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ABSTRACT

A COMPARISON OF THE EFFECTIVENESS OF STANDARD PRINT AND LARGE PRINT IN FACILITATING THE READING SKILLS OF VISUALLY IMPAIRED STUDENTS

By

Kim Crispin Sykes

Educators of visually impaired children are increasingly concerned to help them make the maximum use of residual vision by: (1) direct training of visual skills, (2) use of low vision aids, and (3) use of large print materials.

This concern has been brought into focus by the realization that the majority of visually impaired children--including many in the legally blind category--are print, not braille readers, and that the increasing reading load in schools today, together with the trend towards educating visually impaired children in the public schools, puts an inordinate burden on the handicapped child unless he can utilize the same materials as his peers and be assisted to achieve comparable levels of attainment in the tool subjects.

Though objective evidence is lacking regarding the relative merits of standard print and large print in facilitating the reading skills of visually impaired children, a trend towards greater use of large print can be observed, especially in the last five years with the entry of a growing number of publishers into the large print market.

The purpose of this study is to determine whether visually impaired high school students perform differently on measures of comprehension, reading speed and visual fatigue on standard print and large print material, and what relationship preference for a particular size of print has on reading performance. Additionally, differences between partially sighted and legally blind students are explored.

It is hypothesized that visually impaired high school students will attain higher scores on a standard print test than on a large print test, and that partially sighted students will score higher than legally blind students. It is also hypothesized that there will be no significant difference between the performance of visually impaired students on their preferred size of print and their performance on a non-preferred size of print.

Twenty-four legally blind and 17 partially sighted students took part in the study. All the students had been judged capable of reading print and had received a thorough optometric evaluation which included correction for near vision.

In order to equalize practice effects and fatigue factors favoring either standard print or large print, the students were randomly divided into four groups and the standard print and equivalent large print forms of the Davis Reading Test were administered alternately within each group. All the students were tested individually by the writer. They were free to choose whatever low vision aids they required and were allowed as much time as they needed in order to complete the tests.

Two equivalent forms of the Davis Reading Test, consisting of reading passages followed by multiple-choice questions, were utilized. The test material was made available in standard (10-point) print and in large (18-point) print.

Testing took place under flexible conditions. Each student was free to choose his most comfortable reading distance, and level and angle of illumination. Optical and non-optical aids were freely available and unlimited time was given in which to complete the tests. The students read the timed test passages silently, and responded orally to multiple-choice questions which were scored by the examiner. Measures of comprehension, reading speed, reading distance and visual fatigue were obtained, and the students were asked to state their preferred size of print.

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Data were analyzed using a three-way analysis of variance and by a two-tailed t-test concerning means on related samples.

The prediction that visually impaired students would perform better in standard print than in large print on measures of comprehension, reading speed and visual fatigue was not accepted. However, performance was as effective on the standard print test as it was on the large print test on the measures of comprehension and reading speed. The comprehension of both the legally blind group and the partially sighted group when tested independently was as good on standard print as on large print, and both groups read standard print as quickly as they did large print. Furthermore, the legally blind students found standard print no more fatiguing to read than large print. The only advantage conferred by large print was found among the partially sighted students who experienced less visual fatigue when reading large print than when reading standard print.

Partially sighted students read faster than legally blind students but the two groups achieved comparable levels of comprehension.

Preference for either standard print or large print was found not to be related to performance on the preferred size of print.

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Large print was found to offer little advantage insofar as reading distance is concerned, and no advantage to those students using strong corrective lenses.

It was determined that visual acuity was not related to performance on the measure of comprehension, but both the standard print and large print tests were read faster by those students with higher visual acuities who also experienced less visual fatigue on large print.

Speculations regarding the relationship of I.Q. to performance were inconclusive.

It was therefore concluded that standard print is as effective as large print in facilitating the reading skills of comprehension and reading speed for both the legally blind group and the partially sighted group. Large print appears to offer an ease of seeing for those students whose visual acuities approach the normal range, but offers little advantage in an increased reading distance. No reliance is to be placed on a subjectively determined preference for a certain size of print. Higher visual acuity enables both standard print and large print to be read faster, but does not facilitate comprehension any more than does lower visual acuity.

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

College of Education

1971

ACKNOWLEDGMENTS

I should like to express my appreciation for the support and encouragement of those who assisted me in my studies. To Mrs. Lou Alonso I am especially indebted for her guidance and help in facilitating my work. Special appreciation is extended to Dr. George V. Gore, III, Chairman of my Guidance Committee, and to Dr. J. Edwin Keller, both of whom advised and directed me in this study. Grateful appreciation is also extended to Dr. Ruth H. Useem and Dr. John E. Jordan for their advice and counsel.

I also wish to record my appreciation for the generous assistance given by the staff and students of the Michigan School for the Blind. It was a great pleasure to work with the 41 courteous and helpful high school students who took part in this study. To Mrs. Margaret Polzien and Mr. Francis Hetherington appreciation is expressed for assistance in obtaining subjects for the study. Mrs. Lu Karner and Dr. Roger Seelye of the school's Pediatrics Low Vision Clinic gave unstinted and invaluable help.

Much appreciation is also extended to Miss Mary Kennedy and Mr. Robert Wilson for their help with the analysis of the data.

Without the unfailing support and love of my wife Helen this study would not have reached fruition.

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CHAPTER I

PROBLEM AND BACKGROUND

The Problem

Currently there is widespread interest among educators of visually impaired children focused on aiding them make the maximum use of any residual vision they may possess.[1] There is the realization that the majority of visually impaired children--including many in the legally blind category--are those whose principal sense modality is still a visual one. Maximum utilization of vision will help them overcome what is the major problem of blindness: ". . . how to increase the data available for processing."[2] This realization is giving added impetus to three interrelated educational approaches that attempt to broaden the visually impaired child's scope and intake of information through vision by: (1) direct training of visual skills,

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[1] John W. Jones, Blind Children--Degree of Vision, Mode of Reading, OE-35026, No. 24, USOE Bulletin, U. S. Government Printing Office, 1961, p. 13.

[2] Barbara D. Bateman, "Visually Handicapped Children," in Methods in Special Education, ed. by Norris G. Haring and Richard L. Schiefelbusch (New York: McGraw-Hill, 1967), p. 269.

(2) use of optical aids, and (3) use of large print materials. Teachers of visually impaired children are increasingly utilizing all three approaches in their attempts to help children achieve their optimum level of visual functioning.

Innovative methods that will broaden the scope and help speed up the intake of information gained through print are principally needed for three reasons: (1) since the beginning of this century the reading load of the grade school child has constantly increased,[1] (2) visually impaired children are increasingly receiving their education along with their sighted peers in the regular public schools[2]--a trend that puts an inordinate burden on the handicapped child unless he is able to utilize the same materials as his peers and be assisted to achieve comparable levels of attainment in the tool subjects, and (3) the vast majority of legally blind children in public school programs, and a large percentage of blind children in residential schools, read print and not braille.[3]

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[1]Gordon Bixel, "Vision: Key to Learning or Not Learning," Education, LXXXVII, No. 3 (Nov. 1966), 180-184.

[2]John W. Jones, The Visually Handicapped Child at Home and School, OE-35045-68, Superintendent of Documents Catalog No. FS5.235:35045-68, Washington, D.C., U. S. Government Printing Office, 1961, p. 13.

[3]Jones, Blind Children--Degree of Vision, Mode of Reading, p. 17.

For those students whose principal mode of reading is braille it is recognized that:

> The nearest solution for closing the gap in reading capacity between blind and sighted students has been the introduction of disc or tape recordings. Blind students can achieve about 70 percent of the reading rate of their peers through the use of recorded educational material. Now educational material can be presented in recorded form to blind students by use of two-speeded speech methods.[1]

Undoubtedly, many partially sighted and legally blind children who read print also make use of listening devices, but it is the braille students who would find the greatest need for recordings and speeded speech and these students form only 14 percent of legally blind children in public schools and 61 percent of legally blind students in residential schools.[2] We therefore are still faced with the problem of aiding not only those legally blind children whose main avenue of reading is through inkprint, but also aiding visually impaired children of whatever level of visual acuity make the maximum use of their residual vision by both visual training procedures and by the more effective utilization of standard print and of specialized materials and equipment such as large print and optical aids.

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[1]George V. Gore, "A Comparison of Two Methods of Speeded Speech Presented to Blind Senior High School Students" (unpublished Ph.D. dissertation, Teachers College, Columbia University, 1968), p. 2.

[2]Jones, Blind Children--Degree of Vision, Mode of Reading, p. 17.

Speculation regarding the place and value of standard print, large print, and optical aids in classes for legally blind and partially sighted children often finds proponents of one method at odds with those who advocate another. To the writer's knowledge no objective evidence has yet been brought to bear on the relative merits of standard print and of large print and their efficacy in enhancing the reading skills of visually impaired children.

Purpose

Specifically, this study seeks to answer the following questions:

1. Is there a difference in the scores attained by visually impaired high school students on the Davis Reading Test presented in large print and the scores they attain on an equivalent form of the test presented in standard print?

2. Is there a difference in the amount of visual fatigue experienced by visually impaired high school students presented with the Davis Reading Test in large print and the amount of visual fatigue they experience when an equivalent form of the test is presented in standard print?

3. Is there a difference in the scores attained and the visual fatigue manifested by visually impaired high school students presented with the Davis Reading Test

in their preferred size of print than in the scores they attain and the visual fatigue manifested on an equivalent form of the test presented in an alternative size of print?

Exploratory question

4. Is there a difference in the scores attained by legally blind high school students and the scores attained by partially sighted high school students on the Davis Reading Test presented in large print, and the scores they attain on an equivalent form of the test presented in standard print?

Definitions

Visually impaired students.--Those with all degrees of visual loss short of a complete loss of sight.[1] In this study those students whose visual acuity lies between 20/60 and 20/900. There are two categories of visually impaired individuals:

> Legally blind students--those whose central visual acuity does not exceed 20/200 in the better eye with correcting lenses or whose visual field is less than an angle of 20 degrees.[2]

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[1]American Foundation for the Blind, Facts About Blindness (New York: American Foundation for the Blind, 1967).

[2]The National Society for the Prevention of Blindness, Inc., Estimated Statistics on Blindness and Vision Problems (New York: National Society for the Prevention of Blindness, Inc., 1966), p. 10.

Partially sighted students--those with a corrected visual acuity in the better eye of 20/70 to 20/200.[1] (Two students in this study with acuities of 20/60 are included in the partially sighted category.)

High school students.--Indicates grades 8, 9, 10, 11 and 12.

Standard print (or standard type).--Indicates 10-point type (one point of type equals 1/72 of an inch).

Large print (or large type).--Generally understood to mean materials printed in 14-point type or larger. In this study the term refers to 18-point type which is the most commonly used large type size.[2]

Optical aids for near vision.--The concern in this study is with those aids that are used in reading. These have been classified as: (1) spectacles, (2) spectacle modifications, (3) nonspectacle magnifiers, and (4) projection magnifiers.[3] The following optical aids were used by students in this study:

Conventional spectacles--full-size or half-eye.

Hand-held magnifiers.

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[1] Ibid., p. 10.

[2] Library of Congress, Division for the Blind and Physically Handicapped, Reference Circular (Washington, D.C., Library of Congress, 1970), p. 1.

[3] Gerald Fonda, Management of the Patient with Subnormal Vision (2nd ed.; St. Louis: C. V. Mosby Company, 1970), p. 20.

Microscopic lens--a magnifying spectacle lens, or a lens system, of short focal length for near viewing, designed to provide a flat field of view comparatively free from aberrations.[1]

Bifocal lens--a spectacle lens of two portions whose focal powers differ from each other.[2] The difference in spherical power between the distance and the near corrections in a bifocal lens is referred to as the "add" (addition).[3]

Loupe--any magnifying aid, monocular or binocular, held in the hand or mounted in front of the eye for viewing very minute objects at very close range, but without image inversion as in a microscope.[4]

Subnormal vision.--Vision considered to be inferior to normal vision, as represented by accepted standard of acuity, field of vision, or motility, and uncorrectable by conventional lenses, or the branch of visual care identified with its correction or rehabilitation by special aids or techniques.[5]

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[1] Dictionary of Visual Science (Philadelphia: Chilton Company, 1960), p. 405.

[2] Ibid., p. 395.

[3] Ibid., p. 15.

[4] Ibid., p. 422.

[5] Ibid., p. 769.

Low vision aids (or subnormal vision aids).--Optical aids in excess of 3.00 Diopters,[1] and non-optical aids such as reading slits, reading stands, additional illumination, etc.

Non-optical magnification.--Achieved by reducing the distance between the observer and the object of regard. Magnification of 2X is provided when type that is 20 inches from the eye is moved to 10 inches from the eyes and magnification of 20X by moving type that is 20 inches from the eyes to 1 inch from the eyes.[2]

Diopter.--Unit of measurement of refraction. The number of diopters of power being equal to the reciprocal of the focal length in meters.[3] (i.e. a 1 D lens has a focal length of 1 m.) Each four diopters is equivalent to one power in magnification (i.e. 8 D equals 2X).[4]

Near vision.--Vision or visual acuity for objects at distances corresponding to the normal reading distance, varying from 13 to 16 inches.[5]

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[1]Fonda, Management of the Patient with Subnormal Vision, p. 144.

[2]Ibid., p. 60.

[3]Dictionary of Visual Science, p. 197.

[4]Dan M. Gorden and Charles G. Ritter, Optical Aids for Residual Vision (New York: American Foundation for the Blind, 1954), p. 2.

[5]Dictionary of Visual Science, p. 768.

Distance vision.--Vision or visual acuity for objects at distances representing reasonably approximate dioptric equivalents of infinity, the distance of 20 ft. or 6 m. being commonly accepted for clinical purposes.[1]

Visual acuity.--Acuteness or clearness of vision.[2] Usually measured with a Snellen chart in terms of the Snellen fraction (i.e. if a person's vision is 20/40 he is seated 20 feet from the chart, but only able to read letters that should be read by the normal eye at 40 feet).[3]

Foot-candle.--The light received at a point on a surface one foot from the flame of a standard candle and perpendicular to the flame.[4]

Reading skills.--Reading speed and level of comprehension.

Level of comprehension.--Scaled score on the first 40 questions of the Davis Reading Test.

Reading speed.--Time taken to complete the reading passages of the Davis Reading Test.

Visual fatigue.--A measure of involuntary blinking over a timed interval.

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[1] Ibid., p. 767.

[2] Ibid., p. 12.

[3] Edson J. Andrews, Synopsis of Ophthalmology (The Florida State University, Dept. of Habilitative Sciences, 1969), p. 18.

[4] National Education Association, Teaching About Light and Sight (Washington, D.C.: National Education Association, 1946).

Types of material in the Davis Reading Test.--The test consists of reading passages followed by multiple-choice questions. It is designed to measure five categories of reading skills: (1) finding the answers to questions answered explicitly or in paraphrase in a passage; (2) weaving together the ideas in a passage and grasping its central thought; (3) making inferences about the content of a passage and about the purpose or point of view of its author; (4) recognizing the tone and mood of a passage and the literary devices used by its author; and (5) following the structure of a passage.[1]

Background and Need

The trend towards integrating visually impaired children into the public day schools[2] illustrates that there has come about a changing philosophy regarding the education of these children. The concern is no longer with segregating the child with impaired vision and then providing him with esoteric texts and materials, but rather with placing him in school with his sighted peers and helping him, wherever possible, use exactly the same

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[1]Frederick B. Davis and Charlotte Croon Davis, *Davis Reading Test* (New York: The Psychological Corporation, Manual 1962, Series 1 and 2, 1962).

[2]Jones, *Blind Children--Degree of Vision, Mode of Reading*, p. 27.

materials and books they use. Today the concern is with "sight utilization" not "sight saving" for it is recognized that eye work is to be encouraged if optimum visual efficiency is to be achieved.[1] Because of these two emphases it is vital that every possible assistance be given to the visually impaired child to ensure his happy and successful placement alongside his sighted peers. Bommarito seeks to apply a standard of psychovisual efficiency so that a visually impaired child, irrespective of his degree of visual acuity, will be placed in school according to his ability to read standard print or large print. The advantages of such an approach would be that the child could be educated in the local school and, most importantly, would be using a visual approach to learning which is much more effective than the cumbersome and laborious braille system or other tactual methods of instruction.[2]

Although there is a changing philosophy with regard to the education of visually impaired children and the optimum use of vision, little is known of the relative

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[1]Natalie Barraga, Increased Visual Behavior in Low Vision Children, Research Series 13 (New York: American Foundation for the Blind, 1964), p. 1.

[2]James W. Bommarito, "Implications of Severe Visual Handicaps for School Personnel," The Record--Teachers College, LXX, No. 6 (March 1969), 523-534.

merits of segregated or integrated education[1,2] or of the effects of teaching procedures that utilize specialized apparatus and materials such as large print and optical aids.

Nolan's 1963 review of the achievement of blind students, states that there are no studies comparing the effectiveness of educational procedures for blind children in any subject areas.[3] This paucity of research is paralleled in the partially sighted area for here, too, research on the educational achievement and academic success of the partially sighted is practically non-existent.[4]

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[1] Thomas M. Stephens and Jack W. Birch, "Merits of Special Class, Resource, and Itinerant Plans for Teaching Partially Seeing Children," Exceptional Children, XXXV (Feb. 1969), 481-5.

[2] (A noteworthy recent exception is a descriptive study by McGuinness of totally blind children educated in itinerant teacher, resource room, and special school settings. This study gives evidence in favor of integrated education for blind children, and finds that such settings facilitate the social integration of blind children with their sighted peers and promotes social maturity and independence. Furthermore, integrated settings are as efficacious as other settings in fostering braille skills.) Very Rev. Richard Michael McGuinness, "A Descriptive Study of Blind Children Educated in Itinerant Teacher, Resource Room, and Special School Settings," Columbia University, Ph.D., 1969--University Microfilms, Ann Arbor, 1970.

[3] Carson Y. Nolan, "The Visually Impaired," in Behavioral Research on Exceptional Children, ed. by S. A. Kirk and Bluma Weiner (Washington: Council for Exceptional Children, 1963), pp. 115-155.

[4] Barbara D. Bateman, "Visually Handicapped Children," in Methods in Special Education, ed. by N. G. Haring and R. L. Schiefelbusch (New York: McGraw-Hill, 1967), p. 284.

Bateman points out that "educators must be helped to obtain all possible information about how well and under what conditions each child uses whatever vision he has."[1] Massie notes that studies are urgently needed in areas concerning low vision aids and communication media because many partially seeing children are now attending regular classes thanks to the availability and use of low vision aids.[2] Jones, too, advocates research into the efficiency and effects of the use of reading aids and large print since "teachers have observed for some time that a considerable number of children with borderline vision read ordinary or even very small print faster and more effectively than they do large print."[3] This echoes the same point made by Hathaway[4] twenty-seven years ago, and by Sloan[5] in 1963.

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[1] *Ibid.*, p. 286.

[2] Dennis Massie, "Guidelines for Research in the Education of Partially Seeing Children," *The New Outlook for the Blind*, LIX, No. 2 (Feb. 1965), 57-58.

[3] Jones, *Blind Children--Degree of Vision, Mode of Reading*, p. 25.

[4] Winifred Hathaway, *Education and Health of the Partially Seeing Child* (4th ed.; New York: Columbia University, 1959), p. 116.

[5] A. E. Sloan, "Ophthalmologist's Need for Guidance from Educators of the Partially Seeing," *Sight Saving Review*, XXXIII, No. 3 (Fall 1963), 142.

Leaving aside the consideration of reading by listening, there is no doubt that widespread confusion exists in both public schools and residential schools regarding the most appropriate mode of reading for visually impaired students: braille, large print, standard print, a combination of large print and standard print, and, all too often, a combination of print and braille! Jones' 1961 landmark survey showed that 82 percent of legally blind children in public school programs read print, 14 percent read braille, and 4 percent read both print and braille; whereas 61 percent of legally blind children in residential schools read braille, 29 percent read print, and 10 percent read both braille and print.[1] It can be seen from these figures that visual acuity bears little relationship to the mode of reading since large numbers of children with 20/200 vision or less read print; and different emphases are placed on print, braille, or a combination of print and braille, depending on the type of educational placement. However, one might expect a larger number of print readers among the public school students because 43 percent were at the upper visual acuity level (20/200), while in the residential schools only 17 percent had that much vision.[2]

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[1]Jones, Blind Children--Degree of Vision, Mode of Reading, p. 17.

[2]Bateman, Methods in Special Education, p. 263.

Residential schools might also be expected to have more multi-handicapped children than the public schools. Nolan replicated the Jones study and noted that the number of legally blind print readers increased by five percent between 1960 and 1963; he also found an increase of 12 percent among residential school students whose vision was "object perception" or better who were registered as print readers.[1] Reappraising these two studies in 1966, Nolan found a significant shift from braille to large print and a consistent trend towards greater use of residual vision. He also noted a substantial proportion of students whose vision ranged from 20/200 to 3/200 who were able to utilize regular inkprint books, which he thought may reflect a trend towards use of optical aids to read smaller print.[2] Other studies bear out the fact that many legally blind individuals habitually read inkprint of varying sizes or use combinations of both braille and inkprint.[3,4]

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[1]Carson Y. Nolan, "Blind Children; Degree of Vision, Mode of Reading; a 1963 Replication," Inspection and Introspection of Special Education (Washington, D.C.: Council for Exceptional Children, 1964), pp. 86-94.

[2]Carson Y. Nolan, "A 1966 Reappraisal of the Relationship between Visual Acuity and Mode of Reading for Blind Children," New Outlook for the Blind, LXI, No. 8 (Oct. 1967), 255-261.

[3]Katie N. Sibert, "The 'Legally Blind' Child with Useful Residual Vision," International Journal for the Education of the Blind, XVI, No. 2 (Dec. 1966), 33-44.

[4]Erick Josephson, "A Study of Blind Readers," American Library Association Bulletin, LVIII, No. 6 (June 1964), 543-547.

While many schools for blind children make an individual appraisal of each child before selecting the most suitable mode of reading,[1] some legally blind children spend long years learning braille for which they find little use in later life. All too often schools feel that it is advisable to establish braille reading skills first if there is any doubt as to which method of reading is best for a child with low vision.[2] Faye, Koehler, and Sanborn found that 24 percent of students at the New York State School for the Blind should never have been taught braille. It was determined that 48 students could read print either by using optical aids or by holding the print close to their eyes.[3] Other schools seek a compromise and allow some children to learn braille by both touch and sight![4] It would be intriguing to discover why this paradox exists and whether it is ever justified on grounds other than a prognosis of deteriorating vision that will lead to total blindness.

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[1]Rachel F. Rawls, "Use of Braille and Print Reading Material in Schools for the Blind," International Journal for the Education of the Blind, XI, No. 1 (1961), 10-14.

[2]Ibid., p. 14.

[3]Fonda, Management of the Patient with Subnormal Vision, p. 18.

[4]Maire McAteer, "A Comparative Study of the Visual and Tactual Learning of Braille," The Teacher of the Blind, LIII, No. 1 (Oct. 1964), 22-26.

One could make out a case for teaching both print and braille skills to older students with extremely low visual acuities whose school work or careers demand the ability to read from notes for public speaking or who require lecture notes in braille. Such students would likely be seeking careers at the professional level and might quite quickly acquire the necessary braille skills that would be so arduously attained by younger and less intelligent visually impaired children. Certainly the teaching of print and braille concurrently in the primary grades will most likely result in "confusion and academic retardation."[1]

Barraga has taken advantage of the fact that some low vision students read both by braille and print. She divided twelve legally blind girls into four groups of three, and gave specific reading instruction to one group in print (type-size unspecified) and to another group in braille. After only six 45 minute periods of instruction over three weeks, the print group showed a mean gain in reading speed while the braille group showed a mean gain in vocabulary. There were no changes in the scores of the two control groups, except for one girl in the print control group who increased her score. The study can perhaps

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[1]Fonda, Management of the Patient with Subnormal Vision, p. 19.

be faulted because of the small number of subjects and also because the same form of the reading test was used for both initial and final testing. However, it does point to the necessity for specific instruction, regardless of the reading medium, and also demonstrates that "many students in the upper grades would welcome assistance in developing higher reading skills."[1] Barraga recommends a broader study to determine whether a single reading medium is more desirable than using both braille and print. Another recommendation might also have been a follow-up study to determine whether the experimental groups, in the absence of further instruction, maintained their gains over a longer period of time.

A most disturbing report published in 1968 revealed that 130 multiply impaired blind children reported as having reading vision used braille as their principal mode of reading![2] When one considers the myriad problems faced by these children it would seem the last straw to impose the additional burden upon them of acquiring braille skills needlessly.

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[1]Natalie Barraga, "Mode of Reading for Low Vision Students," International Journal for the Education of the Blind, XII, No. 4 (1963), 103-107.

[2]Milton D. Graham, Multiply-Impaired Blind Children: A National Problem (New York: American Foundation for the Blind, 1968), p. 17.

Educators of visually impaired children know only too well the frustrations brought about by forcing a child to learn braille by touch when he is eager to make use of his residual vision for that purpose. Though the child may be prevented from using his vision when under direct supervision he will surely use it at all other times when he is unobserved. If a visually impaired child is considered to have reading vision or can read braille by sight, he must be given every opportunity to acquire ink-print reading skills before the implementation of braille procedures is considered. Fonda is quite emphatic on this point:

> No patient should be advised to read braille if he can read type. It is educationally, vocationally, socially, and psychologically better to read type, even if it means reading at a slower speed. Braille is equated with total blindness, and nobody wants to be labeled blind.[1]

Use of large print is assumed to affect speed of reading. Nolan found that large print readers among his legally blind sample averaged 93 w.p.m. only, which is approximately the same speed achieved by readers of braille.[2] On the other hand, Bateman found with her sample of partially sighted children that their reading

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[1]Fonda, Management of the Patient with Subnormal Vision, p. 17.

[2]C. Y. Nolan, "Reading and Listening in Learning by the Blind," Progress Report, PHS grant No. NE-04870-04 (Louisville, Kentucky: American Printing House for the Blind, 1966).

achievement did not differ from that of normally seeing children.[1] The variable at work in these contrasting studies would appear to be degree of vision rather than large print per se and would lead us to conclude that the lower the visual acuity, the more difficult it is to read large print fluently.

Not only is there a trend towards the greater use of large print in schools and classes for the visually impaired, but there is also increasing emphasis being given to fitting children with optical aids. A survey of 42 low vision clinics in 1963 indicated that more than half of the children examined received optical aids, and that preschool children were seen in a majority of the clinics.[2] Unfortunately, the general feeling that optical aids are "a gadget to the average pupil; a hindrance to scholars,"[3] prejudices many against them and gives rise to the opinion that optical aids are of limited usefulness. Others have argued that with the amount of reading that has to be done in schools today, constant use of optical

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[1]Barbara D. Bateman, Reading and Psycholinguistic Processes of Partially Seeing Children, Council for Exceptional Children, NEA, Research Monograph Series A, No. 5, 1963, p. 19.

[2]Clara H. Robertson, "Services Reported by Optical Aids Clinics," International Journal for the Education of the Blind, XIII (Dec. 1963), 59-61.

[3]Rawls, "Braille and Print Reading Material," p. 13.

aids would prove burdensome. What is often forgotten by those who use such an argument is that reading-type activities form only a small percentage of the total school day. Researchers have indicated that 57.5 percent of class time in the elementary school and 90 percent of class time in the high school is spent in listening.[1] It therefore appears unlikely that long periods of time will be spent using optical aids for close work, especially when reading activities are spread throughout the school day. Furthermore, optical aids may make the difference between classifying the child as blind or partially sighted for educational purposes.[2]

Whatever the arguments, there is little doubt that the pioneering work now being done in the utilization of low vision, together with the services offered by the low vision clinic, and the increasing use of large print, are having tremendous influence on educational practices with visually impaired children.

It must be borne in mind, however, that while our concern here is with optical aids and the optimum size of print, the "use of one modality should not be stressed to

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[1]Stanford E. Taylor, Listening, What Research Says to the Teacher, No. 29, Association of Classroom Teachers of the National Education Association (April 1969), p. 3.

[2]Bommarito, "Implications of Severe Visual Handicaps for School Personnel," p. 529.

the point of neglect of the others . . . efforts should be made to develop maximally all of the capacities and potentialities of the individual child."[1]

Review of Literature

Large print and optical aids are two basic methods that are used to present inkprint materials to visually impaired readers. Both involve the enlargement of type: one by printing letters in sizes greater than normal, the other through optical magnification. There is also the non-optical method of magnifying print by simply bringing the printed page closer to the eyes. Closed circuit television, though not yet clinically evaluated, appears to be indicated for those multi-handicapped persons who cannot hold a paper steady and need magnification of more than 4X; or those persons with acuities of 20/2000 who cannot read 18-point print at a distance of 1 inch from the eye.[2]

Large print

Large print refers to materials printed in 14-point type or larger, and can be produced by: (1) photo enlarging of ordinary type; (2) re-setting of ordinary type into

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[1]Cleves Kederis and Samuel C. Ashcroft, "The Austin Conference on Utilization of Low Vision," Education of the Visually Handicapped, XI, No. 2 (May 1970), 35.

[2]Fonda, Management of the Patient with Subnormal Vision, p. 155.

the type size desired; or (3) using a large type typewriter.[1] Most large print books are produced by the first technique.

The original purpose of large print was to enable people to read print at the regular reading distance because it was believed that holding the text close to the eye was injurious.[2] Large print was recommended for partially sighted persons so that 18- to 24-point type could be read 14 to 30 inches from the eye.[3] This notion is no longer held; rather, full use of residual vision at whatever distance is encouraged and is considered necessary if maximum visual efficiency is to be attained.

The Library of Congress, Division for the Blind and Physically Handicapped, lists 44 publishers of large print materials, most of whom have entered the market in the last five years.[4] It was not until 1965, in fact, that a commercial publisher entered the large print business.[5] It is likely that an increasing number of publishers will enter the large print market, especially

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[1] Reference Circular, p. 1.

[2] Fonda, Management of the Patient with Subnormal Vision, p. 8.

[3] Ibid., p. 14.

[4] Reference Circular, p. 1.

[5] Alfred D. Hagle, "The Large Print in Revolution," Library Journal, September 15, 1967 (reprint).

as the costs of reprinting titles in large print are coming down due to the new photo-offset techniques.[1]

Despite the growing number of titles in large print, little research has been conducted to determine the attitudes of visually impaired persons of any age to large print materials.[2] A questionnaire mailed to registrants with the New York Public Libraries, however, revealed a strong interest in large print book services. Since the introduction of large print titles, circulation has grown steadily, many readers apparently turning to large print to lessen visual fatigue and obtain ease of reading, rather than because of limited vision.[3]

There is said to be an increasing need for large print materials in schools. The National Society for the Prevention of Blindness cites a critical shortage of large print materials in both elementary and secondary schools--a shortage brought into focus because of the trend towards educating visually impaired children in public schools.[4]

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[1]John N. Gartner, "Large Type Reading Materials for the Visually Handicapped," _The New Outlook for the Blind_,(October 1968)(reprint), pp. 233-239.

[2]_Ibid_., p. 235.

[3]Richard J. Muller, "Large Print Reading Books; a Special Study," _American Library Association Bulletin_, LXII, No. 6 (June 1968), 735-8.

[4]National Society for the Prevention of Blindness, Inc., _Guidelines for the Production of Material in Large Type_ (New York: National Society for the Prevention of Blindness, Inc., 1965), p. 3.

Volunteer groups are now active in the production of large print materials in an attempt to satisfy the growing need.[1]

The remarkable expansion of large print materials brought about by publishers entering the large print market and by the number of volunteer groups producing materials is taking place without firm evidence that large print is any better than standard print as a method of bringing printed materials to the vast majority of visually impaired individuals. One possible reason for the present strong advocacy of large print is that, as yet, low vision aids are not readily available and that until they are large print has its place "especially for certain students and many older people."[2] The proponents of optical aids, however, make the point that even if optical aids were available, the proliferation of books in large print may actually discourage their use.[3]

Fonda notes that "the demand for books in large type is great because of custom and tradition . . . the belief is that if type is larger it must be easier to read

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[1] Ibid., p. 3.

[2] National Accreditation Council for Agencies Serving the Blind and Visually Handicapped, Standards for Production of Reading Materials for the Blind and Visually Handicapped (New York: National Accreditation Council for Agencies Serving the Blind and Visually Handicapped, 1970), p. 14.

[3] Ibid., p. 13.

and, therefore, better for the eyes."[1] Instead of taking the easy way out by recommending large type books, what is needed is "a long-range, conscientious approach by more counselors, educators, and ophthalmologists to reduce the unnecessary use of large-type books."[2]

Some evidence is available pointing out that a number of visually impaired persons, given the opportunity, could read as well with standard print as they do with large print. Livingstone[3] confirmed Pinter's[4] finding that increasing the size of Binet test materials had no effect on the performance of partially seeing children. Mueller found that enlarging the Peabody Picture Vocabulary Test pictures did not significantly increase the scores of partially sighted children, though children with vision of 10/200 to 20/200 did perform better when the size of the test plates was increased. He concluded that "large

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[1]Fonda, Management of the Patient with Subnormal Vision, p. 14.

[2]Ibid., p. 13.

[3]J. S. Livingstone, "Evaluation of Enlarged Test Forms Used with the Partially Seeing," Sight Saving Review, XXVIII (1958), 37-39.

[4]R. Pinter, "Intelligence Testing of Partially Sighted Children," Journal of Educational Psychology, XXXIII (1942), 265-272.

type may be of little help to the child with a vision better than 20/200."[1]

On the other hand, analyses of teacher responses to questionnaires covering 297 partially sighted children in grades 1-12, found that there was a direct relationship in the amount of visual impairment and a dependence on large print.[2] Karnes and Wollersheim found that partially seeing children in their study performed significantly better in reading on a large print test than on a standard print test and came to the conclusion that "it would seem advisable to provide these children with reading materials in large print."[3] They also pointed out that the children read the large print with more comfort and less fatigue.

Fonda argues persuasively that most readers of large print would do just as well with standard print once the idea is accepted that magnification of the print can best be achieved by holding the material closer to the eyes. It is now recognized that "using the eyes does no

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[1]M. W. Mueller, "Effect of Illustration Size on Test Performance of Visually Limited Children," Exceptional Children, XXIX (Nov. 1962), 124-8.

[2]Barbara D. Bateman and Janis L. Wetherell, "Some Educational Characteristics of Partially Seeing Children," International Journal for the Education of the Blind, XVII, No. 2 (Dec. 1967), 33-40.

[3]Merle B. Karnes and Janet P. Wollersheim, "Intensive Differential Diagnosis of Partially Seeing Children to Determine the Implications of Education," Exceptional Children, XXX (Sept. 1963), 17-25.

harm, regardless of the distance that reading material is held."[1] He states that standard 12-point type is read as clearly at 4.8 inches as 18-point type at 8 inches from the eye.[2] Newspaper text (8-point type) can be read by a person whose vision is 20/200 provided he brings it up to 3.5 inches from his eyes.[3] "Furthermore, large print offers no advantage insofar as the field of vision is concerned if standard type can be read by holding it closer to the eye."[4]

Large type can be resorted to if a person's vision fails or if he cannot see standard print clearly enough. Fonda is careful to point out, however, that:

> The ability to read standard type depends upon intelligence, motivation, counseling, correction of subnormal vision, and encouragement. The educator needs to be informed about the near visual acuity and the reading distance, because he should make the final decision after all the facts are collected and appraised.[5]

There were four studies prior to 1961 dealing with type size and style which have been analyzed by Eakin, Pratt and McFarland who concluded that: (1) 24-point type is better than 30-point type, (2) significantly more

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[1]Fonda, Management of the Patient with Subnormal Vision, p. 8.

[2]Ibid., p. 9.

[3]Ibid., p. 12.

[4]Ibid., p. 16.

[5]Ibid.

partially sighted children can read 24-point type than can read type sizes smaller than 24-point, (3) average reading speed did increase slightly, but not significantly so, with the larger type sizes, (4) accuracy of reading was the same among all type sizes, (5) there was no significant difference to prove 18-point type was read any faster than 24-point type, (6) serif type face was read faster than sans serif type face, and (7) partially sighted children read faster than legally blind children.[1] A study by Kastl dealing with type style, noted that different type faces convey different emotional meanings: sans serif type was associated with a sprightly mood while serif type face was associated with a sad mood.[2] This finding has educational implications not only for controlling the emotional impact of reading materials but also, perhaps, to fit the appropriate type face to the text content. Legibility of various ink and paper color combinations was considered by Nolan but he found no significant differences among combinations of two ink and five paper colors.[3] Two

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[1]William M. Eakin, Robert J. A. Pratt and Thomas L. McFarland, Type Size Research for the Partially Seeing Child (Pittsburgh: Stanwix House, Inc., 1961).

[2]A. J. Kastl and I. L. Child, "Emotional Meaning of Four Typographical Variables," Journal of Applied Psychology, LII, No. 6 (Dec. 1968), 440-6.

[3]Carson Y. Nolan, "Legibility of Ink and Paper Color Combinations for Readers of Large Type," International Journal for the Education of the Blind, X, No. 3 (March 1961), 82-84.

other studies that have important educational implications note that material that contains familiar and meaningful words can be read at a greater distance[1] and more quickly[2] than unfamiliar material. Educators can therefore bring about success and continued motivation by ensuring that any reading material is suitable both in content and meaning for the individual child.

Prince has made the important observation that much can be done to make print legible even for some individuals with uncorrectable visual acuity.[3] He has given some useful guidelines to be considered in the preparation of books for visually impaired readers, noting that research is needed in these areas of printing: (1) type size, (2) type style and proportions, (3) interletter spacing, (4) interword spacing, (5) interline spacing, (6) line width, and (7) contrast of type with paper.[4]

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[1] C. P. Taylor, "The Relative Legibility of Black and White Print," Journal of Educational Psychology, XXV (1934), 561-578.

[2] R. L. Erdmann and A. S. Neal, "Word Legibility as a Function of Letter Legibility, with Word Size, Word Familiarity, and Resolution as Parameters," Journal of Applied Psychology, LII, No. 5 (Oct. 1968), 403-9.

[3] Jack H. Prince, "Relationships of Reading Types to Uncorrectable Lowered Visual Ability," American Journal of Optometry, XXXIV (1957), 581-595.

[4] Jack H. Prince, "Aid for the Visually Handicapped A Guide for Printers and Publishers," in Piez, Gladys, T., "Report on Prince Study," American Library Association Bulletin, LVIII, No. 4 (April 1964), 324-5.

Birch, Tisdall, Peabody and Sterrett undertook a most thorough and comprehensive study dealing with school achievement and effect of type size on reading in visually handicapped children.[1] A number of important observations regarding large print and low vision aids are made that are pertinent to the present study. Five equivalent forms of the Metropolitan Achievement Test (MAT) were administered to a sample of 814 partially sighted fifth and sixth grade students, and a "best" MAT score was determined (i.e., the type size on which a child earned his best MAT score was designated the type size most suitable for reading for that child). The full Stanford Achievement Test was then administered in the "best" size of type for each student (i.e., 12, 15, 18, 21 or 24-point). The most general finding was that "no one of the type sizes used can be considered superior to others with respect to optimum accommodation of partially seeing children in performing school-like reading tasks."[2] However, 43.4 percent of children seemed (sic) to need 21- and 24-point; 41.0 percent could read 12- and 15-point best; and neither

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[1]Jack W. Birch, William J. Tisdall, Ralph Peabody and Robert Sterrett, School Achievement and Effect of Type Size on Reading in Visually Handicapped Children, U.S. Department of HEW, Office of Education (Washington, D.C.: Educational Resources Information Center Document Reproduction Service, R842-05, 1966).

[2]Ibid., p. 71.

group was best suited by 18-point. These results provide some evidence to support the view previously expressed[1] that partially sighted children might well get along without large print. It could be argued that the reason why 43.4 percent of the children "seemed" to need 21- and 24-point type was because they had never been consistently provided with smaller sizes of type and had become psychologically dependent on large print. While it is true that no one size or type face is ideally suited to all readers "for some, type size may bear less relationship to readability than such factors as familiarity with the type style, illumination, contrast, focal distance, width of line, and the spacing of letters, words, and lines or combinations thereof."[2] The other aspect of this study that is pertinent concerns the optical aids used under best type size conditions. Two hundred fourteen children in the sixth grade Scholastic Achievement Test reading sample had the freedom to use optical aids and could employ any reading distance they wished. It was found that only 102 children (less than half the sample) used optical aids, and that an average reading distance of 6.5 inches was employed. Results showed that there was no general relationship among reading speed, comprehension, and type

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[1]Livingstone, "Enlarged Test Forms," p. 26.

[2]Production of Reading Materials, p. 14.

size. In other words, when the children were free to choose optical aids and used their best type size, they performed equally well. It is implied from the results of this study that partially seeing children can use any size of type from 12- to 24-point provided they are given the time and freedom to use aids. Interestingly, the authors remark that "when satisfactory magnifier-projectors are developed, the reprinting of books in larger type is a step which might be by-passed."[1]

As yet unanswered is the question of whether a subjectively determined size of large print is any more efficacious in enhancing reading skills than is standard print in a situation where an individual is free to use optical aids and is under no time pressure. It appears likely that high performance on a particular size of print has been conditioned by past school experiences where prevalent teaching techniques may have encouraged use of a particular size of large print and, it seems, discouraged the use of optical aids (only 50 percent of children in the Birch study chose to use an optical aid).[2]

This study seeks a more objective determination as to whether standard print is, in general, equally or more efficacious than large print in determining reading ability.

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[1]Birch, _et al._, "School Achievement," p. 115.

[2]_Ibid._, p. 72.

The question of the use of optical aids assumes further importance when we consider the numerous disadvantages concerning reading materials in large print:

(1) rarely available in high school and college texts and not available in books at the graduate level.
(2) not available for all subject matter and in all editions of same book.
(3) disability is emphasized.
(4) more expensive than standard type.
(5) large size and heaviness of books are objectionable to children.
(6) illustrations are not in color.
(7) large type does not prepare a child for employment and competition in adult life where standard type is used.
(8) large type material is usually not available for adults.[1]

One could add to this list the psychological impact of being faced with what appears to be much lengthier reading material than it would otherwise appear to be if in standard print.

Fonda notes, however, that large print is indicated in these situations:

(1) when distant vision ranges from 2/200 to 10/200.
(2) when 12-point type (pica typewriter) cannot be read at 2 inches from the eye.
(3) when a greater reading distance is mandatory, for example, for mathematics and accounting.
(4) when a patient insists that large type is more comfortable and easier on his eyes.[2]

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[1]Fonda, Management of the Patient with Subnormal Vision, p. 13.

[2]Ibid., p. 14.

<u>Optical aids for near vision</u>

The concern here is with optical aids for near vision which have been categorized as:

<u>Spectacles</u>:
- (a) strong convex full-size or half-eye spectacles
- (b) best-form lenses (ground to give a larger field of vision)
- (c) specially designed lenses (air-space lenses, aspheric lenses, etc.)
- (d) telescopic spectacles with reading additions

<u>Spectacle modifications</u>:
- (a) binocular head-borne loupe (i.e., anterior extension of a spectacle)
- (b) auxiliary convex lenses (for sliding over one or both spectacle lenses)
- (c) monocular telescopic clip-on unit

<u>Nonspectacle magnifiers</u>:
- (a) hand-held magnifiers
- (b) stand magnifiers (fixed object to lens distance)
- (c) stand magnifiers (focusable)
- (d) paperweight magnifiers (rests on paper)
- (e) non-magnifying reading aids--reading slit

<u>Projection magnifiers</u>:
- (a) Megascope: 12X and 20X
- (b) AOC projection magnifiers.[1]

The primary function of optical aids prescribed for individuals who can benefit from correction, is "to provide an enlarged retinal stimulus pattern and call into play more nerve receptors."[2] This principle has been illustrated by Fonda who states that when the object of regard is moved from 20 inches to two inches from the eye

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[1] <u>Ibid</u>., p. 20.

[2] Alfred A. Rosenbloom, Jr., <u>Classification, Description and Use of Low Vision Aids</u> (Washington, D.C.: American Association of Instructors of the Blind, Inc.), mimeo, no date given.

the linear dimension of the retinal image is increased ten times. Thus, the visually impaired person sees "by virtue of a large blurred image rather than by a smaller, sharp retinal image."[1]

It is only in the past 10 to 15 years that we have seen a tremendous increase in the use of optical aids by visually impaired individuals.[2] Myths and prejudices regarding optical aids have been slow to dispel, but opinion no longer has it that strong glasses hurt the eyes or that it is harmful to the eyes to hold the print too close.[3] In fact, "the shorter distance actually gives magnification, and is only disturbing to the extent that the patient becomes fatigued if he is forced to exercise more accommodative effort than he can tolerate with comfort."[4]

There can be no doubt regarding the value of optical aids. A survey of 500 legally blind clients carried out by the Industrial Home for the Blind, Brooklyn, reported that "of the 340 clients who benefited from the

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[1]Fonda, Management of the Patient with Subnormal Vision, p. 105.

[2]C. W. Tillett, "Optical Aids in the Education of Partially Sighted Students," Sight Saving Review, XXXVII, No. 1 (Spring 1967), 9-13.

[3]Benjamin Milder, "Advantages of the Optical Aids Clinic," Sight Saving Review, XXX, No. 2 (Summer 1960), 78-88.

[4]Ibid., p. 83.

optical aids service, 238 had improved near vision and 183 improved far vision."[1] Furthermore, "four students who formerly used braille are now reading inkprint. Three who were in sight-saving classes are now in regular classes."[2] This study found only 18 percent who could not benefit from optical aids and 14 percent who could not adapt to the prescribed aid.

A study by Fonda, Thomas and Gore details the advancement in reading-medium made possible by near-vision correction for children with surgical aphakia for congenital cataracts: 28 patients were enabled to read 4- and 5-point type at three inches; 12 were enabled to read 6- to 9-point type at three inches; 1 advanced from braille to large print; 5 from braille to standard print; and 3 from large print to standard print, indicating that "there are many low vision patients with surgical aphakia for congenital cataracts now reading either braille or large type who could be reading regular type, and there are some now reading only braille who could be enabled to read large type."[3] Of 31 patients evaluated according to

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[1]Herbert Rusalem, "Industrial Home for the Blind Optical Aids Survey--A Review of Research," <u>New Outlook for the Blind</u>, LI, No. 10 (Dec. 1957), 454-6.

[2]<u>Ibid</u>., p. 455.

[3]Gerald Fonda, Henry Thomas and George V. Gore, III, "Low Vision Corrections for Congenital Cataracts and Surgical Aphakia in Children," Progress Report 1, <u>The Sight Saving Review</u> (Summer 1969), pp. 85-92.

strict criteria, 30 were successful in adjustment to and benefit gained from lenses.

Gibbons reported on the use of optical aids among 500 low vision patients in 40 clinics. Thirty-five percent showed significant improvement in vision and continued to use their special lenses. It was also revealed that

> . . . young persons often get benefits from vision aids more easily than do adults. Intelligence, motivation, and objective are important factors in continued successful use of these devices.[1]

Tillett points out, however, that the need for optical aids at the younger age levels is not great. Young children have strong accommodative power and can partly compensate by holding print closer to the eyes. Lenses prescribed for young children tend to be relatively weak due partly to the child's strong accommodation and partly to the widespread use of large print reading materials.[2] Lebensohn notes, nonetheless, that most children with normal intelligence and motivation who have vision that is 4/200 or better and characterized by an adequate peripheral field can be prescribed an aid for reading.[3]

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[1]Helen Gibbons, "Low-Vision Aids--The Educator's Responsibility," International Journal for the Education of the Blind, XII, No. 4 (May 1963), 107-9.

[2]Tillett, "Optical Aids," p. 13.

[3]James E. Lebensohn, "Newer Optical Aids for Children with Low Vision," American Journal of Ophthalmology, XXXXVI, No. 6 (Dec. 1958).

Lebensohn has also stated that if optical aids were used routinely the visual acuity requirements for regular classroom work could probably be lowered to 10/200 or less.[1]

Views differ when it comes to the question of judging the limits of visual acuity below which optical aids are useful. Milder found that persons with a visual acuity of 12/200 or more were able to read regular size print when using appropriate lenses but that optical aids were of no practical value in reading for those whose visual acuity was less than 5/200.[2] Lebensohn holds the opinion that "visual aids are apparently valueless if the corrected acuity is below 4/200 or the counting of fingers at 2 meters."[3] Other researchers found that among a group of legally blind veterans that "the patient should have at least 3/200 vision to be a good candidate."[4] This writer

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[1]J. E. Lebensohn, "Scientific and Practical Considerations Involved in the Near Vision Test with Presentation of a Practical and Informative Near Vision Chart," American Journal of Ophthalmology, XIX (1936), 110.

[2]Milder, "Optical Aids Clinic," p. 79.

[3]J. E. Lebensohn, "Optical Aids for Subnormal Vision," Sight Saving Review, XXVI, No. 4 (Winter 1956), 201-9.

[4]Albert E. Sloane, E. U. Farnsworth, G. E. Fonda, R. F. Penn, L. Robinson and C. W. Tillett, The Value of Low Vision Aids: A Panel Discussion (New York: National Society for the Prevention of Blindness, 1961), p. 5.

knows one person whose visual acuity in the eye he uses for reading is only 20/2000 yet he can read standard print comfortably using a 14X spectacle lens for periods of up to 15 minutes. As would be expected, his major means of reading is by listening, but he uses print to a greater extent than braille.[1]

Another example concerns a bright 19 year old college girl with a visual acuity of 20/2000 in the temporal part of her left retina who can read music notation at six inches with a +20 diopter spectacle lens. Her instructor has instituted a program of print reading and is having a good deal of success in teaching her block capitals which he is gradually reducing in size. Although it is unclear as to whether she will ever be able to read lower-case characters fluently, her instructor aims for her to at least be able to read her own correspondence which would give her the privacy that is so often denied blind persons.[2]

It is difficult to be precise on this point because so many factors enter into the ability to utilize low vision. In discussing the advantages of the optical

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[1]Discussion with Dr. George V. Gore, III, Michigan State University, October 1970.

[2]Personal letter to the writer from Henry Thomas, Instructor, New Jersey State Commission for the Blind, 1100 Raymond Ave., Newark, N.J. Dated November 5, 1970.

aids clinic, Milder notes that the most important variable entering into acceptance of optical aids is the level of vision. ". . . studies at our center reveal that ability to read newspaper print (8-point type) with the assistance of an optical aid can be achieved in the vast majority of persons having vision of 12/200 or better."[1] Other factors he cites are: recency of loss of vision; age (the older one gets the less adaptable one becomes); pathologic process (most aids are prescribed for the older age groups with eye diseases common to advancing years); and the fact that practically all devices for improving reading vision involve shorter focal length, smaller field of vision, and interference with existing distance vision.[2]

Other difficulties are that as reading distance decreases it becomes difficult to illuminate the reading page; aberrations become noticeable unless the high power lenses used are especially designed to minimize such defects; and as the depth of focus decreases with increasing lens power it becomes more difficult to maintain the reading page at a proper distance from the lens.[3] However,

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[1]Milder, "Optical Aids Clinic," p. 79.

[2]*Ibid.*, p. 82.

[3]L. L. Sloan and D. J. Brown, "Reading Cards for Selection of Optical Aids for the Partially Sighted," *American Journal of Ophthalmology*, LV, No. 6 (June 1963), 1187-1199.

"by far the most important factor in the successful use of visual aids is the will to make them work."[1]

These problems make it clear why it is necessary that visually impaired persons be given assistance in the use of optical aids. Assistance from a clinic team can help clear up misconceptions about the use of optical aids; provide information regarding adequate amounts of illumination; and aid the individual over the trial period that is so necessary to facilitate adjustment and adaptation to the use of the aid. Stimson places great emphasis on an adequate period of adjustment in order that the client may: "(1) learn a new head and eye relationship, (2) re-adjust hand and eye relationships, (3) accept a narrower reading span, (4) become accustomed to the shallower depth of focus, and (5) learn to move the book or paper before the eye rather than eyes and head."[2] He prescribes lenses with sufficient dioptric power for the patient to see 24-point type comfortably, and then when sufficient progress has been made, changes to smaller type and a new lens prescription.[3]

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[1]Milder, "Optical Aids Clinic," p. 82.

[2]Russell L. Stimson, Optical Aids for Low Acuity (Los Angeles, California: Braille Institute of America, 1957), p. 16.

[3]*Ibid.*, p. 16.

Freudenberger and Robbins recommend that a personality pattern procedure be used in predicting whether a person will accept or reject optical aids. They found that amicable, optimistic clients tended to accept optical aids, whereas hostile, pessimistic clients tended to reject optical aids.[1]

Techniques of assistance for children need modification as children do not have the complex needs for optical aids that adults have; their needs will vary at different grade levels, so frequent re-evaluation is necessary to check present needs and requirements; diagnosis is likely to be drawn out over a longer period because of fatigue factors; prescription of an optical aid will be predicated on the child's ability to use it (i.e., additional handicaps may preclude the use of such aids); and the overall aim will be to fit the child with the simplest optical aid possible. A final decision regarding the suitability of an optical aid will be made subjectively by the individual child.[2]

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[1]Herbert J. Freudenberger and Irving Robbins, The Relationship between Five Selected Personality Characteristics on the Acceptance or Rejection of Optical Aids in a Low Vision Population: A Study, July 1957 to May 1958 (New York: American Foundation for the Blind, Inc., 1959).

[2]Roger R. Seelye, Notes from an address given to the Conference for Teachers and Administrators of the Blind and Partially Seeing, Waldenwoods, Hartland, Michigan, April 1970.

Correct fitting of an optical aid and the necessary help given by the low vision clinic should foster a realistic orientation towards the use of optical aids so that

> . . . those persons who have used the aid . . . come to think of themselves not as blind and not as sighted, but as people with impaired or partial vision, and they are willing to accept any means that will enable them to make use of their remaining vision.[1]

Summary statement

While there are few studies dealing with the relative merits of different sizes of print in facilitating the reading skills of visually impaired students, what evidence there is points out that many visually impaired individuals are able to read standard print provided they are given the opportunity and receive encouragement to do so.

The increasing use of optical aids and the emphasis now being given to visual training procedures are accelerating the trend from braille to print, and from large print to standard print.

Hypotheses

There are six major hypotheses and three exploratory hypotheses, as follows:

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[1]Regina Little, "Getting the Most out of Visual Aids," New Outlook for the Blind, LIX, No. 4 (April 1965), 141-4.

1. Visually impaired high school students will attain significantly higher scores in level of comprehension on the Davis Reading Test presented in standard print than they will on an equivalent form of the Davis Reading Test presented in large print.

2. Visually impaired high school students will attain significantly higher scores in reading speed on the Davis Reading Test presented in standard print than they will on an equivalent form of the Davis Reading Test presented in large print.

3. Visually impaired high school students will experience less visual fatigue on the Davis Reading Test presented in standard print than they will on an equivalent form of the Davis Reading Test presented in large print.

4.[1] (a) The legally blind group and the partially sighted group tested independently will attain higher mean comprehension scores on the Davis Reading Test presented in standard print than on an equivalent form of the test presented in large print.

4. (b) Partially sighted students will score higher than legally blind students.

5. (a) The legally blind group and the partially sighted group tested independently will attain higher mean reading speed scores on the Davis Reading Test presented

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[1]Hypotheses 4, 5 and 6 are to be regarded as exploratory because of the small number of subjects (i.e., 17) in each category.

in standard print than on an equivalent form of the test presented in large print.

5. (b) Partially sighted students will score higher than legally blind students.

6. (a) The legally blind group and the partially sighted group tested independently will experience less visual fatigue on the Davis Reading Test presented in standard print than on an equivalent form of the test presented in large print.

(b) Partially sighted students will experience less visual fatigue than legally blind students.

7. There will be no significant difference between the performance of visually impaired high school students in level of comprehension on the Davis Reading Test presented in their preferred size of print and in their performance on an equivalent form of the test presented in an alternative size of print.

8. There will be no significant difference between the performance of visually impaired high school students in reading speed on the Davis Reading Test presented in their preferred size of print and in their performance on an equivalent form of the test presented in an alternative size of print.

9. There will be no significant difference between the amount of visual fatigue experienced by visually impaired high school students on the Davis Reading Test presented in their preferred size of print and in the amount of visual fatigue experienced on an equivalent form of the test presented in an alternative size of print.

CHAPTER II

DESIGN OF THE STUDY

Subjects

Forty-one visually impaired students, 28 boys and 13 girls, in grades 8 through 12 at the Michigan School for the Blind took part in this study. Their ages ranged from 20 years, 11 months to 13 years, 3 months, and the mean I.Q. for all subjects was 104 with a range from 90 to 135. Table 1 details their age, grade, and I.Q. distribution after they were randomly placed into four groups for the purposes of testing.

Twenty-four students were legally blind and 17 were partially sighted; their visual acuities ranged from 20/900 to 20/60 and were spread throughout this range as shown in Table 2.

With the exception of 11 students who were excluded because of additional handicaps, the sample constituted all the partially sighted and legally blind students in grades 8 through 12 who had been appraised at the school's Pediatrics Low Vision Clinic and who had been judged capable of reading print. All subjects had experience in reading both standard and large print, though four of the legally blind students were primarily braille readers.

Table 1. Age, grade, and I.Q. distribution within groups I, II, III and IV after randomized placement of subjects.[1]

	Group I			Group II			Group III			Group IV		
Subjects	Age	Grade	I.Q.	Age	Grade	I.Q.	Age	Grade	I.Q.	Age	Grade	I.Q.
Legally blind												
1	17.10	11	109	18.11	12	103	17.06	12	105	17.03	11	116
2	18.11	11	106	17.11	12	112	18.06	11	90	19.09	11	100
3	17.01	10	91	17.08	12	100	18.00	11	112	16.11	10	94
4	16.09	10	110	16.02	11	120	18.08	11	94	18.04	10	95
5	15.03	10	135	15.03	10	100	16.11	11	103	14.03	9	112
6	16.05	10	93	18.01	10	--	15.05	10	119			
7	20.11	12	120									
Partially sighted												
8	19.03	11	92	16.09	12	119	16.03	11	91	17.07	12	102
9	18.07	11	94	15.09	10	101	19.00	11	94	14.09	9	121
10	17.04	10	101	14.00	8	104	15.02	9	110	14.03	8	94
11	13.03	8	107	14.08	8	106	20.11	12	90	15.06	8	--
12	15.08	9	90									
Mean	17.03		104.0	16.06		107.2	17.08		100.8	16.06		104.2

[1]See Table 4 for meaning of group designations.

Table 2. Visual acuity.

	Legally Blind										Partially Sighted[1]				
Visual Acuity[2]	20/ 900	20/ 800	20/ 640	20/ 560	20/ 480	20/ 450	20/ 400	20/ 280	20/ 240	20/ 200	20/ 160	20/ 120	20/ 100	20/ 80	20/ 60
Subjects	1	2	1	1	1	1	4	2	5	6	7	6	1	1	2

[1]Seven partially sighted students had previously been categorized as legally blind when their visual acuities had been determined at a testing distance of 20 feet from the test chart.

[2]Thirty-five of the 41 students have had their visual acuities converted from a testing distance of either 5 feet or 10 feet from the test chart.

A number of reasons were considered in selecting high school students. Older students were more likely to have: (1) been fitted with optical aids for both distance and near vision; (2) been exposed to optical aids, large print and standard print; (3) reached their maximum normal rate of reading;[1] (4) the ability to read for longer periods of time, thus making a measure of visual fatigue more feasible;[2] and (5) full medical, optometric and educational information readily available. Furthermore, it is in high school that students find most of their reading materials in standard print, rather than in the large print that is common in reading materials for younger children.[3]

Visually impaired students whose records showed evidence of additional handicaps were excluded from the study. A number of writers point out that the reading problems of many children are brought about as a result of low capacity and emotional disturbances;[4] learning

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[1]Albert J. Harris, How to Increase Reading Ability (New York: Longmans, Green and Co., 1953).

[2]Birch, et al., "School Achievement," p. 25.

[3]Edith C. Kirk, "Physical Conditions for Reading," The Reading Teacher, XXII, No. 3 (Dec. 1968), 223-7.

[4]W. Hull, "Low Vision Aids; a Teacher's Sight Saving Review, XXXII, No. 1 (Spring 1962), 22-3.

disabilities,[1] and neurologic and psychiatric problems.[2] Where there are reading difficulties, there is evidence that "the eyes, as a matter of fact, are not often a causative factor,"[3] and that achievement in reading is not limited by visual acuity.[4] Students with I.Q.'s of less than 90 were therefore excluded as were those students with learning disabilities and emotional problems.

The optometric evaluation at the school's Pediatrics Low Vision Clinic includes correction for both distance and near vision and has been a pioneering feature of the Michigan School for the Blind since the Spring of 1969. Following optometric analysis and the fitting of optical aids, the students are given specific help and training in the use of their aids and in the utilization of low vision. The major eye defects of the students can be noted in Table 3.

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[1]Barbara Bateman, "Mild Visual Defect and Learning Problems in Partially Seeing Children," Sight Saving Review, XXXIII, No. 1 (Spring 1963).

[2]H. K. Goldberg, "Vision and the Reading Problem," Sight Saving Review, XXXVII (Spring 1967), 6-8.

[3]John V. Nicholls, "Children with Reading Difficulties," Sight Saving Review, XXXVII, No. 1 (Spring 1966), 27-30.

[4]W. H. Edson, "Relation Between Visual Characteristics and Specific Silent Reading Abilities," Journal of Educational Research, LVI, No. 6 (February 1953), 451-7.

Table 3. Major eye defects of the visually impaired high school students.

Defect	Number of Students
<u>Eyeball in general</u>	
High myopia	3
Glaucoma	1
Albinism	2
Coloboma	3
Aniridia	2
Toxic amblyopia	1
Amblyopia	1
<u>Lens</u>	
Cataract (four with surgical aphakia)	5
<u>Iris</u>	
Iritis	1
<u>Retina</u>	
Retrolental fibroplasia	10
Retinal and macular degeneration	6
<u>Cornea</u>	
Congenital corneal clouding	1
Keratomalacia	1
<u>Optic nerve</u>	
Optic atrophy	3
Neuroretinitis	1

Procedure

In order to equalize practice effects and fatigue factors favoring either standard print or large print, presentations of the standard print and the equivalent large print forms of the Davis Reading Test were alternated as can be seen in Table 4. Students in Group I took form 2A in standard print and the equivalent form 2B in large print; students in Group II took form 2A in large print and equivalent form 2B in standard print; students in Group III took form 2B in standard print and equivalent form 2A in large print; and students in Group IV took form 2B in large print and equivalent form 2A in standard print. Every student therefore took the Davis Reading Test twice; once in standard print and once in large print.

All students were tested individually by the writer in the Pediatrics Low Vision Clinic of the Michigan School for the Blind during the period from January 9, 1971 to February 15, 1971. Prior to this an orientation meeting with the students was arranged to explain the purposes of the study and the methods of testing.

Testing took place during the students' study-hall periods, after school, or at weekends so as not to disrupt their on-going school program. Because of the difficulties encountered in scheduling appointments the intervals between administering the two forms of the Davis Reading

Table 4. Order of presentation of the equivalent standard print and large print forms of the Davis Reading Test.

Order of Presentation	Test Forms: Standard Print	Test Forms: Large Print
First	Group I--Test 2A (7 legally blind subjects 5 partially sighted subjects)	Group II--Test 2A (6 legally blind subjects 4 partially sighted subjects)
	Group III--Test 2B (6 legally blind subjects 4 partially sighted subjects)	Group IV--Test 2B (5 legally blind subjects 4 partially sighted subjects)
Second	Group II--Test 2B	Group I--Test 2B
	Group IV--Test 2A	Group III--Test 2A

Test varied from 7 to 35 days, with an average of 18 days between tests. It was found necessary to schedule additional appointments for 16 subjects who were unable to finish a test at one sitting.

The test situation was made as relaxed and flexible as possible; the students were allowed as much time as they needed in order to complete the test and could rest between reading passages if they wished. The test instructions were read to the testee and it was explained that the initial reading of each passage was to be done without stopping; that the test was to be read silently; and that answers were to be given orally to be recorded by the examiner. This procedure removed a good deal of additional fatigue and pressure from the testee who would otherwise have had to handle an answer paper and pencil, in addition to the reading materials and optical aids.

A practice page of print taken from an unused portion of the Davis Reading Test was provided on the first page of each test booklet in order that the student might find his most comfortable reading position, reading distance, and level and angle of illumination. A measure of the individual's reading distance was made at this time.

Before testing commenced the student was free to choose whatever optical or non-optical aids he desired.

An angled reading-lamp[1] with two levels of intensity was provided and a reading-stand and reading-slits were also available. Table 5 details the types of optical and non-optical aids employed by the students when reading the standard print and large print forms of the test.

After the test had been underway for twenty minutes a measure of visual fatigue was obtained from each student by taking a five minute count of his involuntary eye-blink rate. Finally, at the end of the second test the student was asked which size print he preferred.

Materials

Forms 2A and 2B for grades 8, 9, 10 and 11 were selected from the four equivalent forms of Series 2 of the Davis Reading Test which is an instrument that presents the student with interesting material of the type he is expected to read in high school.[2] This particular test was selected both for its high interest content, for the clarity of its print, and also because it was printed in the familiar Roman type. It has been recommended as an outstanding example of the test writer's art in that it has unusually effective collections of passages and

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[1]Tensor portable lamp, model 6500, 120V, 30 watts (1133 bulb), Tensor Corp., Brooklyn, N.Y. 11207.

[2]Davis and Davis, Davis Reading Test.

Table 5. Low vision aids used when reading standard print and large print.

Low Vision Aid	Standard Print	Large Print
Optical aids		
Spectacles	6	8
Bifocal spectacles	7	7
Microscopic lenses	12	7
Loupe	1	-
Hand-held magnifier	1	-
Non-optical aids		
Reading stand	-	3
High-intensity lamp	23	18
Low-intensity lamp	8	9
Overhead light	10	14
Optical aids not used	15	19

Optometric evaluation indicated 8 subjects did not require optical aids.

Optical aids were recommended for 7 subjects, each of whom either forgot to bring their aid, chose not to use it, or had not yet received parental permission to purchase the aid.

questions for assessing the ability of students to garner meaning from the printed page.[1] The test manual indicates that the equivalent forms of the test meet high standards of reliability and validity and that all eight sets (i.e., each set contains 40 items) are closely matched with respect to item difficulty, item internal consistency, and number of words per item, and matched as nearly as practicable in content and type of item.[2] Five categories of reading skills are measured: (1) finding the answers to questions answered explicitly or in paraphrase in a passage; (2) weaving together the ideas in a passage and grasping its central thought; (3) making inferences about the content of a passage and about the purpose or point of view of its author; (4) recognizing the tone and mood of a passage and the literary devices used by its author; and (5) following the structure of a passage. Only the first 40 items of this 80 item test were utilized to yield a level of comprehension score and a reading speed score. The procedures outlined in the test manual were utilized to arrive at a scaled level of comprehension score which indicates the degree of comprehension attained while progressing at a self-determined rate of working as

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[1] William E. Coffman, Buros 6th Mental Measurements Year Book (New Jersey: Gryphon Press, 1965), p. 786.

[2] Davis and Davis, Davis Reading Test, p. 29.

rapidly as possible without making careless mistakes. The reading speed score was determined by timing the silent reading of the test passages.

Test Modifications

Before testing was carried out, modifications were made in the size and format of the Davis Reading Test, in the procedures for administering the test, and in the measures taken.

The first sets (i.e., first 40 items) of Forms 2A and 2B were reproduced in large print and the format was further altered to allow the reading passages to be on the left-hand page with the questions on the opposite pages.

The testee was encouraged to choose his optimum level of illumination and reading distance, and was free to use whatever optical and non-optical aids he desired. Unlimited time was given in which to complete the test.

In addition to obtaining a level of comprehension score and a reading speed score, measures of visual fatigue and reading distance were made, and the student was asked which size print he preferred.

Type size

The first sets of Forms 2A and 2B of the Davis Reading Test for grades 8 through 11 were selected; these were available in 10-point type[1,2] and were also photographically enlarged 80 percent of the original size to 18-point type.[3]

Eighteen-point type was selected as the most appropriate size for the large print form of the test since a number of authorities recommend this size.[4,5] Eighteen-point type is also the type size most commonly used for large print materials.[6] Nolan has noted that while varying conclusions have been reached regarding the suitability of 24-point or 18-point as the best type size for large print

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[1]The test is set in 10-point linotype times Roman with short descenders; the reading passages are leaded 2-points while the 5 options for each item are set on 10-point slugs without leading. The Psychological Corporation, Test Division,(New York--personal communication, November 4, 1970).

[2]It should be noted that though the type size is said to be 10-point, it more closely matches, though is not quite as large, as the 12-point print on the Lebensohn near vision chart. The lower-case, 10-point characters are approximately 2mm high.

[3]Photo-enlargement using a 24" Kenro Vertical Process Camera. All-Star Printing, 621 W. Lenawee, Lansing, Michigan.

[4]Rates and Standards for Volunteers Engaged in the Production of Braille, Large Type, or Tape Recorded Materials for the Visually Handicapped, Office of the Superintendent of Public Instruction, Educational Materials Coordinating Unit, State of Illinois, Chicago, 1966, p. 11.

[5]The Use of Optical Aids for the Partially Sighted, Royal National Institute for the Blind, Report of the Joint Committee of the RNIB and the London County Council, 1952.

[6]Reference Circular, Library of Congress, p. 1.

materials, findings to date do not clearly demonstrate which of the two is better than the other.[1]

Ten-point type was selected as the most appropriate size for the standard print form of the Davis Reading Test. The British Association for the Advancement of Science recommended that "for those over nine years of age, a gradual increase in the size of type until twelve years or over, then 10-point type."[2] Other authorities have come to similar conclusions. Tinker and Paterson found that 10, 11 and 12-point type was preferred for grades 5 through 8.[3] McNamara, Paterson and Tinker found that children in grade 3 preferred 10- and 12-point type.[4] Ten-point type was also seen to be the most appropriate size because high school materials are invariably in this size type.

Format

When the two sets of the Davis Reading Test were reproduced in large print, care was taken to follow the

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[1]Carson Y. Nolan, "Readability of Large Types; A Study of Type Sizes and Type Styles," International Journal for the Education of the Blind, IX, No. 2 (Dec. 1959), 41-44.

[2]Hathaway, Partially Seeing Child, p. 108.

[3]M. A. Tinker and D. G. Paterson, "Reader Preferences and Typography," Journal of Applied Psychology, XXVI (1952), 38-40.

[4]W. G. McNamara, D. G. Paterson and M. A. Tinker, "The Influence of Size of Type on Speed of Reading in the Primary Grades," Sight Saving Review, XXIII (1953), 28-33.

standards for the reproduction of large print materials by photo-enlargement recommended by the National Accreditation Council for Agencies Serving the Blind and Visually Handicapped.[1]

The format of both the standard print and large print copies of the test was altered so that the reading passages were separated from the questions and placed on the left-hand pages, with the questions on the opposite pages. This was done in order that the students might more easily refer from question to passage than they might otherwise have done with the reading passages and questions on the same page. In any event, a straightforward 80 percent enlargement of an entire page of the 10-point text would have made the large print copy much too large to handle.

It has been questioned whether alterations in the format of otherwise equivalent forms of a test might bring about significant differences in scores. A study by Lopez indicates that such changes do not result in significant differences in reading scores.[2]

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[1] Production of Reading Materials, p. 19.

[2] D. C. Lopez, Effects of Test Format on the Reading Scores of Fifth Grade Children (San Jose, California: Department of Industrial Arts, San Jose State College, 1961).

Test conditions

It was considered of paramount importance that the students be tested in a relaxed, flexible situation that might as nearly as possible resemble good classroom conditions. To bring this about, consideration was given to providing adequate illumination; a comfortable reading distance and position; a free choice of optical and non-optical aids; and sufficient time in which to complete the test. A sample passage taken from an unused part of the Davis Reading Test was provided at the front of each test booklet to enable the student to adjust his reading distance, position, level of illumination, and choice of aids.

Illumination.--Demila notes that the two prime determinants of visual fatigue are quality of print and lighting conditions, and states that "extensive and intensive concern with the optimal conditions of legibility is the most effective way to combat visual fatigue."[1] Birch and his associates found that teachers of partially sighted children indicated that 15.3 percent of their children required an increase of normal light, while 6.2 percent required a decrease of normal light.[2] It has been estimated that in order to compensate for eye difficulties,

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[1]Lorraine A. Demila, "Visual Fatigue and Reading," Journal of Education, CLI, No. 2 (Dec. 1968), 4-34.

[2]Birch, et al., "School Achievement," p. 47.

the partially sighted require a higher level of illumination, and it is recommended that a minimum of 50 foot-candles be used in classrooms for the partially sighted.[1] In their study, Eakin, Pratt and McFarland used a lighting intensity that fell within the range of 35 to 50 foot-candles and they also reduced the lighting to a comfortable level for those students with albinism.[2]

Another problem is presented if a person has to read holding the printed page very close to his eye; his head obscures the light and the page is then in the dark. Such an individual can best be helped by sitting him with the eye that he uses next to a window; light intensity can be regulated by distance from the window.[3] Alternatively a reading-lamp can be used and intensity regulated by moving the lamp.

The students in this study were tested in a room which had natural light from a window supplemented by an overhead fluorescent light. In addition, a small angled reading-lamp with two level of intensity was provided. It was ensured that students choosing additional illumination from the lamp had the shade of the lamp towards the eye in order to minimize glare.

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[1]Eakin, et al., "Type Size Research," p. 16.

[2]Sloane, et al., Low Vision Aids, p. 16.

[3]Hathaway, Partially Seeing Child, p. 92.

Reading distance.--The trenchant point has been made that since it is impossible at the present time to specify the educational significance from the type of eye defect, we should let each child choose

> those conditions (lighting, angle of viewing, type size) which are most comfortable for him. Until we have actual evidence that all children with cataracts can best read from a distance of X inches with Y amount of light, etc., it seems arbitrary to do anything other than allow him freedom to explore and choose those conditions which are best for him.[1]

This advice was followed in the testing situation; each student was free to vary his reading distance, choose his own level of illumination, and proceed at his own pace.

Because he has the available accommodative powers a child with an eye defect may well be able to read by holding a book just a few inches from his eye. Children with high myopia, for example, have been known to read 4-point type at two inches without glasses.[2] Individuals with myopia will, in fact, remove their glasses in order to read by the non-optical method.

Support for flexibility in determining reading distance can be found in some low vision clinics that follow a procedure in testing that allows their clients to find their own most suitable testing distance, so that

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[1]Bateman, "Visually Handicapped Children," p. 287.

[2]Gerald Fonda, "An Evaluation of Large Type," New Outlook for the Blind, Dec. 1966.

"with each increase in power of the reading lens, the patient finds the distance at which the print is in focus and indicates the smallest print which he can read at this distance."[1]

Optical and non-optical aids.--Table 5 details the optical and non-optical reading aids used by the students on the standard print and large print forms of the test.

Time.--It was considered most important that the students should be under no time pressure when taking the test, so they were given as much time as they needed in order to complete the test. Sixteen students were scheduled for additional sessions in order to complete the test.

Test measures

The students read the test silently and responded orally to the multiple-choice type questions which were scored by the examiner. Measures of level of comprehension, speed of reading, reading distance and visual fatigue were recorded. The students were asked to state their preferred size of print after completing the second test.

Level of comprehension.--The procedures outlined in the test manual were utilized to arrive at a scaled level of comprehension score.

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[1] Sloan and Brown, "Selection of Optical Aids," p. 1189.

Reading speed.--A reading speed score was determined by summing the time taken by the student to read each of the passages.

Reading distance.--A measure of reading distance was determined at the beginning of each test using a sample passage taken from an unused portion of the Davis Reading Test. This distance was checked again towards the end of the test.

Visual fatigue.--Visual fatigue is the most significant educational problem of partially seeing children.[1] It is

> that state in which the visual mechanism, after operating in less than optimal conditions, ceases to function with maximum efficiency. In the reading situation, this is characterized by increased number of fixations per line of print, more regressions per line, slower rate of reading, less accuracy, and diminished comprehension.[2]

Demila considers it is brought about not by a prolonged activity such as reading but rather as a function of eye strain,[3] the determinants of which are a function of the conditions of legibility--namely, print and lighting.

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[1]Birch, et al., "School Achievement," p. 47.

[2]Demila, "Visual Fatigue and Reading," p. 8.

[3]Fonda prefers the term "eye fatigue" and states that "the eyes fatigue more easily when a patient is expending maximum accommodation and interpreting a blurred retinal image. Eye fatigue is part of general fatigue because of the additional effort required to read in an uncomfortable position." See Management of the Patient with Subnormal Vision, p. 9.

Since the test situation enabled each student to find his own best reading conditions on each form of the test, it is presumed that visual fatigue is a function of the difference between reading large print as opposed to reading standard print.

The criterion used as a measure of visual fatigue is that of involuntary blinking. Luckiesh reported that a decade of research had established the rate of involuntary blinking as a sensitive criterion of ease of seeing, provided representative groups of subjects were used under carefully controlled conditions.[1] The blink is considered to be a relief mechanism and, therefore, associated with strain and fatigue; it is also an involuntary reflex since the students, while absorbed in the task of reading, do not exercise voluntary control over their rate of blinking. Luckiesh discusses the results of ten years of research which showed that blink rate: (1) increases as the period of reading increases, (2) is greater while reading 6-point than while reading 12-point type under identical conditions, (3) is greater when subjects wear incorrect eyeglasses than when they wear correct ones, (4) is greater while reading with a glaring light source in the visual field than when the glare is absent, (5) is greater under

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[1]Matthew Luckiesh, Light, Vision and Seeing (New York: D. Van Nostrand Company, Inc., 1944), p. 206.

conditions of poor illumination than when illumination is increased, (6) is less for Memphis Medium type face than for Textype or Caslon Old Face, (7) is less for medium than for light, bold or extra-bold type, and (8) is less for leading (i.e., space between lines of type) of 6-point than for solid set, 1-point 2-point or 3-point leading.[1]

Visual fatigue was measured by counting the involuntary eye-blinks of the testee over a five minute period after the test had been underway for 20 minutes. The students, after 20 minutes involvement with the test, should have overcome any fear of the test situation and be involved in the test to the extent that their eye-blinks were truly involuntary. Care was taken to observe the student outside of his visual field, where possible, so that he was unaware of this procedure.

Preferred size of print.--At the end of the second test the student was asked whether he preferred standard print or large print.

Summary statement

Equivalent forms 2A and 2B of the Davis Reading Test printed in 10-point and 18-point type were administered individually to a sample of 41 visually impaired high school students. Presentations of the two equivalent

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[1] Ibid.

forms were alternated over a 6 week period. Twelve students took form 2A in standard print and form 2B in large print; 10 students took form 2A in large print and form 2B in standard print; 10 students took form 2B in standard print and form 2A in large print; and 9 students took form 2B in large print and form 2A in standard print.

Optical and non-optical aids could be used as desired, and each student was enabled to find his most comfortable reading position, reading distance, and level and angle of illumination. Unlimited time was allowed to complete the test.

Measures of comprehension, reading speed, reading distance, and visual fatigue were taken, and the student was asked to state his preferred size of print.

Analysis of Data[1]

Hypotheses 1, 2, 3, 4, 5 and 6 were tested using a three-way analysis of variance.[2] Before this was done seven subjects from the legally blind group were randomly dropped in order to equalize the number in this group with the number of subjects in the partially sighted group, and

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[1]Use of the Michigan State University computing facilities was made possible through support, in part, from the National Science Foundation.

[2]1604 Analysis of Variance, Robert I. Jennrich, University of Wisconsin, Numerical Analysis Department.

the visual fatigue scores of 13 subjects were estimated at the means for their groups. All raw scores were then converted to standard scores. Where the analysis of variance yielded significant F-ratios post-hoc, Tukey method comparisons to test the above hypotheses were carried out.

Hypotheses 7, 8 and 9 were analyzed using a two-tailed t-test for inferences concerning two means on paired observations: that is, observations taken on the same individual. The statistic used was:

$$\frac{\bar{D}}{Sd/\sqrt{n}} \sim t_{n-1}$$

Data from the entire sample of 41 subjects were included in the t-test analysis.

CHAPTER III

RESULTS OF THE STUDY

Before analysis of variance could be carried out seven subjects were randomly dropped from the legally blind group in order to equalize the number of subjects in this group with those in the partially sighted group. Table 6 shows the means of the original data before this procedure was implemented. It should be noted that higher mean scores in reading speed and visual fatigue in this table indicate poorer performance on these measures. For example, legally blind students took an average of 20.56 minutes to read the standard print form of the Davis Reading Test whereas they took only 19.03 minutes to read the large print test. Likewise, the mean eye-blink rate for partially sighted students reading standard print was 13.27 blinks whereas their mean eye-blink rate when reading the large print test was only 8.00.

Because of difficulties encountered in recording eye-blink data, the scores of 13 subjects were estimated at the means for their groups.

It was also necessary to convert the raw data to standard scores and then to reverse the sign for the

Table 6. Mean raw scores on comprehension, reading speed and visual fatigue.

	Standard Print			Large Print		
Subjects	Comprehension	Speed*	Fatigue*	Comprehension	Speed*	Fatigue*
Legally Blind	64.83	20.56	13.29	65.08	19.03	13.11
	[17]	[17]	[17]	[17]	[17]	[17]
	(24)	(24)	(24)	(24)	(24)	(24)
Partially Sighted	63.47	10.55	13.27	61.94	9.36	8.00
	[17]	[17]	[17]	[17]	[17]	[17]
	(17)	(17)	(17)	(17)	(17)	(17)
Total	64.26	16.41	13.28	63.78	15.02	10.99
	[34]	[34]	[34]	[34]	[34]	[34]
	(41)	(41)	(41)	(41)	(41)	(41)

*Higher scores indicate poorer performance

[ ]N's for analysis of variance

( )N's for t-test

reading speed and visual fatigue scores in order that negative scores should indicate poorer performance as was already the case for the comprehension scores. Table 7 details the mean standard scores on the measures of comprehension, reading speed and visual fatigue.

Following the equalization of the group numbers and the conversion of the raw data to standard scores a three-way analyais of variance was carried out. Table 8 details the total analysis of variance which generated four significant F ratios and two non-significant ratios.

The F ratio of 4.048 for groups was not significant, leading to the conclusion that there is no significant difference between the two groups of legally blind and partially sighted students when overall comparison is made across all variables.

There is a significant F value of 5.275 for print size which indicates a significant difference between the performance of visually impaired students on standard print and their performance on large print. The mean totals of -.079 for standard print and .079 for large print in Table 7 show that overall performance is better in large print than in standard print.

The non-significant F ratio of .086 for print by group interaction leads to the inference that there are no significant interactions among the two print sizes and the two groups. In other words, on the combined measures

Table 7. Mean standard scores on comprehension, reading speed and visual fatigue.

	Standard Print			Large Print			
Subjects	Comprehension	Speed	Fatigue	Comprehension	Speed	Fatigue	Total
Legally Blind	.054	-.589	-.256	.198	-.427	-.147	-.195
Partially Sighted	-.009	.448	-.125	-.242	.567	.528	.195
Total		-.079			.079		

*Negative scores indicate poorer performance

Table 8. Total analysis of variance.

Sources of Variance	DF	Mean Square	F
Groups (G)	1	7.721148	$\frac{G}{S:G} = 4.048^{NS}$
Subjects within groups (S:G)	32	1.907342	--
Print size (P)	1	1.286523	$\frac{P}{PS:G} = 5.275^{*}$
Measures (M)	2	0.000000	--
Print X groups (PG)	1	0.021030	$\frac{PG}{PS:G} = .086^{NS}$
Measures X groups (MG)	2	6.823959	$\frac{MG}{MS:G} = 4.533^{*}$
Print X subjects within groups (PS:G)	32	0.243879	--
Measures X subjects within groups (MS:G)	64	1.505325	--
Print X measures (PM)	2	0.775303	$\frac{PM}{MPS:G} = 3.891^{*}$
Measures X print X groups (MPG)	2	0.921134	$\frac{MPG}{MPS:G} = 4.623^{*}$
Measures X print X subjects within groups (MPS:G)	64	0.199232	--

*Significant at .05 level

^{NS}Not significant

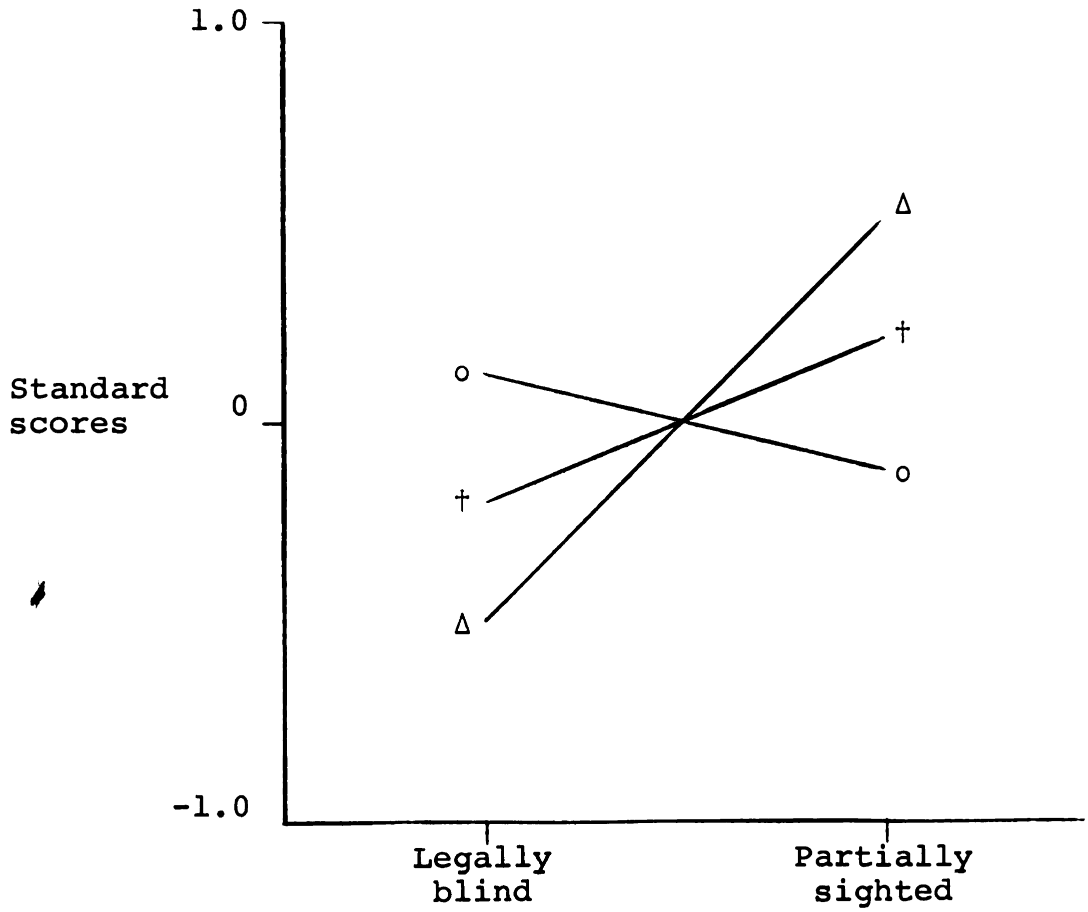
of comprehension, reading speed and visual fatigue the performance of the legally blind and partially sighted groups does not differ as a function of print size.

A significant F-ratio of 4.533 for measures by groups interaction across the two print sizes shows that significant differences can be found depending on the measures used and whether one is partially sighted or legally blind. Figure 1 illustrates the measures by groups interaction from which it can be seen that the mean scores of partially sighted students are higher for reading speed and visual fatigue (positive scores indicating better performance); this order is reversed for the mean comprehension scores, the legally blind group scoring higher than the partially sighted group.

The F-ratio of 3.891 for print by measures interaction is significant. From the information in Figure 2 it can be seen that differences in performance in standard print and large print lie on the measures of reading speed and visual fatigue whereas there is little difference in mean scores on the measure of comprehension. Since this ratio was significant post-hoc, Tukey method comparisons were carried out to test hypotheses 1, 2 and 3.

Hypothesis 1

Hypothesis 1 postulated that visually impaired high school students would attain significantly higher



o Comprehension
Δ Reading speed
† Visual fatigue

Figure 1. Measures by group interaction.

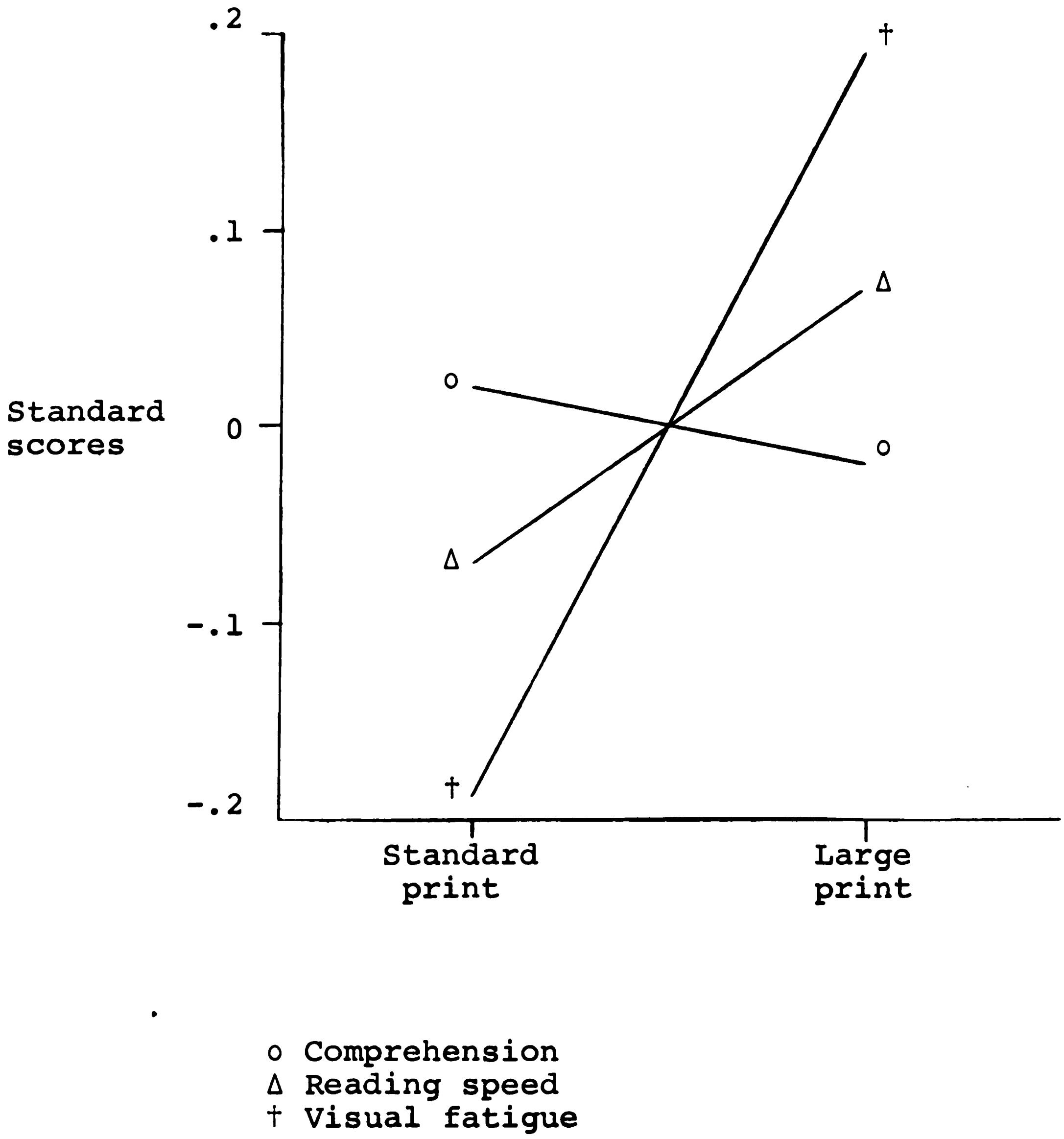


Figure 2. Print by measures interaction.

scores in comprehension on the Davis Reading Test presented in standard print than they would on an equivalent form of the test presented in large print. Table 9 shows the mean difference score between the two print sizes on level of comprehension to be .045 which is not significant. Therefore the hypothesis that visually impaired students will attain significantly higher comprehension scores in standard print than in large print is not accepted.

Table 9. Analysis of the difference scores between standard print and large print (Means, standard deviations and Tukey comparisons).

Comprehension	Speed	Fatigue
$\bar{D}$ = .045	$\bar{D}$ = - .140	$\bar{D}$ = - .382
Sd = .076	Sd = .076	Sd = .076
q = .588^{NS}	q = -1.83^{NS}	q = -4.99*

*Significant at .05 level

^{NS}Not significant

Hypothesis 2

It was postulated in hypothesis 2 that visually impaired high school students would attain significantly higher reading speed scores on the Davis Reading Test presented in standard print than on an equivalent form of the test presented in large print. From Table 9 it can be seen that the mean difference score on reading speed was

-.140 which was not significant. Therefore the hypothesis that visually impaired students will read the standard print test faster than the large print test is not accepted.

Hypothesis 3

It was stated in hypothesis 3 that visually impaired high school students would experience less visual fatigue on the Davis Reading Test presented in standard print than on an equivalent form of the test presented in large print. Inspection of the mean difference score of -.382 in Table 9 shows that this difference was significant at the .05 level. The hypothesis that visually impaired students will experience less visual fatigue when reading standard print is, however, not accepted since the direction of the scores is opposite to that indicated in the hypothesis. Significantly less visual fatigue is, in fact, experienced in large print than in standard print.

The final significant F-ratio of 4.623 is the one concerning measures by print by group interactions. Information about these interactions can be seen in Figure 3. Since this ratio was significant, post-hoc, Tukey method comparisons were carried out to test exploratory hypotheses 4, 5 and 6.

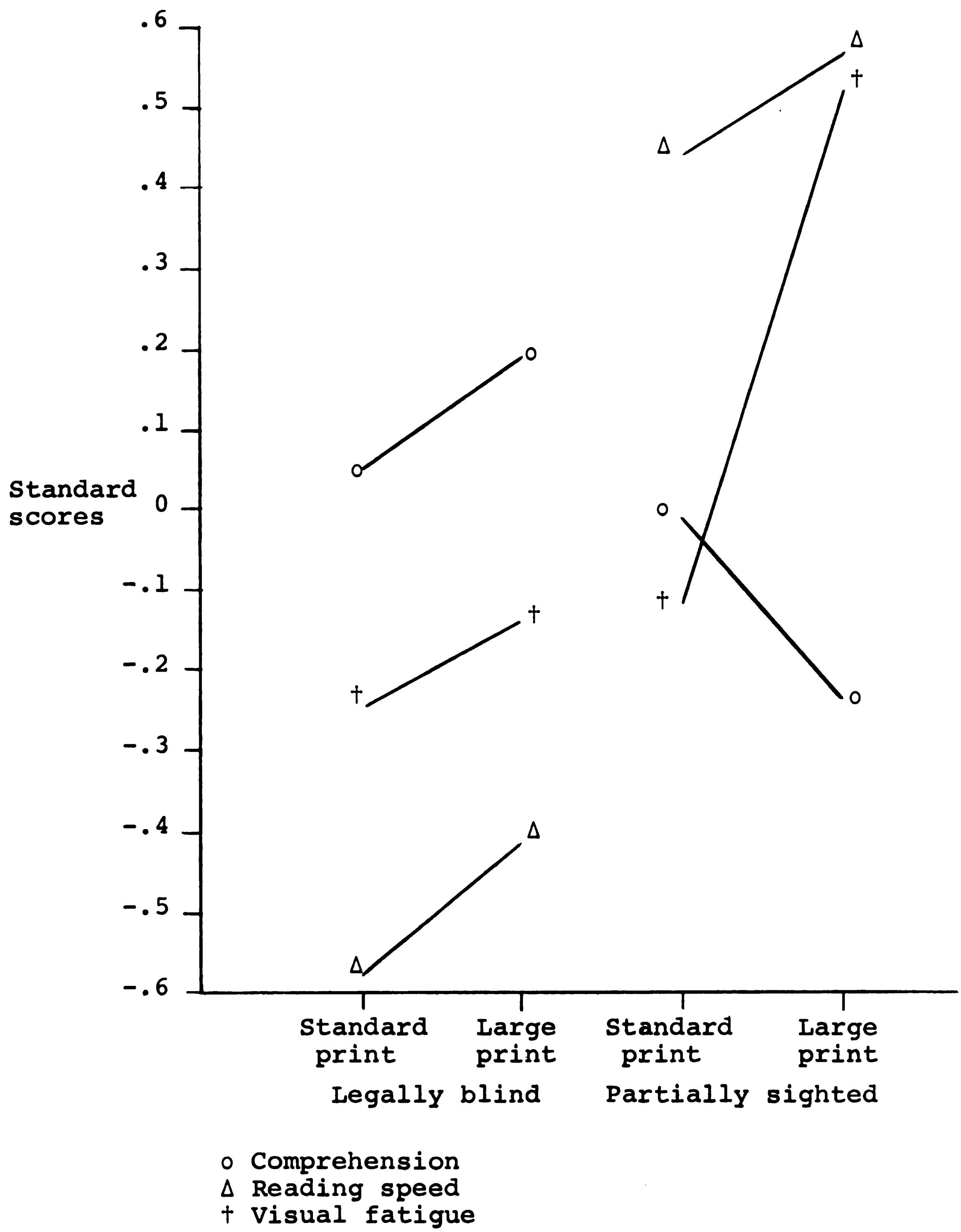


Figure 3. Measures by print by group interactions.

Hypothesis 4:a

It was stated in this hypothesis that the legally blind group and the partially sighted group tested independently would attain significantly higher mean comprehension scores on the Davis Reading Test presented in standard print than on an equivalent form of the test presented in large print. Tukey's test was applied to compare the means of the legally blind group on the measure of comprehension in standard print and large print. It can be seen in Table 10 that there was a mean print difference score of -.144 which was not significant. The same procedure was used to compare the means of the partially sighted group on the measure of comprehension. This group had a mean print difference score of -.233 which also was not significant. It is therefore concluded that there are no significant differences in comprehension on the two print sizes for the two groups of legally blind and partially sighted students. The hypothesis that higher comprehension scores would be attained in standard print is therefore not accepted.

Hypothesis 4:b

It was further postulated that partially sighted students would score higher than legally blind students. Inspection of Figure 3 shows that partially sighted students performed less well than legally blind students on

Table 10. Analysis of the difference scores between standard print and large print (Means, standard deviations and Tukey comparisons).

Legally Blind			Partially Sighted		
Comprehension	Speed	Fatigue	Comprehension	Speed	Fatigue
$\bar{D} = -.144$	$\bar{D} = -.162$	$\bar{D} = -.109$	$\bar{D} = -.233$	$\bar{D} = -.119$	$\bar{D} = -.653$
Sd = .108	Sd = .108	Sd = .108	Sd = .108	Sd = .108	Sd = .108
$q = -1.33^{NS}$	$q = -1.49^{NS}$	$q = -1.00^{NS}$	$q = -2.15^{NS}$	$q = -1.09^{NS}$	$q = -6.03$*

*Significant at .05 level

^{NS}Not significant

the measure of comprehension in both standard print and large print, the difference between the two groups being somewhat greater for large print than standard print. Table 11 gives mean group difference scores of -.063 and -.440 which were not significant. The hypothesis that partially sighted students will gain higher comprehension scores in standard print and large print than legally blind students is therefore not accepted.

Hypothesis 5:a

It was postulated that the legally blind group and the partially sighted group tested independently would attain higher mean reading speed scores on the Davis Reading Test presented in standard print than on an equivalent form of the test presented in large print. Tukey's test was applied to compare the means of the legally blind group on the measure of reading speed. Table 10 shows that there was a mean print difference score of -.162 for this group which was not significant. Tukey's test was then applied to the mean print difference score of the partially sighted group on the measure of reading speed; the difference here of -.119 was also found to be not significant. It is therefore concluded that there are no significant differences in reading speed on the two print sizes for the two groups of legally blind and partially

Table 11. Analysis of the difference scores between legally blind and partially sighted groups (Means, standard deviations and Tukey comparisons).

Standard Print			Large Print		
Comprehension	Speed	Fatigue	Comprehension	Speed	Fatigue
$\bar{D}$ = -.063	$\bar{D}$ = 1.037	$\bar{D}$ = - .131	$\bar{D}$ = - .440	$\bar{D}$ = .994	$\bar{D}$ = .675
Sd = .108	Sd = .108	Sd = .108	Sd = .108	Sd = .108	Sd = .108
q = $-.58^{NS}$	q = 9.60*	q = -1.21^{NS}	q = -4.07^{NS}	q = 9.20*	q = 6.25*

*Significant at .05 level

^{NS}Not significant

sighted students. The hypothesis that higher reading speed scores would be attained in standard print is therefore not accepted.

Hypothesis 5:b

It was further hypothesized that partially sighted students would score higher than legally blind students. Referring to Figure 3 it can clearly be seen that partially sighted students achieved much higher reading speed scores than legally blind students on both standard print and large print, the difference being fractionally greater for standard print than for large print. When Tukey's test was applied to the mean group differences in reading speed of 1.037 and .944 there was found to be a significant difference between the performance of the legally blind and partially sighted groups on both standard print and large print as can be seen in Table 11. The hypothesis that partially sighted students would score higher than legally blind students on the measure of reading speed is therefore accepted.

Hypothesis 6:a

It was hypothesized that the legally blind group and the partially sighted group tested independently would experience less visual fatigue on the Davis Reading Test presented in standard print than on an equivalent form of the test presented in large print. Tukey's test was applied to compare the means of the legally blind group on the measure of visual fatigue and it can be seen from Table 10 that the mean print difference score of -.109 was not significant. The same procedure was then used to compare the means of the partially sighted group on the measure of visual fatigue. This group had a mean print difference score of -.653 which was found to be significant at the .05 level. It can therefore be concluded that there is no significant difference in the amount of visual fatigue experienced by legally blind subjects on the two print sizes, but that there is a significant difference in the amount of visual fatigue experienced by the partially sighted subjects. The hypothesis that less visual fatigue will be experienced on standard print than on large print is, however, not accepted because the significant difference in the partially sighted group is opposite to that predicted. Partially sighted students experienced significantly less visual fatigue when reading the large print test than when reading the standard print test.

Hypothesis 6:b

It was further postulated that partially sighted students would experience significantly less visual fatigue than legally blind students. Referring to Figure 3 it can be seen that this was indeed the case. Tukey's test was applied to compare the mean difference scores of the legally blind and partially sighted groups on the measure of visual fatigue; these were, respectively, -.131 and .675, the latter score being significant at the .05 level as can be seen in Table 11. The hypothesis that partially sighted students would experience significantly less visual fatigue than legally blind students is therefore accepted in the case of large print, but since there was no significance between the mean scores on standard print the hypothesis, in this case, is not accepted.

Hypotheses 7, 8 and 9 concerning performance in preferred versus non-preferred print size were tested using a two-tailed t-test for inferences concerning two means on paired observations. Table 12 details the mean differences and standard deviation of differences for scores on preferred and non-preferred print.

Table 12. Analysis of the difference scores between preferred and non-preferred print size (Means, standard deviations, t-test comparisons).

Comprehension	Speed	Fatigue
$\bar{D}$ = .48	$\bar{D}$ = - .12	$\bar{D}$ = -2.14
Sd = 4.08	Sd = 4.17	Sd = 7.07
t = .73^{NS}	t = - .18^{NS}	t = -1.89^{NS}

^{NS}Not significant

Hypothesis 7

To test the seventh hypothesis that there would be no significant difference between the performance of visually impaired high school students in level of comprehension on the Davis Reading Test presented in their preferred size of print and in their performance on an equivalent form of the test presented in an alternative size of print, a comparison of the mean scores was made. It can be seen from Table 12 that there is a mean difference of .48 between the comprehension scores on the preferred versus the non-preferred forms of the test. A statistical analysis of this difference yielded a t value of .73 which was not significant. Therefore the hypothesis is accepted.

Hypothesis 8

Hypothesis 8 postulates that there will be no significant difference between the performance of visually impaired high school students in reading speed on the Davis Reading Test presented in their preferred size of print and in their performance on an equivalent form of the test presented in an alternative size of print. Inspection of the data in Table 12 shows that there is a mean difference of -.12 between reading speed scores on the preferred versus non-preferred forms of the test. A statistical analysis of this difference yielded a t value of -.18 which is not significant. Therefore the hypothesis is accepted.

Hypothesis 9

Hypothesis 9 predicted that there will be no significant difference between the amount of visual fatigue experienced by visually impaired high school students on the Davis Reading Test presented in their preferred size of print and in the amount of visual fatigue experienced on an equivalent form of the test presented in an alternative size of print. Inspection of the data in Table 12 shows that there is a mean difference of -2.14 between the visual fatigue scores on the preferred versus non-preferred tests. A statistical analysis of this difference yielded a t value of -1.89 which is not significant. Therefore the hypothesis is accepted.

In the course of the study it was felt to be of interest to look at the reading distance employed by the students; to compare high I.Q. with low I.Q. students; to investigate the relationship of visual acuity to performance; and to determine the reading rate in w.p.m.

Reading Distance

The average reading distance of the visually impaired high school students on the standard print form of the Davis Reading Test was 4.9 inches and on the large print test 6.7 inches.

Those students not using optical aids for reading either the standard print or the large print tests had an average reading distance of 5.3 inches for standard print and 7.5 inches for large print.

Upper and Lower Quartile Groups Ranked According to I.Q.

Table 13 shows the raw scores of the upper quartile and lower quartile groups ranked according to I.Q. Inspection of the mean scores for the higher I.Q. group shows that this group did fractionally better in comprehension but performed less well in reading speed and visual fatigue in standard print than in large print. The lower I.Q. group also performed better in comprehension on standard print and likewise did less well in reading speed and visual fatigue in standard print than in large print. It is interesting to note that the lower quartile group, while doing less well in comprehension than the upper quartile group, did perform better than this group in reading speed and visual fatigue.

Table 13. Comparison of scores between standard print and large print in upper and lower quartile groups ranked according to IQ.

			Standard Print			Large Print	
Subjects	IQ	Comprehension	Speed*	Fatigue*	Comprehension	Speed*	Fatigue*
1	135	72	12.75	13.29	75	11.90	13.11
2	121	53	16.10	13.27	51	12.16	8.00
3	120	54	19.41	35.00	60	32.05	16.00
4	120	80	41.78	11.00	71	32.00	15.00
5	119	63	36.35	5.00	71	31.06	8.00
6	119	74	8.18	18.00	72	8.80	13.00
7	116	72	13.53	13.29	73	17.86	13.11
8	112	63	8.38	13.29	64	8.81	13.11
9	112	63	40.31	13.29	62	34.00	13.11
10	112	66	12.18	3.00	66	10.66	4.00
11	94	63	10.26	11.00	62	10.20	15.00
12	94	63	10.85	3.00	58	12.30	9.00
13	94	62	13.00	23.00	63	8.45	9.00
14	93	62	12.38	11.00	62	10.48	8.00
15	92	58	11.85	12.00	53	8.70	3.00
16	91	62	15.36	15.00	65	15.21	6.00
17	91	55	9.20	13.27	58	7.53	8.00
18	90	65	13.56	13.00	66	14.06	16.00
19	90	68	13.43	13.27	61	10.43	8.00
20	90	63	9.31	10.00	61	10.18	9.00
Upper		66.0	20.89	13.84	66.5	19.93	11.64
Lower		62.1	11.92	12.45	60.9	10.75	9.10

*Higher scores indicate poorer performance

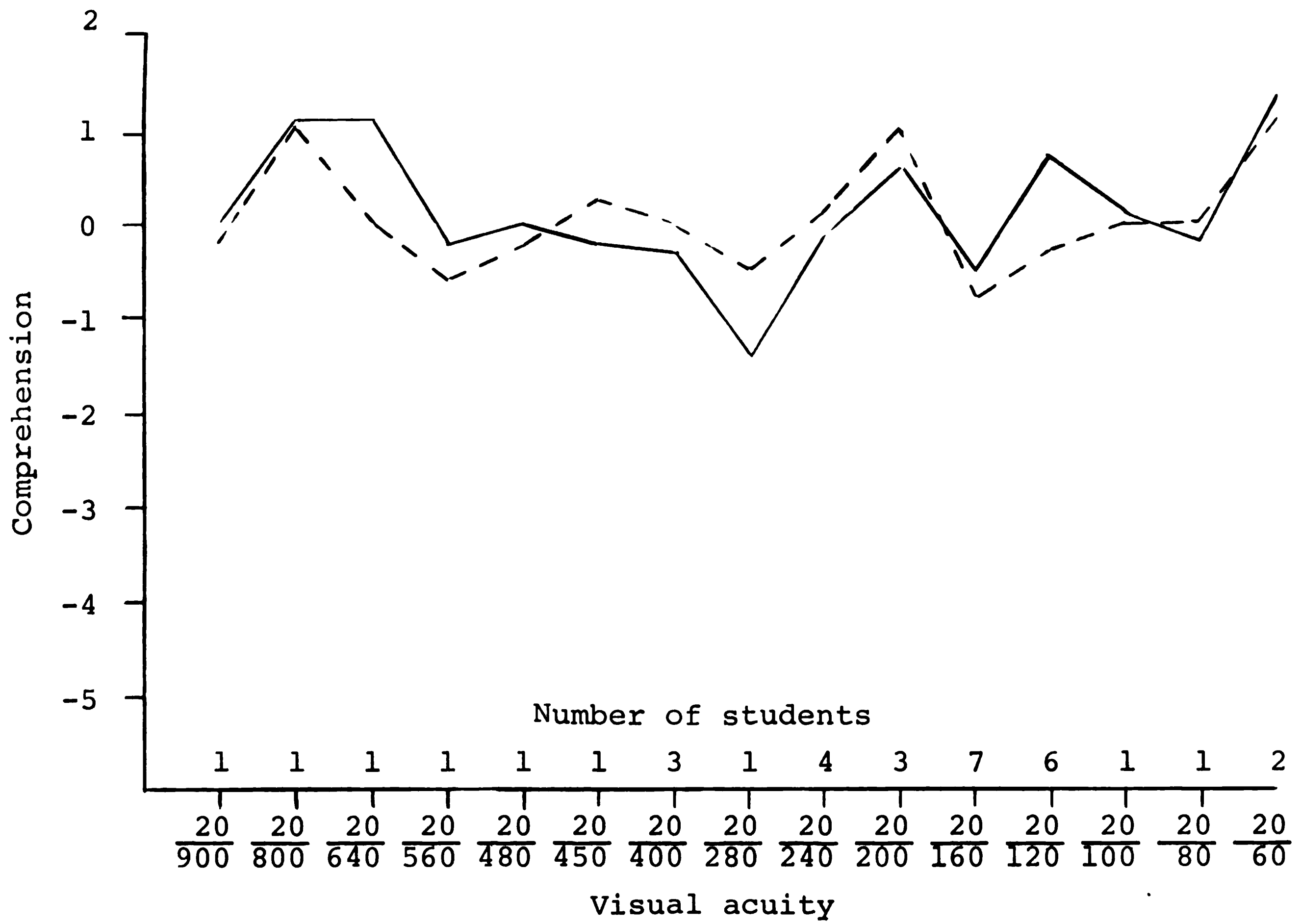
Relationship of Visual Acuity to Performance

Figures 4, 5 and 6 diagram standard scores on the measures of comprehension, reading speed and visual fatigue and their relationship to visual acuity. It should be noted that there is unreliability in the curves shown in these figures because they are based on the averages of the scores of very small numbers of subjects at each level of acuity.

From Figure 4 it can be seen that visual acuity bears no relationship to level of comprehension. Students with low visual acuities performed as well as those with higher acuities. Furthermore, there is little difference between performance on standard print and large print.

Figure 5 shows the relationship of visual acuity to reading speed. Here a trend can be observed towards faster speed of reading for subjects with higher acuities. There is little difference to be observed between scores on standard print and scores on large print.

The relationship of visual fatigue to visual acuity can be observed in Figure 6. The only discernable trend here is for subjects with acuities above 20/120 to experience progressively less visual fatigue on large print than on standard print. At acuities below 20/120 there is little difference between scores on standard print and large print apart from one subject with a visual acuity of



— Standard print
--- Large print

Figure 4. Relationship of comprehension scores to visual acuity.

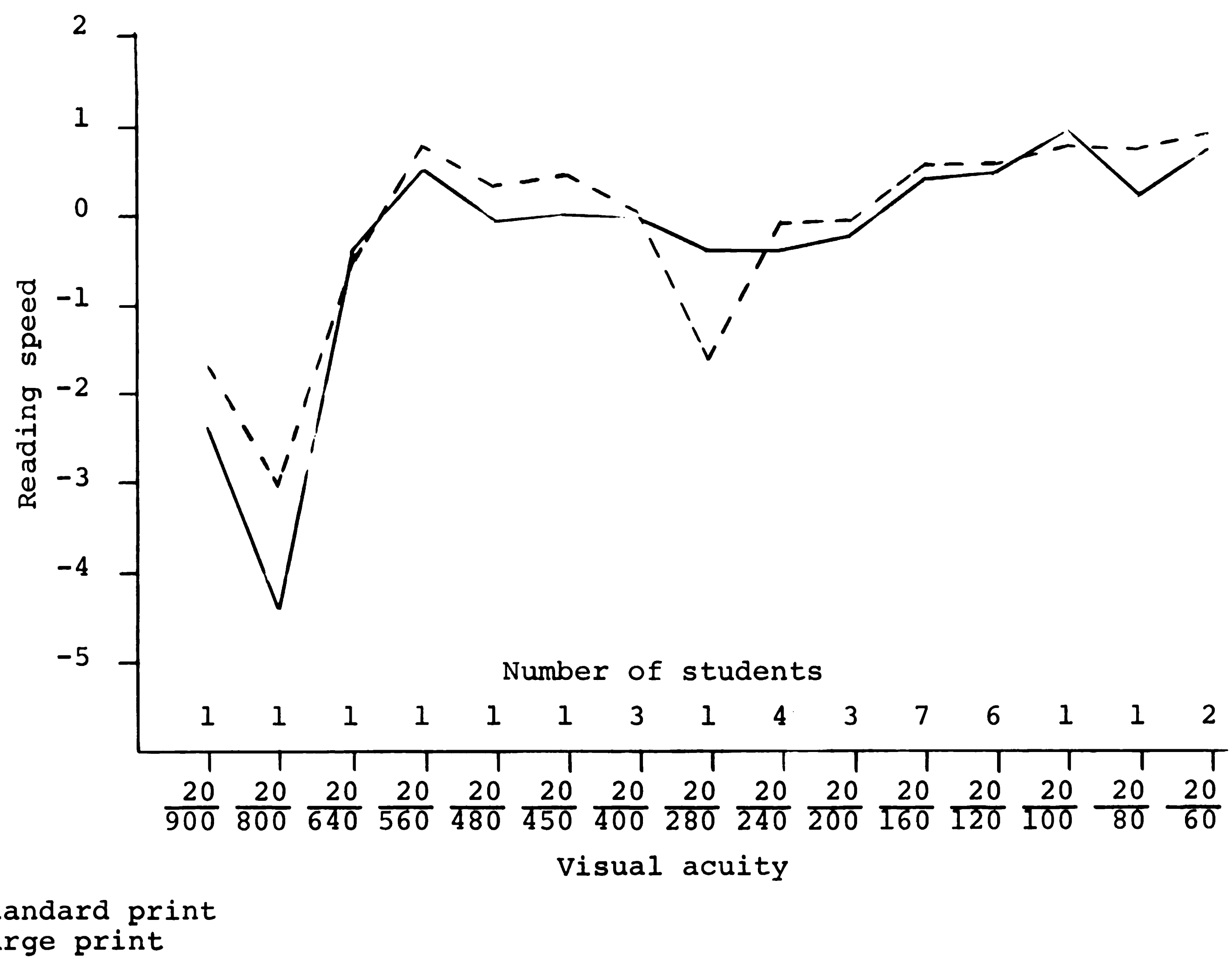
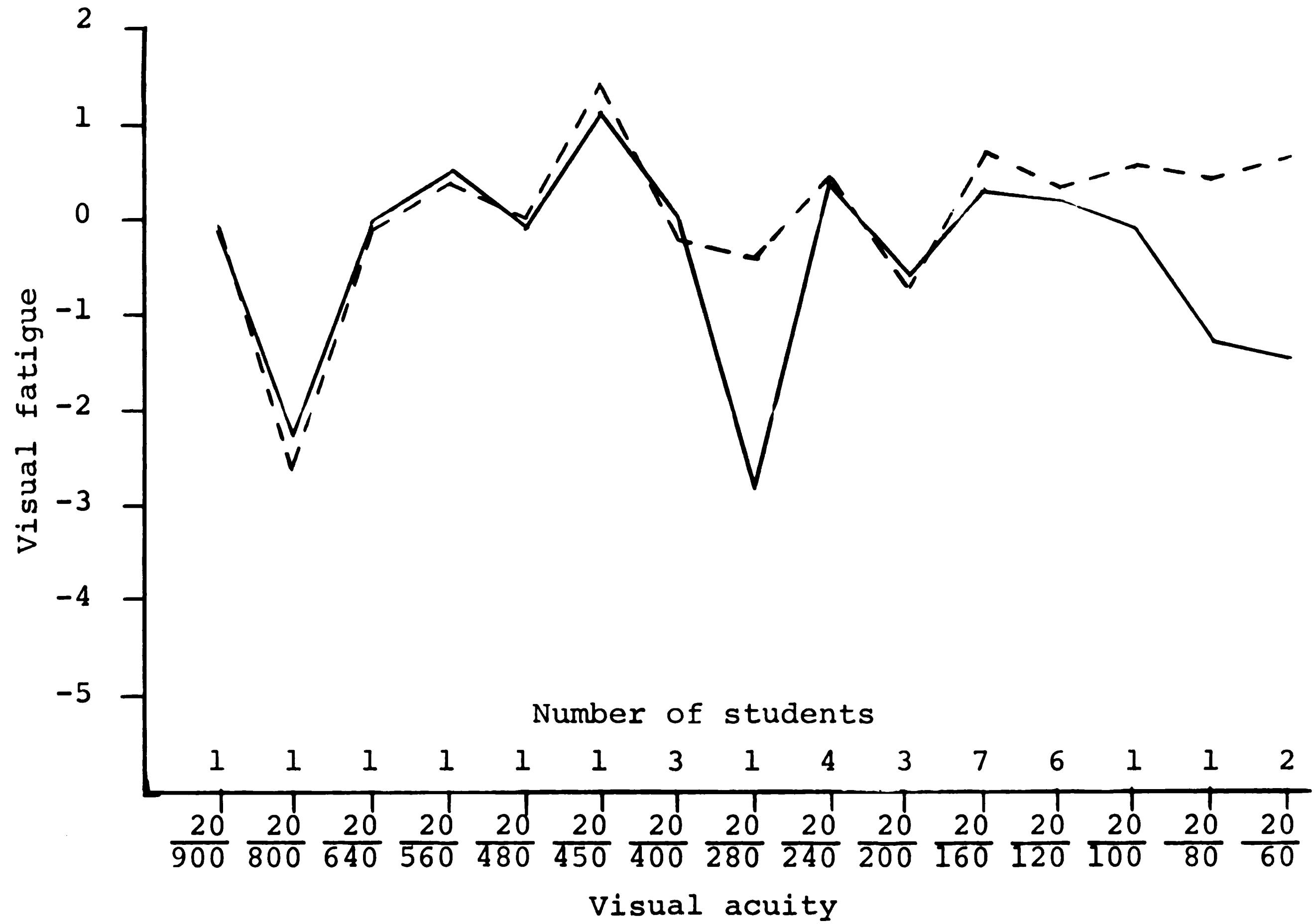


Figure 5. Relationship of reading speed scores to visual acuity.



— Standard print
--- Large print

Figure 6. Relationship of visual fatigue to visual acuity.

20/280 who experienced much more visual fatigue on standard print than on large print. One student with a visual acuity of 20/800 who took longer than anyone else to read the tests experienced significant amounts of visual fatigue on both standard print and large print. Other than these two students visual fatigue seems to be experienced as much by partially sighted students as by legally blind students in both print sizes.

Reading Rate in w.p.m.

It was determined that legally blind students read the standard print test at 48 w.p.m. and the large print test at 52 w.p.m.; whereas partially sighted students read the standard print test at 60 w.p.m. and the large print test at 65 w.p.m.

CHAPTER IV

INTERPRETATION AND CONCLUSIONS

The first three hypotheses postulated that visually impaired students would perform better in standard print than in large print on measures of comprehension, reading speed and visual fatigue. From the statistical analysis it was determined that the students manifested significantly less visual fatigue on the large print test than on the standard print test. There were, however, no significant differences in performance in standard print and large print on the measures of comprehension and reading speed.

The data regarding visual fatigue must, however, be interpreted with caution. The writer encountered a number of problems in measuring eye-blink rate. It was extremely difficult at times to determine a blink from a squinting or screwing up of the eyes, and it was impossible in some cases to judge blink rate at all because the student's eyes were hidden by long hair or by the test booklet being held very close to the face. Although care was taken in attempting to observe the student outside of his visual field, it is likely that a few students were aware of being scrutinized and this might possibly have brought about an increase in their blink rate. Because of these difficulties it was decided to exclude the eye-blink data of six partially sighted and seven legally blind students. The eye-blink scores for these 13 students were therefore estimated at the means for their groups.

Since there were no significant differences between performance in the two print sizes on measures of comprehension and reading speed it can be concluded that standard print, while no better, is as effective as large print in facilitating speed of reading and comprehension. These findings lend support to what has been surmised previously, that when visually impaired persons are given the opportunity and good reading conditions they can read standard print just as fluently as they read large print. This suggests that unless there is evidence that large print provides a significant ease of seeing there is every reason to encourage the use of standard print.

It was stated in hypotheses 4:a, 5:a and 6:a that the legally blind group and the partially sighted group tested independently would attain higher scores in standard print than in large print on the measures of comprehension, reading speed and visual fatigue. The findings indicated that there were no significant differences between scores on standard print and large print except for the one significant difference in the partially sighted group whose members manifested significantly less visual fatigue when reading the large print material than when reading standard print. Therefore it can be concluded that standard print is as effective as large print in facilitating comprehension and reading speed for both partially sighted and legally blind students. This would hold true as far as the legally blind group is concerned on the measure of visual fatigue. The partially sighted group, however, manifested significantly less visual fatigue on the large print material than on the standard print material. It would therefore appear that large print does confer a significant ease of seeing for partially sighted students, and this would constitute its only advantage over standard print in this study. It was surmised that the partially sighted group might have used different optical aids for the standard print and large print tests and that this might have influenced the levels of visual fatigue experienced on the two tests. However, a check revealed that six partially sighted students used no aids for either test and ten students used the same aid for reading both the standard print and large print tests. Only one partially sighted student used a different aid for each of the two tests. All the students in this study had used both standard and large print (though four legally blind students were primarily braille readers) but it could be that the partially sighted students were more familiar and practiced in the use of large print which might account for the lesser amount of visual fatigue on this test.

Hypotheses 4:b, 5:b and 6:b stated that partially sighted students would gain significantly higher scores than legally blind students. The analysis of the results shows that partially sighted students gained higher scores in both standard print and large print on the measure of reading speed and experienced less visual fatigue on the large print test than the legally blind group. There were no significant differences in the scores of the two groups on the measure of comprehension or in the amount of visual fatigue manifested when reading standard print material.

It is to be expected that the partially sighted group would read both standard print and large print faster than the legally blind group. Many of the legally blind students had extremely low visual acuities and some were primarily braille students and therefore not as practiced as the partially sighted group in reading print. One legally blind student, for example, took 59.73 minutes to read the passages of the standard print test and 45.61 minutes to read the large print test. In contrast, a partially sighted student read the standard print test in 3.41 minutes and the large print test in 4.36 minutes.

It is interesting to note that while higher visual acuity confers a significant advantage in speed of reading this is not the case as regards comprehension. Though there was no significant difference between the legally blind and partially sighted groups in comprehension, the legally blind group did somewhat better than the partially sighted group on this measure.

The partially sighted students did not manifest less visual fatigue than the legally blind students on the standard print material though they were significantly less fatigued than the legally blind group when reading large print material. On checking the optical aids used by the legally blind group it was found, as expected, they were more powerful than those used by the partially sighted group, and it could be that the increased light-gathering properties of the more powerful lenses might well result in greater visual fatigue for the legally blind group. On the other hand, it is difficult to determine why the partially sighted group did not also manifest less visual fatigue than the legally blind group on the standard print test. The optical aids used by the partially sighted group to read standard print did not differ from those they used to read large print. Two legally blind students, however, used stronger lenses to read the standard print test, and four others who had not needed lenses to read large print required them in order to read the standard print material. One would therefore expect that the partially sighted group would experience a lesser amount of visual fatigue than the legally blind group on the standard print test if the high powered lenses were contributing to fatigue factors.

It may be that the answer lies in the partially sighted students' greater familiarity and practice with large print materials which could explain the difference in fatigue scores between the two groups.

Hypotheses 7, 8 and 9 were accepted. There were no significant differences in performance on the tests in preferred and non-preferred size of print. It can therefore be concluded that a subjective choice of preferred print size bears little or no relationship to performance on the chosen size of print.

We can speculate on what might have led a large number of students to state a preference for a particular size of print when they clearly do just as well on a non-preferred size of print. Of the 39 students who expressed a preference for either standard print or large print, almost two-thirds (27 students) said they preferred standard print. A number of different reasons for this preference centered around: ease of reading, greater convenience, less fatiguing, quicker to read, better illustrated, and easier to handle. Most of the students who preferred large print did so because they found it easier to see (rather than easier to read) than standard print. A few students stated that large print was less fatiguing to read and was quicker to read than standard print.

Despite the obvious advantages of standard print that were probably recognized by the students, it seemed significant to the writer that not one student said he preferred standard print because it gave him greater feelings of normality. Could it be that some students tend to choose standard print in preference to large print because large print categorizes them as handicapped? The majority of students in this study had spent part of their school careers in the public schools before transferring to a residential school and a number of them now found they were doing their schoolwork in large print rather than the standard print to which they had been accustomed.

The answer, however, might well be simpler than rejection of large print because of an underlying rejection of one's handicap. An article printed in large type appears to contain much more material than the same article printed in standard type. This could lead one to make an incorrect estimate regarding the length of the article and, because it appears to be much longer, to prefer the standard print article which looks to contain much less material. Whatever the reasons, it would seem necessary for there to be a careful appraisal of each student's reading skills on both standard print and large print before guidance can be given regarding the more suitable reading medium, and to regard with suspicion a subjectively determined preference for a certain size of print.

Reading Distance

The reading distance of each student was checked at the beginning and again towards the end of each test. It was determined that the average reading distance of the visually impaired high school students on the standard print form of the Davis Reading Test was 4.9 inches and on the large print test 6.7 inches. It appears therefore that large print confers little advantage insofar as reading distance is concerned. While many students could read the large print at a greater distance than the standard print and would begin by holding the large print test material further from the eyes, all of them quite quickly decreased the reading distance as the test progressed.

A number of students with higher visual acuities were able to maintain a greater reading distance on the large print test, especially those using relatively weak corrective lenses and those who did not use optical aids for reading. The average reading distance for those students not using optical aids on either standard print or large print was 5.3 inches for standard print and 7.5 inches for large print.

It was noted that the reading distance of those students using very strong corrective lenses varied hardly at all from one size of print to the other, because of the very small range of focus of the high plus lenses.

Upper and Lower Quartile Groups Ranked According to I.Q.

It has been surmised by some educators that low I.Q. visually impaired children tend to perform better when reading large print than standard print. In order to shed light on this proposition it was decided to compare the data of the upper and lower quartile groups.

It was found that both the high I.Q. group and the low I.Q. group performed rather better in comprehension but performed less well in reading speed and visual fatigue in standard print than in large print.

An unexpected finding was that the low I.Q. group while doing less well in comprehension than the high I.Q. group did perform better than this group in reading speed and visual fatigue. A possible explanation may be because of the greater number of partially sighted students in the lower I.Q. group than in the upper I.Q. group (six to two); or because the higher I.Q. children made a more realistic appraisal of the difficulties of the test and slowed their reading rate in order to concentrate and better comprehend the material. The greater concentration might account for the higher level of visual fatigue as measured by eye-blink rate.

This data, of course, must be regarded as speculative because the sampling procedure did not control for the confounding variables of acuity, age, etc.

Visual Acuity and Performance

It was determined that: (1) there was no relationship between visual acuity and comprehension; (2) that students with higher acuities read faster than those with lower acuities; and (3) that students with acuities above 20/120 progressively experienced less visual fatigue on large print than on standard print. It has been remarked that this last finding might be because of the partially sighted students' greater familiarity and practice with large print rather than because large print is intrinsically less fatiguing to read than standard print.

Apart from the expected finding that higher visual acuity enhances reading speed, it would appear that little reliance can be placed on visual acuity as a guide to the reading performance of visually impaired students.

Reading Rate in w.p.m.

Legally blind students read the standard print test at 48 w.p.m. and the large print test at 52 w.p.m.; the partially sighted students read the standard print test at 60 w.p.m. and the large print test at 65 w.p.m.

These reading rates appear to be very poor when compared with the rate of 250 w.p.m. which is a rough estimate of the normal rate of reading for high school students.[1] They also compare unfavorably with the average reading rate for braille which is about 90 w.p.m.[2]

It must be remembered, however, that reading rate in this study was essentially a speed of comprehension rate. Norms for rate of reading are misleading because results vary depending on the type of material used and the type of comprehension checks employed.[3] Harris details four types of reading rates suitable for different purposes: skimming, rapid reading, normal, and careful. As yet, no one has attempted to set up rate norms for these four different kinds of rates.[4]

The visually impaired students reading the Davis Reading Test would certainly employ a very careful rate of reading because of the complexity of the passages and the detailed comprehension checks employed, and this would drastically reduce their rate of reading.

All that can be safely said about these data is that large print is marginally faster to read than standard print for both partially sighted and legally blind students, and that partially sighted students read about 12 w.p.m. faster than legally blind students.

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[1]Harris, How to Increase Reading Ability, p. 508.

[2]Carson Y. Nolan, "Reading and Listening in Learning by the Blind," Exceptional Children, XXIX, No. 7 (March, 1963), 315.

[3]Harris, How to Increase Reading Ability, p. 508.

[4]Ibid., p. 509.

Summary Statement

It is concluded that when visually impaired high school students are tested under optimum reading conditions and when corrective lenses for near vision have been prescribed, they perform as well in standard print as in large print on measures of comprehension and reading speed. Large print, however, is apparently less fatiguing to read than standard print possibly because of the students' greater familiarity and practice with large print materials.

Both the legally blind students and the partially sighted students comprehend standard print as well as they do large print, and they read standard print as quickly as they do large print. The legally blind students find standard print no more fatiguing to read than large print, though the partially sighted students do experience less visual fatigue when reading large print than standard print.

Partially sighted students read faster than legally blind students but the two groups achieve comparable levels of comprehension. Partially sighted students also experience less visual fatigue than legally blind students when reading large print, but not when reading standard print.

No reliance is to be placed on a subjectively determined preference for a certain size of print, since the visually impaired students' performance in preferred print size did not differ significantly from performance in their non-preferred print size.

Large print offers little advantage insofar as reading distance is concerned, and no advantage for those students who use strong corrective lenses for reading.

Speculations regarding the relationship of I.Q. to performance were inconclusive.

Visual acuity is not related to performance on the measure of comprehension, but those students with high acuities are able to read both standard print and large print faster, and experience progressively less visual fatigue on large print.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

The Problem

Educators of visually impaired children are increasingly concerned to help them make the maximum use of residual vision by: (1) direct training of visual skills, (2) use of low vision aids, and (3) use of large print materials.

This concern has been brought into focus by the realization that the majority of visually impaired children--including many in the legally blind category--are print, not braille readers, and that the increasing reading load in schools today, together with the trend towards educating visually impaired children in the public schools, puts an inordinate burden on the handicapped child unless he can utilize the same materials as his peers and be assisted to achieve comparable levels of attainment in the tool subjects.

Though objective evidence is lacking regarding the relative merits of standard print and large print in facilitating the reading skills of visually impaired children, a trend towards greater use of large print can be observed, especially in the last five years with the entry of a large number of publishers into the large print market.

Purpose of the Study

The purpose of the study was to determine whether visually impaired high school students performed differently on measures of comprehension, reading speed and visual fatigue on standard print and large print material, and what relationship preference for a particular size of print had on reading performance. Additionally, it was decided to explore any differences between the performances of partially sighted and legally blind students.

It was hypothesized that visually impaired high school students would attain higher scores on the standard print test than on the large print test, and that partially sighted students would score higher than legally blind students. It was also hypothesized that visually impaired students would perform equally well on preferred as on non-preferred size of print.

Design of the Study

Subjects

Twenty-four legally blind and 17 partially sighted students took part in the study. All students had been judged capable of reading print and had received a most thorough optometric evaluation and, when necessary, had been fitted with corrective lenses for near vision.

Procedure

In order to equalize practice effects and fatigue factors favoring either standard print or large print, the students were randomly divided into four groups and the presentations of the standard print and equivalent large print forms of the Davis Reading Test were alternated. All students were tested individually by the writer. They were free to choose whatever low vision aids they required and were allowed as much time as they needed in order to complete the test.

Materials

Two equivalent forms of the Davis Reading Test, consisting of reading passages followed by multiple-choice questions were utilized.

Test modifications

The Davis Reading Test was made available in standard (10-point) print and in large (18-point) print. The reading passages were placed on the left-hand pages with the multiple-choice questions opposite them on the right-hand pages.

Test conditions

The students were tested under flexible conditions. Each student was free to choose his most comfortable reading distance and level and angle of illumination. Optical and non-optical aids were freely available and unlimited time was given in which to complete the tests.

<u>Test measures</u>

The students read the timed test passages silently and responded orally to multiple-choice questions which were scored by the examiner. Measures of comprehension, reading speed, reading distance and visual fatigue were obtained. After completing the second test the students were asked to state their preferred size of print.

Analysis of the Data

The hypotheses concerning preferred size of print were analyzed using a two-tailed t-test concerning means on related samples. All other hypotheses were tested using a three-way analysis of variance.

Conclusions

The prediction that visually impaired students would perform better in standard print than in large print on measures of comprehension, reading speed and visual fatigue was not accepted. However, performance was as good on the standard print test as it was on the large print test on the measures of comprehension and reading speed. The comprehension of both the legally blind group and the partially sighted group was as good on standard print as on large print, and both groups read standard print as quickly as they did large print. Furthermore, the legally blind students found standard print no more fatiguing to read than large print. The only advantage conferred by large print was found among the partially sighted students who experienced less visual fatigue when reading large print than when reading standard print.

Partially sighted students read faster than legally blind students but the two groups achieved comparable levels of comprehension.

Performance was found to be as good on the non-preferred print size as it was on preferred print size.

Large print offers little advantage insofar as reading distance is concerned, and no advantage to those students using strong corrective lenses.

Visual acuity was not related to performance on the measure of comprehension, but both standard print and large print were read faster by those students with higher acuities who also experienced less visual fatigue on large print.

Speculations regarding the relationship of I.Q. to performance were inconclusive.

The writer therefore concludes that standard print is as effective as large print in facilitating the reading skills of comprehension and reading speed for both legally blind and partially sighted students. Large print appears to offer an ease of seeing for those students whose visual acuities approach the normal range, but offers little advantage in an increased reading distance. No reliance is to be placed on a subjectively determined preference for a certain size of print. Higher visual acuity enables both standard print and large print to be read faster but does not facilitate comprehension any more than does lower visual acuity.

Recommendations

The students in this study were fortunate in having thorough and repeated optometric evaluations that included correction for both distant and near vision. Specific assistance was given to motivational problems and in aiding the students understand and use their optical aids more effectively. The students were also receiving direction in the utilization of visual skills, the initial thrust of this recently introduced program being towards the teaching of print reading to those students with no previous knowledge of print, and also in the overcoming of emotional barriers to reading. It is recommended that this type of assistance be provided for all visually impaired children. Parental education and involvement is seen to be crucial since the parents of a number of students were procrastinating about allowing their children to be fitted with the necessary optical aids.

There is reason to believe that those visually impaired individuals who have received correction for near vision and who can see well enough to read print should, in most cases, be able to use standard print materials. Attention must be given, however, to providing optimum reading conditions. Large print will continue to have value for many people with very low acuities who cannot for physical or psychological reasons use standard print, or for those whose work demands an increase in the size of print.

Evidence presented in this study points out how unreliable visual acuity is as a guide to reading ability, though higher acuity undoubtedly facilitates reading speed. It is therefore recommended that emphasis should be placed on an individual appraisal of each visually impaired student to ascertain his functional use of vision. An objective measure of the reading skills of each individual is needed, rather than placing reliance on a subjective preference for a certain size of print or on offering guidance based on a measure of visual acuity.

Despite the adequate illumination in the room in which they were tested, most of the students in this study chose also to use an angled reading lamp at high intensity when taking the test. It is therefore recommended that an adequate number of reading lamps having variable intensity levels be made available in classes for the visually impaired.

It is considered better for those who read by holding the book very close to the eyes, to move the book rather than the head when scanning the lines of print. The writer found that the majority of students used the latter method and most of them made frequent changes of posture, some holding the book close up to the face, others placing the book flat on the desk and hunching up over it to read. Very few chose to use a reading stand. It is therefore recommended that students be taught how best to read by moving the book in front of the eyes, and that research be undertaken to devise a means of holding the book at eye-level that would enable the individual to move the page horizontally across his field of vision and, at the end of each line, move the page vertically and across to the beginning of the next line.

Where large print materials have to be used it is recommended that the size and weight of the book be reduced, and that the binding be such that the pages can be flipped over to be held against the back of the book--a very effective means of reducing its bulk.

This study is limited in that the period of reading demanded of the students was rather brief. Research is therefore indicated to determine which size of print best facilitates longer reading periods. Research is also needed to explore the use of large print materials vis-à-vis optical aids. It could be that it is less fatiguing for some individuals to read large print without optical aids than it is to read standard print with the help of optical aids. In view of the slow reading rate of the visually impaired students it would be of interest to determine whether rapid reading techniques might foster speed of reading. Also it must not be forgotten that if a student is reading at a very slow rate his main mode of input may have to be an auditory one to overcome the difference in reading rate between the sighted and the visually impaired.

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APPENDIX

SAMPLE STANDARD PRINT AND LARGE PRINT

TEST PASSAGES

MAY 1, 1898

Oh, dewy were the Spanish isles
that humid day in May
When Dewey was the commodore
on broad Manila Bay.
And dewy were the Spanish eyes
that looked upon the sight
For Dewey met the Spanish fleet
and put it all to flight.
And do we know that Dewey won
and did not lose a single son
Of Uncle Sam? Do we? Of course, we do!

33. This verse plays on the word (or words)

A Spanish.
B day in May.
C commodore.
D do we.
E single son.

34. The "Spanish eyes" were

A bright.
B tearful.
C fresh and young.
D hopeful.
E half closed.

35. The battle mentioned was

A bloody.
B bravely fought.
C one-sided.
D indecisive.
E lengthy.

36. The tone of this verse is

A mournful.
B warlike.
C reverent.
D light.
E formal.

The difficulties of the Chinese language are well known. It consists of thousands of characters, not inflected or agglutinated (agglutination is forming new words by combining two or more significant words) as Western languages are. They can be classified under three heads: pictograms (pictures of objects, much simplified), ideograms (composite symbols standing for abstract ideas), and phonograms (representations of spoken sounds). This last class of character now constitutes at least nine-tenths of the language.

37. Which of the following English words is most likely to be represented in Chinese by an ideogram?

A Warrior
B Rainstorm
C Prison
D Confidence
E Wind

38. Which of the following English words appears to have been formed by agglutination?

A Breakfast
B Hullabaloo
C Whistle
D Wigwam
E Children

39. Which type of Chinese character occurs most frequently in the language?

A Pictogram
B Ideogram
C Phonogram
D The types are about equal in this respect.
E The passage does not say.

40. "They" (line 6) refers to

A "difficulties" (line 1).
B "thousands of characters" (lines 2-3).
C "new words" (line 4).
D "significant words" (line 5).
E "Western languages" (line 6).

Go on to the next page.

MAY 1, 1898

Oh, dewy were the Spanish isles
  that humid day in May
When Dewey was the commodore
  on broad Manila Bay.
And dewy were the Spanish eyes
  that looked upon the sight
For Dewey met the Spanish fleet
  and put it all to flight.
And do we know that Dewey won
  and did not lose a single son
Of Uncle Sam? Do we? Of course, we do!

33. This verse plays on the word (or words)

- **A** Spanish.
- **B** day in May.
- **C** commodore.
- **D** do we.
- **E** single son.

34. The "Spanish eyes" were

- **A** bright.
- **B** tearful.
- **C** fresh and young.
- **D** hopeful.
- **E** half closed.