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# The distance rock test: A normative study

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## Abstract

The distance rock test: A normative study



## Degree Type

Thesis

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Master of Science in Vision Science

## Committee Chair

Harold M. Haynes

## Subject Categories

Optometry

# THE DISTANCE ROCK TEST:
# A NORMATIVE STUDY

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Pacific University College of Optometry
In Partial Fulfillment of the
Requirements of the Degree of
Doctor of Optometry

By
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Larry D. Stoppel
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Approved 

Dr. Harold M. Haynes, Advisor

ACKNOWLEDGEMENTS

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A special thank you to Herbert Armstrong, Superintendent of the Forest Grove School District. We also appreciate the cooperation and help of the students, teachers, and administrators of Joseph Gales Grade School, Echo Shaw Grade School, and Neal Armstrong Junior High School.

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# INTRODUCTION

The vision screening device commonly used by most schools is the far Snellen Chart. This is normally administered by the school nurse or P.E. teacher. While this device may be effective in screening out myopia or astigmatism, it fails to take into account a myriad of visual variables, the failure of any one of which may decrease visual performance.

The design of this project was aimed at standardizing a screening test that would encompass more variables than the Snellen Visual Acuity Chart at far. The test used in this project included performance involving saccadic fixations, gross convergence response with an associated accomodative response, precise fixation, fine accomodative responses, form detection, letter recognition, as well as distance refraction. The test used was a distance rock test. The aim of this project was not to fraction out the various visual mechanisms involved in the distance rock procedure, but to provide normalized data for its use. The distance rock is "the measurement of the response time of the visual system to shift from distance to near and back to distance to a given discriminatory criterion or task."[1] The test originated with Dr. Harold M. Haynes and was refined and developed by Claude Stevens in his senior thesis in 1970.

The Stevens study established the distances, lighting conditions, and targets, using Sloan curved and straight letters. In

addition to developing the test conditions, he also found that there was a longer response time for smaller target sizes than for the larger, presumably due to finer accomodative and convergence adjustments.

Performance on larger 20/80 letters was faster than on 20/25 letters by a significant factor. This held true for binocular, monocular and the five inter-letter separation conditions. Naming errors were also fewer on the larger letters than on the smaller letters.[2]

In 1974 Mann, Martin, and Moore used the distance rock test to survey 591 schoolchildren from grades one through six.[3] Normal classroom illumination was used. Children were timed, reading a combination of 20/80 and 20/25 letters. A single timing for each child, reading both charts in their entirety, was recorded. The instructions were modified to be understood by each age level. The task was practiced until the examiner could be certain that the child understood the test. The child then completed the test. Any child who could not read 20/25 at near or at far was excluded from the tabulation of data. Also, children who could not name the letters were left out of the data.

The study found marked differences in response time, varying with age and grade. The response time per cycle changed between the first and sixth grade. The sixth grade distribution was skewed toward higher performance. The distribution for each

grade level, in addition, was positively skewed. There were extremes in individual response time of 12 seconds to 15 seconds per cycle. Both intergrade and intragrade variations were noted. The study found that the older the child, the quicker the response.

Lynn Dubow found that the cycles per minute could be increased with training, showing that the distance rock test findings are not fixed but are amenable to practice.[4] This had been assumed by those in visual training for some time.

Once the data had been obtained it was converted from the elapsed time data to cycles per minute. The intergrade variance was found to be nonconsequential when converted. Differences among test scores from the mean in cycles per minute were on an equidistant linear scale but the differences in elapsed time scores in seconds were not. The conversion of elapsed time scores to scale unit of cycles per minute facilitates comparison with other tests, such as accomodative and prism rock tests. It was decided that the performance was best described by using equal scale units, i.e. cycles per minute.

Previous testing has shown, then, that performance on the distance rock test varies with training, age, and intertarget separation. Other variables affecting performance include refractive errors and differences in oculomotor skills. These oculomotor skills include saccadic fixations, gross and fine convergence responses, and gross and fine accomodative responses. Also, form detection, letter recognition, and verbal naming responses may affect performance. Studies to differentiate the relative contribution of these several variables have not been performed.

# PROBLEM

This study was designed with a twofold purpose. It was designed to measure performance on a distance rock test on children from grades one through nine. The variables selected for study were letter size, 20/80 as compared with 20/25, as well as the grade level, age, and sex of the subjects.

Previous findings suggested that the distance rock test could be used as a reliable screening device, if normative data were available. The study was designed to gather that normative data for each grade level, age, sex (if sex was found to be an important variable), and also to provide pass/fail criteria for the distance rock test.

## SUBJECTS

Subjects consisted of 408 elementary students, grades 1 through 6, and 225 junior high students, grades 7 through 9. Subjects were in attendance in the West Linn School District at Halsey, Oregon, and the Forest Grove School District at Forest Grove, Oregon. The West Linn District students were measured in November of 1976 while the Forest Grove students were measured in January of 1977. West Linn students were part of a school screening. Forest Grove students were specifically tested for this study. Subjects were excluded if they did not know the letters of the alphabet.

## EQUIPMENT

The two charts, one for far and one for near, were designed for use at 20 feet and 16 inches respectively. Letter sizes were photographically reproduced to 20/80 and 20/25 Snellen acuity sizes. Sloan letters were used at the standard letter separations of the Standard Sloan Acuity chart. Choice of the target letters was based on a fourth year optometry thesis by Stevens.[5]

Both charts consisted of six horizontal lines of 12 letters. Rows of 20/80 letters were alternately mixed with the 20/25 letters. Rows 1,3, and 5 were 20/80 while rows 2, 4, and 6 were 20/25. Both the far and near charts were identical in form but consisted of different letters. See Figures 1 and 2.


Figure 1


Figure 2

Figure 1 and figure 2 on the preceeding page are reproductions of the actual charts. They are not reproduced to actual scale. The far chart was designed so that letter sizes equaled 20/80 and 20/25 acuity demand at 20 feet. The far chart's matte finish gave maximum contrast between the black letters and the white background. This finish also provided minimum glare.

The letter size for the near chart gave an acuity demand of 20/80 and 20/25 at a 16 inch testing distance. The finish was similar to the nearpoint Snellen card commonly used in nearpoint testing.

The printing of the charts was done by the Times Litho-Print of Forest Grove, Oregon.

## PROCEDURE

The distance chart was mounted on a wall 20 feet from a school desk. The near chart was positioned 16 inches from the subject by the examiner.

Each child was positioned facing the distant chart standing flush against the school desk. Distance from the subject to the distant chart was 20 feet, plus or minus 3 inches. The examiner, sitting to the side of the child, 90 degrees from line of sight, could then position the near card at the required sixteen-inch distance.

Instructions: The examiner pointed out the distant chart and said, "Name the first big letter on that chart." Next, pointing to the near chart, "Name the first large letter on this card." Again the child was directed to the distant chart and asked, "What is the next big letter on the chart? And now what is the next big letter on the card?" The subject would alternately name as many letters as necessary until the subject easily understood what was required. If the examiner thought the subject understood the instructions, the examiner would say, "Starting with the first big letter again, keep naming the letters back and forth for one minute, until I stop you. We want to see how many you can read in one minute. When you finish with the first row of large letters, start the second row of large letters. Name the letters as quidkly and as

accurately as possible. Ready, set, begin!"

When it was demonstrated that the subject understood the procedure, a timed run on the large, 20/80 letters was taken. Subjects were allowed to call letters for one minute; all omissions, substitutions, reversals were recorded. When this timed run was completed, the subject was retimed for the small 20/25 letters only.

The total number of letters read in one minute for each letter size was recorded as the gross score. All errors, i.e. reversals, omissions, substitutions, repetitions, and reading the wrong line of large or small letters, was tallied. This error tally was subtracted from the gross score to yield a net "compensated" score.

## ANALYSIS OF RESULTS

The study illustrated that performance on a distance rock test varied with letter size and acuity demand, as well as with grade level and age. It also established performance norms for each of two distance rock tests for each grade level and sex.

Table A shows the number of subjects tested by their grade level. The smallest "N" for any grade was 58 subjects in the second grade. The largest "N" was in the third grade with 87 subjects. The average "N" was 70.8 subjects.

The mean performance level is recorded for each grade level and each distance rock test. It is recorded in cycles per minute.

The performance level in cycles/minute increased with every increase in grade level from 9.55 cycles/minute in the first grade to 25.21 cycles/minute in the ninth grade for the 20/80 acuity demand. A similar increase can be seen for the 20/25 acuity demand. The first grade mean performance level on the 20/25 distance rock test was 4.79 cycles/minute. The ninth grade mean performance level on the 20/25 test was 17.12 cycles/minute.

The 20/80 distance rock test demonstrated an almost three-fold increase in task performance from the first to ninth grade. The 20/25 distance rock showed almost a fourfold increase from first grade to ninth grade.

Table A shows the values of the standard deviation and variance for each grade level and for each distance rock test. The standard deviation and variance increase with increasing grade level.

TABLE A

| | | 20/80 (Cycles/Minute) | | | 20/25 (Cycles/Minute) | | |
|---|---|---|---|---|---|---|---|
| Grade | N | Mean | Standard Deviation | Variance | Mean | Standard Deviation | Variance |
| 1 | 66 | 9.56 | 2.53 | 6.40 | 4.79 | 2.23 | 4.97 |
| 2 | 58 | 11.78 | 2.93 | 8.57 | 6.62 | 2.12 | 4.50 |
| 3 | 87 | 14.71 | 3.60 | 12.96 | 8.43 | 2.98 | 8.91 |
| 4 | 69 | 15.39 | 3.26 | 10.64 | 10.71 | 2.77 | 7.68 |
| 5 | 64 | 18.80 | 3.82 | 14.60 | 12.43 | 3.37 | 11.35 |
| 6 | 69 | 19.95 | 4.48 | 20.03 | 12.70 | 3.70 | 13.74 |
| 7 | 78 | 21.26 | 5.02 | 25.23 | 15.16 | 4.11 | 16.90 |
| 8 | 64 | 23.55 | 4.94 | 24.45 | 15.88 | 4.36 | 19.00 |
| 9 | 83 | 25.21 | 4.94 | 24.39 | 17.12 | 4.73 | 22.41 |
| | 638 | Total | | | | | |

Figure 3 is a graphical illustration of this increased performance level, in cycles/minute, compared with increasing grade level.

The almost linear increase in proficiency on the distance rock tests as grade levels increase is obvious. The slope of the best fit line equals 1.79 for the 20/80 distance rock test. The best fit line has a slope of 1.55 for the 20/25 means.

As shown in figure 3, the standard deviation increases with increasing grade level. The almost parallel slopes of both mean lines illustrates the positive correlation between the two tests.

This chart shows that there is a difference in performance for a visually guided task, the distance rock, for each grade level and for each distance rock acuity demand. It demonstrates that the visual system may very well "develop" with age well into early adulthood.

PERFORMANCE Cycles/Minute

PERFORMANCE vs. GRADE LEVEL

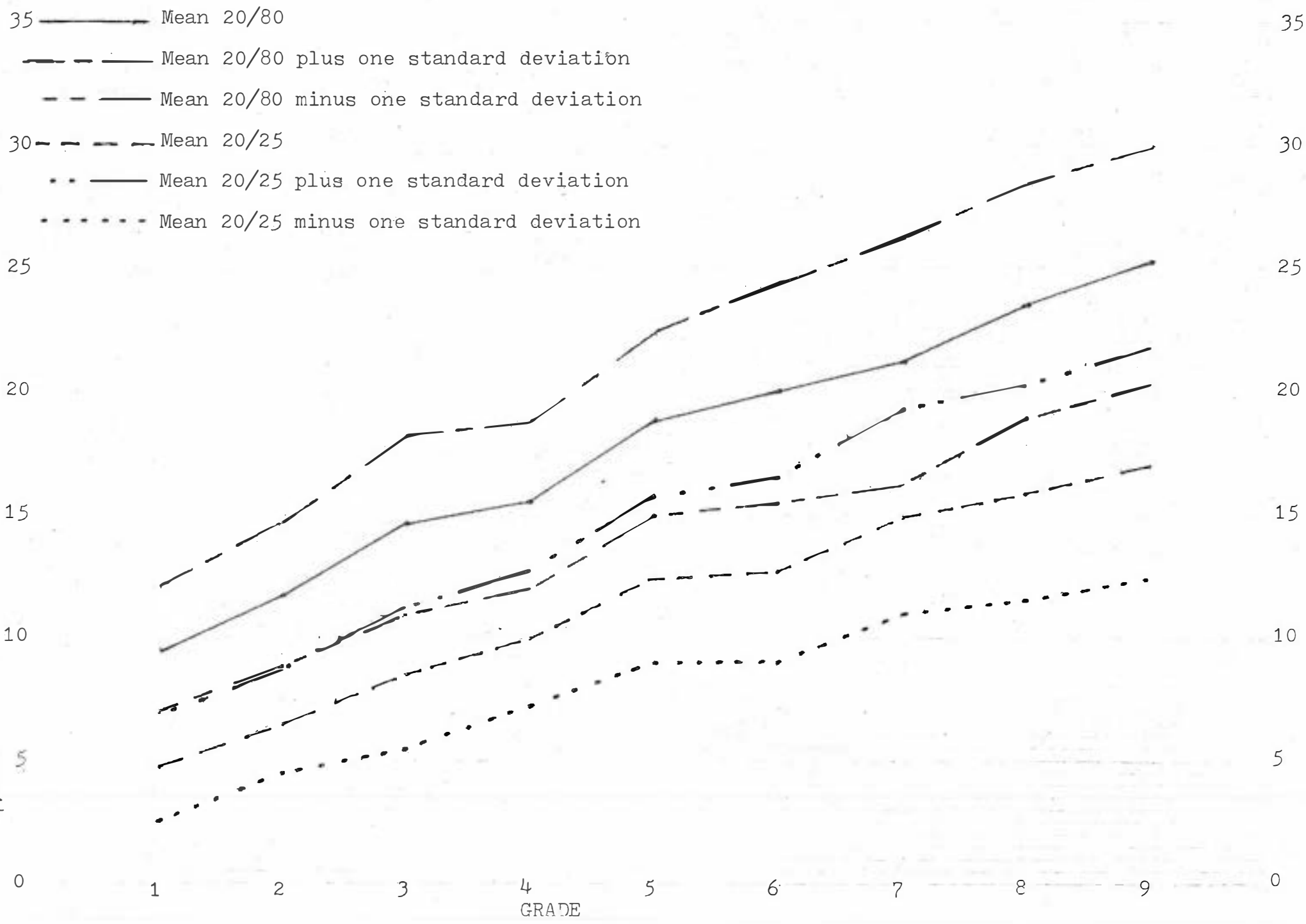
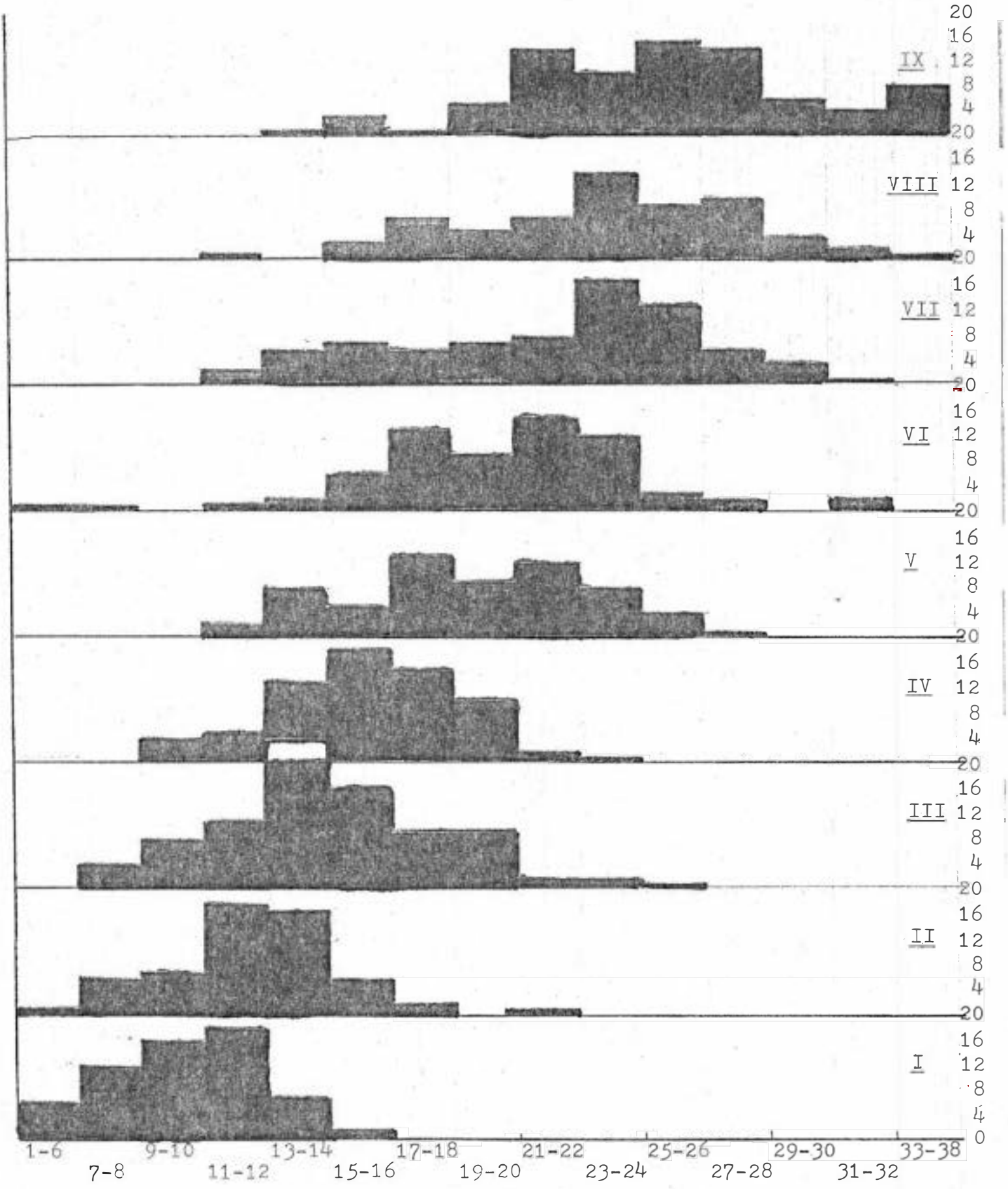


Figure 4 is the frequency histogram for the 20/80 distance rock performance. The distribution of scores follows a normal binomial distribution for each class. The most obvious feature of the histograms are the higher scores with the higher grade level.

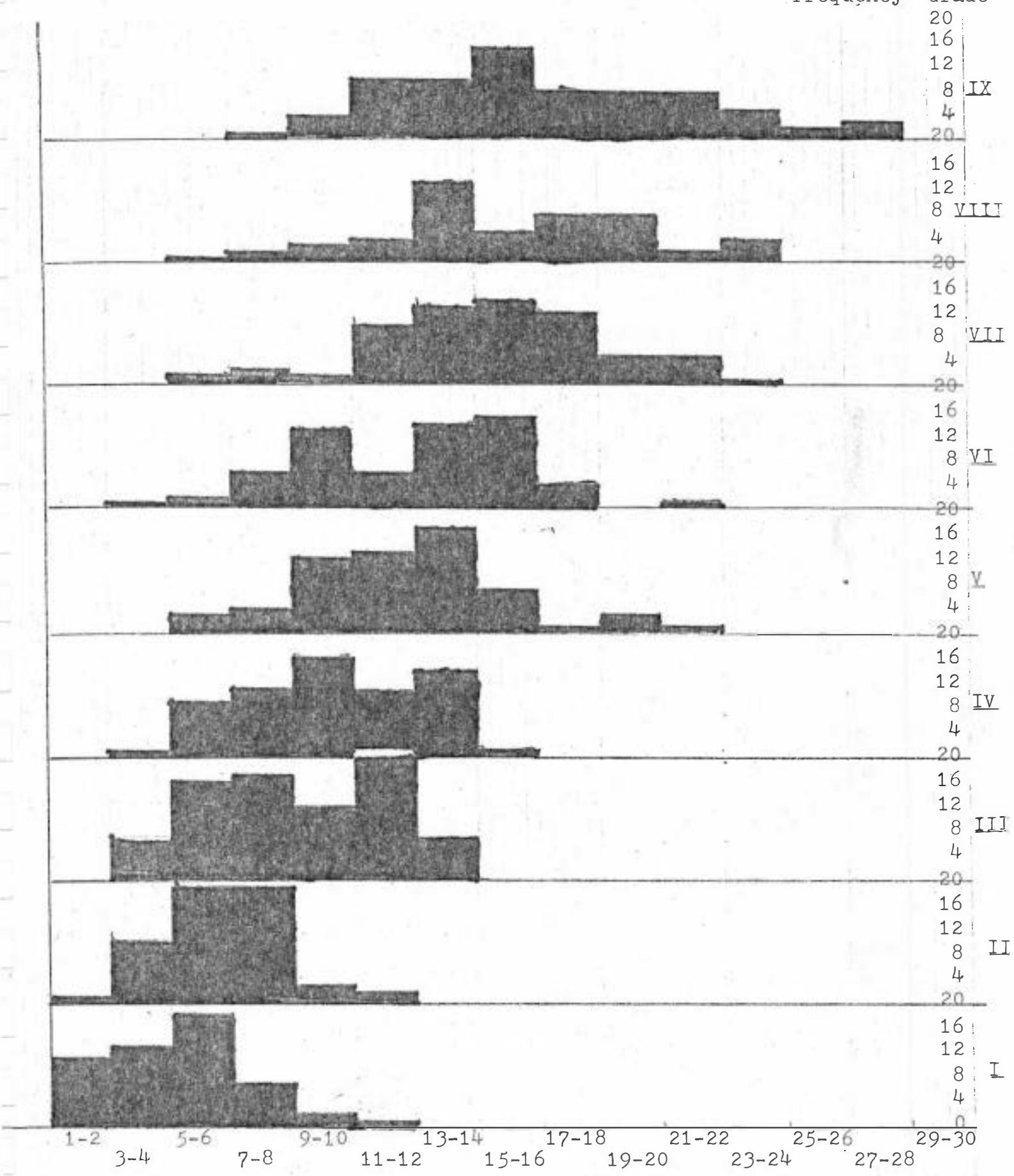
Figure 4 also demonstrates the increased range of response for the higher grades. While the ninth grade mean performance level is the highest, there are ninth grade subjects who have performance levels equal to some subjects in the first and second grades. This suggests that visual development on this test, and the development of the visual skills used, can be highly variable between subjects.

The frequency distribution for each grade level on the 20/25 distance rock test is shown on figure 5.

This same development is seen for the visual system when measured with the 20/25 distance rock test. Just as for the 20/80 distance rock test the 20/25 mean performance level increases with increased grade level. The range of performance levels also increases concurrently with grade level.




20/80 Cycles/Minute




20/25 cycles/minute

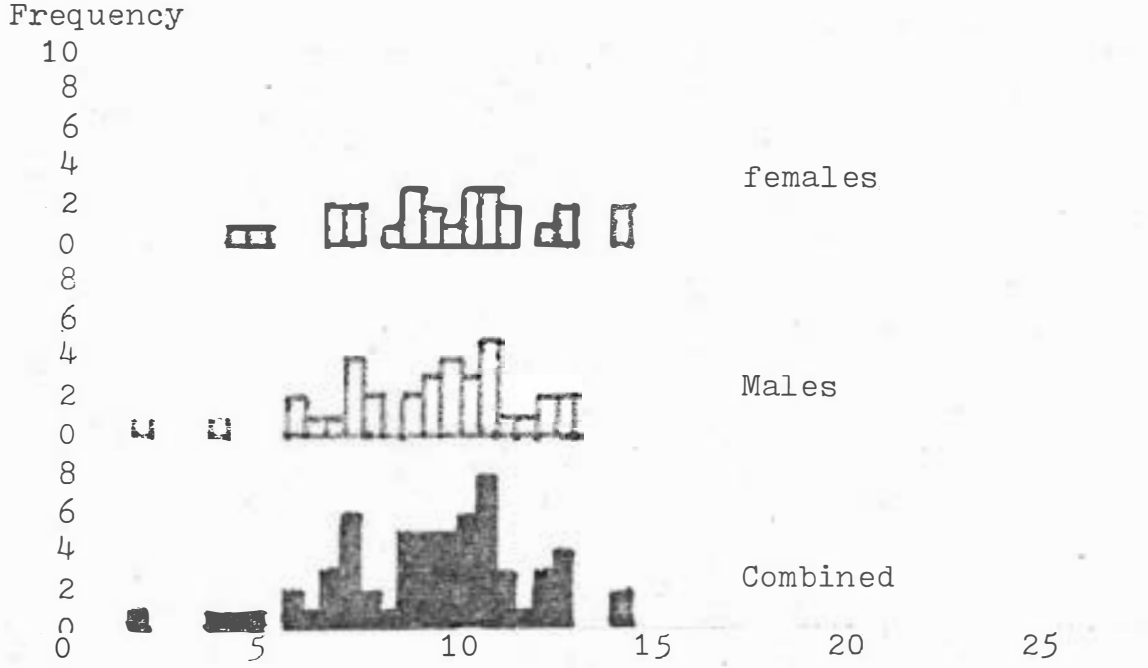
Figures 6 - 14 on the following pages show the same general trends as do the preceeding figures. They also demonstrate the increased speed while performing the 20/80 distance rock test as compared with the 20/25 distance rock test.

By comparing the males, females, and total subjects of each class on each graph, it is evident that the males and females were not "visually" different in each grade.

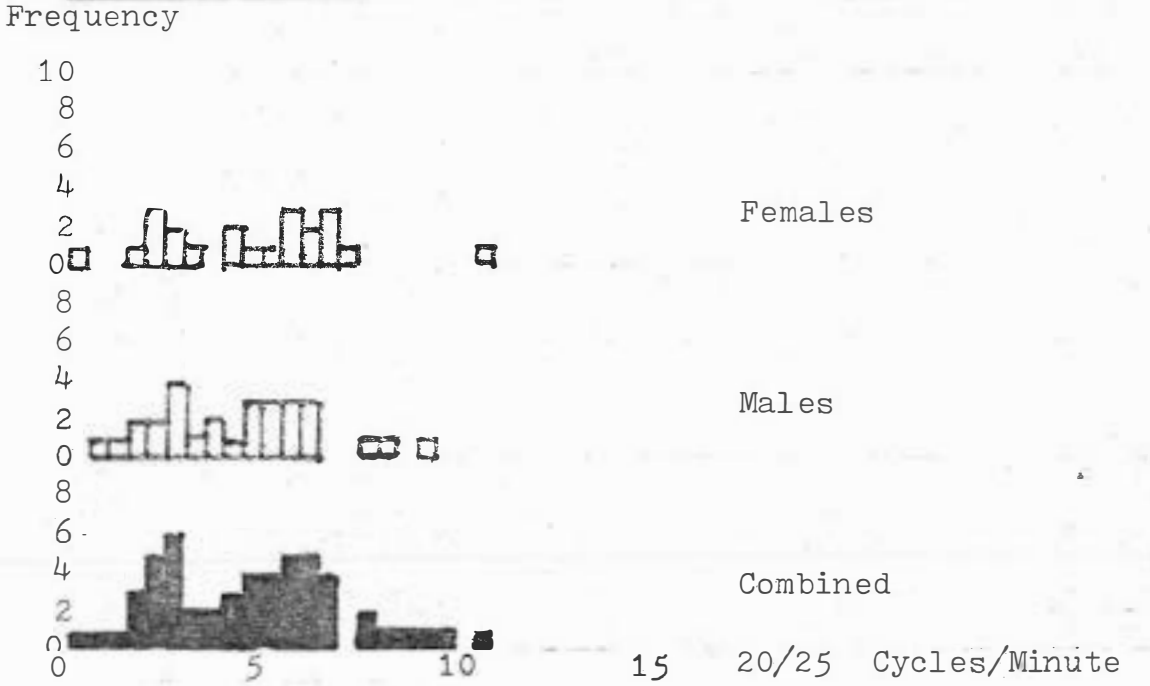
A cursory examination of the data led us to believe that females performed better than males but they were not significantly different. While boys' and girls' physical development does not occur at an equal rate within each age group, their visual "development" is the same regardless of sex.

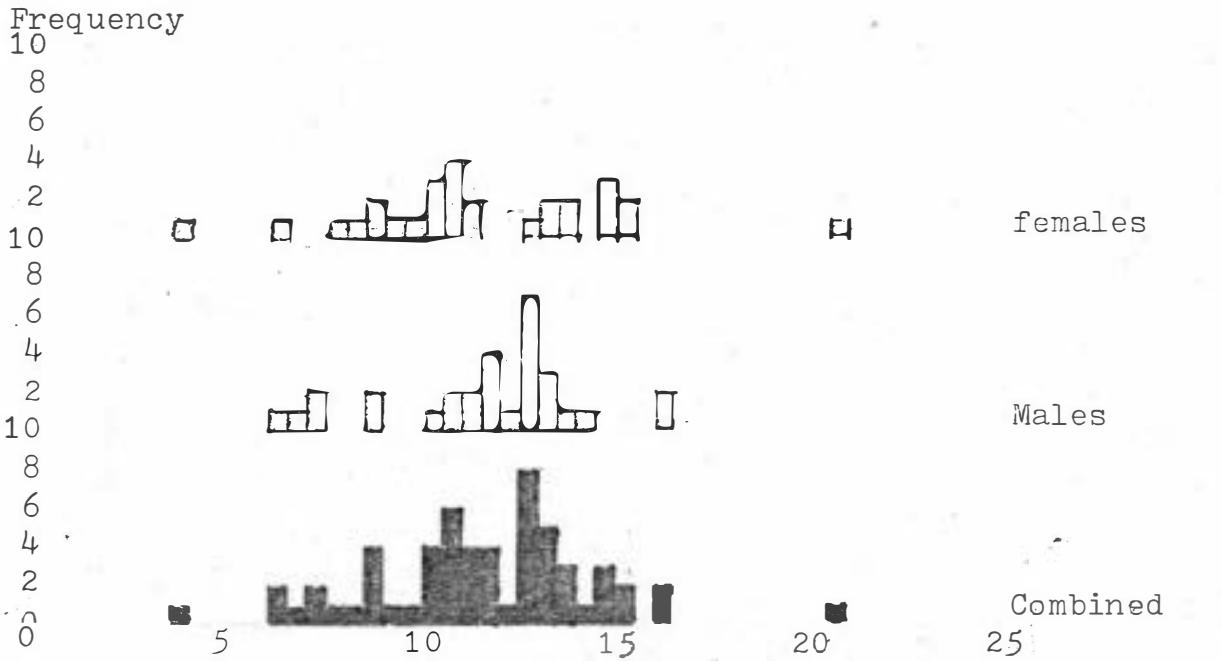
The mean performance level for each distance rock test varied for each grade. We could not conclude, however, that these were radically different tests. Analysis showed that intragrade tests showed the same population trends. That is to say, the deviation from the normal or mean response level on the 20/25 distance rock test was not significantly different from the deviation on the 20/80 distance rock test.

Table B also shows that each respective test's results showed similar intergrade population responses. This held true for grades no more than one grade apart.

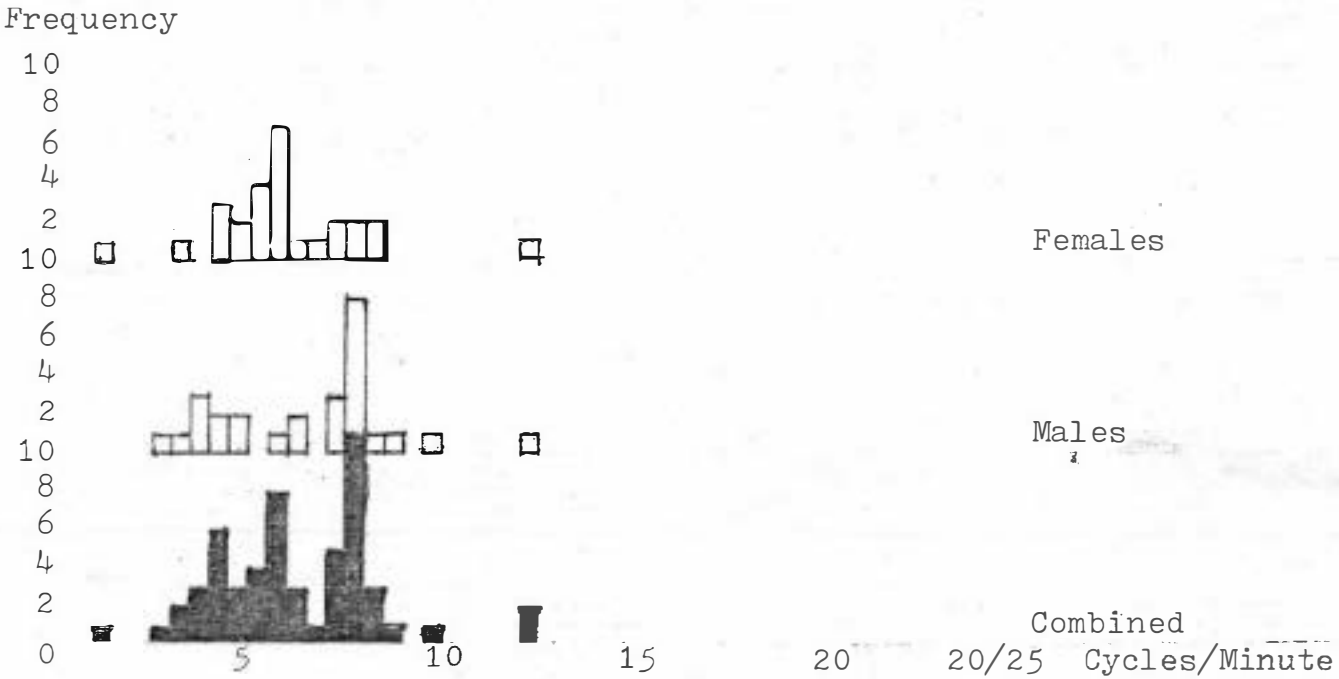

Frequency
10
8
6
4
2
0
females
Males
Combined
0
5
10
15
20
25
20/80 Cycles/Minute

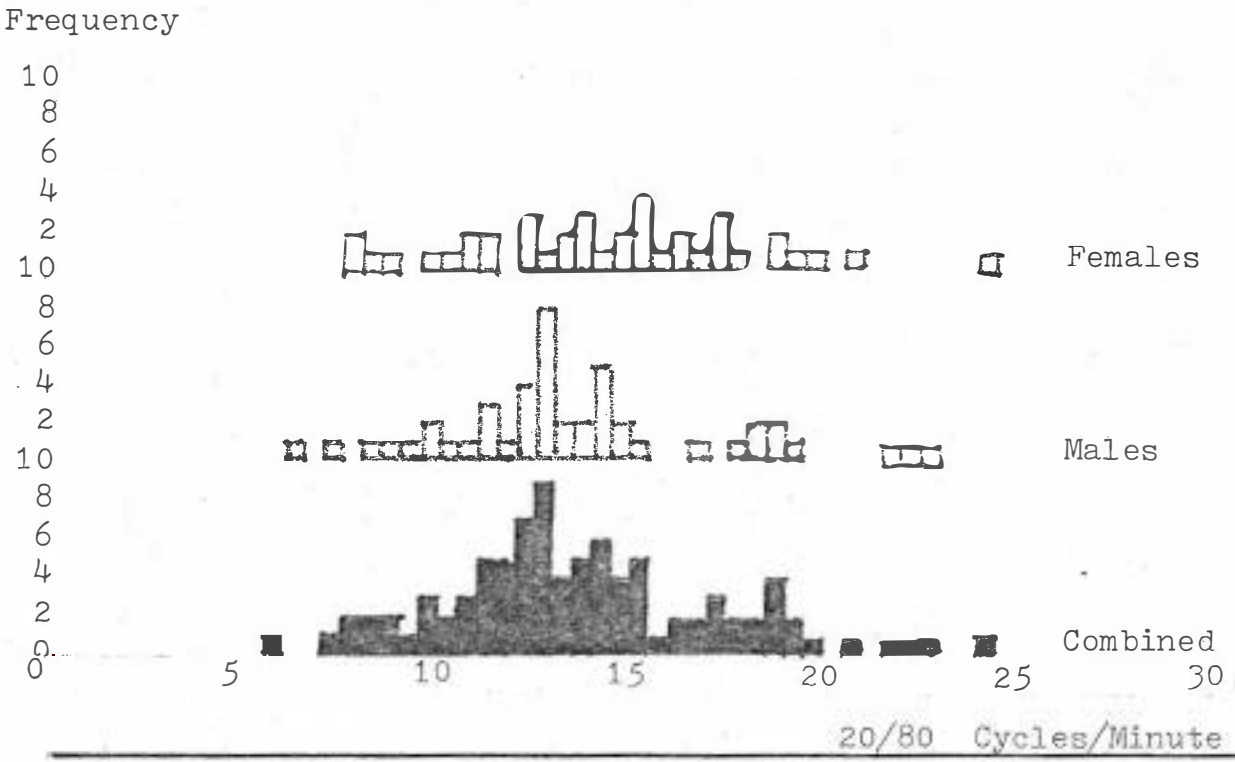
FIRST GRADE


Frequency
10
8
6
4
2
0
Females
Males
Combined
0
5
10
15
20/25 Cycles/Minute

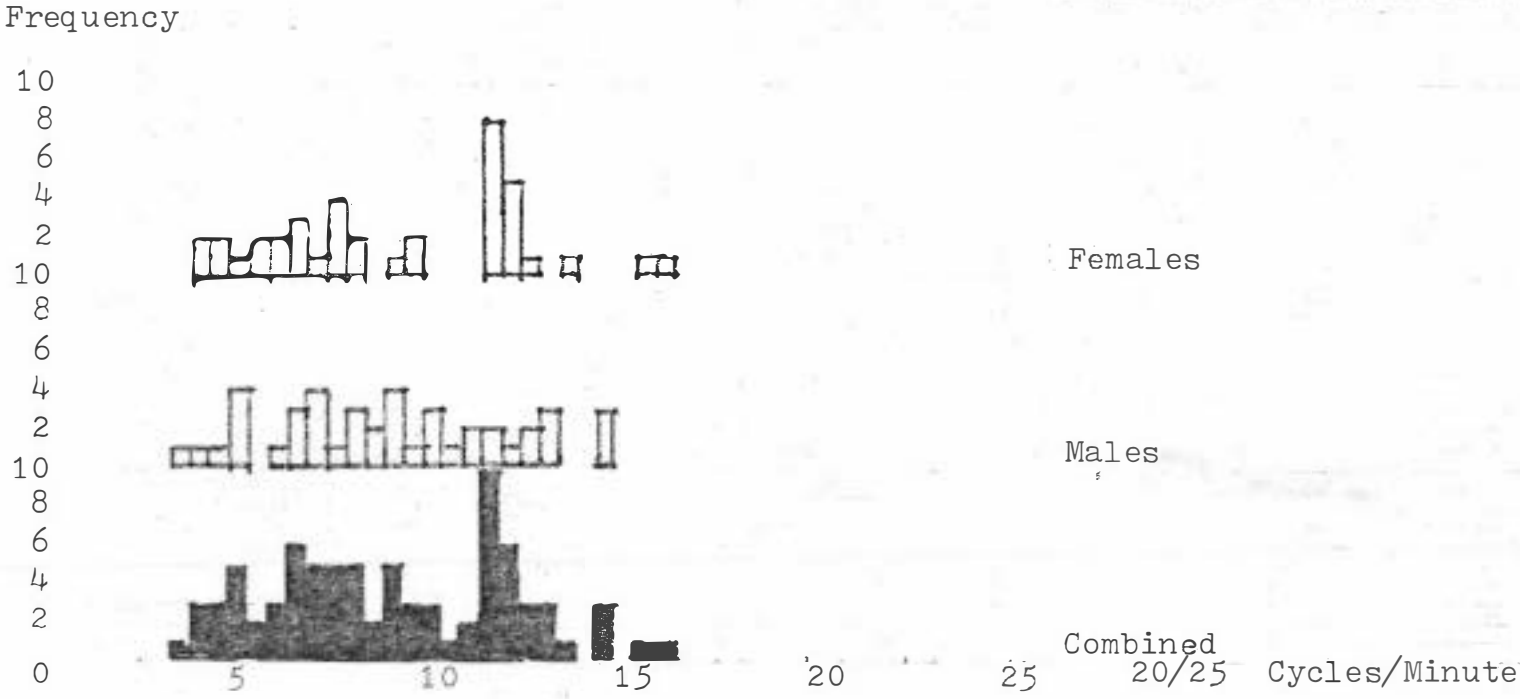


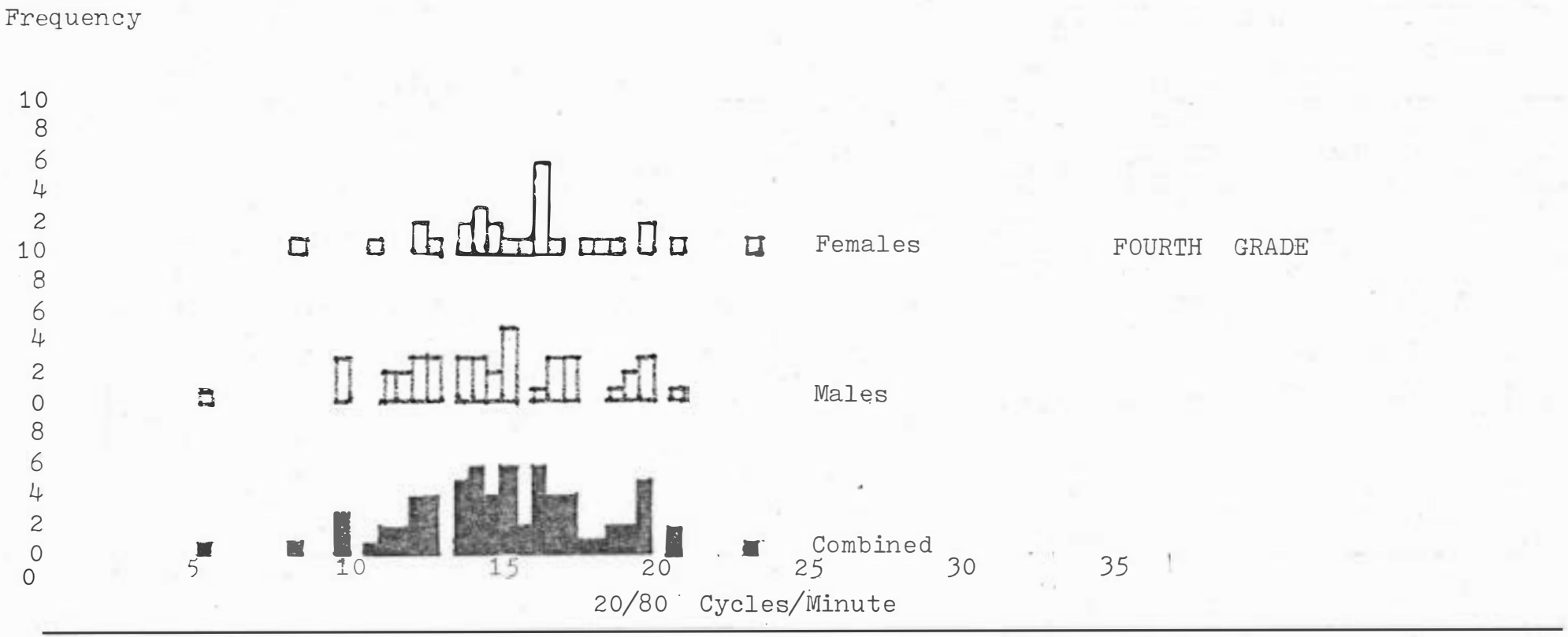

SECOND GRADE

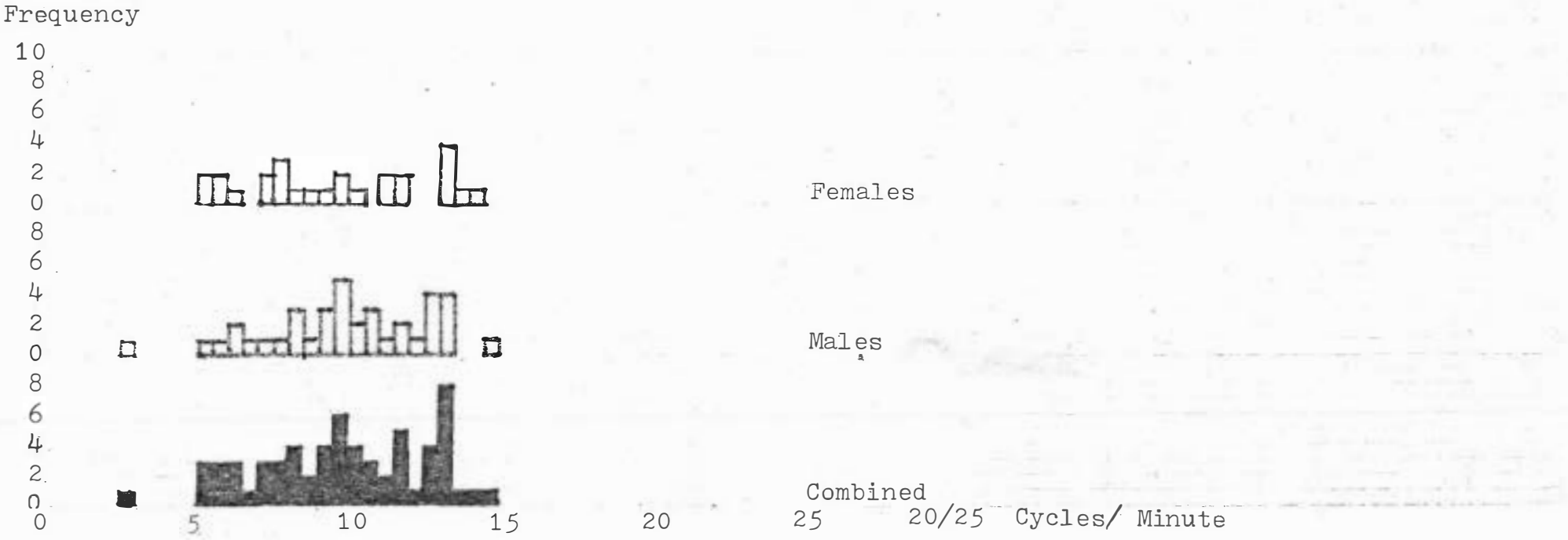



Frequency
10
8
6
4
2
10
8
6
4
2
10
8
6
4
2
0
0
5
10
15
20
25
30
Females
Males
Combined
20/80 Cycles/Minute

THIRD GRADE


Frequency
10
8
6
4
2
10
8
6
4
2
10
8
6
4
2
0
5
10
15
20
25
Females
Males
Combined
20/25 Cycles/Minute


Frequency
10
8
6
4
2
10
8
6
4
2
0
8
6
4
2
0
0
5
10
15
20
25
30
35
Females
Males
Combined
FOURTH GRADE
20/80 Cycles/Minute


Frequency
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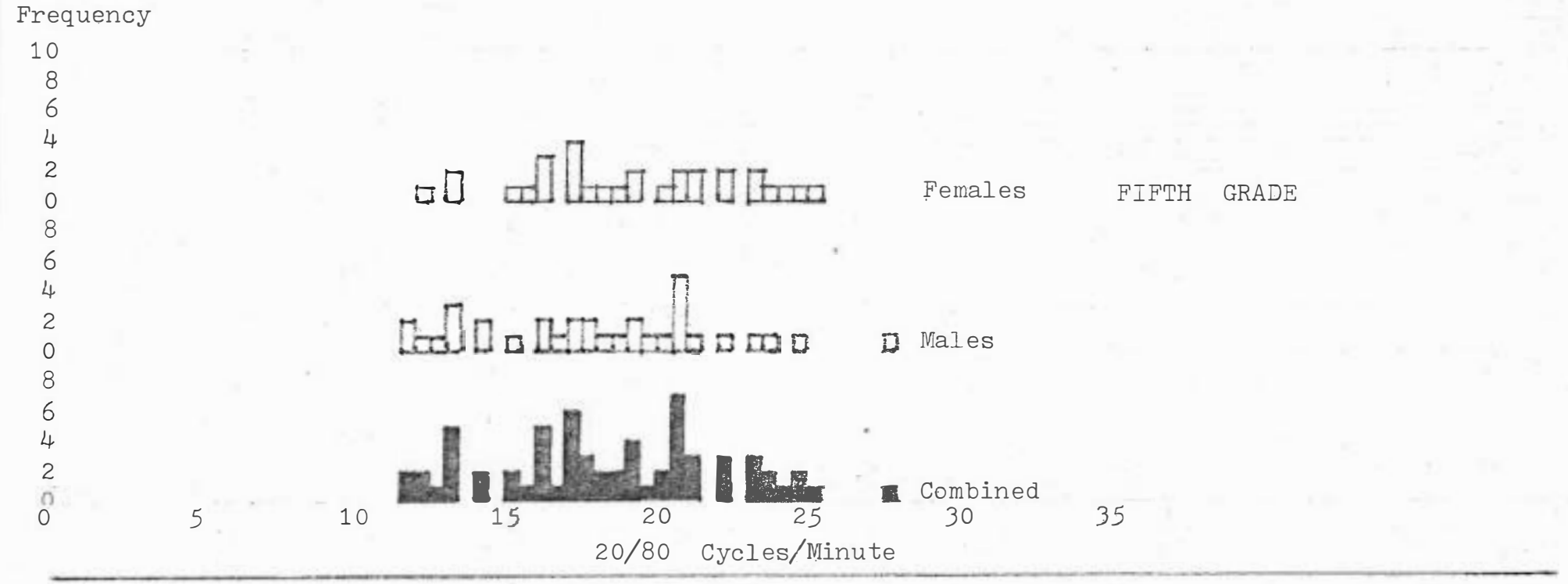
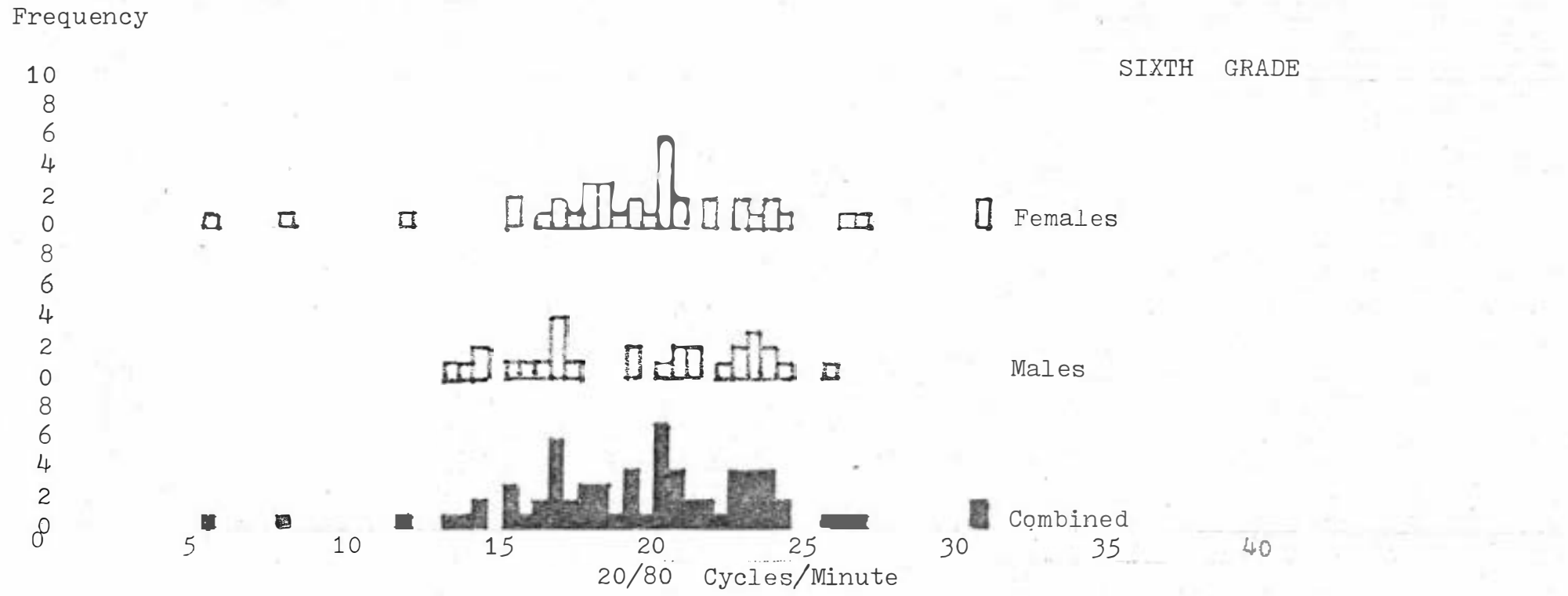
6
4
2
0
8
6
4
2
0
8
6
4
2
0
0
5
10
15
20
25
Females
Males
Combined
20/25 Cycles/ Minute


Frequency
10
8
6
4
2
0
Females
FIFTH GRADE
Males
Combined
0
5
10
15
20
25
30
35
20/80 Cycles/Minute


Frequency
10
8
6
4
2
0
Females
Males
Combined
0
5
10
15
20
25
30
20/25 Cycles/Minute


Frequency
SIXTH GRADE
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8
6
4
2
0
Females
Males
Combined
5
10
15
20
25
30
35
40
20/80 Cycles/Minute


Frequency
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2
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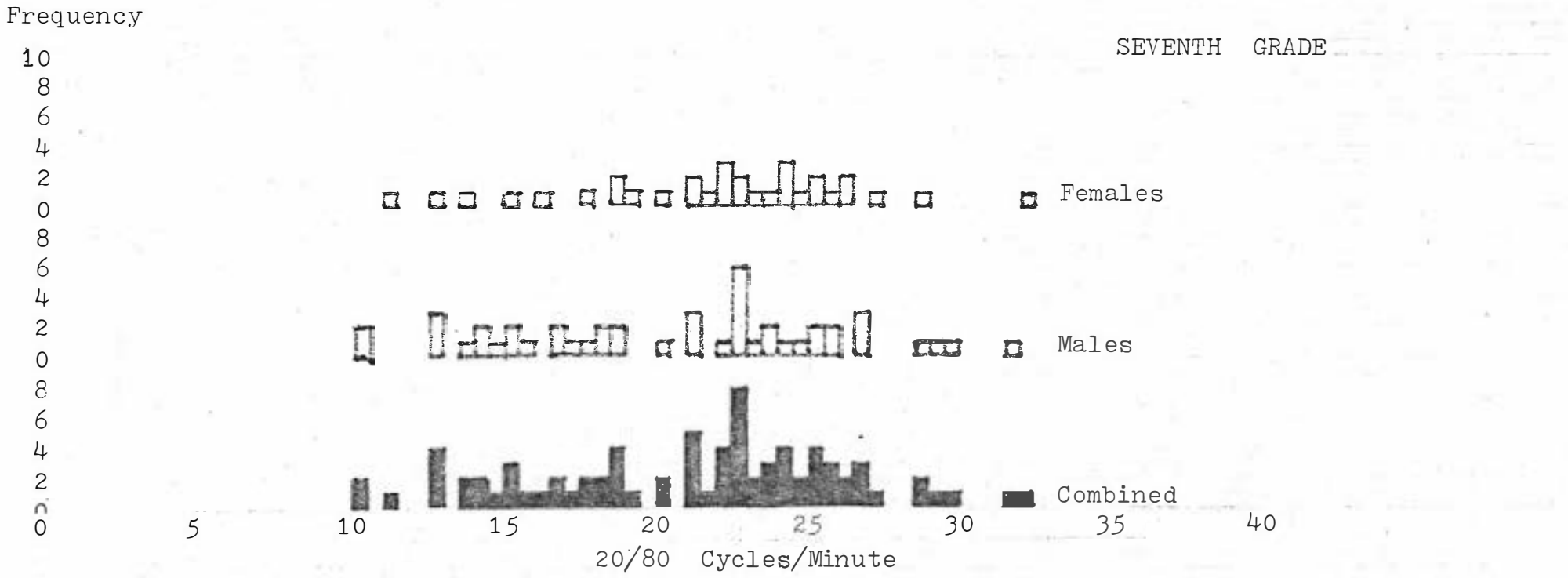
Females
Males
Combined
5
10
15
20
25
30
20/25 Cycles/Minute


Frequency
SEVENTH GRADE
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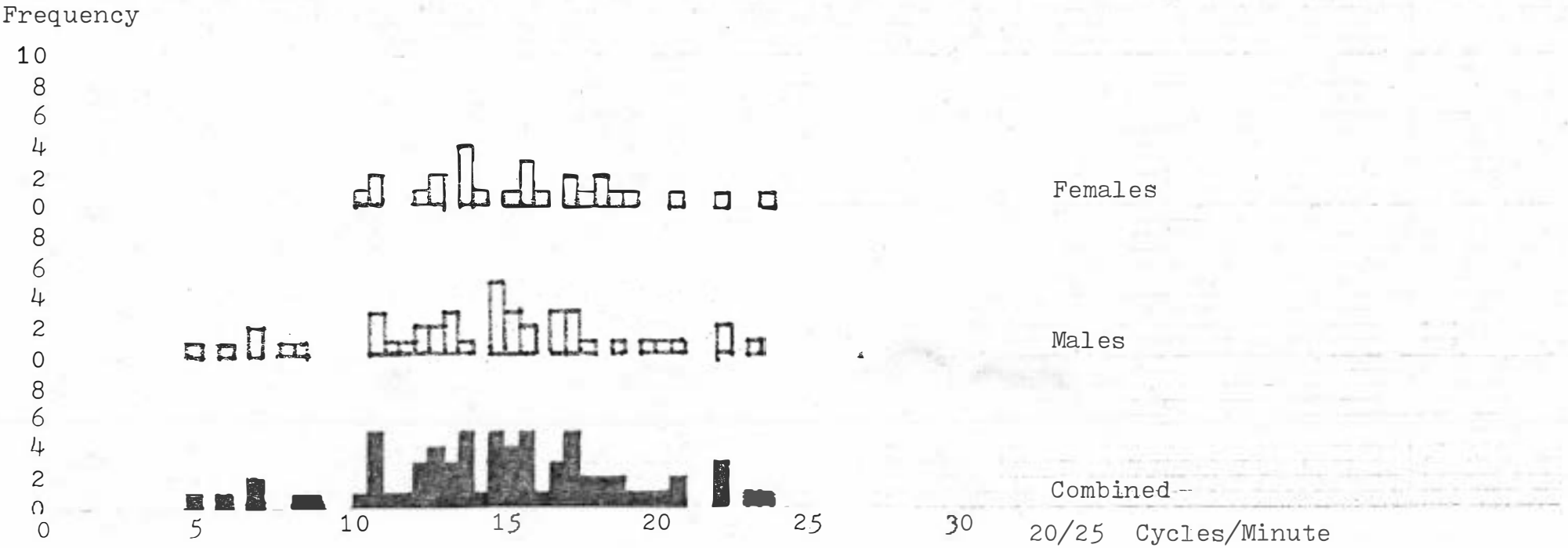
Females
Males
Combined
5
10
15
20
25
30
35
40
20/80 Cycles/Minute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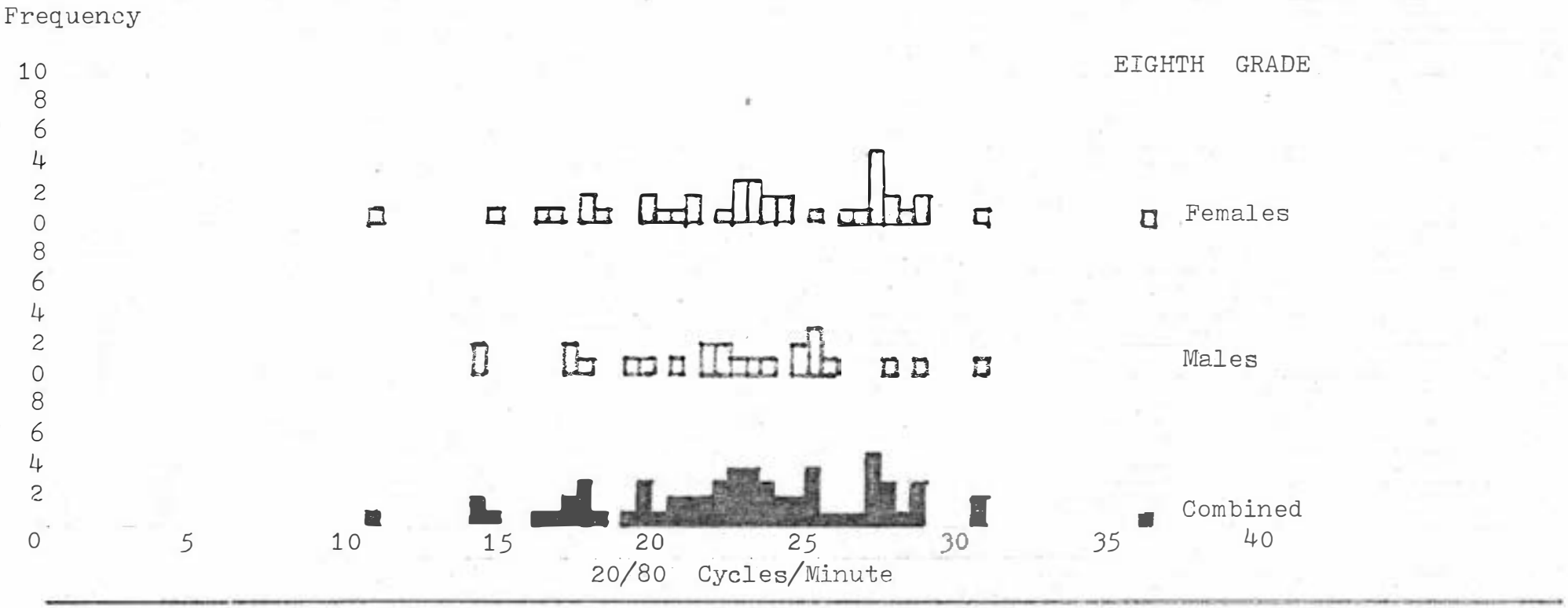
Females
Males
Combined
5
10
15
20
25
30
20/25 Cycles/Minute


Frequency
EIGHTH GRADE
Females
Males
Combined
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6
8
10
5
10
15
20
25
30
35
40
20/80 Cycles/Minute


Frequency
Females
Males
Combined
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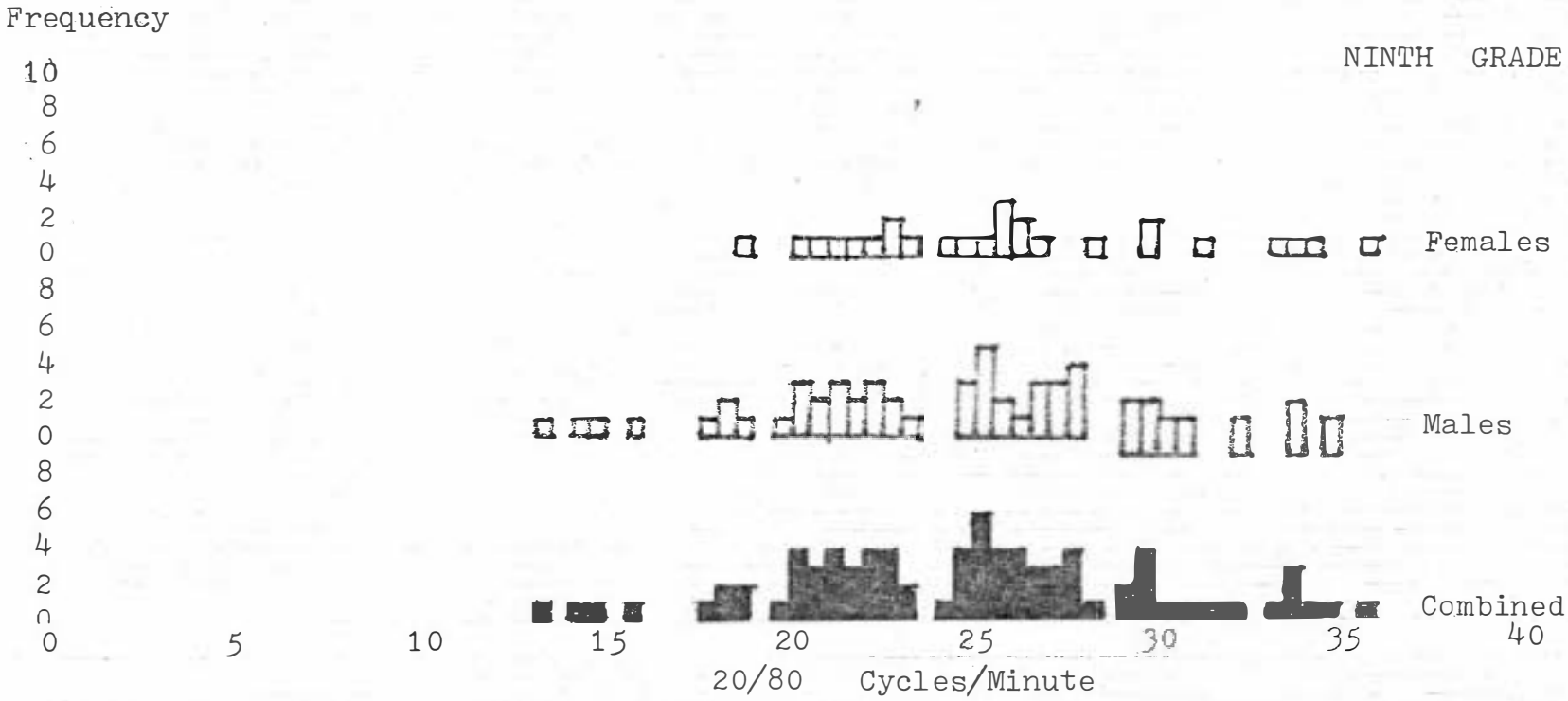
2
4
6
8
10
5
10
15
20
25
30
20/25 Cycles/Minute


Frequency
NINTH GRADE
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8
6
4
2
0
Females
Males
Combined
0
5
10
15
20
25
30
35
40
20/80 Cycles/Minute


Frequency
10
8
6
4
2
0
Females
Males
Combined
0
5
10
15
20
25
30
20/25 Cycles/Minute

TABLE B
Values of Statistical Analysis

| INTRAGRADE 20/80 vs. 20/25 | INTERGRADE 20/80 | INTERGRADE 20/25 |
|---|---|---|
| Grade 1 P(0.01) - | Grade 1 P(0.01) - | Grade 1 P(0.01) - |
| P(0.05) - | Grade 2 P(0.05) - | Grade 2 P(0.05) - |
| Grade 2 P(0.01) Sig | Grade 2 P(0.01) - | Grade 2 P(0.01) Sig |
| P(0.05) Sig | Grade 3 P(0.05) Sig | Grade 3 P(0.05) Sig |
| Grade 3 P(0.01) - | Grade 3 P(0.01) - | Grade 3 P(0.01) - |
| P(0.05) Sig | Grade 4 P(0.05) - | Grade 4 P(0.05) - |
| Grade 4 P(0.01) - | Grade 4 P(0.01) - | Grade 4 P(0.01) - |
| P(0.05) Sig | Grade 5 P(0.05) Sig | Grade 5 P(0.05) Sig |
| Grade 5 P(0.01) - | Grade 5 P(0.01) - | Grade 5 P(0.01) - |
| P(0.05) - | Grade 6 P(0.05) Sig | Grade 6 P(0.05) - |
| Grade 6 P(0.01) - | Grade 6 P(0.01) - | Grade 6 P(0.05) - |
| P(0.05) Sig | Grade 7 P(0.05) - | Grade 7 P(0.05) - |
| Grade 7 P(0.01) - | Grade 7 P(0.01) - | Grade 7 P(0.01) - |
| P(0.05) Sig | Grade 8 P(0.01) - | Grade 8 P(0.05) - |
| Grade 8 P(0.01) - | Grade 8 P(0.01) - | Grade 8 P(0.01) - |
| P(0.05) - | Grade 9 P(0.01) - | Grade 9 P(0.05) - |
| Grade 9 P(0.01) - | Grade 9 P(0.01) Sig | Grade 9 P(0.05) Sig |
| P(0.05) - | Grade 1 P(0.05) Sig | Grade 1 P(0.01) Sig |

Sig = Significant
\- = Not Significant

The criteria used in accessing relative superior, average, or inferior performance are listed on Table C. Average performance was considered the mean in cycles per minute for each grade. Superior performance was one standard deviation greater than the mean in cycles/minute. Inferior performance was one standard deviation below the mean in cycles/minute for each grade.

This inferior performance level was picked as our referral criterion for both the 20/80 and the 20/25 distance rock tests.

Table D is a table of the number and percentage of subjects who fell into one of four referral criterion categories.

The referral criteria were as follows: 1. those subjects who had visual acuity 20/80 or worse at far or near; 2. those subjects who had visual acuity of 20/25 or worse at far or near; 3. those subjects whose performance level was one standard deviation or more below the mean performance level for their grade level on the 20/80 distance rock test; 4. those subjects whose performance level was one standard deviation or more below the mean performance level for their grade level on the 20/25 distance rock test.

Also listed are the numbers and percentages of subjects for each grade whose performance level was one standard deviation or more below the mean performance level for their grade level for both the 20/80 and 20/25 distance rock tests. The final column is the total numbers and percentages of subjects who failed for any one or more of the above reasons.

The referral criterion with the lowest referral rate was the 20/80 or worse visual acuity. This was not unexpected. What was surprising was that 10% of the total subjects tested could not read 20/25 Snellen letters at either near or far. Especially surprising was the fact that eighth graders had the highest 20/25 visual acuity failure referral rate. The rate for the eighth grade was 22% of total subjects. The average 20/25 visual acuity failure rate for each class was only 10%.

The referral criterion on the 20/25 rock test referred 11.5% of the total subjects. The 20/80 rock test referred almost 15% of the total tested subjects. 180 out of 638 subjects, or 28.2%, were referred by one or more criteria.

TABLE C

| | 20/80 (Cycles/Minute) | | | 20/25 (Cycles/Minute) | | |
|---|---|---|---|---|---|---|
| Grade | Superior | Mean | Failure | Superior | Mean | Failure |
| 1 | 12.09 | 9.56 | 7.03 | 7.02 | 4.79 | 2.56 |
| 2 | 14.71 | 11.78 | 8.86 | 8.74 | 6.62 | 4.50 |
| 3 | 18.31 | 14.71 | 11.11 | 11.41 | 8.43 | 5.44 |
| 4 | 18.65 | 15.39 | 12.13 | 12.84 | 10.71 | 7.30 |
| 5 | 22.63 | 18.80 | 14.08 | 15.80 | 12.43 | 9.06 |
| 6 | 24.42 | 19.95 | 15.47 | 16.40 | 12.70 | 9.00 |
| 7 | 26.28 | 21.26 | 16.23 | 19.27 | 15.16 | 11.05 |
| 8 | 28.49 | 23.55 | 18.60 | 20.24 | 15.88 | 11.52 |
| 9 | 30.15 | 25.21 | 20.27 | 21.86 | 17.12 | 12.39 |

Superior=One Standard Deviation above the Mean.

Failure =One Standard Deviation below the Mean

TABLE D - REFERRALS

# TABLE D

## REFERRALS

| Grade | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Failed 20/80 Visual Acuity | number | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 3 |
| | percent | 0% | 0% | 0% | 0% | 0% | 1.4% | 0% | 1.5% | 1.2% | .5% |
| Failed 20/25 Visual Acuity | number | 9 | 4 | 5 | 6 | 3 | 6 | 9 | 14 | 8 | 64 |
| | percent | 13.6% | 6.9% | 5.7% | 8.7% | 4.7% | 8.7% | 11.5% | 22% | 9.6% | 10% |
| Below Referral Criterion on the 20/80 distance rock test | number | 7 | 8 | 14 | 8 | 12 | 7 | 16 | 11 | 10 | 93 |
| | percent | 10.6% | 14% | 16% | 11.6% | 18:8% | 9% | 20% | 17% | 12% | 14.7% |
| Below Referral Criterion on the 20/25 distance rock test | number | 6 | 6 | 12 | 11 | 7 | 9 | 7 | 8 | 9 | 75 |
| | percent | 9% | 10% | 14% | 16% | 11% | 11.5% | 9% | 12.5% | 10.8% | 11.48% |
| Below Referral Criteria on both 20/80 and 20/25 | number | 2 | 2 | 3 | 2 | 3 | 2 | 5 | 3 | 4 | 26 |
| | percent | 3% | 3.4% | 3.5% | 2.9% | 4.7% | 2.6% | 6.4% | 4.7% | 4.8% | 3.6% |
| Total number referrals based on visual acuity or performance criteria | number | 17 | 16 | 26 | 21 | 19 | 18 | 20 | 24 | 19 | 180 |
| | percent | 25.7% | 27.5% | 29.8% | 30% | 29.6% | 26.1% | 25.6% | 37.5% | 22.9% | 28.2% |

Tables E through M show the compensated scores for each distance rock test and each grade.

The compensated score equaled the total number of alternations minus the number of errors. An error was a letter omitted, repeated, or substituted. An error was also a letter called out of place from its normal sequence, that is, the error consisted of calling out a far letter, then a near letter, then a near letter, then a far letter, etc. instead of near, far, near, far, for instance. An error was scored if the subject skipped a line of letters completely and started calling out the wrong line.

These errors were subtracted from the total number of alternations called within a sixty-second period. This score was divided by two to give the compensated score in cycles per minute.

DATA TABLE FOR FIRST GRADE

| Joseph Gales | | Joseph Gales | | Joseph Gales | |
|---|---|---|---|---|---|
| 20/80 | 20/25 | 20/80 | 20/25 | 20/80 | 20/25 |
| M 9.5 | 3 | M 10 | 5.5 | F 9 | 0 |
| M 7.5 | 6 | F 8.5 | 5 | F 13 | 3.5 |
| M 4 | 1*** | M 8.5 | 5 | F 5 | 0* |
| M 11.5 | 3 | M 8 | 4 | F 8.5 | 3 |
| M 6 | 2.5* | M 7 | 6 | F 11.5 | 6 |
| F 4.5 | 0.5*** | M 13 | 5.5 | F 10 | 0 |
| M 8 | 0 | M 7.5 | 3 | F 12.5 | 0 |
| M 11 | 8 | F 6.5 | 3* | F 14.5 | 11 |
| M 9.5 | 2** | M 2 | 0* | F 11 | 2.5 |
| M 10 | 2** | M 11 | 6.5 | M 7.5 | 0 |
| F 13 | 6.5 | M 10 | 2.5 | M 12 | 5.5 |
| M 10.5 | 6.5 | F 12.5 | 4 | M 9 | 8.5 |
| M 11 | 3.5 | F 14.5 | 7 | F 10.5 | 7 |
| F 9 | 6.5 | M 10.5 | 4 | M 9 | 1.5** |
| F 11 | 3.5 | M 7.5 | 0 | F 7 | 6 |
| M 6 | 0 * | M 10.5 | 6.5 | F 11.5 | 3 |
| F 8.5 | 2.5 | M 11 | 4.5 | F 7.5 | 8 |
| F 10.5 | 4.5 | M 10 | 5 | F 10.5 | 7 |
| F 7 | 2.5 | M 11 | 5 | M 13 | 9.5 |
| F 7.5 | 6.5 | F 11 | 4.5 | M 12.5 | 6 |
| | | | | F 9 | 2** |

* Scores greater than one standard deviation below mean of 20/80 only.

** Scores greater than one standard deviation below mean of 20/25 only.

*** Scores greater than one standard deviation below mean of both 20/80 and 20/25.

Scores = Cycles/Minute

DATA TABLE FOR SECOND GRADE

| Joseph Gales | | Joseph Gales | | Joseph Gales | |
|---|---|---|---|---|---|
| 20/80 | 20/25 | 20/80 | 20/25 | 20/80 | 20/25 |
| F 15 | 8 | M 12 | 0 | M 10.5 | 1.5** |
| M 11 | 8 | F 11 | 6 | F 15 | 8.5 |
| F 15.5 | 7.5 | M 12 | 6 | F 10.5 | 3** |
| F 14 | 8 | M 7 | 6* | F 13.5 | 8 |
| M 7.5 | 5.5* | M 13 | 8.5 | F 21 | 12.5 |
| M 13 | 0 | M 9 | 7.5 | F 11 | 10 |
| F 6.5 | 4*** | F 11 | 8 | F 11 | 5 |
| M 13 | 6.5 | M 12.5 | 5 | F 9.5 | 4.5 |
| M 6.5 | 6* | M 7.5 | 4.5* | F 9 | 9 |
| F 11.5 | 4** | F 9 | 3.5** | M 16.5 | 6 |
| M 13 | 6 | F 13 | 7.5 | F 11.5 | 8 |
| M 14 | 7 | F 10.5 | 7.5 | F 15 | 8 |
| F 15.5 | 8 | F 10 | 8 | M 13.5 | 7.5 |
| F 8.5 | 4*** | M 16.5 | 8 | F 14 | 12.5 |
| M 12 | 0 | M 13 | 8.5 | F 13.5 | 6.5 |
| M 13 | 5.5 | M 11.5 | 3.5** | F 8 | 4.5* |
| M 11 | 6 | M 13 | 4.5 | F 4 | 0* |
| M 14.5 | 6 | M 9 | 5.5 | F 10.5 | 5 |
| M 13.5 | 12.5 | M 12 | 5.5 | | |
| M 11.5 | 4.5 | M 13.5 | 8 | | |

* Scores greater than one standard deviation below mean of 20/80 only.

** Scores greater than one standard deviation below mean of 20/25 only.

*** Scores greater than one standard deviation below mean of both 20/80 and 20/25.

Scores = Cycles/Minute

DATA TABLE FOR THIRD GRADE

| Joseph Gales 20/80 | Joseph Gales 20/25 |
|---|---|
| F 16.5 | 8 |
| M 22.5 | 14.5 |
| F 15.5 | 6.5 |
| M 14.5 | 9 |
| M 14 | 0 |
| M 14.5 | 6.5 |
| M 18 | 13 |
| M 18.5 | 10 |
| M 13 | 4.5** |
| M 9 | 0* |
| M 10 | 5*** |
| M 14.5 | 11 |
| F 11 | 6.5 |
| M 11 | 7 |
| F 10.5 | 9* |
| M 13 | 7 |
| F 9 | 4*** |
| M 9.5 | 6.5* |
| F 14.5 | 11.5 |
| M 13 | 6 |
| M 13 | 8 |
| M 14 | 7 |
| M 15.5 | 6.5 |
| F 15.5 | 6.5 |
| M 13 | 0 |
| F 15.5 | 4.5** |
| F 19.5 | 13.5 |
| M 13.5 | 7 |
| M 14.5 | 9.5 |

| Joseph Gales 20/80 | Joseph Gales 20/25 |
|---|---|
| F 14 | 9.5 |
| F 13.5 | 0 |
| M 19.5 | 14.5 |
| F 15 | 7.5 |
| F 19 | 12 |
| F 14 | 4** |
| M 17 | 11 |
| F 14.5 | 7.5 |
| F 12.5 | 6 |
| F 24.5 | 12.5 |
| F 17.5 | 11.5 |
| F 12.5 | 12 |
| F 15 | 11.5 |
| F 11.5 | 8 |
| F 8.5 | 6* |
| M 15 | 8.5 |
| M 12.5 | 5** |
| M 22 | 12.5 |
| F 16.5 | 12 |
| F 8 | 4.5*** |
| F 15.5 | 5.5 |
| M 18.5 | 10.5 |
| F 19 | 12 |
| M 19 | 7.5 |
| M 13 | 8.5 |
| M 11.5 | 3.5** |
| M 13 | 5** |
| F 11 | 7 |
| F 21 | 11.5 |

| West Linn 20/80 | West Linn 20/25 |
|---|---|
| F 13.5 | 5** |
| M 11.5 | 10 |
| M 14.5 | 11.5 |
| M 20 | 14.5 |
| M 11.5 | 12 |
| M 15 | 9 |
| F 8 | 5.5* |
| F 10 | 7.5* |
| M 13.5 | 10 |
| M 12.5 | 0 |
| M 19 | 13 |
| M 8.5 | 8* |
| F 18 | 11.5 |
| F 17 | 11.5 |
| M 12.5 | 5** |
| M 12 | 12 |
| M 13 | 12.5 |
| M 12.5 | 8** |
| M 7.5 | 9* |
| F 13 | 12 |
| M 10 | 9* |
| F 11.5 | 11.5 |
| F 20 | 16 |
| F 14 | 13.5 |
| F 16 | 11.5 |
| M 10.5 | 11.5 |
| F 17.5 | 7.5 |
| M 6.5 | 8* |
| F 12.5 | 9.5 |

* Scores greater than one standard deviation below mean of 20/80 only.

** Scores greater than one standard deviation below mean of 20/25 only.

*** Scores greater than one standard deviation below mean of both 20/80 and 20/25.

Scores = Cycles/Minutes

DATA TABLE FOR FOURTH GRADE

| Joseph Gales | | Joseph Gales | | Echo Shaw | |
|---|---|---|---|---|---|
| 20/80 | 20/25 | 20/80 | 20/25 | 20/80 | 20/25 |
| F 12.5 | 3** | F 16.5 | 14.5 | F 11 | 6.5*** |
| F 13 | 8 | F 23.5 | 12 | F 1.5 | 13.5 |
| M 21 | 13.5 | M 20 | 8.5 | M 14.5 | 11 |
| F 14 | 12 | M 14.5 | 12.5 | M 14 | 9 |
| F 16.5 | 9.5 | M 15.5 | 11.5 | M 17.5 | 13 |
| F 20 | 13.5 | M 12.5 | 8.5 | M 15.5 | 12 |
| M 20 | 0 | M 17.5 | 13.5 | M 15.5 | 13 |
| M 13 | 6.5** | M 14 | 10 | F 16.5 | 13.5 |
| M 15 | 8.5 | F 17 | 10 | F 21 | 11.5 |
| M 11.5 | 12* | M 14 | 10 | F 20 | 12 |
| F 16.5 | 0 | M 19.5 | 16.5 | M 13 | 15 |
| M 17 | 6** | M 17 | 10.5 | M 19 | 10 |
| M 5.5 | 0* | F 14.5 | 6** | M 11.5 | 13* |
| M 12 | 10 | F 15 | 7.5 | F 18.5 | 14 |
| M 12 | 7** | F 14 | 8 | F 14.5 | 6** |
| M 17.5 | 13 | M 16 | 13.5 | M 10 | 0* |
| M 18.5 | 11 | F 14.5 | 5.5** | F 16 | 8.5 |
| M 15.5 | 9.5 | M 17 | 5.5** | F 18 | 10 |
| M 20 | 10.5 | M 13 | 6.5** | F 8.5 | 5.5*** |
| F 16.5 | 10.5 | F 12.5 | 14.5 | | |
| M 10 | 11* | M 10 | 10.5* | | |
| M 14.5 | 0 | M 17.5 | 9.5 | | |
| F 15.5 | 0 | M 12.5 | 8 | | |
| F 16.5 | 13.5 | M 15.5 | 7.5 | | |
| M 15 | 9.5 | F 19 | 9 | | |

* Scores greater than one standard deviation below mean of 20/80 only.

** Scores greater than one standard deviation below mean of 20/25 only.

*** Scores greater than one standard deviation below mean of both 20/80 and 20/25.

Scores = Cycles/Minute

DATA TABLE FOR FIFTH GRADE

| Joseph Gales | | | Echo Shaw | |
|---|---|---|---|---|
| | 20/80 | 20/25 | 20/80 | 20/25 |
| F | 13.5 | 12.5* | M 20 | 11 |
| F | 19 | 0 | F 16.5 | 12 |
| F | 16.5 | 6.5** | F 18 | 9.5 |
| F | 21.5 | 13.5 | M 25 | 14 |
| F | 15.5 | 12 | M 21 | 18.5 |
| M | 13 | 12* | M 12 | 7.5*** |
| M | 14.5 | 19.5* | M 14.5 | 13.5* |
| M | 18 | 9 | F 16 | 11.5 |
| M | 21 | 10 | F 18.5 | 9.5 |
| M | 21 | 13 | F 23.5 | 15 |
| F | 17.5 | 13 | F 21 | 11 |
| M | 17.5 | 0 | F 24.5 | 19.5 |
| M | 21.5 | 13.5 | F 16.5 | 13.5 |
| M | 15.5 | 14.5 | M 12.5 | 10.5* |
| M | 13.5 | 15.5* | F 12.5 | 6.5*** |
| F | 17.5 | 10.5 | M 13.5 | 13* |
| F | 22.5 | 8.5** | M 16.5 | 5** |
| F | 24 | 14 | M 17 | 13.5 |
| F | 19.5 | 13.5 | M21 | 12.5 |
| M | 24 | 13 | F 25 | 16.5 |
| M | 22.5 | 9.5 | F 19.5 | 16.5 |
| M | 21 | 13.5 | F 13.5 | 11* |
| F | 17.5 | 15 | F 23.5 | 19 |
| F | 17.5 | 0 | M 19 | 14.5 |
| F | 21 | 10 | M 18.5 | 10.5 |
| F | 21.5 | 9 | M 10.5 | 11 |
| F | 22.5 | 9.5 | M 18 | 12 |
| F | 20.5 | 11.5 | M 13.5 | 13* |
| M | 12 | 8*** | M 23.5 | 15 |
| M | 19.5 | 13.5 | M 16.5 | 16.5 |
| M | 28 | 21.5 | F 25.5 | 20.5 |
| M | 17.5 | 12 | | |
| M | 19.5 | 8.5** | | |

* Scores greater than one standard deviation below mean of 20/80 only.
** Scores greater than one standard deviation below mean of 20/25 only.
*** Scores greater than one standard deviation below mean of both 20/80 and 20/25.
Scores = Cycles/Minute

DATA TABLE FOR SIXTH GRADE

| | Joseph Gales | |
|---|---|---|
| | 20/80 | 20/25 |
| F | 17 | 13.5 |
| F | 23.5 | 16.5 |
| F | 24 | 7.5** |
| F | 31 | 22 |
| F | 18.5 | 0 |
| M | 24.5 | 17.5 |
| F | 18 | 10 |
| F | 22 | 13.5 |
| M | 17.5 | 14.5 |
| F | 19 | 12.5 |
| F | 20 | 13 |
| F | 21 | 10.5 |
| F | 3 | 0* |
| F | 17.5 | 7.5** |
| M | 14.5 | 11.5* |
| F | 20.5 | 0 |
| F | 0 | 0 |
| M | 17 | 14 |
| M | 20.5 | 14 |
| M | 21.5 | 13.5 |
| F | 27 | 10.5 |
| M | 17 | 16 |
| M | 23 | 10 |
| M | 17 | 9.5 |
| M | 24 | 15 |
| M | 13.5 | 6*** |

| | Joseph Gales | |
|---|---|---|
| | 20/80 | 20/25 |
| F | 16.5 | 9 |
| M | 23.5 | 13 |
| M | 26 | 12 |
| F | 19.5 | 4.5** |
| M | 23.5 | 13.5 |
| F | 18.5 | 9 |
| F | 18.5 | 10 |
| F | 31 | 7.5** |
| M | 21 | 0 |
| M | 24 | 16 |
| M | 22.5 | 17 |
| F | 18 | 22 |
| F | 24.5 | 15.5 |
| F | 17 | 13.5 |
| M | 15.5 | 12.5 |
| F | 20.5 | 15.5 |
| M | 17 | 10 |
| F | 20.5 | 15 |
| F | 18 | 7.5** |

| | Echo Shaw | |
|---|---|---|
| | 20/80 | 20/25 |
| F | 15.5 | 15.5 |
| F | 24 | 10.5 |
| M | 23 | 14.5 |
| M | 14.5 | 10.5* |
| F | 21 | 15.5 |
| F | 12 | 11.5* |
| F | 22 | 14 |
| F | 5.5 | 0* |
| F | 20.5 | 17 |
| F | 19.5 | 16.5 |
| F | 26.5 | 8** |
| M | 19.5 | 13 |
| M | 21.5 | 9 |
| F | 20.5 | 15.5 |
| F | 20.5 | 23.5 |
| F | 15.5 | 15 |
| F | 23 | 16 |
| M | 21 | 16 |
| M | 16 | 16 |
| M | 23.5 | 17.5 |
| M | 16.5 | 11 |
| F | 23 | 10 |
| M | 19.5 | 5.5** |
| M | 14 | 7*** |

* Scores greater than one standard deviation below mean of 20/80 only.

** Scores greater than one standard deviation below mean of 20/25 only.

*** Scores greater than one standard deviation below mean of both 20/80 and 20/25.

Scores = Cycles/Minute

DATA TABLE FOR SEVENTH GRADE

| Neil Armstrong | | Neil Armstrong | | Neil Armstrong | |
|---|---|---|---|---|---|
| | 20/80 | 20/25 | 20/80 | 20/25 | 20/80 | 20/25 |
| M | 39 | 23.5 | F 23 | 13 | F 22.5 | 16 |
| M | 15 | 13.5* | F 22 | 13 | F 23.5 | 16 |
| M | 26 | 0 | M 25 | 15 | F 27.5 | 19.5 |
| M | 13 | 11.5* | M 14.5 | 7*** | F 16.5 | 15.5 |
| M | 15.5 | 0* | M 19 | 7** | M 23.5 | 15.5 |
| M | 32 | 21 | M 24 | 15 | M 14 | 18 |
| M | 30 | 20 | M 18 | 15 | M 17 | 13.5 |
| M | 26 | 8.5** | M 25.5 | 13 | F 21.5 | 11 |
| M | 23 | 17 | M 22.5 | 17.5 | M 25.5 | 13.5 |
| M | 23 | 11 | F 13 | 0* | M 21.5 | 16 |
| F | 25 | 14 | F 21.5 | 18.5 | M 10.5 | 6*** |
| M | 27 | 12.5 | M 18.5 | 14 | M 24 | 20.5 |
| M | 10.5 | 12* | F 19.5 | 0 | M 15.5 | 17.5* |
| F | 26.5 | 18 | M 14.5 | 0* | M 14 | 5*** |
| F | 26.5 | 19 | M 21.5 | 15.5 | F 22.5 | 12.5 |
| F | 22.5 | 17.5 | F 25.5 | 17.5 | F 24 | 22.5 |
| M | 17.5 | 11 | M 13 | 17* | F 20.5 | 14.5 |
| M | 23 | 15.5 | F 18 | 0 | F 23 | 16.5 |
| F | 25.5 | 18.5 | M 16 | 9*** | F 29 | 14 |
| F | 14 | 0* | F 24.5 | 16 | F 24.5 | 14 |
| M | 27 | 22.5 | M 23 | 17.5 | F 24.5 | 21 |
| M | 13 | 0* | F 11.5 | 0* | F 15.5 | 10.5*** |
| M | 20.5 | 17 | M 24.5 | 19 | M 18.5 | 13 |
| F | 19 | 14 | M 21.5 | 12.5 | M 23 | 15 |
| F | 26 | 24 | M 17 | 11 | M 27 | 16 |
| F | 19 | 11 | M 29.5 | 22.5 | | |
| | | | M 23 | 15 | | |

* Scores greater than one standard deviation below mean of 20/80 only.

** Scores greater than one standard deviation below mean of 20/25 only.

*** Scores greater than one standard deviation below mean of both 20/80 and 20/25.

Scores = Cycles/Minute

DATA TABLE FOR EIGHTH GRADE

| | Neil Armstrong 20/80 | 20/25 |
|---|---|---|
| F | 11 | 0* |
| F | 22.5 | 11** |
| F | 27.5 | 0 |
| M | 25.5 | 20.5 |
| F | 28.5 | 14 |
| F | 24.5 | 0 |
| F | 15 | 7*** |
| M | 25 | 8.5** |
| M | 22.5 | 20 |
| F | 20 | 17.5 |
| M | 22 | 14 |
| M | 23.5 | 14 |
| F | 24 | 16 |
| F | 18 | 11*** |
| F | 20 | 0 |
| M | 0 | 0 |
| F | 31 | 22 |
| F | 21 | 19.5 |
| M | 21 | 15.5 |
| F | 18.5 | 14.5 |
| M | 17.5 | 13* |
| F | 29 | 14.5 |
| M | 23 | 0 |

| | Neil Armstrong 20/80 | 20/25 |
|---|---|---|
| M | 20 | 18 |
| M | 17.5 | 13.5* |
| M | 27.5 | 20.5 |
| F | 23.5 | 0 |
| F | 23 | 18.5 |
| F | 17 | 0* |
| F | 16.5 | 16* |
| F | 27.5 | 23 |
| F | 25.5 | 24.5 |
| F | 28 | 14.5 |
| F | 20.5 | 11.5 |
| F | 24 | 13 |
| F | 23 | 18 |
| F | 36.5 | 23 |
| F | 24.5 | 9** |
| F | 27 | 17.5 |
| M | 22 | 14 |
| M | 14.5 | 0* |
| M | 24 | 19 |
| M | 29 | 23 |
| F | 23.5 | 16 |
| F | 23.5 | 15.5 |
| M | 31 | 15.5 |

| | Neil Armstrong 20/80 | 20/25 |
|---|---|---|
| M | 14.5 | 0* |
| M | 22.5 | 13 |
| F | 27.5 | 21 |
| F | 23 | 17 |
| M | 25.5 | 17.5 |
| M | 18 | 6*** |
| M | 25 | 10.5** |
| F | 27.5 | 20 |
| M | 19.5 | 10** |
| M | 28 | 0 |
| M | 25.5 | 0 |
| M | 26 | 14 |
| F | 28 | 12.5 |
| F | 29 | 21.5 |
| F | 18 | 0* |
| F | 26.5 | 20 |
| F | 21.5 | 0 |
| F | 21.5 | 17 |

* Scores greater than one standard deviation below mean of 20/80 only.

** Scores greater than one standard deviation below mean of 20/25 only.

*** Scores greater than one standard deviation below mean of both 20/80 and 20/25.

Scores = Cycles/Minute

DATA TABLE FOR NINTH GRADE

| | Neil Armstrong 20/80 | 20/25 |
|---|---|---|
| M | 30.5 | 21.5 |
| M | 28 | 18 |
| F | 26 | 21.5 |
| F | 25 | 15.5 |
| F | 23.5 | 10.5** |
| F | 21.5 | 15 |
| F | 31.5 | 24 |
| F | 26 | 19 |
| F | 21 | 13 |
| M | 20.5 | 15.5 |
| M | 34 | 21 |
| F | 33.5 | 22 |
| F | 30 | 23.5 |
| M | 28 | 12.5 |
| F | 34 | 25 |
| F | 34.5 | 19.5 |
| M | 34 | 24 |
| M | 30 | 27 |
| M | 21 | 16.5 |
| M | 26 | 18.5 |
| M | 32.5 | 23 |
| M | 27 | 9.5** |
| M | 29.5 | 22.5 |
| M | 23.5 | 16 |
| M | 23 | 13.5 |
| M | 14.5 | 16* |
| F | 26.5 | 19.5 |
| F | 27 | 13 |

| | Neil Armstrong 20/80 | 20/25 |
|---|---|---|
| M | 21.5 | 18 |
| M | 28 | 0 |
| M | 27.5 | 21.5 |
| M | 18.5 | 9.5*** |
| M | 13.5 | 0* |
| M | 25.5 | 12 |
| M | 18 | 0* |
| M | 25 | 12.5 |
| M | 20 | 12.5* |
| F | 19 | 14.5* |
| F | 26.5 | 12.5 |
| M | 19 | 11.5*** |
| M | 25.5 | 17 |
| M | 35 | 25.5 |
| M | 25.5 | 14 |
| M | 20.5 | 14 |
| M | 27.5 | 15 |
| M | 15 | 0* |
| M | 25 | 0 |
| M | 26.5 | 24.5 |
| M | 23 | 16 |
| M | 26 | 19.5 |
| F | 22 | 22.5 |
| F | 28.5 | 14.5 |
| F | 26.5 | 15.5 |
| F | 36 | 27.5 |
| F | 22.5 | 12.5 |

| | Neil Armstrong 20/80 | 20/25 |
|---|---|---|
| M | 22.5 | 18 |
| M | 22 | 19.5 |
| M | 30 | 18.5 |
| M | 20.5 | 11** |
| F | 23 | 16 |
| F | 25.5 | 13.5 |
| M | 0 | 0 |
| M | 22.5 | 0 |
| M | 25.5 | 20 |
| M | 25 | 16.5 |
| M | 22.5 | 14.5 |
| M | 16 | 7.5*** |
| M | 31 | 26.5 |
| M | 27.5 | 18 |
| M | 27 | 20 |
| M | 21 | 0 |
| M | 22 | 11** |
| M | 21.5 | 15.5 |
| M | 21.5 | 15 |
| M | 27 | 19 |
| M | 25.5 | 15 |
| M | 28 | 21 |
| M | 29.5 | 18.5 |
| M | 18.5 | 10*** |
| F | 30 | 20.5 |
| F | 23 | 15.5 |
| F | 20.5 | 27.5 |
| F | 24.5 | 12.5 |

* Scores greater than one standard deviation below mean of 20/80 only.

** Scores greater than one standard deviation below mean of 20/25 only.

*** Scores greater than one standard deviation below mean of both 20/80 and 20/25.

Scores = Cycles/Minute

# DISCUSSION

This project accomplished its objective. It did establish reliable normative data for the distance rock test. Performance improves in a linear fashion with increased grade level on this test. This indicates that visual efficiency, at least for a distant-to-near rock test, as measured in cycles/minute, improves with increasing age.

As expected, the mean performance level on the 20/80 rock test was higher than the 20/25 performance scores. The correlation of paired 20/80 and 20/25 scores is positive but too low to enable one to predict the performance of one from the performance score of the other.

While the correlation was positive, those subjects that fell below the 20/80 distance rock referral criterion did not normally fall below the referral criterion for the 20/25 distance rock. Also, those subjects who fell below the 20/25 distance rock referral criterion normally did not fall below the 20/80 referral criterion. In fact, only 3.6% of those tested fell below the referral criteria on both distance rock tests.

It was expected that those subjects whose visual acuity was poorer than 20/25 would do poorly on the 20/80 distance rock test. This was not found to be the case. This suggests that while visual acuity is a limiting factor in this visual performance test, there are other very important considerations.

A visual system can produce normal or superior visual performance even with degraded proximal imagery. The specific visual factors involved in performing the distance rock test were not differentiated.

It was established that the standard deviation and the mean both increased with grade level. This indicates increased ability to perform on the distance rock test as well as greater variation of visual skills in the higher grades.

The sex of the subjects was found unimportant as a factor. Statistically, the intragrade performance means for males and females were equal. They seem to perform equally well on this distance rock test at each grade level.

## SUMMARY

The distance rock test is a measure of visual performance. It does not measure either the quality of the optical imagery or the fusional ability of the binocular system. It measures how well an individual can perform a given visually guided task in a "real" environment. If an individual has a reduced performance level, then it can be assumed that there may well be an optometric problem. This optometric problem could be defined as a refractive error, a "motor" dysfunction in the visual system, or even a detectable pathology.

The distance rock test for both 20/80 and 20/25 visual acuity incorporates some of the visual skills used in a classroom environment. These are recognition and a verbal response for letters at far (blackboard distance) and at near (reading distance). Copying from the board involves fixation first at far and then at near. Such a task could scholastically handicap someone with a reduced distance rock performance level.

There are other visual motor functions involved besides fixation in a distance rock test. These include accurate accomodative response and convergence responses, as well as compensation for vertical and/or cyclotorsional ocular responses. There is a need for further study focusing on these other variables.

The distance rock tests using both 20/25 and 20/80 visual acuity demands could be compared with O.E.P. case typing, normative scoring analysis, and/or graphical analysis. The distance

rock tests could be compared with various types of squint cases. Monocular rock test results could be studied and evaluated in comparison with binocular rock test results. Normal responses on the distance rock test could be compared with results of subjects with induced motor or sensory problems. That is to say, plus lenses could be used to simulate myopia and minus lenses to simulate hyperopia. Base-in and base-out prisms could be used to simulate a heterophoria, and vertical prisms to simulate a vertical phoria. Subjects with diagnosed, untreated refractive errors could be compared with emmetropes.

These studies involving responses on the distance rock test would enable us to identify these various visual problems. With the results of this and further distance rock test studies, the rock test could be used as a school screening device, and an armed forces screening device, or even a pre-refraction testing device. Already it can be used to evaluate a given optometric therapy, either a spectacle prescription or visual training.

Additional studies should provide normative data for tenth graders and on through college levels. Studies of post academic adults, prepresbyopes, and presbyopes could be valuable. Degradation of performance with loss of accomodative amplitude, whether corrected or uncorrected, would be a valuable diagnostic tool, as well as a possible prescription prognosticator.

One observation made during the testing was that subjects who responded by calling a far and near letter as one response

had a higher performance level on both distance rock tests. Instead of calling out a (near), b (far), c (near), d (far), e (near), etc. they would respond with paired responses, i.e. ab (near-far), cd (near-far), ef (near-far), etc.

Another interesting observation was the frustration and fatigue evidently experienced by some of the children. A preliminary study had third grade students read the entire three lines of both charts alternately far and near. The entire process sometimes took 5 to 7 minutes to read 120 letters alternately far and near. Some students had no trouble reading the entire chart. Other students would become frustrated, angry, and even quit the task. This fatigue threshold may be an item for study.

The subject's losing his place on the charts was not uncommon on either the 20/25 or the 20/80 test. It was more common in the lower grades than the upper grades. The most common spot for a subject to "lose his place" was in the center of the middle 20/25 line. Subjects would count backwards on either the near or far chart, whichever he was sure of, then count the letters on the confused chart to regain his place.

The ability to accurately predict where the eyes should fixate, in order to avoid confusion, might be an integral part of efficient reading. It was also noticed that high-scoring individuals often missed a far and a near letter simultaneously. This caused no confusion and the individual subject continued without being aware of missing any of the letters.

This ability to accurately fixate at near or at far without confusion within a complex stimulous array would be a valuable visual skill to possess in any visually guided task. Visually guided tasks from reading to hockey demand accurate fixation. The ability to predict whether or not a subject has the skill for accurate fixation would be invaluable in assessing ability to function at a given visually guided task. Comparing the distance rock test with eye movement recordings and pointing tasks could give that information.

The possibilities of the distance rock test are many and varied. This study has only begun to develop the possibilities of the distance rock test. It is our hope that further studies in this area will soon be initiated.

FOOTNOTES

[1]Harold M. Haynes, "Preliminary Report on a Distance Rock Test," Pacific University College of Optometry, unpublished paper.

[2]Claude Stevens, "An Exploratory Study to Develop a Distance Rock Test with Letter Size and Spacing Variables," Thesis, Pacific University, 1970.

[3]Stuart Mann, Stephen Martin, Richard Moore, "Survey Results on Elementary School Children with the Distance Rock Test," Thesis, Pacific University, 1974.

[4]Lynn Dubow, "Results of Training with a Distance Rock Test," Thesis, Pacific University, 1975.

[5]Stevens, Op. Cit.

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1. Dubow, Lynn, "Results of Training with a Distance Rock Test," Thesis, Pacific University, 1975.

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4. Stevens, Claude, "An Exploratory Study to Develop a Distance Rock Test with Letter Size and Spacing Variables," Thesis, Pacific University, 1970.