161°	1	-	-	-	-	-	-	-	-	-	-	-	-	1
163°	1	-	-	-	-	1	-	-	-	-	-	-	-	-
164°	1	-	-	-	-	-	-	-	-	-	-	-	-	1
167°	4	3	-	-	-	-	-	-	1	-	-	-	-	-
169°	1	-	-	-	-	-	-	-	1	-	-	-	-	-
170°	1	-	-	-	-	-	-	-	1	-	-	-	-	-
172°	2	-	-	-	-	-	1	-	-	-	-	-	-	1
173°	1	-	-	-	-	-	-	-	-	-	-	-	-	1
176°	2	2	-	-	-	-	-	-	-	-	-	-	-	-
177°	3	1	-	-	-	-	-	-	2	-	-	-	-	-
178°	1	-	-	-	-	-	-	-	-	-	-	-	-	1
179°	2	1	-	-	-	-	-	-	-	1	-	-	-	-
180°	2	-	-	-	-	-	-	-	2	-	-	-	-	-

APPENDIX

RECORDING FORMS

HES-III June 4, 1968

Special Vision Study Appointment Form

Chicago, Illinois, July 23-31, Aug. 15-24, 1968

Name_____Segment No._____Serial No._____

Scheduling restrictions:

	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
A.M.						
P.M.						

☐ Consent given

☐ Consent refused

Remarks:_____

Parent (or Guardian) Name and Address:

_____

_____Telephone No._____

Record of calls and appointment for Special Vision Study:

By	Date	Person Contacted	Appointment (Day, time)	Remarks

___Examination Findings*: ☐ Normal ☐ Abnormal

Tests without Correction --

Binocular lateral phoria, distance (Code) _____

Monocular distance score: Rt._____ Lt._____

Monocular near score: Rt._____ Lt._____

Tests with Correction --

Binocular lateral phoria (Code): Distance _____ Near_____

---

* Abnormals include: Lateral phoria at distance less than 6 or more than 16; lateral phoria at near less than 8 or more than 18; visual acuity code at distance more than 20 in either eye.

PHS 5133-2
6-68

BUDGET BUREAU NO. 68-S68048
EXP. DATE 12/31/68

Special Vision Test Validation Study Examination Form

HES - III
Chicago, Illinois
__ July 23-31, 1968
__ August 15-24, 1968

Name_____Date_____Time_____Case No._____

I. Phoria tests (without cycloplegics) (in diopters)

Without Correction		With Correction	
Distance	Near	Distance	Near
E=__ __.	E^1=__ __.	E=__ __.	E^1=__ __.
X=__ __.	X^1=__ __.	X=__ __.	X^1=__ __.

II. Refraction (with cycloplegics)

Eye	+ or -	Sphere	+ or -	Cylinder	Axis dev.	Acuity
R.	__	__ __.__ __	__	__ __.__ __	__ __ __°	20/ __ __ __
L.	__	__ __.__ __	__	__ __.__ __	__ __ __°	20/ __ __ __

Comments: _____

_____

Note: Phoria readings in whole diopters (E=esophoria, X=exophoria).

COLOR VISION

EXAMINER

NO REPORT

Wears glasses for test: 1 ☐

Wears contact lenses for test: 2 ☐

Wears neither for test: 3 ☐

COLOR VISION TEST NO. 1—Ishihara binocular test

PLATE	READ AS	
1	☐ 12	☐ Other
2	☐ 8	☐ 3 ☐ Other
4	☐ 5	☐ 2 ☐ Other
8	☐ 6	☐ Other
10	☐ 5	☐ Other
14	☐ Other	☐ 5
17	☐ 42	☐ 2 ☐ **42** ☐ 4 ☐ **42** ☐ Other

SCORE: (If total score for plates 2–17 is 6 skip to page 2 of Vision Form)

COLOR VISION TEST NUMBER 2—H-R-R

	PLATE	I	II
B–Y	1		☐ Other
	2		☐ Other
R–G	3		☐ Other
	4		☐ Other
	5		☐ Other
	6		☐ Other

SCORE (1–6): _____

COLOR VISION TEST NO. 2—H-R-R (Continued)

	PLATE	I	II	III	IV
Mi. R–G	7				☐ Other
	8		☐ None		
	9			☐ None	
	10				☐ Other
	11				☐ Other
Mod. R–G	12				☐ Other
	13				☐ Other
	14				☐ Other
Sev. R–G	15				☐ Other
	16				☐ Other

SCORE: (7 through 16) _____ _____

High= ☐ **Protan** ☐ **Deutan**

Mod. B–Y	17				☐ Other
	18				☐ Other
Sev. B–Y	19				☐ Other
	20				☐ Other

SCORE: (17 through 20) _____ _____

High= ☐ **Tritan** ☐ **Tetartan**

VISION 1

SAMPLE NO. (1-5)

DISTANCE VISION—WITHOUT CORRECTION

VISION TESTS

Check tests given first. ☐ Far ☐ Near (Odd numbers distance first; even numbers near first)

DIAL

1. BINOCULAR LATERAL PHORIA—DISTANCE (Check number nearest arrow)

☐ Left of 1 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 / ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 / ☐ 17 ☐ 18 ☐ 19 ☐ 20 ☐ 21

☐ Right of 21 ☐ Arrow or number not visible. Code _____

2. MONOCULAR DISTANCE—SMALL*

Line	Right eye	Score (Check)	Left eye	Score
5	VHDNS OZKRC	___50	CDZNO KSRVH	___50
6	DVZNC SRHKO	___40	CNRKH ZVSDO	___40
7	KNZCO SRDHV	___30	DVHCK OZNSR	___30
8	KNDRS ZVCOH	___25	CDKRO SZVNH	___25
9	VZCHD KNRSO	___20	CVHSZ ORKDN	___20
10	KZSVN HCRDO	___17	DNVHS OKRCZ	___17
11	RCSNV KDHOZ	___15	ZHODC SVNKR	___15
12	ROKHZ NSCVD	___12	KHOZD CSNVR	___12

3. MONOCULAR DISTANCE—LARGE* *(Omit if score on Dial 2)*

Line	Right eye	Score	Left eye	Score
1	SDK	___400	VNC	___400
2 / 2	RCSZO / KNHDV	___200	OZNKS / DRHCV	___200
3	HNZOS KRCVD	___100	RZOHC	KSNDV___100
4	ZHODC SVNKR	___ 70	RKNCZ	HSDVO___ 70

CODE _____ CODE _____

2

TRIAL LENS FOR MYOPIA (Score in lines 1–8, Plates 2, 3—OMIT IF CONTACT LENSES ARE WORN.)

Right eye	☐	☐	☐	☐	☐	☐	☐	☐	SCORE ____
	0	**1**	**1.5**	**2**	**3**	**4**	**5**	**N.A.**	
Left eye	☐	☐	☐	☐	☐	☐	☐	☐	SCORE _____

3A. BINOCULAR DISTANCE—SMALL*

Line	Score
5	OSDNH VKZCR ___ 50
6	RHZCD OSVKN ___ 40
7	SVNHO KCRDZ ___ 30
8	RHSCK OZDVN ___ 25
9	OZRVN HSCKD ___ 20
10	DRHVN ZSKCO ___ 17
11	OSKCV RZHDN ___ 15
12	SKHDN OCVRZ ___ 12

4A. BINOCULAR DISTANCE—LARGE* *(Omit if score on Dial 3A)*

Line	Score
1	KDS ___400
2 / 2	ZSKCO / VRHDN ___200
3	ZNSKH VDRCO ___100
4	OZCRH NSKDV ___ 70

Code _____

*Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.

NEAR VISION—WITHOUT CORRECTION

6. BINOCULAR LATERAL PHORIA—NEAR (Check number nearest arrow)

☐ Left of 1 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 / ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14

☐ 15 ☐ 16 ☐ 17 ☐ 18 / ☐ 19 ☐ 20 ☐ 21 ☐ 22 ☐ 23 ☐ 24 ☐ 25 ☐ 26 ☐ 27 ☐ 28 ☐ 29

☐ 30 ☐ 31 ☐ 32 ☐ 33 ☐ Right of 33 CODE _____

7. MONOCULAR NEAR—SMALL*

Line	Right eye	Score (Check)	Left eye	Score
5	CVRZS DKHNO	___ 50	ZKCRV OHSDN	___ 50
6	VZKCO HRSDN	___ 40	SDKVO ZRHNC	___ 40
7	HSZKN OVCDR	___ 30	DHZRV SOKNC	___ 30
8	OVRHS CNDZK	___ 25	DKOSN RVZCH	___ 25
9	ZHCOR VDNSK	___ 20	RKZVD OSNCH	___ 20
10	RHCVN SDKZO	___ 17	OKSRN DHVCZ	___ 17
11	CNZSR OHKDV	___ 15	VRCHN OZKSD	___ 15
12	ODCNH VRSKZ	___ 12	ROHKS VDNCZ	___ 12

8. MONOCULAR NEAR—LARGE* *(Omit if score on Dial 7)*

Line	Right eye	Score	Left eye	Score
1	NCV	___ 400	DSK	___ 400
2	HNRCD / VOSZK	___ 200	CRSZO / NDVHK	___ 200
3	NDOCV RSZKH	___ 100	OKZHS NCVRD	___ 100
4	VRCNZ OSDHK	___ 70	RCOVN DHKSZ	___ 70

CODE _____ CODE _____

3

9. BINOCULAR NEAR—SMALL*

Line		Score
5	OCVKR ZNSDH	___ 50
6	ZHOCV NDRKS	___ 40
7	SDOVK HRNZC	___ 30
8	DNHKO ZSRVC	___ 25
9	DSVKH ZNOCR	___ 20
10	NZHKO RCVDS	___ 17
11	SNCZO RKVHD	___ 15
12	DHNVO SCZKR	___ 12

NS5. BINOCULAR NEAR—LARGE* *(Omit if score on Dial 9)*

Line		Score
1	NVC	___ 400
2	CZHSN / DKORV	___ 200
3	KSDVO NHZCR	___ 100
4	VZOCS HRNKD	___ 70

CODE _____

*Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.

NEAR VISION—WITH CORRECTION

6. BINOCULAR LATERAL PHORIA—NEAR (Check number nearest arrow)

☐ Left of 1 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 / ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14

☐ 15 ☐ 16 ☐ 17 ☐ 18 / ☐ 19 ☐ 20 ☐ 21 ☐ 22 ☐ 23 ☐ 24 ☐ 25 ☐ 26 ☐ 27 ☐ 28 ☐ 29

☐ 30 ☐ 31 ☐ 32 ☐ 33 ☐ Right of 33 ☐ **Arrow or number not visible** CODE _____

DISTANCE VISION—WITH CORRECTION

CORRECTED VISION
1 ☐ With glasses
2 ☐ With contact lenses

VISION TESTS
DIAL

1. BINOCULAR LATERAL PHORIA—DISTANCE (Check number nearest arrow)

☐ Left of 1 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 / ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10
☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 / ☐ 17 ☐ 18 ☐ 19 ☐ 20 ☐ 21
☐ Right of 21 ☐ Arrow or number not visible. Code ____

5A. MONOCULAR DISTANCE—SMALL*

Line	Right eye	Score (Check)	Left eye	Score
5	KDZNV SHROC	___50	CRNDO SVZHK	___ 50
6	VKRNZ CODHS	___40	ZVCOH DRSNK	___ 40
7	HSDRZ NCVOK	___30	ZKHSO VCDRN	___ 30
8	ZOVCS NRKDH	___25	HNVZS CKRDO	___ 25
9	RHSDK ONCVZ	___20	RHCVN ODSZK	___ 20
10	KNRZD OHVCS	___17	KRNHC OSDVZ	___ 17
11	KZODR HNSCV	___15	SCHZD VKNRO	___ 15
12	RVNSZ KCDOH	___12	CNDZK OHRVS	___ 12

3. MONOCULAR DISTANCE—LARGE* *(Omit if Score on Dial 5A)*

Line	Right eye	Score	Left eye	Score
1	SDK	___ 400	VNC	___ 400
2 / 2	RCSZO / KNHDV	___ 200	OZNKS / DRHCV	___ 200
3	HNZOS KRCVD	___ 100	RZOHC KSNDV	___ 100
4	ZHODC SVNKR	___ 70	RKNCZ HSDVO	___ 70

CODE ____ CODE ____

3A. BINOCULAR DISTANCE—SMALL*

Line		Score
5	OSDNH VKZCR	___50
6	RHZCD OSVKN	___40
7	SVNHO KCRDZ	___30
8	RHSCK OZDVN	___25
9	OZRVN HSCKD	___20
10	DRHVN ZSKCO	___17
11	OSKCV RZHDN	___15
12	SKHDN OCVRZ	___12

4A. BINOCULAR DISTANCE—LARGE* *(Omit if score on Dial 3A)*

Line		Score
1	KDS	___ 400
2 / 2	ZSKCO / VRHDN	___ 200
3	ZNSKH VDRCO	___ 100
4	OZCRH NSKDV	___ 70

CODE ____

LENSOMETER READINGS

EYE LENS	± FIRST READING	± SECOND READING	AXIS
Right			
Left			

*Diagonal line through each letter missed; horizontal line through sections of line not attempted and through top full line not attempted.

TRIAL LENS TEST FOR MYOPIA (Score in lines 1–8, plates 5A, 3)

Right eye	☐	☐	☐	☐	☐	☐	☐	☐	SCORE ____
	0	1	1.5	2	3	4	5	N.A.	
Left eye	☐	☐	☐	☐	☐	☐	☐	☐	SCORE ____

SAMPLE NO (1-5)

VISION—LANDOLT RING TESTS

DISTANCE* (at 10 feet)

WITHOUT CORRECTION

LINE (Code)	RIGHT EYE	LEFT EYE	BINOCULAR
1	200 ☐	200 ☐	200 ☐
2	100 ☐	100 ☐	100 ☐
3	71.4 ☐	71.4 ☐	71.4 ☐
4	50 ☐	50 ☐	50 ☐
5	39.3 ☐	39.3 ☐	39.3 ☐
6	28.6 ☐	28.6 ☐	28.6 ☐
7	25 ☐	25 ☐	25 ☐
8	21.4 ☐	21.4 ☐	21.4 ☐
8	17.9 ☐	17.9 ☐	17.9 ☐
10	14.3 ☐	14.3 ☐	14.3 ☐
11	10.7 ☐	10.7 ☐	10.7 ☐
CODE	_____	_____	_____

WITH CORRECTION

1 ☐ With Glasses
2 ☐ With Contact Lenses

LINE (Code)	RIGHT EYE	LEFT EYE	BINOCULAR
1	200 ☐	200 ☐	200 ☐
2	100 ☐	100 ☐	100 ☐
3	71.4 ☐	71.4 ☐	71.4 ☐
4	50 ☐	50 ☐	50 ☐
5	39.3 ☐	39.3 ☐	39.3 ☐
6	28.6 ☐	28.6 ☐	28.6 ☐
7	25 ☐	25 ☐	25 ☐
8	21.4 ☐	21.4 ☐	21.4 ☐
9	17.9 ☐	17.9 ☐	17.9 ☐
10	14.3 ☐	14.3 ☐	14.3 ☐
11	10.7 ☐	10.7 ☐	10.7 ☐
CODE	_____	_____	_____

TRIAL LENS TEST FOR MYOPIA—without correction (Score in lines 1–8 Monocular Distance—Omit if contact lenses are worn)

Right eye	☐	☐	☐	☐	☐	☐	☐	☐	SCORE _____
	0	**1**	**1.5**	**2**	**3**	**4**	**5**	**N.A.**	
Left eye	☐	☐	☐	☐	☐	☐	☐	☐	SCORE _____

NEAR* (at 14 inches)

LINE (Code)	RIGHT EYE	LEFT EYE	BINOCULAR
1	200 ☐	200 ☐	200 ☐
2	160 ☐	160 ☐	160 ☐
3	125 ☐	125 ☐	125 ☐
4	100 ☐	100 ☐	100 ☐
5	80 ☐	80 ☐	80 ☐
6	60 ☐	60 ☐	60 ☐
7	50 ☐	50 ☐	50 ☐
8	40 ☐	40 ☐	40 ☐
9	30 ☐	30 ☐	30 ☐
10	25 ☐	25 ☐	25 ☐
11	20 ☐	20 ☐	20 ☐
CODE	_____	_____	_____

Check acuity level reached.

TRIAL LENS TEST FOR MYOPIA—with correction (Score in Lines 1–8, Monocular Distance)

Right eye	☐	☐	☐	☐	☐
	0	**1**	**1.5**	**2**	**3**
Left eye	☐	☐	☐	☐	☐

Right eye	☐	☐	☐	SCORE _____
	4	**5**	**N.A.**	
Left eye	☐	☐	☐	SCORE _____

LENSOMETER READINGS (glasses, contact lenses)

EYE LENS	± FIRST READING	± SECOND READING	AXIS
Right			
Left			

5

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