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Approaches to the problems of school vision as found in the literature

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APPROACHES TO THE PROBLEMS OF SCHOOL VISION AS FOUND IN THE LITERATURE

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CHAPTER I

APPROACHES TO THE PROBLEMS OF SCHOOL VISION

That vision plays an important part in school achievement goes without saying. But how large a part? Who is handicapped by it? What can be done to better it? These are questions to which answers have been sought by many routes.

Educators concerned with problems of retarded reading and consequent lowered achievement (and possibly behavior problems) have considered the possibility of visual defect as a contributing factor. School health departments, community optometrists and ophthalmologists have been called upon to contribute their knowledge and skills. Manufacturers of ophthalmic instruments, lighting equipment, and classroom furnishings, school-house planners, text-book authors and publishers, all have made contributions from their own experience and research. Psychologists connected with all these fields have carried on extensive experiments to determine what factors are significant and how they may best be handled.

From the questions centering around the discovery of what pupils are handicapped by their visual status, two main problems emerge:

1. What visual factors may prove handicapping in the school situation? These are still the subject of disagreement and research.

2. How can pupils so handicapped be most readily and certainly picked out for referral to the eye specialist? For this purpose

several tests have been devised--some for use by the school nurse or teacher, some for the professional eye man, or lay helpers under his supervision.

Merely to know who is visually handicapped is not enough. So arises the next problem:

3. How can each child be helped most? While this question must be answered by the professional eye man of the parents' choice, some information as to methods and their use may be helpful to the educator.

Even with the best of vision, a child may be visually handicapped by his environment. This brings up a very important problem:

4. How can the visual problems of all children be kept at a minimum? Lighting standards, classroom arrangement, decoration, and lighting, choice of print and paper for books and other class materials, are among the factors which must be taken into consideration.

These, then, are the four main problems to which answers are sought from the literature. These answers it is hoped to summarize from two view-points:

1. What use can be made of our present information?

2. What further studies should be made?

CHAPTER II

DETERMINING THE IMPORTANCE OF VISUAL FACTORS

Many studies have been made to determine what visual factors have an influence on reading ability, and several excellent surveys have been made of the results in this field.

Earlier Reviews.—Dearborn and Leverett[1], from the background of a University Education Clinic, reviewed the literature to 1942. Discussion of visual defects such as refractive errors, anseikonia, and muscular incoordination, clinical evaluation of these defects, and appraisals of their importance in reading, with reference to experiments on which these discussions are based, were summed up with the statement: "The diversity of thought in matters concerning the relationship between visual defects and reading is now so great that it may have to be described as confusion."

Robinson[2], from another University Readinc Clinic, reviewed the literature as a preliminary step to a new study. Like Dearborn and Leverett, she found disagreement in conclusions, varied age groups,

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[1]Dearborn, Walter F., and Leverett, Hollis M. (Psycho-Educational Clinic, Harvard University) "Visual Defects and Reading," Journal of Experimental Education 13:3 (March 1945), 1[illegible]-124.

[2]Robinson, Helen Mansfield, Why Pupils Fail in Reading Chicago: University of Chicago Press, 1946 Pp. xiii + 257.

and inadequate tests. She summed up the preponderance of opinion to the effect that hyperopia, hyperopic astigmatism, binocular incoordination, restricted visual fields, and aniseikonia in young children seemed most unfavorable to reading achievement.

Eames[1] in 1949 summarized the literature from 1945-1948, for the Review of Educational Research. Reflecting the varied background of the author--ophthalmologist, optometrist, University lecturer and research worker, this review covers not only recent studies of visual factors related to reading, but also the related fields of study in tachistoscopic work, eye movements, readability, and illumination, which will be discussed in later chapters of this paper.

Eberl[2] in 1949 briefly reviewed the relevant literature for the Committee on Visual Problems in Schools, of the American Optometric Association. She pointed out that all statistical studies considered each visual trait separately. In actual practice, the ability to compensate for one deviation from the expected norm by another related deviation might account for absence of expected symptoms in one case, while failure to compensate might result in symptoms where the deviation is much less.

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[1] Eames, Thomas H. "Visual and Related Factors in Reading" Language and the Fine Arts, Review of Educational Research 19:2 (April, 1949), 107-17.

[2] Eberl, Marguerite Thoma, "Caring for the School Child's Vision" Southern Optometrist 2:11 (July, 1949), 23-26.

Still more recently Bing[1], of the same committee, after briefly reviewing the literature, used her optometric background to explain much of the disagreement in findings.

Visual Acuity.--With this background, the findings that inadequate visual acuity did not distinguish the poor readers from the other groups (Monroe[2], Stromberg[3], Eames[4]) now is not opposed to Blake and Dearborn's[5] finding that those with reading difficulty show defective vision, but rather ties in with the findings of Eames[6], Taylor[7], and Farris[8], that hyperopia is more common in poor readers, that of Farris[8] that myopia and myopic astigmatism were associated with good reading, and that of Eames that there are fewer myopes among those with reading difficulty than in the general population. This follows

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[1]Bing, Lois B., "A Critical Analysis of the Literature on Certain Visual Functions Which Seem to be Related to Reading Achievement" Journal of the American Optometric Association 22:8 (March, 1951), 454-463.

[2]Monroe, Marion. Children Who Cannot Read. Chicago: University of Chicago Press, 1932.

[3]Stromberg, Eleroy L. "The Relationship of Measures of Visual Acuity and Ametropia to Reading Speed" Journal of Applied Psychology 22:1 (February, 1938), 70-78.

[4]Eames, Thomas H. "A Comparison of the Ocular Characteristics of Unselected and Reading Disability Groups" Journal of Educational Research. 25:7 (March, 1932), 211-215.

[5]Blake, Maybelle B., and Dearborn, Walter F. "The Improvement of Reading Habits" Journal of Higher Education 6:2 (February, 1935), 83-88.

[6]Eames, op. cit.

[7]Taylor, Earl A. Controlled Reading Chicago: University of Chicag Press, 1937.

[8]Farris, L.P. "Visual Defects as Factors Influencing Achievement in Reading" Journal of Experimental Education 5:1 (September, 1936), 59.

from the fact that visual acuity as measured by the Snellen Chart is in general low for myopes, while satisfactory for persons with moderate degrees of hyperopia.

The importance, then, of near point vision, rather than that for distance, must be realized.

Muscle-Imbalances.—But what of the discrepancies in muscle-imbalance findings?

Fendrick[1], in a study of 50 pairs matched for age, IQ, and schooling, but differing by a year in reading ability, found no evidence of correlation between reading disability and muscle imbalance.

Selzer[2] reported that of a group of poor readers, 90% showed muscle-imbalance, while of an unselected group of 100, only 9% showed this anomaly, and of these, five were poor readers.

Eames[3] reported a greated degree of exophoria in the reading disability group than in the general population. Again[4] he found that

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[1]Fendrick, Paul Visual Characteristics of Poor Readers Teachers College Contributions to Education No. 656. New York: Teachers' College, Columbia University, 1935.

[2]Selzer, Charles A. "Lateral Dominance and Visual Fusion: Their Application to Difficulties in Reading, Writing, Spelling, and Speech" Harvard Monographs in Education, No. 12. Cambridge, Mass.: Harvard University Press, 1933.

[3]Eames, op. cit.

[4]____ "Comparison of Eye Conditions Among 1000 Reading Failures, 500 Ophthalmic Patients, and 150 Unselected Children" The American Journal of Ophthalmology 31:6 (June, 1948), 713-7.

among 1000 children referred as reading failures, 500 ophthalmologic cases, and 150 unselected cases, hyperopia of one diopter or more, and exophoria of six prism diopters or more at reading distance, occurred more frequently among poor readers and eye cases than among the unselected group. They also retarded the speed of word recognition. Whether this retardation correlated with the similar frequency of IQ's below 90, and if so, which was cause and which effect (if either) is not discussed. It should be noted also that the measure of central tendency used was the median rather than the mean, and the level of significance placed at 10%.

In a study of 133 cases of reading disability ranging from grade school to college, Park[1], an ophthalmologist and president of a dyslexia clinic, also found exophoria of 4° or more at reading distance to be significant.

Here again we find diversity of population and of amount of deviation considered significant. Further, as Bing[2] and Eberl[3] point out, the importance of a muscle imbalance varies with the refractive correction and with the ability of the individual to compensate.

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[1]Park, George E., "Reading Difficulty (Dyslexia) from the Ophthalmic Point of View." American Journal of Ophthalmology 31:1 (January, 1948), 28-34.

[2]Bing, Lois B. op. cit.

[3]Eberl, Marguerite T. op. cit.

Aniseikonia.--Unfortunately no recent studies have been reported dealing with aniseikonia and its relation to reading. Robinson[1] states that it was impossible to provide aniseikonic examinations for the 30 retarded readers otherwise exhaustively studied. Two 1938 reports appear contradictory until the discrepancy in age group and in instrument used are realized. That of Dearborn and Anderson[2] indicated that aniseikonia, especially at the reading distance, had a significant relationship with reading difficulty in a group of elementary and high school pupils.

The instrument used was the Ophthalmo-Eikonometer; 1% or more of aniseikonia was assumed to be significant; the experimental group consisted of 100 severe cases of reading disability; the control group of 100 was drawn from selected adults and school children measured for aniseikonia regardless of ability to read, together with some clinical cases who had proved not to be reading disability cases.

The study of Imus, Rothney, and Bear[3], however, indicated no relationship between aniseikonia and reading ability in a group of superior college students.

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[1]Robinson, Helen Mansfield, Why Pupils Fail in Reading. Chicago: University of Chicago Press. 1946

[2]Dearborn, Walter F., and Anderson, Irving. "Aniseikonia as Related to Disability in Reading." Journal of Experimental Psychology 23:6 (December, 1938), 560-577.

[3]Imus, H.A., Rothney, J.W.M., and Bear, R.M. An Evaluation of Visual Factors in Reading Hanover, N.H.: Dartmouth College Publication, 1938.

The instrument used was the tilting field with size lenses; aniseikonia cases were grouped as "mild" (3/4-1%), "moderate" (1¼-2%), or "severe" (over 2%); the group consisted of about 175 college freshmen - the entire class. Scholastic aptitude, reading skill, and school achievement were all considered.

Other Binocular Factors.—Not only muscle-imbalance and aniseikonia, but poor fusion, suppression, convergence insufficiency, and other binocular factors have been found significant in some studies.

In his group of 133 reading disability cases, Park[1] found that weak ductions, convergence insufficiency, and accommodation or convergence spasm, together with the heterophorias, occurred in half of the cases. (Interesting in connection with this study is the specification of print, paper, and illumination used.)

Like Park, Berens (ophthalmologist) and Enos[2] present evidence that convergence insufficiency is a common cause of reading difficulty.

Krous[3], a school principal, reported a screening program for a remedial reading class, carried out by trained optometrists. 177 were judged to have visual difficulty, 54 not to have. Findings indicated

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Park, George E., "Reading Difficulty (Dyslexia) from the Ophthalmic Point of View." American Journal of Ophthalmology, 31:1 (January, 1948), 28-34.

Berens, Conrad, and Enos, Marjorie. "Ocular Factors in Reading Disabilities" American Journal of Orthopsychiatry; 17:3 (July, 1947), 397-403.

Krous, George T., "Visual Analysis Investigations as Part of a Reading Program" Claremont College Reading Conference, (1947), 66-71.

that visual difficulty correlated more highly with faults of fusion, stereopsis, and suppression than with visual acuity. (Park had found little or no fusion difficulty.) His finding that visual service secured for fourteen of these children over a period of two years helped them make an almost normal reading gain as compared with about two-thirds normal in previous years seems to bear out the importance of these binocular factors in the reading situation. An increase in IQ rating from 75 to 85 was attributed to the reading gain and consequent improvement in response where reading was a factor in the test. Unfortunately no distinction is made as between gain due to visual treatment and that due to special instruction (comparable results on the rest of the group would have been helpful.) A feature of this report is the estimate of a saving of $28 per pupil due to the increased rate of progress. This should be a very helpful argument when trying to secure support for the program.

In a recent study, Eberl[1] (optometrist), comparing 60 each of retarded readers, unselected fourth graders, and fourth graders appearing for eye care, found that most of the retarded readers had 20/20 vision and little phoria, but low ductions, unsteady eye-movements, and low perceptual span, i.e., they had not automatically learned the needed visual skills.

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[1]Eberl, Anita, "Visual Difficulties as Related to Scholastic Achievement" The Southern Optometrist. September, October, 1948.

Changes in findings over a period of time.--Bing[1], in her analysis of the literature, pointed out differences were to be expected at different age levels.

Walton[2], (optometrist), studying records of persons seen by him over a period of years, divided them into four groups: those first seen (A) between 1 and 20; (B) between 21 and 40; (C) between 41 and 60; and (D) at 61 or over. The average number of years between first and last visits was slightly over 17. Of 2441 eyes represented, 88% were hyperopic, 11% myopic. No cases showed changes in cylinder power with time; increase in required sphere power averaged .25 to .37D per ten-year period. Myopia tended to increase to age 20, remain static till 60, then diminish. Hyperopic increase and myopic decrease after 60, be attributed to loss of ciliary tonus; myopic increase, to over-development of the eye-ball.

Hendrickson[3] (optometrist), reported increase in incidence of myopia from 1.6% in grade one to 23.9% in grade eight, while hyperopia decreased. Whether this trend is due to close work or to maturing could be proven only with a similar non-school population. The number

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[1]Bing, op. cit.

[2]Walton, Wm. G., Jr., "Refractive Changes in the Eye over a Period of Years" American Journal of Optometry, and Archives of American Academy of Optometry, 27:6 (June, 1950), 267-286.

[3]Hendrickson, Homer, "A Study of Static Retinoscopic Findings on 1000 School Children." Journal of the American Optometric Association, 21:8 (March, 1950), 428-433.

of drop-outs and retarded pupils would also have to be considered.

Kephart[1] also reported that screening tests done on 574 pupils from grades 1-12 showed a high incidence of hyperopia in the early grades, with a mrked decrease from grade to grade until at about the fifth grade myopia became more prevalent than hyperopia. He attributed the change to school experience. In support of this hypothesis, retinoscopic rechecks in September on 84 of these pupils appeared to show a marked recovery from this trend, especially for grades 5-10. (See "Colorado School Surveys" P)

In further support of this hypothesis, Kephart and Mazzoni[2] reported results of orthorater tests on 93 subjects from grades 2-11 before and after summer vacation. Significant improvement in visual acuity and color discrimination, but no consistent change in phorias or depth perception was indicated. The considerable variation in visual acuity change raises the question of differences in summer occupation, as well as of accuracy of measurements and random quality of population.

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[1]Kephart, Newell C., "Visual Changes in Children Associated with School Experience" American Journal of Optometry and Archives of American Academy of Optometry, 27:4 (April, 1950), 195-9.

[2]Kephart, Newell C., and Mazzoni, Henry A. "Changes in Visual Skills of School Children Following Summer Vacation." American Journal of Optometry and Archives of the American Academy of Optometry, 28:1 (January, 1951), 30-35.

Wickwire and Krous[1], working with 90 university students doing close work 4-5 hours a day, found about 50% showing esophoria, about 25%, exophoria. After 6-10 days of studying 12-15 hours a day, out of a group of 20 students, four showing no phoria to start with developed ½ to 1½° of esophoria, while three showing esophoria to start with became more esophoric by ¼ to 3/4°. After two weeks' vacation, five of the seven returned to their original phoric condition, while the other two showed reduced esophoria.

By contrast, Hirsch[2] (optometrist), reporting results on 840 randomly selected children of ages 5-13 given retinoscopic examinations in May-June, 1950 and again in September-October, 1950, by himself and one other optometrist, while he found an average decrease in hypermetropia of .09D per year, found no reduction in this rate during the summer months. He questions the very high percent of myopia indicated by Kephart as being beyond any conceivable random percentage, therefore probably due to sampling error. The much larger number of subjects in the present study, and the statistical analysis by one of the two examiners, with evidence of statistical significance, lend support to the results, as contrasted with those of Kephart's study, where

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[1]Wickwire, G. C., and Krous Ruth, "Sustained Near Vision and Ocular Muscle Balance." Optometric Weekly 42:2 (January 11, 1951), 51-52.

[2]Hirsch, Monroe J. "Effect of School Experience on Refraction of Children" American Journal of Optometry and Archives of the American Academy of Optometry 28:9 (September, 1951), 445-454.

statistical significance was not demonstrated, where the criterion of myopia is not stated, and where the examining optometrists may not have been aware of the statistical procedure. It is interesting to note, however, that at individual age levels, statistically significant change in refraction is shown only at ages 6-9, and that while 58% of the total number showed more myopia or less hyperopia, 42% showed the opposite trend.

Sloane (ophthalmologist) and Gallagher[1] (school physician) reported that of 228 adolescents examined annually with a variation of the Massachusetts Vision Test, 74.5% showed no change binocularly. About 5% showed some improvement binocularly, 15% some improvement in the right eye, 15% some in the left eye; nearly 20% showed some loss binocularly, 16% in right eye only, 14.5% in left eye only. There was little change in heterophoria. The number of changes would seem to warrant annual screening.

Perception.--Including the specifically visual factors is the larger activity, perception, the speed and accuracy of which have been subjects of study.

Buswell[2] presented the hypothesis that reading is most effective when symbol and meaning are directly associated without sub-vocalization.

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[1]Sloane, Albert E. and Gallagher, J. Roswell, "Changes in Vision during Adolescence" American Journal of Ophthalmology, 33:10 (October, 1950), 1538-1542.

[2]Buswell, G. T. "Perceptual Research and Methods of Learning." The Scientific Monthly, 44:6 (June, 1947), 521-26.

Carlson[1] studied the relationship between speed and accuracy of comprehension, using 399 fifth graders. Although no correlations were large enough for confident prediction, he felt that among readers with high IQ, those who read rapidly were most proficient; among those with medium and low IQ, however, slower reading was more efficient, especially if the purpose was exacting or the material difficult.

In this connection Tinker's[2] study of eye movement time, and the increased proportion of reading time required for comprehension, is of interest. Also his stress[3] on training comprehension and assimilation rather than "ideal motor sequences."

Stroud[4], working with 570 pupils in grades four through six, concluded that rate of perception and rate of reading are significantly correlated. He did not, however, find any relationship between rate of visual perception and improveableness in reading rate.

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[1]Carlson, Thorsten R., "The Relationship Between Speed and Accuracy of Comprehension." Journal of Educational Research 42:7 (March, 1949), 500-12.

[2]Tinker, Miles A., "Time Relations for Eye-Movement Measures in Reading." Journal of Educational Psychology 38:1 (January, 1947) 1-10.

[3]_____"The Study of Eye Movements in Reading." Psychological Bulletin 18 (March, 1946), 93-120.

[4]Stroud, J.B.,"Rate of Visual Perception as a Factor in Rate of Reading." Journal of Educational Psychology 36:7 (November, 1945), 487-98.

Eames[1,2] found both passing and failing pupils to recognize objects at about the same rate. Failing pupils, however, showed a much slower rate of word recognition. Both regressed sharply at the tenth year (presumably with the shift from a maximum of oral reading with teacher aid to independent, silent reading for content in various subject areas), the passing group recovering much more rapidly than the failing group. Correlations between speed of perception and visual acuity were low (.32 for picture recognition, .46 for word recognition). No correlations between reading failure and visual acuity were found by the author. The IQ correlation with both types of perception would be of interest.

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[1]Eames, Thomas H., "Relationship Between Visual Acuity and the Speeds of Picture and Word Recognition" Columbia Optometrist 21:42 (May, 1947), 1-7.

[2]_____"The Speed of Object Recognition and of Word Recognition in Groups of Passing and Failing Pupils" The Journal of Educational Research. 38:6 (February, 1947), 119-122.

Reversals.--Fabian[1] reported a tendency of normal children of from six to eight years to rotate horizontal configurations to the vertical position. This tendency he found related to reversals. It normally disappears of itself, however, Anderson and Anderson[2] also refer to this tendency. Kirst[3] presents evidence that faulty space perception might lead to reversals. Mintz[4] found no demonstrable relationship between reversals and handedness, but did state that among his retarded subjects, few were consistently right-sided.

Bing[5] points out that the rather common feeling that mixed dominance may lead to reversals is based upon a faulty understanding of the relationships between eyes and brain. While hands and feet are controlled from the brain hemisphere opposite to themselves, both eyes are represented in both hemispheres. There would seem, therefore, no inherent reason for dominance of right hand with right eye and vice versa.

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[1]Fabian, Abraham A., "Vertical Rotation in Visual-Motor Performance: Its Relationship to Reading Reversals." The Journal of Educational Psychology 36: 3 (March, 1945), 129-59.

[2]Anderson, Harold, and Anderson, Gladys, Projective Techniques New York: Prentice Hall, 1951, P33.

[3]Kirst, E. Moreley, "Reversals in Reading. A Problem in Space Perception." Elementary School Journal, 49:5 (January, 1949), 278-84.

[4]Mintz, Alex, "Reading Reversals and Lateral Preferences in a Group of Intellectually Subnormal Boys" Journal of Educational Psychology 37:7 (November, 1946), 487-501.

[5]Bing, Lois B op. cit.

Eye Movements.--The part played by eye-movements in the reading situation has been another subject of much study. Tinker[1] in 1946 summarized 126 eye-movement studies to that date. Two types of electrically recording apparatus and cornea reflection photography were compared, with the conclusion that the latter was more satisfactory. Reliability proved satisfactory when twenty or more lines were read. Anderson and Morse's[2] study, published in the same month, reached the same conclusion. Ledbetter's[3] study in 1947 also indicated that 200 or more words gave a better test than fewer.

Validity was subject to much disagreement. In a check on comprehension during the eye-movement recording as compared with that under normal reading conditions, Tinker found the validity to be high. Under less carefully controlled setups, other investigators differed.

The eye movements were found to include both forward and regressive moves, between which comes the fixational pause during which perception takes place. The frequency and duration of fixations varied with maturity of the reader and with difficulty of comprehension, as

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[1]Tinker, Miles A., "The Study of Eye Movements in Reading." Psychological Bulletin 18 (March, 1946), 93-120.

[2]Anderson, Irving H., and Morse, Wm. C., "The Place of Instrumentation in the Reading Program. I. Evaluation of the Ophthalmo-Graph" The Journal of Experimental Education 14:3 (March, 1946), 256-62.

[3]Ledbetter, Frances Gresham, "Reading Reactions for Varied Types of Subject Matter: An Analytical Study of the Eye Movements of Eleventh Grade Pupils" Journal of Educational Research 16:20 (October, 1947), 102-115.

did the number of regressions. Ledbetter[1] also found that difficult concepts or meanings slowed down reading more than any other factor. In 1947 Tinker[2] in coordinating several studies found that movement time was never over 10% of fixation time, and in analytical reading might be less than 3%. The change in proportion, and in total reading time, was due to increased frequency and duration of fixation required for comprehension.

Ginsberg[3] points out that while the number of pauses decreases with age and experience, the duration of pauses remains fairly constant; i.e. attention span is increased rather than perceptual speed.

Other findings in Tinker's summary[4] follow: While eye-movement training may be helpful, comprehension and assimilation are more important, and individual capacity should not be ignored in an attempt to establish ideal motor sequences; indeed, motivated reading practice

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[1]Ledbetter, Frances Gresham, "Reading Reactions for Varied Types of Subject Matter: An Analytical Study of the Eye Movements of Eleventh Grade Pupils" Journal of Educational Research 16:20 (October, 1947), 102-115.

[2]Tinker, Miles A., "Time Relations for Eye-Movement Measures in Reading" Journal of Educational Psychology 38:1 (January, 1947) 1-10.

[3]Ginsberg, Leon M. "Ocular Movements and Fixations in Reading" American Journal of Optometry and Archives American Academy of Optometry 28:12 (December, 1951), 605:615.

[4]Tinker, Miles A., "The Study of Eye Movements in Reading." Psychological Bulletin 18 (March, 1946), 93-120.

may give equal gains. Westover[1], working with college freshmen, found motivated reading practice to give gains equal to those secured through controlled reading.

Illumination, legibility of material being read, health and emotional state of the reader, anoxemia, and possibly visual fatigue, may be reflected in results. Too many unqualified workers have overstressed eye-movement techniques in the clinical setup.

The eye-movement deviations due to ocular factors such as muscular imbalance may cause sufficient fatigue to call for treatment of the underlying cause.

Brandt's[2] eye-movement study is interesting as using his own special camera. He found the tendency of first-graders to move the eyes normally from left to right, with about 6.5 fixations per line.

Other Factors in Reading Disability.—An occasional case of reading failure shows adequate vision, adequate general health, adequate intelligence, and no apparent unfavorable emotional conditioning, yet still fails to learn to read. Characteristics and handling of these cases of "specific dyslexia" are discussed by Cole[3].

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[1]Westover, Frederick L., Controlled Eye Movements vs. Practice Exercises in Reading. New York: Bureau of Publications- Teachers' College, Columbia University, (1946) pp 99.

[2]Brandt, Herman F., The Psychology of Seeing New York: The Philosophical Library, 1945, pp 240. Reviewed by Robt. E. Schreiber, Univ. of Chicago, Journal of Educational Research 39:12 (August, 1946), 319-20.

[3]Cole, Edwin M., "Specific Reading Disability—a Problem in Integration and Adaptation." American Journal of Ophthalmology 34:2 part 1 (February, 1951), 226-232.

A rather comprehensive survey of the literature on dyslexia is given by Hallgren[1] with additional contributions from his own experience with 63 school and 128 clinic cases. While 14 to 19% of his cases had visual defects of some type - visual acuity, refractive error, or squint - in none was the dyslexia considered secondary to the visual factor. Similarly neither left eyedness nor mixed dominance, mental subnormality, nor nervous disorders, appeared to be a cause of dyslexia. In some cases it seemed probable that environmental factors may have had an adverse effect. Definite relationship was found between dyslexia and speech defects. The author also felt that his findings indicated that some dyslexias are hereditary in nature.

Another comprehensive study to determine causes of retardation in reading was that of Robinson[2]. Thirty retarded readers between six and sixteen years of age, referred to a Reading Clinic, were studied first for IQ, reading ability and achievement. IQ of 85+, with retardation of .9 year for those with MA and CA below nine, two years for those older, were minimum for acceptance. Examinations by psychiatrist, pediatrician, social worker, ophthalmologist, neurologist, oto-laryngologist, endocrinologist, speech specialist, and psychologist-technician were provided for all, and their findings summarized. These

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[1]Hallgren, B. "Specific Dyslexia" Acta Psychiatrica et Neurologica Supplementum 65. (English Translation) Stockholm, 1950.

[2]Robinson, Helen Mansfield, Why Pupils Fail in Reading. Chicago: University of Chicago Press, 1946, pp xiii, 257.

specialists then decided upon one weak spot most likely to account for poor reading, and set to work to correct it, thus validating their decision. If this brought no improvement, a second weakness was corrected. Illustrative of a case where low metabolism, emotional distrubance, or binocular incoordination might have accounted for inability to concentrate longer than five minutes without falling asleep is one in whom thyroid improved health but not reading, while twelve weeks of orthoptic training cleared up all symptoms. In general, visual, emotional and social factors appeared to have greatest effect on reading.

Eames[1] compared the incidence of disease and defects in 875 reading failures and 486 non-failures. Urino-genital, circulatory and speech difficulties each occurred from five to six times as often among the failures as the non-failures; diseases of nose, throat, and ears, also allergy, occurred twice as often in the failure group; while malnutrition, diseases of lungs, bone and joints, or skin, and specific infectious diseases occurred only in the failing group. General disease conditions occured in 22% more of the failing than the non-failing group.

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[1]Eames, Thomas H., "Incidence of Diseases Among Reading Failures and Non-Failures" The Journal of Pediatrics 33:5 (November, 1948), 614-17.

Eames also presented in 1945[1], 1946[2], and 1947[3], studies of the relationships between prematurity or hypermaturity of birth and vision and reading failure. Prematurity was associated with higher frequency of poor vision throughout the age range (5-17), with a poorer median visual acuity through the ninth year. In a study of 100 poor readers, the percent of children of premature birth was much higher than in the general population.

Bannon[4] (optometrist) pointed out that small refractive errors and muscular-imbalances may provide just enough handicap to discourage the person with little interest and skill, and that patient interests and attitudes must be considered.

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[1] ______, "Comparison of Children of Premature and Full Term Birth Who Fail in Reading" Journal of Educational Research 38:7 (March, 1945)

[2] ______, "Eye Conditions Among Children of Premature, Full Term, and Hypermature Birth" American Journal of Ophthalmology 29:1 (January, 1946), 57-63.

[3] ______, "Effect of Premature Birth on Vision and Reading Failure" Claremont College Reading Conference 12 (1947), 82-83.

[4] Bannon, Robert E. "The Role of the Eye Specialist in Cases of Reading Difficulties" The Sight-Saving Review, 20:4 (Winter, 1950)

CHAPTER III

FINDING THE CHILD WITH VISUAL PROBLEMS

Numerous tests of various types and degrees of complexity have been devised to determine in the school situation, and with a minimum of time and expense, what pupils should be referred for professional eye care. These will be briefly discussed here.

1. Tests Given by School Personnel

Snellen Chart.—This is perhaps the simplest and best-known screening test. For many years it has been administered by school nurses and teachers as the only screening test. Essentially it consists of nine or more rows of letters so designed that at a specified distance each letter will subtend an angle of five minutes, while each stroke of the letter subtends an angle of one minute. For the largest letter, the distance is 200 feet; for the next line, 100 feet; for other lines, 70, 50, 40, 30, 20, 15, and 10 feet respectively. From a distance of twenty feet, the testee reads the smallest line of print legible to him at that distance. His visual acuity is then stated as 20/20 (the norm), 20/30, 20/40, etc., depending on which line was the smallest he could read.

As pointed out by Sloane and Gallagher[1], the visual acuity rating

[1]Sloane, Albert E., and Gallagher, J. Roswell, "The Vision of Adolescent Boys" American Journal of Ophthalmology 33:11 (November, 1950), p. 1746-50.

on this test is subject to variations due to chart condition, unstandardized lighting, and other variations in test conditions. Despite this fact, Jackson and Schye[1] found that poor readers tended to show more serious handicaps on this test than did the better readers. Shaffer[2], summarizing a study of 203 pupils from grades one to eleven in the Ohio State University School, reported that, if carried out carefully and with proper illumination, the Snellen chart was more accurate as a basis of referral than the Massachusetts Vision Test or the Keystone telebinocular. This is in contrast with the general opinion, which favors the use of supplementary tests. Sloane and Gallagher[3] point out that the decision of the professional eye man to give no treatment in a specific case does not necessarily indicate inaccuracy of the screening test—but quite often the ability of the subject to compensate for the defect found. Certainly this decision should rest with the doctor, not with the screening test.

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[1]Jackson, Thomas and Schye, Virginia, "A Comparison of Vision with Reading Scores of Ninth-Grade Pupils" Elementary School Journal 46:1 (September, 1945), 33-35.

[2]Shaffer, Thos. E., "Study of Vision Testing Procedures" American Journal of Public Health 38:8 (August, 1948), 1141-1146.

[3]Sloane, Albert E. and Gallagher, J. Roswell, "A Practical Ophthalmic Test Which Furnishes Quantitative Data" (Modification of Mass. Vision Test) Archives of Ophthalmology 31:3 (March, 1944), 217-222.

In an earlier paper[1] Sloane stated that results found with the Snellen test by teacher and by an ophthalmologist might differ by as much as 30%. When the technician had been properly trained, this difference was reduced to 10%.

Several variations of the Snellen chart are available. For those who cannot read, the "illiterate" or "tumbling" E may be used. For testing at reading distances of 14" or 16", reduced charts are available (the AMA chart represented in Table I, for example). With some of the screening instruments to be described, the characters are on a slide and are projected in the proper size on a screen at whatever object distance is most feasible in a given situation.

Eames Eye Test[2].—This test includes the Snellen chart; a plus lens (+1.50D) to be used with the Snellen chart for detecting hyperopes who are able to accommodate at least during the test period; a coordination test which detects phorias and suppressions, and a fusion test; also an astigmatic chart test and a test of eye dominance. The coordination test and fusion test are especially designed to interest the child. This battery is the simplest and least expensive of tests measuring more factors than the Snellen. A 1950 edition adds near tests to those for distance.

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[1]Sloane, Albert E. "Massachusetts Vision Test" Archives of Ophthalmology 24:5 (November, 1940), 924-39

[2]Eames, Thomas Harrison, "A New Approach to Testing the Eyes of School Children" American Journal of Ophthalmology, 24:10 (October, 1941), 1170-73.

Eames reports a test-retest reliability of 96% on 516 subjects; validity (correlation with professional examination) of 95% on 131 subjects. The visual acuity test alone picks out 62% of the visually inadequate; the plus lens test adds another 19%, while the other tests account for the remaining 19% failed.

Plus Lens Test.—The use of plus lenses with the Snellen chart, for detecting hyperopes in a group of 2000 cases, was reported by Stewart[1] (optometrist). He found that while the tendency to fail when retinoscopy indicated passing practically disappeared with provision against cheating, the tendency to pass when retinoscopy indicated failure continued in the case of 1 and 1 1/4D hyperopes, and concluded that the plus lens test is not comparable to retinoscopy for determining hyperopia.

Eames[2] points out that much variation in the number of failures results from the use of plus lenses differing in power.

Massachusetts Vision Test[3].—This test includes not only the improved Snellen chart (illiterate E) and plus sphere lenses, as does the Eames Eye Test, but provision for measuring phorias both at distance and at near, and controlled lighting, which should make for greater accuracy.

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[1]Stewart, Charles R., "Investigation of Plus-Lens Visual Acuity Screening Test." Optometric Weekly 42:1 (January 4, 1951), 9-13.

[2]Eames, Thomas Harrison - Personal communication.

[3]Oak, Lura, "The Massachusetts Vision Test," American Journal of Public Health 32:10 (October, 1942), 1105-1109.

All units are assembled in one kit for convenience. Developed by the Massachusetts Department of Public Health, it is adapted for use by the nonmedical, but carefully trained, examiner, in screening out those requiring referral to the eye specialist. Professional decision as to which cases should be referred is helpful, however, especially in view of the tendency to over-referral noted by Sloane and Gallagher[1] and by Shaffer[2].

Otherwise the failure level is VA below 20/30; 20/20 vision with plus lens; 4^{Δ} eso or 6^{Δ} exo at distance, 6^{Δ} eso or 8^{Δ} exo at near or $1\frac{1}{4}^{\Delta}$ hyperphoria. At these levels, Sloan & Gallagher reported 29% failure by Snellen, another 7% by the plus lens test, and another 4% by the phoria tests.

This test was accepted by the Council on Physical Therapy of the American Medical Association[3], who considered it especially adapted for children in the lower grades.

A modification of this test developed by Sloane and Gallagher[4] requires little longer, and gives quantitative as well as qualitative results.

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[1]Sloane, Albert E. "Massachusetts Vision Test" <u>Archives of Ophthalmology</u> 24:5 (November, 1940), 924-39

[2]Shaffer, <u>op. cit.</u>

[3]Council on Physical Therapy. <u>Journal of the American Medical Association</u> 22:37 (May, 1943) Quoted by Buros, Oscar Krisen, in <u>Third Mental Measurements Year Book</u> New Brunswick: Rutgers University Press, 1949, p.496

[4]Sloane, Albert E., and Gallagher, J. Roswell, "A Practical Ophthalmic Test Which Furnishes Quantitative Data" (Modification of Mass. Vision Test) <u>Archives of Ophthalmology</u> 31:3 (March, 1944), 217-222

Binocular Reading Test.—This is not a test for visual acuity or phorias, but a supplementary test to detect suppression in the reading situation. It is a stereoscopic test in which a simple paragraph is so presented that twenty words are visible to the right eye only, twenty words to the left eye only, and the rest of the paragraph to both eyes. Omission of the key words for either eye indicates suppression of the images of that eye, except in cases of extremely low visual acuity or marked astigmatism.

The purpose of the test is "to discover the relative participation of each eye in a binocular reading situation and to measure the extent of any preference."[1]

Results on the test as administered to sixty elementary school pupils showed very few cases of omission occurring among the words that were seen binocularly, and no relationship between the position of a word and the per cent of error.

Repeat reliability was determined at .98 in the right eye, .77 in the left eye. Validity was inferred from the fact that 69% of those showing eye preference read significantly better with one eye than with the other. The same was true of the four cases of strabismus and 60% of the cases showing marked defect. Validity of the use of the stereoscope as compared with the conventional presentation of oral reading tests was established by comparison of Gray's Oral Check Tests

[1]Spache, George "A Binocular Reading Test" Journal of Educational Psychology 34:6 (September, 1943), 368-372.

administered by both methods. No significant differences were found.[1]

Another report by Spache[2] indicates that of 23 children showing marked eye preference, 43% read significantly better with the preferred eye than with both; of 29 children differing significantly in reading abilities of the separate eyes, 55% read better with the more efficient eye than with both; while of 21 children with different visual acuity in the two eyes, binocular reading correlated closely with that of the better eye. The conclusion was that ordinary reading tests underestimate the potential reading levels of children in the first two groups.

Robinson[3], using this test with 75 pupils from grades 4, 5, and 6, found only seven showing significant differences between right eye, left eye, and binocular reading efficiency. (Her selection of significant differences were 20 seconds or 8 errors, as compared with Spache's 7 seconds or 2 errors). Of the seven, those reading best binocularly passed all the ortho-rater visual screening tests. She concluded that as the test correlates well with visual efficiency tests, and indicates suppression during reading, it appears valuable as a supplement to a visual screening test.

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[1]Spache, George, "The Validity of the Binocular Reading Test," Journal of Educational Research 41:6 (February, 1948), 461-466.

[2]______ "One-Eyed and two-Eyed Reading" Journal of Educational Research 37:8 (April, 1944), 616-618.

[3]Robinson, Helen M., "Factors Related to Monocular and Binocular Reading Efficiency" American Journal of Optometry and Archives of the American Academy of Optometry 28:7 (July, 1951), 337-346.

2. Eye-Movement Camera

The Ophthalmograph.—The Ophthalmograph[1,2] is a binocular eye-movement camera, which may be used to determine how effectively a pupil uses his eyes in reading. Saccadic forward movements, fixations, and regressive movements, all parts of the normal reading process, are recorded. So, too, are the less desirable deviations between the eyes, which may be handicapping some students. Seldom a part of a screening program, it may be useful in the diagnosis of reading problem cases.

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[1] The Ophthalmograph, Southbridge, Mass.: American Optical Co., 1949, pp 12.

[2] Anderson, Irving H., and Morse, Wm. C., "The Place of Instrumentation in the Reading Program. I Evaluation of the Ophthalmo-Graph" The Journal of Experimental Education 14:3 (March, 1946), 256-62.

3. Visual Survey Services

The Keystone Telebinocular.--Originally designed as a hand stereoscope, this instrument was modified in 1933 and mounted on a stand[1]. New models were developed in 1938, and again in 1947 three new models appeared--for use by the eye professions, for school surveys, and for industrial use, respectively.

Included in the Keystone Visual Survey Service are the Keystone Visual Survey Tests--formerly the Betts Ready-to-Read Tests.

Instead of the familiar Snellen visual acuity chart, a checkerboard pattern in graduated sizes is used to measure "visual efficiency." Results can, if desired, be correlated with Snellen equivalents.

Vertical and lateral imbalance, fusion, suppression, and stereopsis are also screened for.

While better adapted to school use, this instrument is reported[2] to be lower in reliability and validity than the two following instruments.

The Ortho-Rater and the AO Sight-Screener.--Like the Telebinocular, these two instruments are commercial screening devices. They are available only as part of an Industrial (or School) Vision Service, and must be used by well-trained clinicians, under the supervision of a professional eye man. Both instruments measure visual acuity, vertical and laterial phorias, both for distance and near vision. Both measure stereopsis, color vision, and fusion or suppression.

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[1]Buros, Oscar Krisen, op. cit., p. 495 (Test 467)

[2]Imus, Henry A., "Visual Testing Techniques" Transactions American Academy of Ophthalmology and Oto-Laryngology 52 (March-April, 1948), 371.

Imus, quoted above[1] states: "An impartial comparison of the Ortho-Rater, AO Sight-Screener and the Keystone Telebinocular shows that the first two are approximately equal in reliability and validity, with a slight preference for the Ortho-Rater, and that both tests are better in both reliability and validity than the Telebinocular."

He also states that the reliability coefficients for the Ortho-Rater range from .62 to .90, and correlations with clinical tests as follows: visual acuity, .83 to .90; lateral phoria, .70 to .77; vertical phoria, .50. For the Sight-Screener[2], coefficients of reliability of .55 to .84 are quoted, with validity coefficients slightly lower.

While the Ortho-Rater has been used in some rather extensive school screening projects, no such report has been made on the AO Sight-Screener.

One report covering 574 pupils in grades 1-12 (Kephart and Exton[3]) indicated good correlation between retinoscopic findings of hyperopia, emmetropia, and myopia and Ortho-Rater visual findings, but slight relationship with Ortho-Rater phoria readings.

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[1] Ibid., p 373

[2] Ibid., p 374

[3] Kephart, Newell C., and Exton, Alfred H., "Preliminary Study of a Survey of Visual Skills among School Children. <u>Colorado Optometrist</u> 7:12 (October, 1949)

4. Professional Screening Methods

With the increasing interest of optometrists and ophthalmologists in school vision, the use of the retinoscope and ophthalmoscope has become increasingly common in the screening situation. At least one kit has been devised especially for this use by optometrists, while variations in technique, with or without screening instruments previously described, have made possible more thorough surveys, without prohibitive increase in time required.

Los Angeles County Optometric Association Skills Test[1].—Designed especially for use by optometrists, this includes in a small, compact kit, such slides, lenses, and prisms as are needed for screening purposes. Slides are available for use with either the American Optical, the Bausch and Lomb, or the ordinary .35mm projector. The record form provides a scale for adjusting the distance of the projector from the screen.

Visual acuity is measured with or without glasses according to the pupil's usual practice. Both distance and near tests are made of visual acuity, fusion, suppression, and lateral phorias. Vertical phorias, depth perception, and subjective estimate of illumination are measured at distance; range of near vision, fields, versions and rotations, near point convergence, and color perception, at near. Static retinoscopy, with +1.00D, +2.00D, and +2.50D lenses, provides a fairly accurate

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[1] Goodlaw, Dr. Edward. I. "A Procedure for Optometric Surveys in Industry, Schools, and Other Groups" Optical Journal and Review of Optometry 88:10 (May 15, 1951), 29-37.

estimate of refractive status, and ophthalmoscopy determines the presence or absence of pathology.

The report form is so arranged as to form an easily read profile, from which the optometrist can judge, in view of individual symptoms and needs, whether referral for complete visual study is needed.

Goodlaw[1] states that with one kit, and a retinoscope and ophthalmoscope, three optometrists can survey from 15-20 pupils per hour. A brief case history is taken by a lay helper.

"The Brookfield System".—This system, worked out by O'Shea[2] for use by one optometrist (himself) in a group of comparatively small towns, has been recommended by the Committee on Visual Problems in Schools, of the American Optometric Association[3], as the best choice for surveying the vision of school children—short of a complete visual case study of each child by an optometrist.

A mimeographed check list gives teachers opportunity to furnish information as to the pupil's intelligence, reading ability, general school achievement, behavior, and health. Superior high school pupils served as recorders and assistants. The usual visual acuity tests,

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[1]Ibid.

[2]O'Shea, John B., "The Brookfield System" Journal of the American Optometric Association 18:5 (December, 1946)

[3]Eberl, Marguerite, (Chairman) "Report of the Committee on Visual Problems in Schools" Journal of the American Optometric Association 20:2 (September, 1948), 124, 126.

with and without plus spheres, phoria tests, tests for fusion and stereopsis, were supplemented by several tests not usually included in a screening program. All pupils received the distance acuity tests and static retinoscopy. Beyond that point, failure on any test led to omission of later tests, and automatic recommendation of professional care.

No arbitrary standard was set for passing any test, however, but small defects appraised in view of the relationship between achievement and capacity--if this was low, even slight defects led to referral. Similarly, the ophthalmoscope was used when retinoscopy failed to explain lack of visual acuity. Some were failed because visual training seemed desirable, but with the relization that final decision must rest with the professional man consulted. Several additional tests were made when indicated. Some 20% of the 1160 pupils tested were given the Ophthalmograph eye-movement recording.

Besides "Passing" and "Failure" a rating of "Barely Passing" was used. This was to imply that while vision was for the present adequate to the student's needs, professional care might be needed in the near future. Rechecks were made on doubtful cases.

As compared with complete office examinations, the survey required about one-third as much time.

The accompanying table (Table I) gives a schematic view of visual factors measured by each of these tests or systems. Conspicuous is the trend toward more and more complete tests as the professional eye man comes more directly into the school screening situation. It must be remembered, too, that each test is subject to repeated revision and additions in the interest of accuracy and completeness.

References indicated on the chart are listed below:

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a/ Eberl, Marguerite Thoma, "Outline of Study of School Children's Vision" Journal of the American Optometric Association 20:3 (October, 1948), 182-189.

b/

c/ Spache, George, op. cit.

d/ Bryan, Wendell E., "Colorado School Survey Report" Journal of the American Optometric Association 20:11 (June, 1949), 726-7

e/ "Sight-Screener Record Form" Southbridge, Mass., AOCo., 1946

f/ O'Shea, John B., "The Brookfield System" Journal of the American Optometric Association 18:5 (December, 1946)

Given By	School Authorities					Professionally Supervised Technician		Optometrists	
Visual Factor Measured	Snellen Chart AMA Reading Card	a/ Eames Eye Test	a/ Mass. Vision Test	c/ Binocular Reading Test	a/ Betts Ready to read Visual S&P	d/ Ortho-Rater.	e/ Sight-Screener	a/ Los Angeles Skills Test	f/ Brookfield System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Visual Acuity									
at 20 ft.	Snellen	v	20/20&30			B R L	B R L	v	B R L
at 14-16"	AMA	v				B R L	B R L	v	B R L
Plus Sphere		+1.50	20/20&30						B R L
Astigmatism		chart							retinoscope
Phoria									
Vertical, far		v	v		balance	v	v	v	v
near						v	v		
Lateral, far		v	v		balance	v	v	v	v
near			v			v	v	v	v
Simultaneous vision		v			v		v		
Fusion									
Far		v			v	v			v
Near					v	v			v
Suppression					b/				
Far		v			v		v	v	
Near				v	v		v	v	
Stereopsis									
Far					v	v	v	v	v
Near							v	v	
Eye Dominance		v		v					v
"Visual Efficiency"									
Binocular					v				
Right Eye					v				
Left Eye					v				
Range of near vision								v	
Accommodation									v
Convergence near point								v	v
Fixation ability									v
Freedom of eye movements									v
Versions, rotations								v	
Fields								v	
Color perception						v	v	v	v
Ophthalmoscopy								v	As needed
Retinoscopy									
Static								v	v
Dynamic									v

Table I Screening Methods in use

5. School Vision Surveys

Recommendations of the AOA Committee.—Important work on the problem of school vision has been done by the Committee on Visual Problems in Schools, of the American Optometric Association. In a 1948 report[1] they recommended as to tests and referrals:

1. The ideal situation is a complete visual case study of each child by an optometrist, either in his own office, or in a completely equipped school office.

2. The next choice is a thorough survey by an optometrist—such as the Brookfield System of O'Shea.

3. Failing these, Betts' DB Visual Skills Tests, Los Angeles County Optometric Association skills battery, or "any similar series of tests," supplemented by static retinoscopy, ophthalmoscopy, and as many more tests as possible.

4. If tests must be administered by school authorities rather than optometrists, they should be under the supervision of reading or remedial reading teachers, rather than the health department.

5. In addition to any referred on the basis of visual tests, all children not achieving up to capacity should be referred for complete visual case study. (The following report adds all children failing or near failing in school to those to be referred.)

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[1] Eberl, Marguerite, op.cit.

In 1949[1], the committee added to the list of recommended referrals all children in the lower 25% of their class, also behavior problem cases. To the list of tests mentioned were added the Eames Eye Test and the Massachusetts Vision Test.

In their 1950 Forum[2] the per cent recommended for referral was increased to the lower 33%. Particular screening procedures were "neither condoned, endorsed, or rejected." Complete optometric case study was recommended.

Also in 1948[3], the Committee presented an outline of Study of School Children's Vision, under eight main headings. Pertinent to this section is their listing of suitable tests for school use, with information on points covered by each. For optometrists, a form for complete visual case study is given, also for a report to the school.

The Peoria Visual Screening Project[4].—This project covered all the grade pupils of the city of Peoria—12,667 children from grades one through eight.

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[1]Eberl, Marguerite Thoma, Chairman, "Caring for the School Child's Vision—I" Southern Optometrist 2:11 (July, 1949), 23-26.

[2]Jander, Bernard C., "Forum on Visual Problems of School Children" (Auspices AOA Committee on Visual Problems in the Schools) Journal of the American Optometric Association 21:11 (June, 1950), 633, 634.

[3]Eberl, Marguerite Thoma, Chairman, "Outline of Study of School Children's Vision" Journal of the American Optometric Association 20:3 (October, 1948), 182-189.

[4]Potter, J.A., and Turner, C.S., "The Peoria Visual Screening Project" Journal of the American Optometric Association 21:10 (May, 1950), 566-9

Planned by a joint committee of ophthalmologists and optometrists, presented by the executive secretary of the Illinois Society for the Prevention of Blindness at the invitation of the president of Bradley University, and carried out under the supervision of a committee of seven, representing the interested groups (the four above-mentioned plus public and parochial school heads and city health department), the actual survey was initiated in the fall of 1948.

The Massachusetts Vision Test was selected as the screening instrument. Carefully selected students in education at Bradley University were thoroughly trained as technicians, supervised, and given university credit for their work. Testing room setup, schedules, and report forms were carefully planned to avoid loss of time or distraction by other testees. Cases having had professional care within the year were not examined. The usual Massachusetts Vision Test levels for failure obtained, and one failure ruled the child out from further testing. Referral cards sent to parents for failing cases provided space for parental permission for the doctor seen to report diagnosis to the school.

Results showed: 25% of grade one, 53.3% of grade eight, had visual problems; of these, 6.6% of grade one, over 38% of grade eight, had had professional attention during the past year. Of those below minimum standard who sought professional care, 54.7% were given glasses; 1.6% medical refer; 9.7% orthoptic training; 18% no treatment at present; 13% no treatment nor reason. Comments on the study included: an advisory committee representing interested groups was essential to its success; University cooperation was helpful both to the project and to the student technician for his future work; follow-up by the public health nurse was recommended. This last suggestion seems especially important in view of the low percent of referrals (20.7%) reporting professional care. As professional men volunteered their services where fees could not be afforded, and Delta Beta Phi sorority had agreed to furnish eye glasses where needed, follow-up should result in greater use of the findings of the survey.

The Brookfield Survey.--This survey was made in 1945 in the schools of four small towns in central Massachusetts. Financed by the local Lions Club, after presentation of the need by the School Superintendent, the actual survey was carried out by O'Shea[1], a near-by optometrist. Survey methods have been described under "The Brookfield System."

1150 pupils of grades 1-12 were surveyed. Of these, 37% passed easily, 37% failed, and 26% rated "barely passing" or likely to need professional attention before long.

Interesting is the absence of an arbitrary standard for passing any test, but appraisal of each in view of the relationship between achievement and capacity. The omission of further tests, once failure was definite, and the addition of special tests where results were doubtful, were other features of the study, as was the use of the Ophthalmograph with about 20% of the cases. Rechecks were also made on doubtful cases.

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[1]O'Shea, John B., "School Vision Surveys" Journal of the American Optometric Association 21:7 (February, 1950), 366-8.

Statistical studies based on this survey were made by Leverett[1,2,3]. The first dealt with the wearing of corrections. 13.6% (17.6% of the girls, 10.2% of the boys) were found to have worn corrections at some time. The per cent rose steadily from age group to age group of the girls (8.3% at ages 5-8, to 32.3% at ages 15-19). For the boys the trend was less consistent, rising from a low of 2.2% between five and eight to 15.3% between twelve and fourteen. Above age fifteen, the per cent dropped again to 10.9%. Whether this drop reflected a lower demand on the boys for near point work, fewer complaints and therefore fewer visual examinations for the boys, or a disinclination of boys of this age group to wear glasses, or whether it was due to some chance difference in the population (as, for example, more drop-outs among the boys with poorer vision as legal age limit was reached) cannot be determined from the survey. As there appeared to be no significant sex differences in visual skills, it seemed that attention should be given to the tendency for very young boys and those in the high school group to receive less visual care than the girls of the same ages.

Interesting, too, was the failure of 43.5% of those who had had corrections at some time as compared with 33.8% of those having had no

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[1]Leverett, Hollis M., "The Brookfield Survey Data" I Introduction. Journal of the American Optometric Association 21:9 (April, 1950), 492-4.

[2]Ibid. II "The Wearing of Corrections" Journal of the American Optometric Association 21:10 (May, 1950), 549-552, 554

[3]Ibid. III "Visual Acuity at twenty feet." Journal of the American Optometric Association 22:6 (January, 1951), 342-8

correction. Among the suggested explanations are: the need for change in corrections due to changes in current visual needs; the possible need for visual training as well as glasses; and the possibility of visual defects which are not adequately correctable. No mention is made of the number no longer wearing their corrections.

Study of the visual acuity showed 20/20 vision in 70% of the eyes, and in the binocular vision of 84% of the pupils. Binocular acuity was often better than monocular, possibly because with one good and one poor eye, binocular visual acuity approaches that of the better eye; also many did better with both than with either alone (see also Spache[1] on binocular and monocular reading). 20/20 vision also increased from the five-year age group to the nine-year group, whether because of physiological changes or increased mental maturity.

Comparison with results on the Snellen chart alone shows 42 passing the entire test, while failing the Snellen alone. On the other hand, 215 who passed the Snellen test, failed on some other phase of the survey. This represents a total of 26% differently classified than by the Snellen, presumably more accurately so because of the element of professional judgment and the more thorough examination.

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[1] Spache, George <u>op. cit.</u>

Colorado School Surveys[1].--The Vision Survey Committee of the Colorado Optometric Society, with the cooperation of the Vision Institute of Purdue University, has set up a plan for school vision surveys throughout the state. In each community, agreement is made with the local PTA to conduct the survey for the number of years equal to the number of grades in the school. Local optometrists on the Survey Committee donate their time, supervising the program and doing the retinoscopy and ophthalmoscopy, also external examination. School nurses or PTA members are trained to give the screening tests (Ortho-Rater). Suitable cards bearing the findings are statistically rated at Purdue; reports and notices are sent to school and parents. Refractionists chosen by the parents sign and return the notices when giving visual care. The Vision Survey Committee checks to determine how many of the referred children receive visual care.

Statistical study by the Vision Institute is expected to lead to the establishment of visual standards for school children, also to offer a comparison between children's and adult vision performance.

Statistics on 108 boys surveyed in a state training school showed 44 in need of glasses, 30 in need of visual training, and "very definite correlation between visual curve and delinquency curve"--statistics not given. Needed glasses were supplied by the Colorado Optometric Association.

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[1]Bryan, Wendell E., "Colorado School Survey Report" Journal of the American Optometric Association 20:11 (June, 1949), 726-7.

Of 2014 public school children, 532 were found in need of refraction, 87 with deficient fusion, 11 with vertical imbalance, 41 with lateral imbalance, 17 failing on depth-perception, 14 with strabismus, and 88 with external-eye condition.

Retinoscopic findings are quoted on a much smaller number of pupils, and are essentially those of Kephart and Exton.[1]

Kansas School Surveys[2].—Through the interest and desire of Kansas optometrists to modernize the visual tests in Kansas schools, the Public Health Department of the Kansas Optometric Association came into existence. After some preliminary surveys, in 1941 bulletins were sent to school superintendents and principals describing the services offered.

Starting with 5500 students in 23 Kansas schools in the spring of 1942, and growing until in the fall of 1949, 10,000 children were screened, a total of 200,000 pupils in 150 systems and schools, from kindergarten through high school, were tested. Reading speed and comprehension, IQ, and general physical data were furnished in advance by each school. Eight telebinocular skills were tested by senior high school girls and mothers after special training and under the supervision of local optometrists. The optometrists made ophthalmoscopic and retinoscopic tests. Consolidation of groups made possible the screening of 700 pupils a day, using 20 telebinoculars, with one optometrist supervising, and five optometrists making retinoscopic and ophthalmoscopic tests.

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[1] Kephart and Exton op.cit.

[2] Rust, J.C., "Kansas Pioneers Visual School Surveys" Journal of the American Optometric Association 22:5 (December, 1950), ~~276-9~~

There is further demand for this service, but inadequate funds, although some schools, PTA's, and individuals assume part of the cost, and civic groups help to pay for needed care.

Results show an undue proportion of visual problems in some localities, probably because of general health or lighting. In general, from 25% to 29% failed on each of the following tests: visual efficiency, both far and near; fusion, both far and near; Snellen VA; and retinoscopy, both far and near. 20% showed inadequate stereopsis, 12% lateral imbalance at near, and 6% lateral imbalance at far point. Except for 5% failure on color perception, few other failures were noted.

Prep School Surveys.—Three surveys conducted in different years in the same private school for boys by the same ophthalmologist are interesting because of comparative results at different dates, as well as because of the select population. The boys ranged in age from 13 to 19. The instrument used was a modification of the Massachusetts Vision Test which gives quantitative as well as qualitative results.

As summarized by Sloane and Gallagher[1]:

20/20 binocular vision without glasses dropped 80% to 76.5%, to 72.0%

Failure on the plus lens test (only those without glasses)	10%	6.9%	1.7%
Hyperphoria of 1 or more	2.5	1.5	1.7
Esophoria, 6^{Δ} or more, at distance	5.7	3.1	1.2
at near	2.7	2.5	.5
Exophoria, 4^{Δ} or more, at distance	not given		3.2
8^{Δ} or more, at near	"	"	1.5

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[1]Sloane, Albert E., and Gallagher, J. Roswell, "The Vision of Adolescent Boys" American Journal of Ophthalmology 33:11 (November, 1950), 1746-1750

Why the percent of failure should have dropped so consistently on phorias and so surprisingly on the plus lens test, while 20/20 vision became less common, is not explained or discussed.

The effect of the choice of a passing level is brought out by a comparison of per cent who would be referred at each of these levels:

at 20/30 in both eyes or less in one	21%
at less than 20/25 in both	26%
at less than 20/25 in one	30%

Lower levels—even as low as 20/40—may be satisfactory failure levels in the usual screening setup, in the opinion of the authors, because of the tendency to lower VA ratings under conditions of poorer chart conditions, press of time, etc.

While no correction was given by the eye specialist for some of the cases referred, this was attributed to adequate compensation on the part of the subject, not to inaccuracies in the screening—an interesting comment on the charge of over-referral.

In general, pupils referred on the basis of symptoms only were less often found in need of treatment than those referred on the basis of the screening tests.

Survey	Brookfield 1945	Peoria 1948	Colorado 1949 (9-12 yrs.)	Kansas 1950	Private Prep School
(1)	(2)	(3)	(4)	(5)	(6)
Sponsored by	Lions Club School Dept.	Ill. S.P.B.	Visual Survey Comm. COA	Public Health Dept. K.O.A.	School
Conducted by	O'Shea (optometrist)	Advisory Committee	Local optometrist	Local optometrist	School Ophthalmologist
Assisted by	Teacher's check H.S. pupils	Student technicians	School nurse or PTA member	teacher check-sheet H.S. seniors or mothers	
Financed by	Lions Club	Bradley Univ. instruments technicians	Time donated Purdue Univ.	KOA, volunteer O.D. schools, civic groups	
Glasses by		Prof. men Delta Beta Phi	Colo Opt Assoc		
Instrument	Brookfield System	Mass. Vision	Ortho-Rater Retinoscope, ophthalmo	Retino-, ophthalmoscope Snellen Telebinocular	Modified Mass. Vision
Population	All pupils 4 small towns	All Peoria public and parochial	Public School / Industrial School	Kan. schools, 150 systems 200,000 to date	Private boys' School
Number	1160	12667	2014 / 108	5342 reported	1129, 797, 715
Ages	5-19				13-19 yr.
Grades	1-12	1-8	1-12	K- 12	
Failure Standard	Low ratio achievement-capacity and any defect	Below 20/30 Plus lens 20/20 D eso 4, exo 6 N eso 6, exo 8 or Hyper- 1 1/4	Ortho-Rater standards	Failed Snellen, 26% Retino-, 26% Fusion, far, 25% V. efficiency, 29%	
Results	Passing, 37% Barely", 26% Failure, 37%	With visual problems, 30% Below minimum standard, 17.57%	31% failed / 41% need glasses 28% need orthoptics	Stereopsis, 20% Lateral imbalance, 12% Fusion, near, 27% V.A. Near: R. 27% L. 29%	D4.4$^{\Delta}$, 3.1$^{\Delta}$, 5.7$^{\Delta}$ N2.0$^{\Delta}$, 2.5$^{\Delta}$, 2.7$^{\Delta}$
Reports School	v	Master sheet each grade	v	v	v
Parents	Bare pass care in near future	Below minimum standard	v	v	v
Previous eye care	13.6% (17.6% girls) (10.2% boys) had had glasses	15% within year (6.6% grade 1) (38.34% " 8)			
VA	20/20 70% of eyes 84% binocular increased 5-9 yr.		26% failed / 41% failed	26%-29% failed	20/20 72% 76.5% 80.1%
cf Snellen	failed 215 passing S passed 42 failing S (26% differently classified)				
Follow-up		glasses, 54.7% orthoptics, 9.7% medical 1.6% no treatment 18% over-referral 13%	principal notes scholastic gains / 30-100% gain in studies		

Table II School Surveys

CHAPTER IV

HELP FOR THE CHILD WITH VISUAL PROBLEMS

In general, relief from visual problems is sought through two routes--glasses to correct refractive errors or aniseikonia, and to relieve some squints and phorias--and visual training to improve fusion, overcome suppressions, relieve phorias and convergence insufficiencies, or to improve the perceptual span and speed. Recognition of other contributing factors must also play its part, even in visual correction.

Morrison[1], an optometrist with his own visual clinic, gives for the layman a desription of visual defects, their treatment with glasses and exercises, and the influence on reading. No research is indicated.

Glasses.--A study by Eames[2] indicates that in 100 cases tested with and without glasses, the majority showed increased speed of perception when wearing the correction. The greater the refractive error corrected, the greater the increase in speed. Cases of low myopia were occasionally retarded in reading by glasses; of hyperopia, seldom. Word recognition showed greater improvement than object recognition.

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[1]Morrison, D.E., "Visual Skills and Visual Training" Claremont College Reading Conference 13 (1948), 55-74.

[2]Eames, Thomas H., "The Effect of Glasses for the Correction of Hypermetropia and Myopia on the Speed of Visual Perception of Objects and Words" The Journal of Educational Research 42:7 (March, 1949), 534-40.

Kephant[1] reports a study of 52 boys in the Colorado State Industrial School, all showing need of visual correction. These lads were paired for IQ and grade placement; 25 forming the experimental group were given corrective lenses; 27 controls were not visually corrected.

Environment of both groups out of school, as well as in, was controlled.

Four months later the two groups were again compared. The group with the corrective lenses showed a mean gain in grade placement of 1.21, the controls, only .62.

It was concluded that correction of visual difficulties leads to more rapid progress in school achievement.

This compares with the report of Krous[2] (See p. 10) that visual care for 14 poor readers helped bring their reading gain up almost to normal from a two-thirds normal rate before treatment.

Park[3] stated that while some cases require refractive corrections, glasses should not be empirically prescribed. Crisp[4] (non-experimental)

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[1]Kephant, Newell C., "Visual Corrections and School Achievement" American Journal of Optometry and Archives American Academy of Optometry 28:8 (August, 1951), 421-423.

[2]Krous, George T., "Visual Analysis Investigations as Part of a Reading Program" Claremont College Reading Conference 12 (1947), 66-71.

[3]Park, George E., "Reading Difficulty (Dyslexia) from the Ophthalmic Point of View" American Journal of Ophthalmology 31:1 (January, 1948), 28-34.

[4]Crisp, W.H., "The Psychology of the Poor Reader" American Journal of Ophthalmology 33:2 (February, 1950), 235-42.

also felt that refractive errors probably played a small part in the poor reader's problem, but should not be overlooked. Parkins[1] pointed out that correction of refractive errors may improve concentration, and therefore school work, if not reading rate. Bannon[2], too, suggests that small refractive errors and muscle-imbalances may provide just enough handicap to discourage the person with little interest and skill.

Orthoptic Training.--While cautious as to prescribing glasses, Park[3] recommended orthoptic treatment in 52% of 133 cases of reading difficulty. 15% were also given training to improve eye movement habits and span of recognition.

Sloane and others[4] reported on the effect of a simple group training method upon myopia and visual acuity. No significant changes in refraction were found. This is in accordance with the general feeling that visual training, may help correct binocular incoordination, but not visual acuity. Bannon[5] warned against the belief that orthoptic training can correct amblyopia or refractive error, or even an actual

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[1]Parkins, George A., "Visual Functioning While Reading" American Journal of Optometry and Archives of the American Academy of Optometry 22:9 (September, 1945), 428-432.

[2]Bannon, Robert E., "The Role of the Eye Specialist in Cases of Reading Difficulties" The Sight-Saving Review 20:4 (Winter, 1950).

[3]Park, George E., Op. cit.

[4]Sloane, A.E., Dunphy, E.B., Emmons, W.V., and Gallagher, J.R., "Effect of a Simple Group Training Method upon Myopia and Visual Acuity" Research Quarterly 19:2 (May, 1948), 111-117.

[5]Bannon, Robert E., "Comments on Orthoptics" American Journal of Optometry and Archives American Academy of Optometry 23:11 (November, 1946), 483-497

anomaly in binocular turning of the eyes. What it does accomplish is to train the individual to use his eyes more efficiently in spite of his handicap.

Both Parkins[1] and Peters[2], reporting results of orthoptic training, indicated that motivation was most important. Peters, working with college freshmen of low scholastic and reading ability, divided into three groups according to relative ability, found orthoptic training to be accompanied by significant increase in rate and comprehension by both better and poorer readers. Those with IQ in excess of reading ability gained most in reading; those with IQ lower than reading ability improved in vision, but not in reading.

Parkins' study dealt with 2100 students of grades five through college, in groups paired by results of educational test batteries. Like Peters, he found that interest and scholastic aptitude made for greater gains in reading rate under visual training. He also states that correction of refractive errors improved concentration, therefore aiding school progress if not reading rate.

Armistead and Dannenburg[3] reported on visual gains of 26 pupils

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[1]Parkins, George A. op. cit.

[2]Peters, Henry B., "The Influence of Orthoptic Training on Reading Ability" American Journal of Optometry and Archives of the Academy of Optometry 19:3 (March, 1942), 95-111, and 19:4 (April, 1942), 152-176.

[3]Armistead, J. Davis, and Dannenburg, O. Doyle, "Visual Performance Associated with Reading Problems" Optometric Weekly 39:24 (June 10, 1948), 786-8.

receiving visual training from September to January. Significant gains were noted in accommodative rock, fusion at near, visual acuity at near, and span of recognition. A gain of 106-108 words per minute in reading rate was indicated.

Haines[1] cites the case of a High School senior, a retarded reader, for whom orthoptic training revealed an unspected muscle imbalance, the correction of which improved both vision and reading.

Joslin[2] also reports the case of one lad, a reading failure at twelve, a successful advanced student after adequate visual care and training.

Tachistoscopic Training.--Tachistoscopic training aims at increasing the speed and span of recognition, while preventing regressions. Devices for this purpose range from simple cards for exposing or covering material to be read, to mechanically driven instruments with adjustable speed controls.

Several workers have reported favorably on this type of training. Renshaw[3] reported increase of speed and comprehension in silent reading

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[1] Haines, Howard F., "Orthoptic Training in Convergence Deficiency uncovers Latent Vertical Imbalance--a Case Report" American Journal of Optometry and Archives of American Academy of Optometry 27:7 (July, 1950), 357-60.

[2] Joslin, E.S., "Review of Research on Visual Madadjustments as a Cause of Reading Disability" Columbia Optometrist 23:52 (December, 1949), and 24:53 (February, 1950).

[3] Renshaw, Samuel, "The Visual Perception and Reproduction of Forms by Tachistoscopic Methods" Journal of Psychology 20:2 (October, 1945), 217-32.

by adults as the result of tachistoscopic training. MacLatchy[1] reported much better than average gain by first- and second-graders with similar training. Melcer and Brown[2] also found much improvement with first-graders when using tachistoscopic methods. McQuarrie[3] also recommended tachistoscopic and retinal rivalry training, without giving evidence to back up his view-point. Sutherland[4] found results inconclusive as to efficiency of training. Rapid initial gain dropped off, possibly for lack of motivation. Westover's findings have been discussed under eye movements. (P. 20)

Imus, Rothney, and Bear[5], working with college men, 127 with seeing problems and 383 controls, combined tachistoscopic training with practice to improve comprehension. Their findings showed:

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[1]MacLatchy, Josephine, "Bexley Reading Study" Educational Research Bulletin, Ohio State University 25:7 (September, 1946), 141-68.

[2]Melcer, Fannie Helen, and Brown, Barbara G., "Tachistoscopic Training in the First Grade" The Optometric Weekly 36:49 (December 6, 1945), 12-17-19.

[3]McQuarrie, Chas. W., and Hanson, Bernard I., "Vision Training: An Aid to Better Seeing" Claremont College Reading Conference 12 (1947), 80-84-82.

[4]Sutherland, Jean, "The Relationship Between Perceptual Span and Rate of Reading" Journal of Educational Psychology 37:5 (September, 1946), 373-80.

[5]Imus, H.A., Rothney, J.W.M., and Bear, R.M., "The Dartmouth Remedial Reading Problem" American Journal of Optometry and Archives American Academy of Optometry 20:8 (August, 1943), 269-293

The group receiving training increased comprehension, rate scores, and words per minute faster than the controls.

In comprehension, those with low initial scores gained more than those starting with higher scores; those of lower IQ faster than those with high IQ; visual defect made no significant difference.

In reading rate, those with low initial rate gained more than those starting with a high rate; those with higher IQ faster than those with lower; and those with no visual defects faster than those with visual defects.

As in the case of orthoptic training, motivation as well as scholastic aptitudes was an important factor.

Early Recognition.—Bond and Wagner[1] point out that it is futile and may be harmful to try to teach a child to read before he is ready. Reading readiness includes adequate visual skills, as well as satisfactory hearing and general health, and appropriate speech patterns.

Eberl[2] recommends that lacks in visual skills be discovered in senior kindergarten, before reading instruction is started.

Bing[3] also points out the importance of locating and providing

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[1]Bond, Guy L., and Wagner, Eva Bond, Teaching the Child to Read. New York: MacMillan, 1950. Chapter V

[2]Eberl, Anita, "Visual Difficulties as Related to Scholastic Achievement" The Southern Optometrist 3:1,2 (September-October, 1948).

[3]Bing, Lois B., "A Critical Analysis of the Literature on Certain Visual Functions Which Seem to be Related to Reading Achievement" Journal of the American Optometric Association 22:8 (March, 1951), 454-463.

for those children of school age who are still visually too immature for reading.

Park[1] likewise stresses the importance of early recognition of visual problems and prompt remedial action.

Recognition of Factors Other than Visual.--Reading readiness involves not only adequate visual skills, hearing, and speech, but also such personal and emotional factors as adaptability to the school situation and the group, self-reliance, and well-disciplined behavior.[2] A desire to read and a sufficient background of experience for understanding of material to be read are also important.

Failure to meet these needs before reading instruction is begun, or additional needs appearing as the child grows, may have unfortunate effects on the child's reading.

Bannon[3] pointed out the need for the optometrist to consider patient interests and attitudes, and watch for clues indicating need of referral to other specialists.

Eberl[4], too, stresses the need for noting other handicapping factors--social, emotional, or teaching method, and gives very full

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[1] Park, George E., Op. cit.

[2] Bond, Guy L., and Wagner, Eva Bond, Op. cit.

[3] Bannon, Robert E. "The Role of the Eye Specialist in Cases of Reading Difficulties" The Sight-Saving Review 20:4 (Winter, 1950).

[4] Eberl, Anita, Op. cit.

instructions for case history and visual skills tests recommended.

Bing[1] emphasizes the need for cooperation between all specialists interested in the problem.

Robinson's intensive study of 30 reading failures (see p. 21) indicates a number of factors found in addition to the visual.

Ilg and Davis[2] grouped reading problems into four types, each with its characteristic visual syndrome and indicated therapy. They stress the importance of relieving the child's feeling of being "dumb," reducing pressure to achieve, and motivating by use of a variety of techniques and reading material appropriate to the individual, while retraining motor skills, focussing ability, and ductions. They also raise the question of whether too much teaching is done by text-book methods.

Rychener and Robinson,[3] reporting on 225 children referred to an ophthalmologist because of reading difficulties, found that while 10% had normal reading habits but convergence insufficiency, another 10% showed no comprehension, and 35% needed remedial reading classes rather than visual care. Orthoptic training was given where needed. A letter with instructions for home understanding of and cooperation on the

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[1]Bing, Lois, Op. cit.

[2]Ilg, Vivian, and Davis, L.F., "Parallel Development in Reading and Visual Skills" Optometric Weekly 34:23 (July 15, 1943), 675-680.

[3]Rychener, R.O., and Robinson, A., "Reading Disabilities and the Ophthalmologist" Transactions American Academy of Ophthalmology 53 (November, December, 1948), 107-115 and discussions.

child's problem, stressed encouragement rather than embarrassement of the child, and listed references for further help.

Recommendations from the AOA.--Besides recommending complete visual case study for all children failing a school screening test, all not achieving up to capacity, all in the lower 25% to 30% of their classes, and all behavior problem cases (See Chapter II), members of the Committee on Visual Problems in Schools have stated: "the distinctive service optometry has to offer to school children is in the field of visual training" and "building of proper visual behavior patterns increases reading ability."[1]

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[1] Eberl, Marguerite, "Report of the Committee on Visual Problems in Schools" Journal of the American Optometric Association 20:2 (September, 1948), 124-126.

CHAPTER V

REDUCING THE VISUAL PROBLEMS OF ALL CHILDREN

While it is obvious that some children are more visually handicapped than others, and while relief from these visual handicaps should be sought whenever possible, any child may be visually handicapped by being required to read unsuitable print on unsatisfactory paper, under poor illumination, or even in an undesirable position. What factors in text or other material make for readability? What are the causes of fatigue? What illumination levels are desirable? How can they best be achieved? How do class-room decoration and furnishings affect the child's visual problems? These are the questions to which an answer is sought in this chapter.

1. Readability

In 1945, Dearborn and Leverett[1] pointed out that the requirements for satisfactory vision are definitely related to the work to be done. What, then, are or should be norms for readability?

Summaries.—Chall[2] and Gray[3] presented summaries of research in readability. Both indicated that while progress in the analysis of readability has been made, there is much work yet to be done. Gray emphasized the importance of using the knowledge at hand in creating readable materials, rather than waiting until all the facts are in. More recently, Lorge[4] studied significant factors in readability formulas in use, and concluded that they were helpful to objective evaluation of written material. In 1949, Burtt[5] reviewed methods

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[1]Dearborn, Walter F. and Leverett, Hollis M., "Visual Defects and Reading" Journal of Experimental Education 13:3 (March, 1945), 111-124.

[2]Chall, Jeanne S., "This Business of Readability" Educational Research Bulletin, Ohio State University, 26:1 (January 15, 1947), 1-13.

[3]Gray, Wm. S., "Progress in the Study of Readability" Elementary School Journal 47:9 (May, 1947), 491-99.

[4]Lorge, Irving, "Readability Formulae: An Evaluation" Elementary English 26:2 (February, 1949), 86-95.

[5]Burtt, Harold E., "Typography and Readability" Elementary English 31:4 (April, 1949), 212-21.

currently used in determining legibility (eye-movement photographs, speed of reading tests, flashing techniques, maximum readability distance etc. Blink rate as a criterion he questioned.) He considered the effect of type-size, form, and color, printing stock, and illumination, as reported by earlier investigators.

Criteria.--

Blink Rate. The use of the blink rate as a criterion of readability has been the subject of much dispute. Luckiesh, Guth, and Eastman[1] compared three different blink rate studies, which seemed to show that efficiency in reading is significantly reduced during an hour's time--or even a half hour. Tinker[2], however, in 1945 found blink rates "highly reliable for successive adjacent period of reading", but not when another period intervened. In 1946[3], on the basis of a comparison of reading in lower case vs all capitals, he concluded that blink rate is an unsatisfactory criterion of readability, but reading rate a fairly

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[1]Luckiesh, Matthew; Guth, S.K.; and Eastman, A. A., "Blink-Rate and Ease of Seeing" Illuminating Engineering 42:8 (September, 1947), 584-88.

[2]Tinker, Miles A., "Reliability of Blinking Frequency Employed as a Measure of Readability" Journal of Experimental Psychology 35:4 (October, 1945), 418-24.

[3]Tinker, Miles A., "Validity of Frequency of Blinking as a Criterion of Readability" Journal of Experimental Psychology 36:2 (October, 1946), 453-60.

adequate index. In 1948[1] he found blink rate to indicate that 7 pt newsprint is more readable than 12 pt book-print--contrary to all other evidence available. This supports his earlier contention that blink rate is not a valid criterion. Again in 1950, he reviewed[2] the methods and results of several experiments, both by himself and by other investigators, which seemed to indicate that while blink rate is a fairly reliable measure, it is not valid as a criterion of readability. Bitterman and Soloway[3], comparing changes in blink rate and heart rate when reading with or without distraction by phonograph records, found that while heart rate increased, blink rate remained unchanged--thus supporting the contention that blink rate is not an indication of readability.

Speed of Reading. Using speed of reading (with tests of comprehension at regular intervals) as a criterion, Tinker and Paterson found in 1946[4] that an 18 pica line with 1- to 2- pt leading was most readable;[5] that 7- pt newsprint, 12 pica line, 1- pt leading, was more

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[1]Tinker, Miles A., "Readability of Book Print and Newsprint in Terms of Blink Rate" Journal of Educational Psychology 39:1 (January, 1948), 35-39.

[2]Tinker, Miles A., "Reliability and Validity of Involuntary Blinking as a Measure of Ease of Seeing" Journal of Educational Psychology 41:7 (November, 1950), 417-27.

[3]Bitterman M. E., and Soloway, E., "The Relation Between Frequency of Blinking and Effort Expended in Mental Work" Journal of Experimental Psychology 36:4 (April, 1946), 134-36.

[4]Tinker, Miles A. and Paterson, Donald G., "Effect of Line Width and Leading on Readability of Newspaper Type" Journalism Quarterly 23:3 (September, 1946), 307-09.

[5]Tinker, Miles A. and Paterson, Donald G., "Readability of Mixed Type Forms" Journal of Applied Psychology 25:12 (December, 1946), 631-37.

readable than a medley of type.

Print.--Paterson and Tinker[1] found lower case more legible than all capitals, when suitable type size was used, whether at 15 inches or at 17 feet. Another study[2] showed book print to be more legible because larger and presenting greater brightness contrast than newsprint. In 1947 they compared[3] newsprint in 7- pt. type in a 12½ pica line with leading varying from none to 9- pt. Both speed of reading and readers' judgments indicated that 1- pt. leading was most readable. They also reported results of eight studies to determine the effect on preceptual span of varying type forms, face, size, arrangement, or color. Glanville, Kreezer, and Dallenbach[4] compared the accuracy and speed with which pupils located words in a dictionary when vocabulary was printed in 6- pt. vs 12- pt. bold face, the text being in each case 6- pt. roman. The larger type gave greater speed.

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[1]Paterson, Donald G., and Tinker Miles A., "Readability of Newspaper Headlines Printed in Capitals and in Lower Case" Journal of Applied Psychology 30:2 (April, 1946), 161-68.

[2]Paterson, Donald G., and Tinker Miles A., "The Relative Readability of Newsprint and Book Print" Journal of Applied Psychology 30:5 (October, 1946), 454-59.

[3]Paterson, Donald G., and Tinker Miles A., "Influence of Leading upon Readability of Newspaper Type" Journal of Applied Psychology 31:2 (April, 1947), 160-63.

[4]Glanville, A. Douglas; Kreezer, George L.; and Dallenbach, Karl M., "The Effect of Type-Size on Accuracy of Apprehension and Speed of Localizing Words" American Journal of Psychology 49:2 (April, 1946), 220-35.

2. Fatigue

Like readability, fatigue has been measured in terms of retardation of reading. Hoffman[1] found that number of fixations and number of lines read decreased as early as the first half hour of reading. Carmichael and Dearborn[2], using both book and microfilm material, found no retardation in six hours of reading, although the subjects did suffer a loss of satisfaction. Anderson and Meredith[3], also using both book and microfilm, found no evidence of fatigue in either case, although the microfilm was read 12% more slowly than the book. The discrepancy of the Hoffman study was explained on the basis of inadequate motivation.

Berens and Sells[4,5] reported a study on 37 subjects referred because

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[1] Hoffman, Arthur C., "Eye Movements During Prolonged Reading" Journal of Experimental Psychology 36:2 (April, 1946), 95-118.

[2] Carmichael, Leonard, and Dearborn, Walter F. Reading and Visual Fatigue. Cambridge: Houghton Mifflin Co. (Riverside Press), 1947.

[3] Anderson, Irving H. and Meredith, Cameron W., "The Reading of Projected Books with Special Reference to Rate and Visual Fatigue" The Journal of Educational Research 41:6 (February, 1948), 453-460.

[4] Berens, Conrad, and Sells, Saul B., "Experimental Studies on Fatigue of Accommodation. I. Plan of Research and Observations on Recession of Near Point of Accommodation Following a Period of Interpolated Work on the Ophthalmic Ergograph" Archives of Ophthalmology 31:2 (February, 1944), 148-159.

[5] Berens, Conrad, and Sells, Saul B., "Experimental Studies on Fatigue of Accommodation, II" American Journal of Ophthalmology 33:1 (January, 1945), 47-58.

of asthenopia and eye fatigue, but without pathology. They compared near point accommodation--initial, final, and decrement, after 30 minutes of ergographic exercise or less if subject gave up sooner. They found the decrement to correlate insignificantly with accommodation, power, age, refractive error, muscle balance, or muscle-balance decrement. Topics suggested for further study include motivation, anemia, hypothyroidism, chronic sinusitis, chronic colitis, etc., as well as personality structure and neurotic mechanisms.

Simmerman[1] discusses fatigue from an optometrist's standpoint. Referring to definitions by other writers, he states that it is not impairment nor measurable by impairment; it is directly experienced, personal, cumulative, subject to sudden onset and recovery, not specific to a given body member, not crucially dependent on energy, and not to be defined or analyzed in terms of supposed origin or on the basis of function involved. Discussion of the physiology of fatigue follows, also the statement: "The eyes have been regarded as the most important organs for the inception of fatigue."

He goes on to state that visual fatigue is muscular, not retinal, and that faulty illumination is the commonest cause. Another cause he finds in excessive change in accommodation (far-near-far) and in pupil adjustment (light-dark-light).

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[1]Simmerman, Harold, "Visual Fatigue" American Journal of Optometry and Archives of the American Academy of Optometry 27:11 (November, 1950), 554-61.

3. Illumination

Desirable levels of illumination, like criteria of readability, have been the subject of active disagreement.

Kumitz and Sleight[1] made a comparative study of 12 subjects with normal and 12 with subnormal vision, to determine the amount of light required to give normal visual acuity with a standard checkerboard target. They found that the subjects with normal vision required from 10 to 30 foot-lamberts, those with subnormal vision, from 30 to 40 foot-lamberts (These figures are well above the minimum required for identifying the target.)

Luckiesh[2] summarized the results of several studies conducted in the Lighting Research Laboratory of the General Electric Co., with these conclusions, among others:

"1. Seeing becomes easier as the level of illumination is increased above 100 foot candles, on the white page of reading matter.

"2. Increase in the visibility of tasks results in increase in ease of seeing up to certain levels of brightness, at which optimum seeing results.

"3. Seeing becomes measurably easier if the brightness of the immediate surroundings of the task is of the same order of brightness as the task.

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[1]Kumitz, J. E., and Sleight, R. B., "Effect of Target Brightness on Normal and Subnormal Visual Acuity" Journal of Applied Psychology 33:1 (February, 1949), 83-91.

[2]Luckiesh, Matthew, "How Much Light is Adequate?" Journal of the American Optometric Association 19:3 (October, 1947), 90-94.

"4. Seeing becomes easier as glare is reduced."

Simonson and Brozek[1] reported an experiment using six illumination levels (2, 5, 15, 50, 100, and 300 foot candles). They found that performance was more affected by illumination level than was fatigue, and that optimum illumination varied with the job. While the latter statement is consistent with Luckiesh's report, the former contrasts with Luckiesh's statement: "Production is an inadequate measure of the benefits of higher levels of illumination to the worker. Seeing becomes easier and easier as the level of illumination is increased, long after other factors have caused production to reach an optimum."

In a later report, Luckiesh[2] pointed out that foot-candle levels should vary with contrasts in material being seen, and with the vision of the worker -- poor vision requires more light. Compromise between threshold, optimum, and ideal levels, and economic and practical considerations, must be made. Often direct light should supplement general illumination.

In 1950[3] he described a method for comparing visibility, and presented a table of foot-candles of illumination required for

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[1]Simonson, Ernest and Brozek, Josef, "Effects of Illumination Level on Visual Performance and Fatigue" Journal of the Optical Society of America 38:4 (April, 1948), 384-9.

[2]Luckiesh, Matthew "Recommended Foot Candle Levels for Prolonged Critical Seeing" Journal of the Optical Society of America, 38:8 (August, 1948), 712-718.

[3]Luckiesh, Matthew, "The Measurement of Visibility" Southern Optometrist 3:12 (October, 1950), 13-15.

several tasks to make them equal in visibility to 8- pt. type under 10 foot-candles. While 24-pt. type required only 1/10 as much light, average pencil writing required twice as much; newsprints, three times as much; 3-pt. type, nine times; white thread on white, over 17 times; and black thread on black, 40 times--for equal visibility. He makes the interesting suggestion that vision could be appraised in terms of visibility--or the amount of light required to recognize a given target, rather than the size target units recognized under standard conditions. This point he bears out in another paper[1] in which he states that 20/20 vision requires 30 foot-candles; 20/40, 90 foot-candles, and 20/80, 200 foot-candles to make good print equally visible.

In another 1950 report[2], after stating that increase of illumination from 3 to 12 ft-c increased production 34%; from 6 to 12 ft-c, 18%; from 12 to 48 ft-c, 11%; and from 24 to 48 ft-c, 6%, he concluded that 50 ft-c should give adequate visibility for most tasks. Citing a case where vibration of work material increased visual fatigue without reducing production, and the element of time required to learn to work faster even with increased illumination, he warned against accepting production as an accurate criterion of ease

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[1]Luckiesh, Matthew, "Visual Acuity and Visual Tasks" The Southern Optometrist 3:8 (April, 1950), 17-19.

[2]Luckiesh, Matthew, "Production is an Inadequate Criterion of Seeing" Southern Optometrist 3:10 (June, 1950), 15-17.

of seeing. Efficiency--not amount of work per hour or per dollar, but ratio of useful output to total--he considers a better criterion.

Tinker in 1945[1], from a review of related studies and new data from 60 subjects, concluded that there was a "marked tendency to prefer intensities of illumination at and above the brightness to which the subject was adapted"; and that therefore, preferred intensities were unsatisfactory bases for prescribing of lighting.

In 1946[2], he implied that recommended intensities were too high, but recommendations for distribution of light, brightness contrast, and color of light, were satisfactory. In 1947[3] essentially the same findings were reported. His recommendations: for normal eyes, 10-15 ft-c for reading good print, 15-20 ft-c, for newspaper print 20-30 ft-c for handwriting, 30-40 ft-c for 6-pt. type, and a maximum of 40-50 ft-c for the most severe visual tasks are in contrast to those of Luckiesch. At the lower levels he recommended an additional 5-10 ft-c for subnormal eyes, but found this unnecessary at the higher levels.

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[1]Tinker, Miles A., "Effect of Visual Adaptation Upon Intensity of Illumination Preferred for Reading With Direct Lighting" Journal of Applied Psychology 29:6 (December, 1945), 471-76.

[2]Tinker, Miles A., "Illumination Standards" American Journal of Public Health 36:9 (September, 1946), 963-73.

[3]Tinker, Miles A., "Illumination Standards for Effective and Easy Seeing" Psychological Bulletin 44:5 (September, 1947), 435-50.

In 1948, he again[1] reviewed recent recommended illumination standards for the Illuminating Engineers, and expressed a feeling that in general they reflect what the traffic will bear, rather than what is best for the individual.

In 1948, also, Birren,[2] out of a background of fifteen years of "substantial experience in hundreds of factories, offices, schools and hospitals, reviewed the theories of brightness, lighting intensities, ideal light levels and brightness ratios, with further references to the "pathology of eyestrain", the psychology of seeing, the phenomena of color constancy, and the promotion of safety through increase in foot-candle levels and a safety color code.

He concludes that many of the arguments for either higher or lower illumination levels are invalidated by faulty reflectance levels and brightness ratios of room surfaces, furniture, or equipment. In average interiors, he considers 20 foot-candles a satisfactory level, with 25-35 foot-candles for critical seeing.

As reflectance levels go up with use of lighter finishes on floors, walls, and other surfaces, the brightness ratio being kept low, he feels that general illumination may be increased to a maximum

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[1]Tinker, Miles A., "Trends in Illumination Standards" Illuminating Engineering 43:8 (September, 1948), 866-81.

[2]Birren, Faber, "The Ophthalmic Aspects of Illumination, Brightness, and Color" Transactions American Academy of Ophthalmology and Oto-Laryngology 52 (May-June, 1948), 566-583.

of about 50 foot-candles. Beyond that point, supplementary light should be used when needed for critical seeing, the task being made moderately brighter than the surroundings.

4. "The Coordinated Classroom"

A recent development in practical application of lighting standards deals with class-room lighting, decoration, and arrangement.

Harmon[1] in 1949 reported an intensive study of the effect of classroom environment. Incidence of visual, nutritional, postural, and dental difficulties, chronic fatigue, and possible chronic infection, were studied before, six months after, and eighteen months after, redecoration, installation of daylight controls, and seating rearrangement. Visual difficulties dropped from 53.3% to 18.6%; nutritional problems from 71.3% to 37.2% in six months. Gains in educational age were about ten months as compared with six months in a control school. Relatively low reduction in nutritional problems in Grades 1A and 2B was attributed to undesirable seating arrangements—rather surprising, considering their high reduction in visual problems. It would be interesting to know what visual problems were involved, and what conditions were found in the following November and May.

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[1] Harmon, Darrell B. The Coordinated Classroom Grand Rapids 2, Mich.: American Seating Co., A.I.A. File No. 35-B, (on request) (1949), pp 48.

A similar experiment in Wisconsin was reported by Moore[1] in 1950. One of two similar classrooms was improved according to Harmon's plans, the second serving as a control. All children in both rooms were tested before the experiment and again 4½ months later "with skills cards, stereoscopes, ophthalmoscopes, retinoscopes, and distance acuity and fixation charts." Case history sheets were also filled out by parents and teachers. "Surveys showed an improvement in the visual condition of 10% of the children in the improved room, and 40% digression of those children of the control room." Improved work and study habits were also attributed to the change.

Carrying the same idea over into the home, Mowbray[2] gives suggestions for adequate lighting of the child's home environment. Task area lighting by lamps out of the field of vision, adequate general illumination, diffusing devices to reduce glare, flat-white ceilings and pastel non-gloss wall finishes to reflect without glare, drapes mounted three to six inches out from the wall and held back by tie-backs to permit fullest utilization of daylight, light rather than dark window coverings, restriction of dark, shiny, or brilliant decorative items to less critical seeing areas, are among his recommendations.

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[1]Moore, W. Linhard, "A Coordinated Classroom Experiment" Journal of the American Optometric Association 21:6 (January, 1950), 316-318.

[2]Mowbray, John F. and Mowbray, D. L., "Children's Vision in Home Environment" Optometric Weekly 42:4 (January 25, 1951), 123-139.

5. Miscellaneous

A study in the relation of diet to vision and reading is that of Harrell[1] on the addition of thiamin in the diet of a group of orphanage children. Indications were that those who received the thiamin during the first year showed an improvement in IQ, educational achievement, height, weight, and reaction time, which they maintained by comparison with the group receiving it the second year instead. Visual acuity and retention gains by the group receiving thiamin the second year only, appeared to give them a lead over the group receiving thiamin the first year only.

The general conclusion drawn was that "cumulative effects of a superior dietary throughout a lifetime may, nevertheless, spell the difference between alert, successful living and a marginal existence."

Another unique contribution was Tinker's study[2] on the effect of vibration simulating that of a moving train. He drew two conclusions: that vibration reduced speed of perception about 5%; and that the speed-of-reading technique used "may be employed to advantage to measure readability of print."

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[1]Harrell, Ruth F., Further Effects of Added Thiamin on Learning and Other Processes. Contributions to Education No. 928, New York: Teachers College, Columbia University. 1947.

[2]Tinker, Miles A., "Effect of Vibration Upon Reading" American Journal of Psychology 41:3 (July, 1948), 386-90.

6. Summary

The question: "What visual factors may prove handicapping in the school situation?" has been given many conflicting answers, depending upon the population studied, the testing methods (visual and educational) used, the standards set in each case, and the background and technique of the research worker. While hyperopia and muscle imbalances seem to be the offenders most readily screened out, their importance in any given case, and the presence and importance of less obvious faults of fusion, suppression, alternation, etc., appear to be problems for solution by the professional eye man in each case.

As Bing[1] has suggested, there is need for validation of opinions as to amounts of deviation (phorias, refractive errors, etc.) actually handicapping in the reading situation, and for more complete visual studies, with a search for possible handicapping syndromes as distinguished from individual deviations.

"How can pupils so handicapped be picked out for referral?" may be answered at several levels. With the Snellen chart, the Eames Eye Test, and the Massachusetts Vision Test available for use by school personnel, a good start can be made, and a large percentage of visually handicapped pupils referred for care.

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[1] Bing, Lois B., "A Critical Analysis of the Literature on Certain Visual Functions Which Seem to be Related to Reading Achievement" Journal of the American Optometric Association 22:8 (March, 1951), 454-463.

The use of the binocular reading test and the ophthalmograph in remedial reading groups can help to explain some of the problems, and give a clue to more satisfactory handling.

The increasing number of extensive school vision surveys set up in cooperation with and supervised or carried out by professional eye men, with statistical studies of the findings, should not only bring to professional eye care those pupils in need of it in the areas screened, but also shed further light on the efficiency of the instruments and techniques available for this work. This, in turn, will lead to their improvement.

Careful follow-up to determine whether recommended eye care was received, and evaluation of its actual contribution to the progress of the pupils involved would seem to be necessary for complete validation of the program.

"How can each child be helped most?", visually speaking, is a matter for determination by the eye man chosen by the parents. It is being increasingly appreciated especially among optometrists, that visual training, with or without glasses, may play an important part in relieving visual problems. Visual care by the alert specialist may also bring to light interests and attitudes of the pupil which should be utilized by the school personnel working with him.

Again, careful evaluation of the visual factors causing difficulty, availability and judicious selection and use of remedial equipment, and treatment of the <u>whole child</u>, are essential. Perhaps the recognition by the school that he <u>has</u> a problem, rather than <u>is</u> one, will of itself do much to help him. Progress in treatment methods by the eye professions can be counted on.

"How can visual problems of all children be kept at a minimum?" Judicious selection of paper and print for class-room materials must be considered by both publishers and school personnel, and adapted to the age level of the pupils.

Better lighting of the school-room--including adequate, well-controlled use of day-light, as well as carefully planned artificial lighting--is essential. Classroom planning that keeps lighting contrasts at a reasonable level, provides work-surfaces and seats that make for comfortable, balanced posture, with adequate, comfortable lighting free from undesirable shadows, will do much to keep the visual problems of all at a minimum.

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