READING PERFORMANCE OF VISUALLY IMPAIRED PRINT READERS USING STANDARD PRINT, LARGE PRINT AND MAGNIFICATION

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ABSTRACT

READING PERFORMANCE OF VISUALLY IMPAIRED PRINT READERS USING STANDARD PRINT, LARGE PRINT AND MAGNIFICATION

By

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Sixty-four visually impaired elementary age print readers from eight locations in Ontario and Michigan were individually tested under four reading conditions.

The purpose of this study was to seek objective information regarding the relative effectiveness of standard and large print, used with and without magnification in facilitating the reading skills of visually impaired elementary age print readers.

Specifically the study sought to determine whether the reading speed, accuracy and comprehension scores of visually impaired elementary age print readers would differ when reading twelve and eighteen point print with and without magnification.

The children were individually tested with four parallel forms of the Gray Oral Reading Test. Reading speed, accuracy and comprehension scores were tabulated.

The prediction that there would be no difference between performance on large and standard print as measured

by reading speed, accuracy and comprehension, proved to be accurate. It was concluded that visually impaired elementary age print readers, as a total group, (when no differentiation is made for acuity level or eye defect) perform equally well on standard and large print.

The hypotheses which predicted that there would be no difference in performance of visually impaired elementary age print readers as measured by reading speed, accuracy and comprehension, when reading either standard or large print as compared with reading standard print magnified, were all rejected. It was concluded that magnification of standard print was less effective in facilitating the reading skills of visually impaired elementary age print readers than either large or standard print without magnification. This conclusion was also based on comparisons within the entire group.

The prediction that there would be no difference between performance under conditions preferred by the subjects and alternate test conditions was found to be correct. It was concluded that the subjective judgement of visually impaired elementary age print readers was not to be relied on as an indicator for selecting the most appropriate material or reading condition. The supposition that age, intelligence and acuity level would significantly affect performance could not be proven. Some supporting evidence was found, to suggest that acuity level and eye defect may be factors which do influence performance.

Evidence in this study suggests that large print may be marginally better than standard print but that it is not significantly so. From the information gathered in this study it would seem that there may be subgroups within the larger population of visually impaired elementary age print readers for whom large print is more important.

This study also produced information which indicates that there are some children for whom simple magnification of standard print is beneficial.

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By

John Bock

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The completion of each phase in an individual's professional development provides an opportunity for taking stock. At such time one is reminded of the debt which he has accumulated.

A thesis represents the involvement and efforts of many people, and although the researcher accepts full responsibility for any weaknesses which may appear, the credit for strengths must be shared. The writer has been the beneficiary of considerable assistance from so many sources that it is not possible to mention by name everyone who has played a role in this study. This does not diminish his appreciation of their individual and collective efforts.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Problem

There is a continuing concern among educators for the development of learning environments which are conducive to the optimal development and maximum use of the potentialities which an individual may possess.

In recent years there has been increased emphasis on the possibility of enabling the visually impaired child to make greater and more efficient use of his residual vision. The realization that the majority of visually impaired children, including many in the legally blind category, are able to read print, has stimulated a lively interest in (a) direct vision training, (b) the use of low vision aids, and (c) the use of large type print materials.

One of the primary objectives for individuals with low vision is to maximize their ability to receive and perceive greater quantities of the environment through the visual sense in the most effective manner.[1] Three important considerations in any attempt to facilitate this process are, (a) the individual person, (b) the

characteristics of the stimulus, and (c) the nature of the stimulus.

Since reading provides one of the chief avenues to information within the public school setting, it follows that printed materials occupy a position of major importance in the educational process. The quality of these materials and/or the manner in which they are utilized, may therefore contribute significantly to the relative effectiveness of their use by the reader.

Examination of current practices in programs for the visually impaired suggest two basic approaches toward modification of the stimulus in the reading process. The objective in both, use of large print and use of magnification, is to effect an increase in the size of the retinal image. The use of enlarged print has been intermittently promoted since 1880 when it was first introduced "for children with weak sight whose eyes must be spared."[2] However, the use of optical magnifications is a relatively recent occurrence.[3]

Though objective evidence is still somewhat lacking regarding the relative merits of standard print, large print and optical aids in facilitating the reading skills of visually impaired children, a new interest in this area of education appears to be developing.[4]

The changing philosophy in special education, towards integration of the handicapped child, has resulted

in increased numbers of visually impaired children receiving their education alongside their sighted peers in the regular public schools.[5] This trend has, in some instances greatly extended the demand for an increase in the quantity and variety of large print materials. There is no doubt that many of the current practices in public schools are based on sound reasoning and an accurate assessment of children's needs but there remains some doubt regarding the efficacy of certain practices. Fonda[6] indicates that the widespread use of large print books may be one of these. He contends that, "The demand for books in large print is great because of custom and tradition."[7] In his opinion it is reasonable to expect that most readers of large print would do just as well with standard print.

Ophthalmologists[8] at a major children's eye service center have recently suggested that further research is needed at the elementary level to determine the size of print required for acceptable reading on the part of the visually impaired child.

The use of optical devices as aids in the utilization of standard print has been suggested as a possible alternative to the use of large print.[9,10] Minner[11] states that he is convinced that most of the school children and others now using large print books could be using ordinary print if they were given appropriate aids.

To the extent that magnification and large print perform a similar function, one might expect that they would be equally effective in facilitating the reading skills of visually impaired pupils. Proponents of optical aids indicate that the need for large print will diminish if more widespread use is made of optical aids.[12] They express concern, however, that continual expansion of the large print field may actually discourage the increased acceptance of aids.

Root[13] expresses concern about this problem and emphasizes that the use of optical aids by visually impaired pupils needs a great deal of mutual exploration by educators and ophthalmologists. She emphasizes that in this relatively new area of specialization there is much to be gained by sharing information regarding the efficacy of these aids in the classroom setting.

Present emphasis on "sight utilization" as opposed to "sight saving" has raised numerous questions regarding the extent to which the use of standard or large print materials should be promoted in the elementary school.[14] The lack of objective evidence regarding these questions underscores the need for research in this area.

Bateman[15] emphasizes that the most striking conclusion to be reached from a survey of the major research literature on the partially seeing, is that such research is almost non-existent. At the same time it has been pointed out by others[16] that traditional practice must be

carefully examined and new knowledge and procedures developed if the partially seeing child is to reach his potential development.

The Purpose of The Study

The purpose of this study was to seek objective information regarding the relative effectiveness of standard and large print, used with and without magnification, in facilitating the reading skills of visually impaired print readers at the elementary level.

Additional information was sought regarding the possible influence of preference for standard or large print used with and without magnification on the reading performance of visually impaired print readers at the elementary level.

And finally, exploratory evidence was sought regarding the possible effects of age, intelligence and visual acuity on the reading performance of visually impaired elementary age print readers using standard and large print with and without magnification.

Major Questions

Specifically, this study sought to answer the following questions:

1. Is there a difference between the reading speed scores obtained by visually impaired elementary age print readers on parallel forms of the Gray Oral reading test presented in standard and large print, with and without magnification.

2. Is there a difference between reading accuracy scores obtained by visually impaired elementary age print readers on parallel forms of the Gray Oral reading test presented in standard and large print, with and without magnification.

3. Is there a difference between reading comprehension scores obtained by visually impaired elementary age print readers on parallel forms of the Gray Oral reading test presented in standard and large print, with and without magnification.

Exploratory Questions

These questions sought to explore the possible influence of additional factors.

1. Is there a difference between the reading scores obtained by visually impaired, early and late elementary age print readers on parallel forms of the Gray Oral Reading Test presented in standard and large print, with and without magnification?

2. Is there a difference between the reading scores obtained by visually impaired elementary age print readers of upper and lower intelligence ranges, on parallel forms of the Gray Oral Reading Test presented in standard and large print, with and without magnification.

3. Is there a difference between the reading scores obtained by visually impaired elementary age print readers with greater and lessor degrees of vision on parallel forms of the Gray Oral Reading Test presented

in standard and large print, with and without magnification.

This chapter has presented an introduction to the problems and outlined the purpose of this study. Chapter II includes a brief review of the related literature and a summary of the conclusions which may be drawn from it. The research procedures are given in Chapter III. Chapter IV deals with the research design and analysis of the results. The findings of the study and conclusions based on these findings are discussed in Chapter V.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter, devoted to a review of some of the related literature, will deal briefly with the visually impaired reader, the characteristics of print, optical aids, illumination and the reading process. Consideration will also be given to experimental design, measures of legibility and to related studies performed previously.

The Visually Impaired Reader

To describe visually impaired children is a difficult task. Their similiarities are few; they are, according to Nolan "quite heterogenous in regard to visual disability, visual acuity and other characteristics."[17] There is a wide variance in the degree and kind of functional loss among visually impaired children resulting from different pathological conditions.[18]

Clinically, subnormal vision is defined by literal interpretation of the acuity chart. Visual acuity in these terms usually indicates the degree of central or direct vision performed with the fovea, but in the absence of this, it represents peripheral vision.[19] Central vision

refers to our awareness of the objects at which we are looking directly, that is, those along or near the visual axis.[20] Peripheral vision involves the ability to sense the parts of the visual field which surround the central part.[21]

Measures of visual acuity provide some knowledge regarding the size of the retinal image that can be appreciated by the eye.[22] They are generally expressed in the form of a fraction, but this does not therefore represent the true percentage of normal vision.[23]

Visual acuity is based on the interaction of a complex variety of factors which include the presence or absence of optical defects, the size of the pupil, the state of light-dark adaptation, the part of the retina stimulated and the luminance of different parts of the test objects and the brightness contrasts.[24] Simple mathematical representations of this dynamic function are therefore subject to severe limitations.[25]

The accommodative power of a visually impaired person's eye is a matter of particular interest to a consideration of appropriate print size. Accommodation is the process by which the refractive power of the lens in the eye is adjusted so that both, distant and near objects may be distinctly imaged upon the retina.[26] The stimulus to accommodation is thought to be a blurred image upon the retina which causes active contraction or

relaxation of the ciliary muscles. Accommodation arises from a variation in the thickness of the curvature of the lens.[27] It is generally accepted that children tend to have relatively high powers of accommodation but that with an increase in age the "near point" of vision recedes at a fairly constant rate.[28]

The available power of accommodation becomes significant when the reader holds materials closer in order to increase the retinal image.[29] Fonda[30] indicates that the eyes fatigue more easily when a person is expending maximum accommodation and interpreting a blurred retinal image. The relative amount of accommodation present would seem to be an important factor in limiting the reading distance.

Traditional classification systems generally refer to children with significantly less than normal vision as either legally blind or partially sighted. Legal blindness is defined as vision of 20/200 or less in the better eye with best correction, or a visual field limited to twenty degrees or less. The partially sighted have a measured visual acuity of 20/70 to 20/200.[31] Hathaway[32] points out that such criteria have proved to be inadequate in describing children for educational purposes. Bateman[33] confirms this view and suggests that more adequate criteria need to be established. Rosenbloom[34], while not offering it as a final solution, does indicate that more consideration should be given to the primary mode of reading as a

descriptive factor. Aschcroft,[35] however, reminds us that the problems inherent in the use of such criteria have been adequately demonstrated by recent studies which indicate that mode of reading may be more closely related to the program in which the pupil is enrolled than to his actual visual ability. In spite of these limitations a classification, which emphasizes actual performance rather than physical disability, does offer an educationally useful alternative.[36]

Characteristics of Print

Interest in the physical characteristics of printed material derives mainly from a concern over making this medium of communication more efficient and effective.[37] Studies which examined the effectiveness and print characteristics prior to 1940, used readability and legibility interchangeably to mean "ease and speed of reading at a natural reading distance."[38] More recently, with the advent of "readability formulas" this term has taken on an entirely new meaning. Readability now refers to content difficulty rather than print characteristics.[39]

Legibility of print, as defined by Tinker,[40] is concerned with the ease, accuracy and efficiency of perceiving printed symbols while reading with understanding. In comparing legibility of varying print materials one wants to know to what extent the typography fosters ease, accuracy and speed of reading.[41,42]

Research in this area has been conducted primarily with normally sighted adults.[43] Only a limited number of studies have concerned themselves with the problems of the partially sighted.[44] Much of the research with either of these groups has been focused on type face, type size and leading, although width of lines, inter-column spacing, weight of paper and other factors were also considered.[45,46]

Type face refers to the symbol which appears on the printed page. All type is divided into families, each family being composed of several "type faces". Every "type face" is a particular design given to each of the characters of the alphabet.[47] Some are very ornate and light, others quite plain and bold. A number of type faces are designed with "serifs" - fine cross strokes at the top and bottom of each letter. "Sans serif type" faces, often used in advertising, are designed without the fine cross strokes.

Type size is measured in "points". A point has been defined as 1/72 of an inch with twelve points equal to one pica or 1/6 of an inch.[48] In typography, point size indicates the vertical dimension of the body type. The actual face of the type will be somewhat smaller because of the space occupied by the shoulders on each side of the face, which produces a blank space between the letters and the lines.[49] If the lines are to be separated further this may be done by "leading".[50] "Leads"

are blank pieces of type metal which may be two, four, eight or twelve points in thickness inserted between the lines of type. In the letterpress process, type body size was fixed through standardization but type face size could vary within the same body size.[51]

The introduction of offset lithography, has contributed to some confusion in the area of type measurement. By this method any book which is optically enlarged may be labelled as a large print edition. This form of labelling has brought about a situation where there are "large print" books in existence whose actual print is smaller than the print in the regular edition of other books.[52]

To avoid confusion inherent in the lithographic process, Nolan[53] has recommended a scale for measuring the height of capital letters as they appear in print. By this scale seventy-two, forty-eight, twenty-four, eighteen and twelve point print have capital letters whose respective heights are .750, .500, .250, .188 and .125 inches. This scale, already adopted by a number of publishers, also served as a guide to type size* in this study.

Magnification

Optical devices currently available to persons with low vision, range from simple hand magnifying lenses to

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*See Appendix A.

sophisticated tailor-made optical systems prescribed by the ophthalmic services.[54] In attempting to delineate the function of these optical aids, Gnade[55] points out that the optical aid begins where conventional glasses end. The aid therefore is a plus value. Scholz also points out that the sole purpose of the convex lens in an optical aid is to produce a larger image on the retina by magnification.[56] Many of these lenses have been borrowed from industry while others have been specifically developed for this purpose.[57]

Low vision optical aids can be categorized into distance and close work aids.[58,59] Apart from this, optical aids are generally described in terms of their focal length measured in diopters corresponding to their power of magnification. A diopter is the reciprocal of the focal length of a lens measured in meters. A four diopter lens measured in meters. A four diopter lens would have a focal length of one fourth meter. In general, it may be assumed (in the higher ranges) that every four diopters are equivalent to one power of magnification.[60]

Distance aids include telescopic lens glasses, clip on loupes, monocular and binocular field glasses.

Close work or reading aids include microscopic lens glasses, telescopic lens glasses with a reading cap, head-born loupe, hand held magnifiers, focusable stand magnifiers, paperweight (Visolett) and projection magnifiers.[61]

The size of the image produced on the retina through the use of a magnifying device depends in part on the power of the lens and the manner in which it is utilized.[62] The power of stand magnifiers, for example, can be increased by moving the eye away from the lens, but this procedure will also increase peripheral distortion.[63] The use of stand magnifiers, according to Rosenbloom,[64] frequently permits improved illumination of the printed page while relieving the person from the necesity of precise focusing required by the use of many other aids.

The possible working distance and the extent of the visual field are both dependent on the power and size of the lens being used. With an increase in the strength of the lens of a given size there is also a continual decrease in the depth and perimeter of the field.[65] With severe depth restrictions the object to be viewed or the paper to be read must be held quite steady because any tremor will move the print out of focus and make it unreadable.[66]

Magnification of the retinal image may also be achieved without the use of lenses. Non-optical magnification of 2X can be provided by reducing the distance between the observer and the object being viewed, by half. This principle is applicable to both distant and near vision. Television viewed at two feet produces magnification of 5X relative to a ten foot viewing distance.

Standard print (12 point) produces the same size retinal image at four inches as does large type (eighteen point) held at 6.8 inches.[67] Fonda[68] suggests that this form of magnification is not only more versatile and less expensive than the use of lenses but also quite practical for classroom use.

Illumination

Illumination here is used to refer to the amount of light, its diffusion, distribution and direction. Appropriate illumination is a prime requisite for effective seeing.[69] Research has indicated certain relationships between light intensity, visual acuity, size of object discriminated and brightness contrast.[70,71,72,73] Brightness contrast refers to the difference in brightness between an object and its background such as print on paper, or between two objects in the visual field.[74] Seagers states that, "the greater the contrast the more easily the visual task is performed."[75] Others[76] have pointed out that the level of contrast between ink and paper will influence the amount of illumination required for efficient reading.

Light intensity is also of significance when optical aids are being used since light intensity may affect the power of the lens required. Scholz[77] indicates that within certain limits an increase of intensity may

permit the use of a lower power lens. In other instances it may produce an effect which eliminates the need for magnification. Seagers suggests that, "since visual acuity increases markedly with an increase in illumination, additional light is sometimes said to act as a magnifier."[78]

Many visually impaired persons require a higher level of illumination for reading, than persons with normal sight. It is also known, however, that certain eye defects necessitate reduced levels of illumination for maximum visual efficiency.[79] Luckiesh[80] cites data which show that persons with subnormal vision have marked increases in acuity when illumination is increased from one, to ten, to one hundred foot candles. This improvement was present whether or not they were wearing their corrective glasses. The findings of Kuntz and Sleight[81] suggest that persons with subnormal vision gain significantly more in visual acuity terms with an increase in target brightness than do persons with normal sight. On the basis of these and other findings Tinker[82] suggests that illumination, for sustained readings by visually impaired persons, should have a minimum brightness of forty footcandles.

The Reading Process

Reading is a highly complicated process. The fact that authorities, in this field, have never agreed on one definition of reading, attests to its complexity.[83] Cohen[84] suggests that reading may be described as the processing of a visual symbol into an oral-aural symbol

that elicits intellectual and emotional response drawn from experience. Heilman[85] indicates that reading always involves the simultaneous application of a great number of mechanical and comprehension skills, all of which are influenced by the reader's attitudes, knowledge, and past experience.

Reading, according to Faye,

> . . . is a complex brain function which begins with a visual image and ends with some sort of action. It is a high level associative function which, if intact, works in spite of imperfect vision, and, if impaired is not able to profit from a perfect visual system.[86]

The skills or abilities stressed in reading instruction are (1) comprehension, (2) vocabulary, (3) speed and (4) accuracy. Each of these factors is obviously related to the other three.[87] The development of one involves others to a greater or lesser extent.

Normal reading growth is developmental. With adequate preparation most children continue to progress in basic reading skills through the primary grades.[88] For the average eight year old, reading is generally a pleasurable experience. He can deal with new words by phonetics or by context and he maintains the meaning of what he reads orally.[89]

During the intermediate grades most children continue to perfect the basic reading abilities acquired in earlier grades. This is accompanied by a greater emphasis upon the growth of specialized abilities and skills

needed for reading content subject matter.[90] It is not generally known to what extent materials influence this development.

Research evidence does indicate that many of the techniques and skills employed in proficient silent reading are also used in oral reading.[91] It follows, therefore, that children do not learn two entirely different sets of reading skills but that proficiency in oral and silent reading are related. A pupil may, therefore, demonstrate his acquired skills through either oral or silent reading.

Experimental Design

The problem of developing effective experimental controls according to Henderson[92], is often a complicating and/or restrictive factor in research related to human behavior and learning. To develop or even to recognize adequate experimental controls is a difficult requirement in most social situations. The environment in a psychological or educational context is always complex, and total control well nigh impossible.[93] In her review of the research performed previous to 1969, related to print size and visually handicapped readers, Shaw concludes that, "the lack of decisive results"[94] may be attributed to this very problem. The problem, however, need not prevent the development of meaningful enquiry if the importance of a good design is recognized.[95]

Evaluation Criteria

Experimental evaluations of the relative effectiveness of various type faces and print sizes in promoting ease of reading have utilized a number of different criteria. Tinker[96] has carefully reviewed some of the more commonly used criteria such as speed of perception, blink rate, visibility, fatigue, readers' opinions and rate of work. On the basis of his own extensive research and a review of the work of others he concludes that the most acceptable criteria for comparing the legibility of varying print is a measure of work performance. Criteria of work performance such as reading speed, accuracy and comprehension are currently recognized as being the most valid vriteria available.[97]

Research on Print Size

Initial research on print size began in Cleveland, Ohio in 1913,[98] when Irwin investigated eighteen, twenty-four, thirty and thirty-six point sizes in seven styles of type. According to his findings twenty-four point Century Schoolbook and Caslon Bold types proved most popular with teachers and pupils. Not enough detail is given in published descriptions to allow replication. It is known, however, that pupils were asked to read material aloud at a distance most comfortable to them.

The twenty-four point print which became the standard for most special textbooks in sight-saving classes as a result of Irwin's work, remained unchallenged until Fortner[99] compared eighteen and twenty-four point print for ease of reading, in 1943. Fortner's research utilized eye blink rate and reader's opinion as criteria for ease of reading. The findings of this study were statisticlly insignificant.

Eakin, Pratt and McFarland[100] in 1952 made an attempt to compare the readability of twelve, eighteen and twenty-four point type. The subjects in this study were divided into groups, but the matching of the groups was not well established and all groups did not receive the same stimulus. Reading distance was held constant at fourteen inches however illumination was not standardized. The investigators were unable to come to statistically significant conclusions although they did suggest that the twenty-four point size was preferrable since more children were able to read it at fourteen inches.

A further clarification of the issue was sougt by Nolan[101] in 1959. With a well designed study he compared eighteen and twenty-four point print in different type styles. He demonstrated that visually impaired children found common serif type (Antique Oldstyle) significantly more legible than sans serif type (Metrolite Medium) however, he was unable to find statistically significant

differences in legibility between eighteen and twenty-four point print.

In a differential diagnosis of sixteen partially sighted children, ranging in age from seven to fifteen, Karnes and Wollershein[102] found that the children in their study performed significantly better on sixteen point than on ten point print and concluded that it would be advisable to provide these children with reading materials in large print, "if for no other reason than that they may read with more comfort and find reading less fatiguing."[103]

In a study involving a sample of fifth and sixth graders from fifteen states, Birch[104] and his associates attempted to relate an examination of use of twelve, fifteen, eighteen, twenty-one and twenty-four point print to an evaluation of the academic achievement of visually impaired pupils. Experimental controls appear to have been weakened due to the necessity of conducting the testing through the mails. Controls for (a) differences in administration, (b) practice in taking tests, (c) levels of motivation of students were dependent on a spread of these effects.

The report makes no mention of any attempt to control lighting or the scheduling of comparative tests. It may be for these and other reasons that the findings on print size were inconclusive.

The Library Association of London sponsored a research project in 1969 to determine appropriate print size and style for visually impaired readers which, although it focused mainly on adult readers, does have considerable relevance here. The study conducted by Shaw[105] recognized the importance of experimental controls. In a testing format patterned closely after Tinker's extensive legibility research studies, an effort was made to control lighting, testing environment and test administration. Like Tinker, she used short paragraphs printed in varying type styles and print sizes. On the basis of her investigation, Shaw concluded that type size was one of the most important factors in print legibility for partially sighted adult readers. Her findings also indicated that print size was a significant legibility factor with children. The similarity in her findings with these two groups may, however, have been affected by the fact that, the majority (thirty-four out of forty-eight) of children in her sample were fourteen years of age or older.

The most recent study, which addresses itself to the issue of print size, was performed by Sykes[106] with a group of forty-one visually impaired students at the Michigan School for the Blind. The stated purpose of this investigation was to compare the effectiveness of standard and large print in enhancing the reading skills of visually impaired high school students. The mean age of the sample was seventeen and their mean I.Q. just over one hundred.

Two equivalent forms of the Davis Reading Test were administered in twelve and eighteen point print during separate sessions. One of the difficulties encountered by the investigator was a scheduling problem. This resulted in an average delay of eighteen days between tests. Illumination and reading distance were subject to individual preference. The format of the testing sessions allowed students to read the materials silently and then to respond to comprehension questions orally. The blink rate was used as a basis for a visual fatigue score.

Sykes determined, on the basis of his analysis, that the only advantage offered by large print was a reduction in the visual fatigue of partially sighted students. He concluded that standard print was as effective as large print in facilitating the reading speed and reading comprehension skills of both partially sighted and legally blind students.

Research on Magnification

The value of optical aids has been demonstrated in a survey conducted by Rusalem[107] at the Industrial Home for the Blind, Brooklyn. The findings of the survey indicated that 340 persons in a group of 500 benefited from optical aids service. Of these, ". . . 238 had improved near vision."[108]

This review of the literature produced no evidence of any objective evaluation of various hand and stand magnifiers frequently found in schools. Indications are that such devices have been and still are being placed there largely on the basis of subjective judgements of sighted persons.[109]

Summary Statement

The research on print size is limited. Few studies address themselves to the problems of the elementary school child. While objective evidence is limited, there are some indications that large print may be preferable at the elementary level, but that this is not necessarily so at the secondary level.

Still lacking is objective evidence regarding the relative value of magnifiers which can be used to enlarge standard print through optical magnification to a size comparable to large print.

Objective evidence is also lacking regarding the extent to which personal preference may be a useful guide in selecting appropriate print size for visually impaired elementary age print readers.

There is also insufficient information available with respect to the relative importance of large print in facilitating the reading skills of visually impaired print readers at the elementary level.

Hypotheses

Twelve hypotheses were developed as follows:

H_1 There is no difference between the reading speed scores attained by visually impaired elementary age print readers when reading large print without magnification and when reading standard print without magnification.

H_2 There is no difference between the reading speed scores attained by visually impaired elementary age print readers when reading standard print without magnification and when reading standard print with magnification.

H_3 There is no difference between the reading speed scores attained by visually impaired elementary age print readers when reading large print without magnification and when reading standard print with magnification.

H_4 There is no difference between the reading accuracy scores attained by visually impaired elementary age print readers when reading large print without magnification and when reading standard print with magnification.

H_5 There is no difference between the reading accuracy scores attained by visually impaired elementary age print readers when reading standard print without magnification and when reading standard print with magnification.

H_6 There is no difference between the reading accuracy scores attained by visually impaired elementary age print readers when reading large print without magnification and when reading standard print with magnification.

H_7 There is no difference between the reading comprehension scores attained by visually impaired elementary age print readers when reading large print without magnification and when reading standard print without magnification.

H_8 There is no difference between the reading comprehension scores attained by visually impaired elementary age print readers when reading standard print without magnification and when reading standard print with magnification.

H_9 There is no difference between the reading comprehension scores attained by visually impaired elementary age print readers when reading large print without magnification and when reading standard print with magnification.

H_{10} There is no difference between the reading speed scores attained by visually impaired elementary age print readers, reading under preferred test conditions and when reading under alternative test conditions.

H_{11} There is no difference between the reading speed scores attained by visually impaired elementary age print readers, reading under preferred test conditions and when reading under alternative test conditions.

H_{12} There is no difference between the reading speed scores attained by visually impaired elementary age print readers reading under preferred test conditions and when reading under alternative test conditions.

CHAPTER III

METHODOLOGY

The relative effect of large and standard print and the use of magnification on the reading skills of visually impaired elementary age print readers was examined through the use of objective data based on individual reading performance under varying test conditions.

The selection of factors to be tested and the choice of test procedures and instruments in this study required a compromise between (a) keeping the test within manageable time limits, (b) making the tests valid and (c) relating them to normal reading situations.

Sixty-four visually impaired elementary age print readers were given four parallel forms of the Gray Oral Reading Test under four treatment conditions. The treatments consisted of reading standard and large print, with and without magnification. The reading speed, reading accuracy and reading comprehension was recorded for each subject under all four conditions.

The discussion which follows will consider in greater detail, the selection of the sample, the test variables, the testing procedure and the materials and equipment used.

Sample

The sixty-four children included in this study, were selected from the school districts of North York (Toronto) and London in the province of Ontario, the school districts of Warren, Livonia, Lakeshore, Flint and Grand Rapids in the State of Michigan and from classes for the partially sighted at the Michigan School for the Blind.

To be included the children needed to be (a) visually impaired (20/70 or less with normal correction), (b) between eight and twelve years of age, (c) able to read at the grade one level and (d) able to read twelve point print without aids other than the use of ordinary glasses or holding the paper nearer to the eye.

Teachers were asked to refer to the examiner all print readers who met conditions (a) and (b). The examiner made the final selection during the initial part of the test interview based on conditions (c) and (d).

Independent Variables

Print Size

Print size was selected as one independent variable. Given the limited amount of objective evidence available regarding the possible effect of this variable on reading skills of visually impaired children at the elementary level, and the fact that most teachers of these children

need to make decisions with respect to appropriate print size from time to time, this seemed an important choice.

An examination of a number of elementary texts indicated twelve point print as the size most commonly used. Tillet,[110] in reviewing current practice, confirms these findings.

Present recommendations[111] of the National Accreditation Council for the Production of Large Print Books suggest eighteen point as the most appropriate size. A brief survey of large print books in use, showed that in practice eighteen point print was the most frequently occurring size.

On the basis of these findings it was decided, albeit somewhat arbitrarily, that twelve point print and eighteen point print were to be designated as standard and large print respectively, for the purpose of this study.

Magnification

Magnification was chosen as a second factor for consideration in this study. It has been suggested that magnification may facilitate the reading process by allowing the child to use less of his accommodative power[112] or compensate for the lack of it[113] and thereby reduce fatigue.

The amount of magnification required to compensate for differences between standard and large print is relatively small. But it is not generally known to what extent the use of such magnification might provide a viable alternative to the use of large print or to what extent it might render standard print and large print more effective in facilitating an individual's reading skill. The ready availability of low power nagnifiers and their currently increased introduction into classrooms[114] influenced the choice of low magnification as the variable to be examined in this study. This, however, is not to say that high power magnification available in a variety of optical devices is not important and in as great a need of objective examination.

Intelligence Score and the Age

Intelligence score and the age of the children were selected as additional factors of interest in order to carry out a further exploratory analysis of the experimental results.

Stimson[115] has suggested that intelligence plays an important part in seeing, because the mechanism used in seeing can be estimated to be half ocular and half cerebral. One might argue, therefore, that relative weakness in the cerebral function could possibly be offset by improvements in visual image, or ocular function. Conversely it might

be suggested that greater interpretive facility would compensate for more limited ocular functioning. It is not readily apparent whether differences in print size would produce differences in ocular stimulation great enough to cause differences in performance by brighter and less able children.

The British Association for the Advancement of Science[116] has made the recommendation that the print of books for younger children with normal sight should be appropriately enlarged. It would seem that a higher level of visibility and perceptibility brought about by increased letter size would be conducive to the development of reading skills. Barraga[117] argues that reduction in the size of stimuli, once learning development has been established, is imperative if visual function is to reach its peak. For this reason one might expect that large print may be of greater importance at different age levels. Age, therefore, became a variable of interest about which additional information was sought.

Materials

The test materials utilized in the assessment of the relative effectiveness of varying print size and optical magnification have been identified as one of the most important variables.

In order to control for difficulty level of words and content, it was deemed important that reading materials be selected which had been standardized on these factors.

The selection of forms A, B, C, and D of the Gray Oral Reading Test was based on the above considerations and the fact that the test provided for continuous text, closely related to normal classroom reading materials. These forms were reported to have coefficients of equivalence ranging .973 to .982[119]. Each of these forms contained a series of thirteen paragraphs of increasing difficulty. This permitted the subject to read paragraphs of the same difficulty level in each of the forms under different treatment conditions and at the same time gave opportunity for subjects of different abilities to read paragraphs appropriate to their ability level. The manual which accompanied this test provided for standardized scoring of speeding, accuracy and comprehension.[120]

The test, as published, was not available in the required print sizes. For purposes of this investigation the print size had to be modified. With written permission of the Test Division of Bobbs Merrill Company, the test was reproduced by photo-offset lithography in twelve and eighteen point print according to standards defined earlier in this study. According to Nolan,[121] this procedure is employed in producing most of the large print texts currently available for classroom use.

Equipment

A stand magnifier with a large lens* which would allow for binocular vision and would enlarge twelve point type by fifty percent in order to produce an optical image comparable in size to eighteen point print was considered to be the most appropriate instrument for purposes of this study. Such an instrument allowed the subject complete freedom to concentrate on the reading material and required no physical effort on his part.

The Ednalite Masterlens,[122] selected for use in this study had a large viewing area and a high quality glass lens. This magnifier also had its own light source which could be focused directly on the reading material and thus permitted the standardized level of illumination to be maintained while materials were being viewed through the magnifying lens.

The lens itself was mounted on a swivel which permitted the positioning of the lens and the reading materials at right angles to the reader's line of vision for greater viewing comfort. The positioning flexibility of the lens also permitted the materials to be placed at the appropriate distance from the lens to achieve fifty-percent magnification.

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*See Appendix B.

A perpendicular distance of seven and one half inches from the reading material produced this magnification and served as the standard in this study.

The performance of each subject was recorded by means of a portable Model 7612 Realtone Cassette tape recorder. Separate cassettes were used to collect data for individual subjects.

A standardized level of illumination (50 - 60 foot lamberts) was maintained by the use of portable light fixtures with metal shades, equipped with two hundred watt incandescent work/study bulbs. The relative intensity of these lights was controlled by the use of a rheostat control.

The level of illumination was measured with a General Electric type 213 light meter.

Procedure

The selection of the particular experimental controls used for the assignment of subjects in this study was based on the need to compare the influence of four different testing conditions on the reading process. The effective matching of sufficient numbers of visually impaired children with respect to the many variables affecting the reading process would be extremely difficult in view of the limited numbers of children available for study and the wide range of their individual differences.

To control for these individual differences the use of repeated measures seemed most appropriate. Additional control was required in matching use of standard and large print, with and without magnification with each of the four forms of the Gray Oral Reading Test in order to achieve equal representation of the forms with each of the conditions. It was also considered important to control for possible bias which might result from the order of presentation of the test forms and/or test conditions.

Equal representation of test forms and test conditions as well as order of presentation were controlled by the use of a four by four graeco-latin square.[123] Four rows of the letters A, B, C, D and four columns of numbers one through four were independently arranged at random. Letters were assigned to each of the four forms of the Gray Oral Reading Test and numbers to each of the four test conditions, standard and large print, with and without magnification. This procedure yielded the following four sequences of presentation.

a)	B3	C4	D2	A1
b)	A4	D3	C1	B2
c)	D1	A2	B4	C3
d)	C2	B1	A3	D4

Within this set of sequences each of the four forms was paired with each of the four test conditions assuring equal representation of the forms and test conditions.

The sixty-four subjects were later assigned to the four sequences by means of a table of random numbers.

These procedures gave some assurance that additional factors, not controlled or balanced, would not produce systematic bias.[124]

Control of environmental factors such as noise and interruption was achieved by conducting actual testing in a separate room with only the subject and the examiner present. Differential lighting, although a potentially important factor in the reading process, was not examined separately in this study. Care was taken to avoid glare and to maintain a standardized level of illumination. The level of illumination when reading with and without the magnifier was maintained at approximately 50 - 60 foot lamberts. This was slightly higher than the level suggested as adequate by Tinker.[125] It did not, however, conflict with his further suggestion that higher intensities might be employed with safety, provided the diffusion of light was properly controlled.[126]

The entire work area was covered by desk blotter size sheets of light grey news print in order to avoid glare from polished desks and to standardize the levels of contrast in work area.

The magnifier, tape recorder and all the materials to be used in an interview were arranged prior to the entry of each subject. The distance between the reading materials

and the magnifying lens was controlled by the use of a small reading stand placed at a distance of seven and one half inches from the lens. The subject's reading distance from the paper or the magnifying lens was not controlled. Individuals were free to choose their own reading distance.

The Interview

The interview was conducted in two parts. The first part of the interview served to familiarize the subject with his surroundings and the nature of the task to be performed. During this part of the interview an attempt was made to achieve a relaxed atmosphere. The subject was given colorful trinkets and printed material to examine with and without the magnifier. When the subject appeared to be ready the examiner began the second part of the interview and proceeded with the sequence below, which served as a guide for the remainder of the interview.

(a) The subject was given a card containing a paragraph printed in standard print thought to be suitable to his reading level and asked to read the paragraph orally. He was then asked to respond to simple comprehension questions. Adjustments in level of difficulty were made as necessary. This step set the stage for procedures followed in the Gray Oral Reading Test and provided some assurance that the subject was able to read standard print before the actual testing began.

If the subject was unable to read, he was given alternate tasks to do in order that he would not feel rejected but was not included in the sample. Those children who were able to read then proceeded to the formal testing.

(b) The subject was presented with the Gray Oral Reading Test forms in the sequence determined earlier by the research design. The subject was asked to read three consecutive paragraphs aloud. After reading each paragraph, the subject was asked to respond to standard comprehension questions supplied by the test manual for each paragraph.

The subject was asked to read parallel paragraphs from each of four forms under each of the four test conditions.

(c) The subject was asked to state which of the four test conditions he liked best.

(d) The entire interview was recorded on tape in order to facilitate the timing and scoring of the test passages.

The Scoring

The scoring of the results was carried out according to the following criteria.

(a) Reading speed was calculated in terms of the number of words read per minute.

(b) Reading accuracy was based on the total number of errors. Subject's score was calculated by subtracting errors from 25.

(c) The comprehension score was determined by the number of correct responses. Correct answers received two points, partial answers one point and wrong answers no credit. Each treatment had a possible comprehension total of twenty-four points.

Additional data such as age, intelligence and acuity level were collected by the examiner from existing records.

CHAPTER IV

FINDINGS OF THE STUDY

Sample

A total of eighty-two visually impaired children, eight to twelve years of age, with a visual acuity of 20/70 or less were referred to the examiner. Sixty-four of these children were able to meet the final criteria, ability to read twelve point print at the first grade level, during the pretest screening.

The distribution of the children by age and sex may be noted in Table 1. The reader will note that the distribution is somewhat skewed, both in terms of age and sex. Boys made up slightly more than sixty percent of the sample. Approximately nineteen percent of the children were under ten while forty-nine percent were more than ten years old.

The average age for girls in the total group was 10.84 years while for the boys it was slightly less at 10.18 years. The average age for the total group was 10.45.

Measures of intelligence based on an individual pychological examination were available for only forty-two of the children, included in the study.

TABLE 1.--Distribution of the sample by age and sex.

Age	Boys	Girls	Total	Percentage
8	4	1	5	7.8
9	6	1	7	10.9
10	13	7	20	31.2
11	9	9	18	28.2
12	6	8	14	21.9
Total	38	26	64	
Average	10.18	10.84	10.45	
Percentage	60.7	39.3		

The available scores, as shown in Figure 1, ranged from a low of 63 to a high of 139. The mean intelligence quotient for the group of forty-two was 98.3.

Since the criteria for inclusion in the study were the same for all sixty-four children the writer has no reason to believe that the twenty-two children for whom such scores were not available differed significantly in intelligence from those for whom they were available. The writer's own observations and other available information tended to support this contention.

The available intelligence scores plotted in Figure 1 seem to indicate that the sample was fairly representative of a normal population as far as intelligence was concerned.

The visual acuity scores presented in Table 2 indicate a spread in acuity from 20/70 to 20/400. The reader will note that half of the children have acuity levels which would allow them to be classified as legally blind. Another fact which is very apparent is that twenty of the remaining thirty-two children are at the lower end of the continuum for partially sighted. The reader will also want to be aware of the fact that forty of the children were wearing glasses at the time of testing.

The eye defects of the children in the sample varied considerably. Findings in this regard are given in Table 3. A number of the children had several defects reported in their eye chart. Numerous combinations of the various

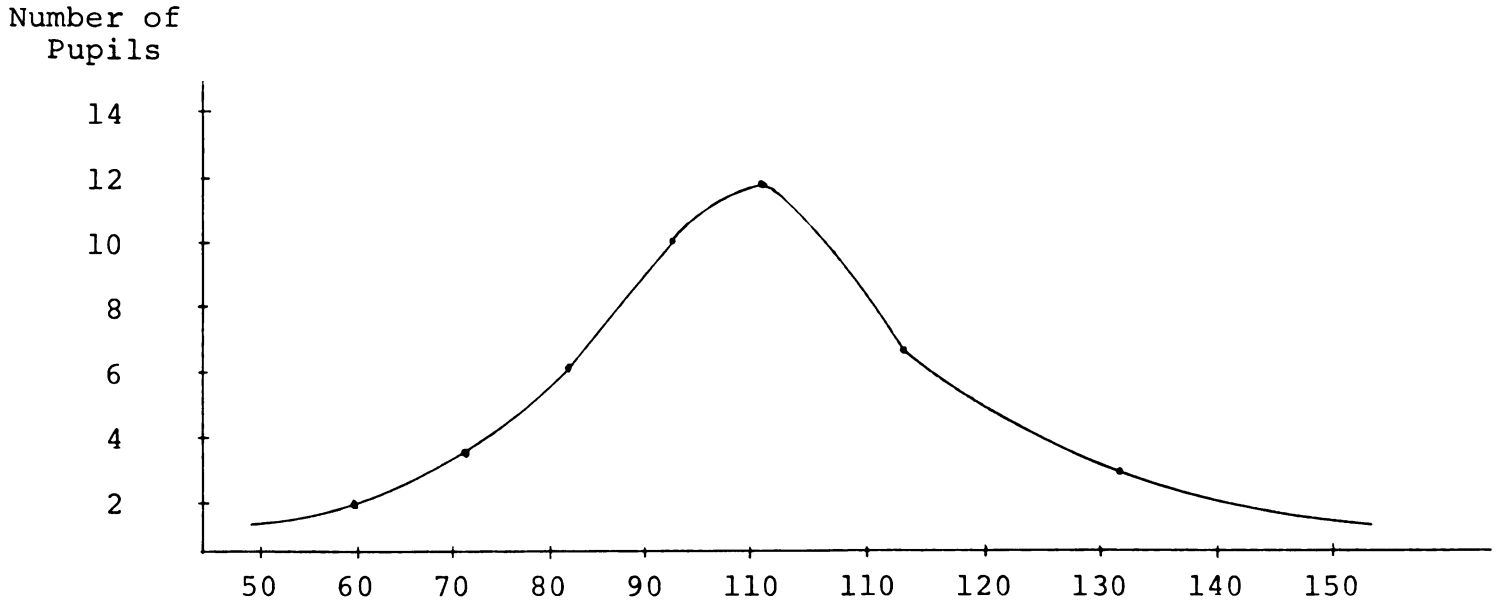

Figure 1.--Distribution of intelligence scores.

TABLE 2.--Visual acuity.

Visual Acuity*	20/70	20/80	20/100	20/200	20/260	20/300	20/400
Subjects	6	6	20	23	2	5	2
Percent	9.3	9.3	31.4	35.9	3.1	7.9	3.1

*The acuity scores were converted where a testing distance of five or ten feet had been used.

TABLE 3.--Major eye defects of children in the sample.

Defect	Number of Students	
Lens		
Cataract (2 with surgical aphakia)	10	
		10
Iris		
Colomboma	1	
		1
Retina		
Macular degeneration	4	
Chorioretinitis	3	
Pigment degeneration	1	
Albinism	1	
		9
Optic Nerve		
Optic atrophy	5	
Ocular dystrophy	2	
Atropic fundus	1	
		8
Eyeball in General		
Myopia	5	
Glaucoma	2	
		7
Neural and Muscular		
Nystagmus	19	
Amblyopia	3	
Esotropia	1	
Exotropia	1	
		24
Other		
Undiagnosed	4	
Brain tumor	1	
		5

defects might have been listed. The table shows only those which appeared to be major defects in each case. In some cases, however, these defects by themselves might not cause a disability severe enough to bring about significant visual impairment. It is often the combination of several factors which brings about visual impairment.

The reader will also want to be aware of some of the characteristics of the eighteen children eliminated during the final sample selection. Table 4 provides some information with regard to age, sex and reason for exclusion. Thirteen of the children were lacking in sufficient reading skill. School records indicated that a number of these children were in the lower quartile of the intelligence range and this may have accounted for some of their difficulties. The sex ratio was quite similar to that of the group included in the sample. Two-thirds of this group were boys while just over sixty percent of the sample were also boys.

The age distribution, however, of this group varies considerably from that of the sample. Eight of the eighteen children were eight years of age. The average age for this group was 8.8 years as compared to 10.4 years for the sample.

It should also be noted that only three of the children were excluded because they were unable to see the materials and two because their inability to attend made it impossible for them to participate in the test.

TABLE 4.--Children eliminated during final sample selection.

Age	Sex	Reason for Elimination		
		Insufficient Reading Skill	Unable to See Material	Inability to Attend
8	Girls	2		1
	Boys	4	1	
9	Girls		1	
	Boys	4		1
10	Girls	1		
	Boys	1	1	
11	Girls	1		
	Boys			
		13	3	2

Analysis of Data

The analysis of the data was influenced considerably by one unexpected finding. It had not been anticipated that twenty of the sixty-four children in the sample would not be able to use the stand magnifier at all.

In view of this finding, the earlier consideration of an analysis by means of a graeco-latin square was discarded in favor of a two way analysis of variance with repeated measures since the latter is more versatile with respect to such problems.

It was also decided that two separate analyses were to be made for the first nine hypotheses. The first analysis was based on the performance of the total group of sixty-four subjects with zeros entered for those who could not utilize the magnifier. The second analysis focused on the forty-four subjects who were able to read under all four conditions.

A separate two-way analysis of variance with a subjects by conditions design, was carried out for each of the dependent variables in order to test the first nine hypotheses. Post hoc Tukey comparisons were performed when F values were significant. Dependent sample T-tests were used to test hypotheses ten to twelve.

TABLE 5.--Overview of hypotheses to be tested.

Independent Variables	Dependent Variables		
	Speed	Accuracy	Comprehension
Lge print vs Std print	H_1	H_4	H_7
Std print vs Std print mag	H_2	H_5	H_8
Lge print vs Std print mag	H_3	H_6	H_9
Preferred vs Alternate	H_{10}	H_{11}	H_{12}

The main analysis relating to the twelve hypotheses was performed with subjects' raw scores* on reading speed, accuracy and comprehension. For the exploratory analysis these scores were converted into standard scores and combined by equal weighting into a reading proficiency score.

The raw score means for reading speed, reading accuracy and reading comprehension are shown in Table 6 for both the total sample of sixty-four and the partial sample of forty-four subjects.

Two of the most readily apparent features of Table 6 are, (a) the tendency of performance on large print to exceed performance on standard print and, (b) the negative effect of magnification on performance scores. These trends, although not significant, appeared in both the total and partial sample means. The only exception that was noted

*See Appendix C.

TABLE 6.--Mean raw scores on reading speed, accuracy and comprehension for total sample of sixty-four subjects and partial sample of forty-four subjects.

Reading Skill	Subjects	Standard Print without Magnification	Standard Print with Magnification	Large Print without Magnification	Large Print with Magnification
Reading Speed[a]	64	90.04	52.17	94.50	58.57
	44	93.77	75.88	94.68	85.20
Reading Accuracy[b]	64	17.40	10.26	18.56	11.40
	44	17.61	14.93	18.40	16.59
Reading Comprehension[c]	64	20.42	14.18	21.26	14.46
	44	20.34	20.63	21.13	21.04

Higher scores indicate better performance.

[a]Words per minute.

[b]Scores shown represent the number of errors subtracted from 25.

[c]Scores shown represent correct responses.

was a very slight positive gain on reading comprehension when standard print was magnified for those children who were able to use magnification.

Twelve separate tests (nine analysis of variance and three T-tests) were conducted to examine the major research and the exploratory questions. A .01 level of significance was used with all tests. This gave the total experiment a .12 level of significance.

In order to facilitate a presentation of the results and to allow the reader to make comparisons more readily, the hypotheses will be dealt with in groups of three as they relate to each of the dependent measures.

Hypotheses 1, 2 and 3 relate to reading speed. The overall analysis of variance for reading speed with sixty-four subjects as presented in Table 7 shows a significant F value of 44.18. The overall analysis of variance for forty-four subjects given in Table 7, also showed a significant, although somewhat lower F value of 17.13.

Hypothesis I

Hypothesis one postulated that there would be no difference between the reading speed scores of visually impaired elementary age print readers when reading large print without magnification and when reading standard print without magnification. Table 8 presents the mean difference

TABLE 7.--Analysis of variance of reading speed scores for total sample of sixty-four subjects and partial sample of forty-four subjects.

Sources of Variance		DF	Mean Square		F
Sixty-four Subjects	Subjects (S)	63	3992.28		
	Conditions (C)	3	29694.50	C/I	44.18*
	Interaction (I)	189	672.86		
Forty-four Subjects	Subjects (S)	43	2950.31		
	Conditions (C)	3	3388.28	C/I	17.13*
	Interaction (I)	129	197.74		

*$p < .01$

score for reading speed between the two print sizes when read without magnification. The difference score of 4.45 for the total group of sixty-four subjects is not significant. The difference score of .91 for forty-four subjects is also not significant. Therefore the hypothesis that there will be no difference between the reading speed scores of visually impaired elementary age print readers when reading large print without magnification and when reading standard print without magnification is accepted.

TABLE 8.--Analysis of the reading speed (words per minute) difference scores between large print without magnification and standard print without magnification (Means, standard deviations and Tukey comparisons).

Sixty-four subjects		Forty-four subjects	
Lge print	94.50	Lge print	94.68
Std print	90.04	Std print	93.77
D =	4.45[NS]	D =	.91[NS]
Sd =	25.92	Sd =	14.06
q =	13.95	q =	9.33

[NS]Not significant

Hypothesis 2

It was stated in hypothesis 2 that there would be no difference between the reading speed scores attained by visually impaired elementary age print readers when reading

standard print with magnification and when reading standard print without magnification.

Table 9 shows the difference scores on reading speed under the conditions of hypothesis 2. The mean difference score of 37.87 and 17.89 for sixty-four and forty-four subjects respectively, were both significant at the .01 level. The hypothesis that there is no difference between the reading speed scores of visually impaired elementary age print readers when reading standard print with magnification and when reading standard print without magnification is therefore rejected.

TABLE 9.--Analysis of the reading speed (words per minute) difference scores between standard print without magnification and standard print with magnification (Means standard deviations and Tukey comparisons).

Sixty-four subjects		Forty-four subjects	
Std print no mag	90.04	Std print no mag	93.77
Std print mag	52.17	Std print mag	75.88
D =	37.87*	D =	17.89*
Sd =	25.92	Sd =	14.06
q =	13.95	q =	9.33

*p <.01

Hypothesis 3

It was further postulated in hypothesis 3 that there would be no difference in the reading speed scores of visually impaired elementary age print readers when reading large print without magnification and when reading standard print with magnification. The difference scores for reading speed under conditions as stated in hypothesis 3 may be noted in Table 10. The table indicates a significant difference score of 42.33 and 18.80 for the total and the partial sample respectively. The hypothesis that there is no difference in the reading speed scores of visually impaired elementary age print readers when reading large print without magnification and when reading standard print with magnification is therefore not accepted.

TABLE 10.--Analysis of the reading speed (words per minute) difference scores between large print without magnification and standard print with magnification (Means, standard deviations and Tukey comparisons.)

Sixty-four subjects		Forty-four subjects	
Lge print	94.50	Lge print	94.68
Std print	52.17	Std print	75.88
D =	42.33*	D =	18.80*
Sd =	25.92	Sd =	14.06
q =	13.95	q =	9.33

*p <.01

Hypotheses 4, 5 and 6 relate to reading accuracy. The analysis of variance for reading accuracy with sixty-four subjects presented in Table 11 indicates a significant F value of 41.40. A similar analysis for the forty-four subjects also given in Table 11 showed a significant, although somewhat lower, F value of 10.50.

Hypothesis 4

Hypothesis 4 postulated that there would be no difference between the reading accuracy scores attained by visually impaired elementary age print readers when reading large print without magnification and when reading standard print without magnification. Table 12 posts the mean difference scores for reading accuracy when the two print sizes were read without magnification. The difference score of 1.16 resulting from the comparison of sixty-four subjects is insignificant. The even lower difference score of .79 for the group of forty-four is also not significant. The hypothesis that there is no difference between the reading accuracy scores of visually impaired elementary age print readers when reading standard print without magnification and when reading large print without magnification, is therefore accepted.

TABLE 11.--Analysis of variance of reading accuracy scores for total sample of sixty-four subjects and partial sample of forty-four subjects.

Sources of Variance		DF	Mean Square		F
Sixty-four Subjects	Subjects (S)	63	93.52		
	Conditions (C)	3	1118.27	C/I	41.40*
	Interaction (I)	189	27.45		
Forty-four Subjects	Subjects (S)	43	47.72		
	Conditions (C)	3	99.07	C/I	10.50*
	Interaction (I)	129	9.42		

*$p < .01$

TABLE 12.--Analysis of the reading accuracy difference scores between large print without magnification and standard print without magnification (Means, standard deviations and Tukey comparisons).

Sixty-four subjects		Forty-four subjects	
Lge print	18.56	Lge print	18.40
Std print	17.40	Std print	17.61
D =	1.16[NS]	D =	.79[NS]
Sd =	5.23	Sd =	3.06
q =	2.82	q =	2.03

[NS]Not significant

Hypothesis 5

It was stated in hypothesis 5 that there would be no difference between the reading accuracy scores attained by visually impaired elementary age print readers when reading standard print without magnification and when reading standard print with magnification. The difference scores presented in Table 13 show that in comparisons of the means for both the sixty-four and the forty-four subjects, a significant difference was found. The difference for the first group was 7.14 and the difference for the second group was 2.68.

The hypothesis that there is no difference in the reading accuracy scores of visually impaired elementary age print readers when reading standard print with magnification and when reading standard print without magnification is therefore not accepted.

TABLE 13.--Analysis of the reading accuracy difference scores between standard print without magnification and standard print with magnification (Means, standard deviations and Tukey comparisons).

Sixty-four subjects		Forty-four subjects	
Std print no mag	17.40	Std print no mag	17.61
Std print mag	10.26	Std print mag	14.93
D =	7.14*	D =	2.68*
Sd =	5.23	Sd =	3.06
q =	2.82	q =	2.03

*p <.01

Hypothesis 6

It was postulated in hypothesis 6 that there is no difference in the reading accuracy scores of visually impaired elementary age print readers when reading large print without magnification and when reading standard print with magnification.

The presentation of the difference scores in Table 13 from a comparison of the means on reading accuracy for sixty-four and forty-four subjects shows that both difference scores are significant. The difference for the first comparison is 8.30 and the difference for the second comparison is 3.47.

The hypothesis that there is no difference between the reading accuracy scores of visually impaired elementary age print readers when reading large print without mangification and when reading standard print with magnification, is therefore not accepted.

TABLE 14.--Analysis of the reading accuracy difference scores between large print without magnification and standard print with magnification (Means, standard deviations and Tukey comparisons).

Sixty-four subjects		Forty-four subjects	
Lge print	18.56	Lge print	18.40
Std print mag	10.26	Std print mag	14.93
D =	8.30*	D =	3.47*
Sd =	5.23	Sd =	3.06
q =	2.82	q =	2.03

*p <.01

Hypotheses 7, 8 and 9 are related to reading comprehension. The results of the overall analysis of variance on reading comprehension for the group of sixty-four are given in Table 15. The reader will note that the F value of 23.43 is significant, indicating a difference between the test conditions.

However the results of the overall analysis of reading comprehension for the group of forty-four subjects given in Table 15, shows an F value of .788 which is not significant.

Hypothesis 7

It was postulated in hypothesis 7 that there would be no difference between the reading comprehension scores attained by visually impaired elementary age print readers when reading large print without magnification and when reading standard print without magnification.

TABLE 15.--Analysis of variance of reading comprehension scores for total sample of sixty-four subjects and partial sample of forty-four subjects.

Sources of Variance		DF	Mean Square		F
Sixty-four Subjects	Subjects (S)	63	113.23		
	Conditions (C)	3	914.10	C/I	23.43*
	Interaction (I)	189	39.09		
Forty-four Subjects	Subjects (S)	43	28.89		
	Conditions (C)	3	6.02	C/I	.788^{NS}
	Interaction (i)	129	7.63		

*$p < .01$

^{NS}Not signiticant

The difference score of .844 on reading comprehension shown in Table 16 was found to be insignificant. Therefore the hypothesis that there is no difference between the reading comprehension scores of visually impaired elementary age print readers when reading large print without magnification and when reading standard print without magnification was accepted.

TABLE 16.--Analysis of the reading comprehension difference scores between large print without magnification and standard print without magnification (Means, standard deviations and Tukey comparisons).

Sixty-four subjects	
Lge print	21.26
Std print	20.42
D =	.84[NS]
Sd =	6.24
q =	3.36

[NS]Not significant

Hypothesis 8

It was further postulated that there would be no difference between the reading comprehension scores attained by visually impaired elementary age print readers when reading standard print without magnification and when reading standard print with magnification.

Table 17 shows a difference score of 6.24 based on the comparison of means from the performance of sixty-four children. This difference was significant. Therefore the hypothesis that there is no difference between the reading comprehension scores of visually impaired elementary age print readers when reading standard print without magnification and when reading standard print with magnification was not accepted.

It should be remembered, however, that the overall analysis of variance for reading comprehension, based on the scores of forty-four subjects given in Table 15, showed an F value which was insignificant.

TABLE 17.--Analysis of the reading comprehension difference scores between standard print without magnification and standard print with magnification (Means, standard deviations and Tukey comparisons).

Sixty-four subjects	
Std print no mag	20.42
Std print mag	14.18
D =	6.24*
Sd =	6.24
q =	3.36

*p <.01

Hypothesis 9

It was stated in hypothesis 9 that there would be no difference between the reading comprehension scores of visually impaired elementary age print readers when reading large print without magnification and when reading standard print with magnification.

The difference score given in Table 18 was based on the means for sixty-four subjects. The difference of 7.08 was found to be significant.

The hypothesis that there is no difference between the reading comprehension scores of visually impaired elementary age print readers when reading large print without magnification and when reading standard print with magnification therefore was not accepted.

It should, however, not be overlooked that the overall analysis on reading comprehension of the scores for forty-four subjects shown in Table 15 produced an F value which was insignificant.

TABLE 18.--Analysis of the reading comprehension difference scores between large print without magnification and standard print with magnification (Means, standard deviations and Tukey comparisons).

Sixty-four subjects	
Lge print	21.26
Std print mag	14.18
D =	7.08*
Sd =	6.24
q =	3.36

*p <.01

Hypotheses 10, 11 and 12 are concerned with the reading performance of visually impaired print readers when reading under conditions for which they have stated a preference as opposed to reading under those conditions they had not selected.

Before proceeding to the statistical findings it seemed appropriate to interject additional observations of the examiner here.

The examiner noted that very few children contemplated their choice for any length of time. They appeared to be certain of their choice and not swayed by momentary novelty of one or the other choice.

The reader will note from Table 19 that the fifty children who preferred conditions without the magnifier were almost equally divided with twenty-seven preferring standard print and twenty-three large print. Those preferring conditions involving the magnifier showed a similar split with eight choosing large print and six standard.

TABLE 19.--Distribution of the stated preference for four conditions.

Condition	Number
Standard print without magnification	27
Standard print with magnification	6
Large print without magnification	23
Large print with magnification	8
	64

Hypothesis 10

It was postulated in hypothesis 10 that there would be no difference in the reading speed of visually impaired elementary age print readers reading under preferred test conditions and when reading under alternative test conditions. The analysis of the difference scores presented in Table 20 shows that the difference of 2.3 was not significant. Hypothesis 10 is therefore accepted.

Hypothesis 11

Hypothesis 11 stated that there would be no difference in the reading accuracy scores of visually impaired elementary age print readers under preferred test conditions and when reading under alternate test conditions. It was noted in Table 20 that the difference score of .44 was not significant. Hypothesis 11 is therefore accepted.

Hypothesis 12

It was stated in hypothesis 12 that there would be no difference in the reading comprehension scores of visually impaired elementary age print readers reading under preferred test conditions and when reading under alternate test conditions. The findings presented in Table 20 indicate that the difference of .50 is not significant. Therefore hypothesis 12 is accepted.

TABLE 20.--Analysis of the difference scores between preferred and alternate test conditions (means, standard deviations and t values).

	Means		$\bar{d}$	Sd	t
	Preferred	Alternate			
Reading Speed	89.50	87.20	2.30	12.32	1.48^{NS}
Reading Accuracy	17.56	17.12	.44	2.43	1.41^{NS}
Reading Comprehension	21.00	20.50	.50	2.36	1.49^{NS}

^{NS}Not significant

Exploratory Analyses

The exploratory analyses were undertaken in order to examine the possible influence of age, intelligence and acuity level on reading performance with large and standard print.

The focus of these analyses was on the comparison of print size alone. Magnification was not considered. This made it possible to include all those subjects who were partially excluded earlier because they could not use the magnifier.

The analyses here made use of a combined reading proficiency score based on the combination of reading speed, reading accuracy and reading comprehension.

It was anticipated that there might be a difference in the reading proficiency scores of visually impaired upper and lower elementary age print readers.

To test this notion the sample was divided into an upper and lower age group of thirty-one children each. The first group was comprised of eleven and twelve year olds, the second of eight, nine and ten year olds. Two older subjects were randomly discarded to balance the size of the groups.

The results of the analysis of variance given in Table 21 show that the groups by conditions interaction was not statistically significant indicating that the groups performed in a similar manner.

TABLE 21.--Analysis of variance of reading proficiency scores for groups of upper and lower visually impaired elementary age children.

Sources of Variance	DF	Mean Square	F
Groups (G)	1	.7890	
Subjects within Groups (S(G))	61	.1583	$\frac{P \times G}{P \times (S(G))} = .031^{NS}$
Print (P)	1	.5074	
Print x Groups (P x G)	1	.0520	
Print x Subjects within Groups (P x S(G))	59	.1676	

^{NS}Not significant

The question regarding the influence of intelligence was approached in a manner similar to the method used with question of age.

The children for whom an I.Q. was available were divided into two groups of twenty. Those with an I.Q. in excess of one hundred made up one group and those with I.Q.s of below one hundred made up the second group. The two children with intelligence quotients of exactly one hundred were not included.

Table 22 gives the results of this analysis which indicates that the upper and lower intelligence groups paralleled each other in performance on different print sizes. The interaction of groups and conditions was insignificant indicating that intelligence was not a major influence in the pattern of the scores.

The final analysis of reading proficiency focused on the influence of acuity level. The sample was divided according to acuity level, into two groups of thirty-two subjects. Subjects with better than 20/200 formed one group and those with 20/200 or less formed the second group.

The results of this analysis, presented in Table 23 show no significant interaction between the two groups. No statistical difference in the two groups was apparent. One may therefore speculate that the acuity level of elementary age print readers did not significantly affect their performance on reading tasks presented in either standard or large print.

TABLE 22.--Analysis of variance of reading proficiency scores with visually impaired elementary children belonging to upper and lower intelligence groups.

Sources of Variance	DF	Mean Square	F
Groups (G)	1	.2357	
Subjects within Groups (S(G))	39	.1588	$\frac{P \times G}{P \times (S(G))} = .159^{NS}$
Print (P)	1	.3050	
Print x Groups (P x G)	1	.0403	
Print x Subjects within Groups (P x S(G))	37	.1738	

^{NS}Not significant

TABLE 23.--Analysis of variance of reading proficiency scores with two groups of visually impaired elementary children having visual acuity greater and less than 20/200.

Sources of Variance	DF	Mean Square	F
Groups (G)	1	.0001	
Subjects within Groups (S(G))	63	.1977	$\frac{P \times G}{P \times (S(G))} = .683^{NS}$
Print (P)	1	.4612	
Print x Groups (P x G)	1	.0930	
Print x Subjects within Groups (P x S(G))	61	.1365	

^{NS}Not significant

CHAPTER V

INTERPRETATIONS OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Sample

Normally one would have expected that the majority of children classed as visually impaired print readers by the public schools would have had an acuity level greater than 20/200.

The fact that half the sample could have been categorized as legally blind (20/200 or less) would seem to be an indication of a trend that appeared obvious in most of the districts visited.

It may be an indication that many visually impaired children with higher acuities are no longer considered handicapped in these districts and are being absorbed into the regular school population.

The special help in these districts appeared to be concentrated on those children who had moderate to severe visual problems.

It had not been anticipated that a first grade reading level would create any difficulty with eight year olds who, in the majority of cases, would have had at least

two years of formal instruction. This does not, however, seem to have been a valid assumption. The fact that a disproportionate number of eight year olds had to be excluded, suggests that this criterion may have been a problem. In some cases, the child's inability to read may also suggest that there could have been a delay in obtaining special services. A number of the children were receiving special help for the first time during the current year.

The rather obvious majority of boys in the sample could not be explained by any of the observations made by the examiner, except perhaps, the fact that boys appear to dominate most special groups. It is a well known and a well documented fact that more males than females are found in most disability areas.

Analyses of Hypotheses

Print Size

The null hypotheses 1, 2 and 3 relating to a comparison of large and standard print when used without magnification, were all accepted since no statistical differences could be found. This appears to be somewhat of a contradiction to the fact that the raw score means consistently favored large print. A conclusion of no difference is also at variance with other observations (to be discussed later) regarding the performance of

subjects on large and standard print. While there does not appear to be a simple answer for these apparent differences, a number of possible answers may be suggested.

It may well be that in fact no such differences exist. Such an explanation, however, is not necessarily the one we should accept without qualification. The fact that Sykes[127] also found that raw score means consistently favored large print, suggests the possibility of other explanations.

It may be that the comparatively brief testing period required to read three paragraphs was insufficient time for adequate discrimination between the two print sizes. The possibility exists that longer testing periods might bring out significant differences. On the other hand, the possibility also exists that the observed differences favoring large print, are a result of greater familiarity with these materials, although this did not appear to be the case with most of the children in the sample.

In order to explore the possibility of alternative explanations, the presentation of additional facts which appear to be related to this question, seem warranted at this point.

The reader should be aware of the fact that mean scores on reading proficiency used in the final analysis of variance (Table 23) with upper and lower acuity groups

showed divergent trends. Since the trends were not great enough to cause a significant interaction they might easily be overlooked. Also it should be noted that the explanations based on them are little more than educated guesses. However, it was interesting to note that the group with the lower acuity level showed a mean score of .467 on standard print which increased to .521 for large print. In contrast to this the group with the higher acuity level showed a mean of .401 on standard print which decreased to a mean of .347 on large print. Figure 2 illustrates these trends.

These trends would seem to indicate that the use of large print by children with higher acuities actually has a negative effect on their reading proficiency. At the same time the trends seem to support the use of large print for children with lower acuities.

A further examination of the data on reading speed brought out additional facts which lend some support to this notion and will therefore also be of interest.

A comparison of children whose reading speed was highest on large print with those who performed best on standard print given in relation to eye defect and acuity level is shown in Table 24.

The comparison indicates that forty-five out of sixty-four children had higher reading speed scores on large print. This is about seventy per cent of the sample.

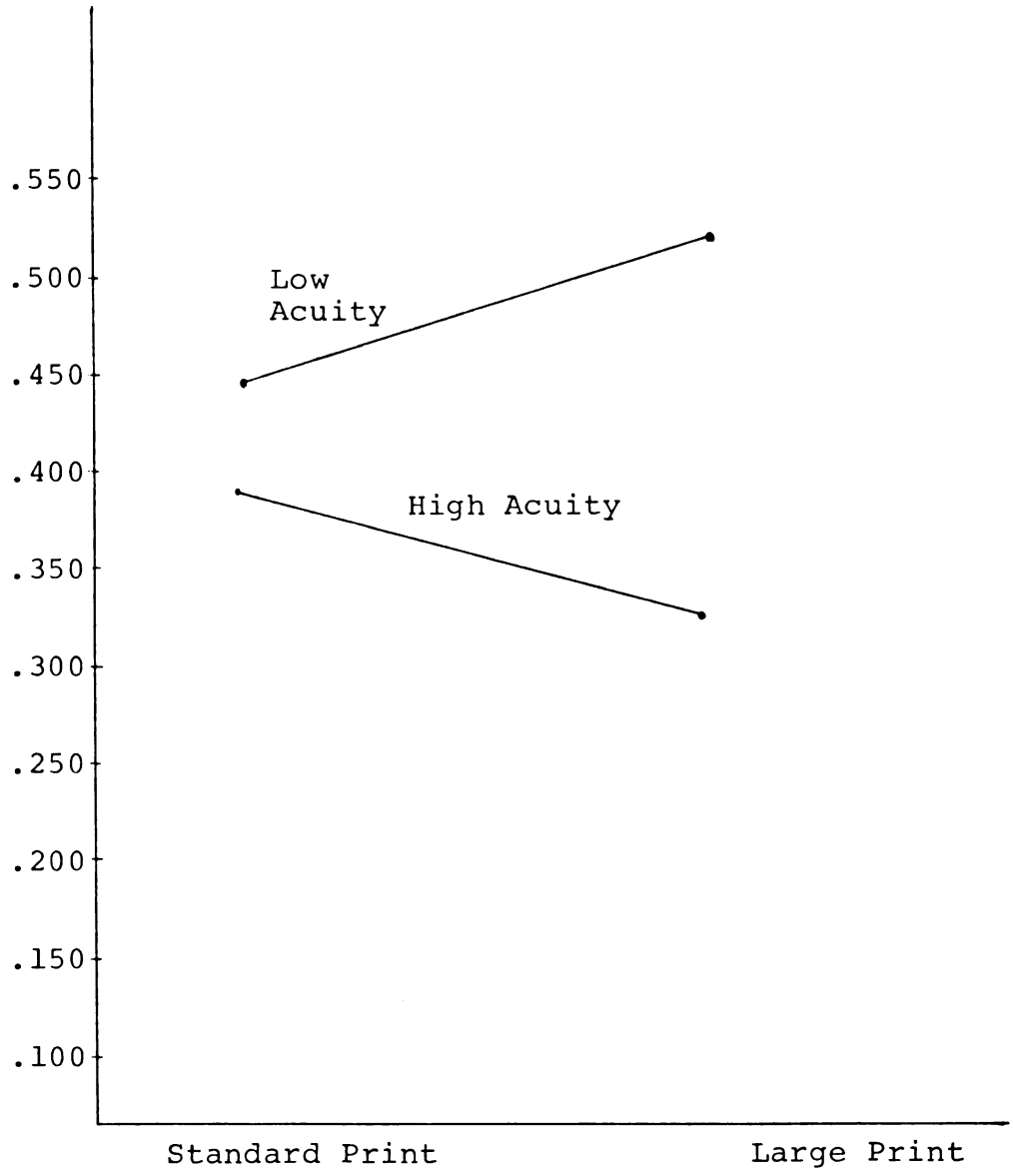

Figure 2.--Reading proficiency mean scores for low and high acuity groups.

TABLE 24.--Numbers of children whose reading speed was greatest on large or standard print read without magnification when distributed according to eye defect and acuity level.

Defect	Acuity > 20/200		Acuity < 20/200		Total
Lens	5	(2)	3		10
Retina		(2)	6	(1)	9
Optic Nerve	3	(1)	3	(1)	8
Neural and Muscular	9	(4)	7	(4)	24
Iris			1		1
Eyeball in General	2	(2)	3		7
Other		(2)	3		5
	19	13	26	6	64

( ) Performed best on standard print.

The comparison also indicates that acuity level bears some relationship to performance on a particular print size. It is readily apparent that the majority of the children (26 out of 32) with acuities of 20/200 or less had their highest reading speed when using large print.

It should be noted, however, that the same is not true for children with acuities greater than 20/200 where a majority (19 out of 32) had their highest reading speed score on standard print.

Table 24 does not, however, appear to reveal any well defined patterns which might indicate that a particular eye defect would favor one print size over another. One possible exception may be that eight out of ten children with a lens defect favored large print.

The supposition that acuity level does appear to be related to performance on different print sizes, may offer another and perhaps the most plausible explanation for the insignificant differences in the total group.

If in fact the acuity level is important, then the performance of children of different acuity levels would tend to have a leveling effect on overall performance on large print. As noted earlier, if children with higher acuity levels are restricted in performance on large print while those with lower acuity perform better, the net effect will be a compromise somewhere near their combined performance on standard print.

From the available evidence it was concluded that large print and standard print were equally effective in facilitating the reading skills of visually impaired elementary age print readers when no further differentiation for type and severity of defect is made. This conclusion, however, must be interpreted with some caution because of the additional findings.

Magnification

The hypotheses 4, 5 and 6 all state that there will be no difference in reading performance of visually impaired elementary age print readers when reading standard print with and without the magnifier. These hypotheses were all rejected since significant differences were found to exist in reading speed, reading accuracy and reading comprehension between the two conditions.

The large significant differences were brought about by the fact that twenty children were unable to use the magnifier and obtained zero scores. But even when allowance was made for this fact, it was found that mean scores for reading speed and reading accuracy were still significantly different under the two conditions.

In order to explore possible relationships between eye defects and ability to use the magnifier a distribution of the twenty children who could not use the magnifier was made in relation to eye defect and acuity level.

The figures in Table 25 show no particular bias with respect to any one eye defect. It will be noted, however, that fourteen of the twenty children had acuities of 20/200 or less. Observations made by the examiner during the interview seemed to indicate that a number of these children might have been able to use greater magnification. In some further post-test discussion they indicated an ability to use higher power hand magnifiers. Figures in Table 25 suggest that severity of visual loss played an important role in deciding whether or not an individual could use the magnifier.

It was interesting to note, however, that six children had their highest reading speed scores when using the magnifier. This number might have been greater if more practice time had been available to the children before the actual testing.

It was also found that of the six children whose best reading performance was with the magnifier, five had acuity levels better than 20/200. No relationship between eye defect and use of the magnifier, as indicated in Table 26 however, was readily apparent.

The evidence in this study clearly leads to the conclusion that the magnifier used with standard print is not as effective as is standard print alone, in facilitating the reading skills of visually impaired elementary children.

TABLE 25.--Number of visually impaired elementary age print readers who were unable to use the magnifier distributed according to eye defect and acuity level.

Defect	Acuity > 20/200	Acuity < 20/200	Total
Lens	2	1	3
Iris		1	1
Retina		4	4
Neural and Muscular	1	4	5
Optic Nerve	1	2	3
Eyeball in General	2	1	3
Other		1	1
	6	14	20

TABLE 26.--Visually impaired elementary age print readers, whose reading speed was highest when using the magnifier as distributed by major eye defect and acuity level.

Eye Defect	Acuity > 20/200	Acuity < 20/200	Total
Nystagmus	1		1
Chorioretinitis		1	1
Esotropia	1		1
Myopia	1		1
Macular Degeneration	1		1
Undiagnosed	—	—	1
	4	1	6

The hypotheses 7, 8 and 9, which stated that there would be no difference between the reading scores attained by visually impaired elementary age print readers using large print without magnification and standard print with the magnifier, were not accepted.

Much of what was said earlier, with regard to standard print used with and without the magnifier, might be repeated here. Apparently there were only limited numbers of children in this sample who made effective use of this particular magnifier. Although it is not known what might have taken place after extended practice sessions, the evidence here leads the experimenter to conclude that large print without magnification is more effective in facilitating the reading skills of visually impaired elementary age print readers than standard print used with the magnifier. This study suggests that this form of magnification alone cannot be considered a viable alternative to the use of large print for a majority of visually impaired elementary age print readers.

Reading Preference

The three null hypotheses 10, 11 and 12, which stated that there would be no difference between reading performance under preferred and alternate reading conditions, were all accepted. It is interesting to note that in spite of considerable differences in the performance of the children under different test conditions they did not seem to select

conditions under which they performed best with any consistency. One must conclude from the results that the subjective judgment of visually impaired elementary age print readers cannot be relied on.

Summary of Hypotheses Testing

The summary of test results in Table 27 shows that magnification, not print size accounted for significant differences.

TABLE 27.--Summary of hypotheses tested.

Independent Variables	Dependent Variables		
	Speed	Accuracy	Comprehension
Lge print vs Std print	H_1^{NS}	H_4^{NS}	H_7^{NS}
Std print vs Std print mag	H_2^*	H_5^*	H_8^*
Lge print vs Std print mag	H_3^*	H_6^*	H_9^*
Preferred vs Alternate	H_{10}^{NS}	H_{11}^{NS}	H_{12}^{NS}

^{NS}Not significant

$^*p < .01$

Exploratory Analyses

Age

It had been suggested that possible differences in performance, on large and standard print might be found

between upper and lower elementary age print readers. No evidence of the existence of such differences was found. This may have been due to the fact that age differences in the sample were not large to begin with. It may also have been caused by the limited number of children at the upper and lower extremes of the age range.

Even though the results of this analysis must be considered as speculative, it would suggest that there is no reason to believe that such differences do in fact exist.

Intelligence

Intelligence is generally considered to be a factor in the performance of all tasks involving cerebral processing.

The importance of this factor in interpreting different print sizes did not appear to be great with individuals who were able to read. This may have been partially due to the size of the sample used in this analysis. While conclusions, here too, were only speculative, there was no evidence to indicate that intelligence might be an important factor. The test results would lead us to conclude that intelligence plays a negligible, if any, role in the performance of visually impaired elementary age print readers, on different print sizes.

Acuity Level

The influence of acuity level on reading performance, when different print sizes are used, has been questioned on

numerous occasions. As noted in the earlier discussion, apparent differences have been found previously. A common sense conclusion might be that differences did in fact exist. The existence of such differences, however, has not been statistically verified. It may be that sampling methods have been responsible for camouflaging the existence of such differences. The analysis here, although it cannot be considered as reliable, also leads to the conclusion that no such differences exist. It was only the further examination of the trends in the means that suggested the speculation that acuity level may in fact influence performance on different print sizes. It may also be a combination of factors in which certain defects along with certain acuity levels together, produce differences. Although the statistical analysis was negative, there appears to be sufficient additional information to warrant the supposition that acuity level may have an influence on the performance of visually impaired elementary age print readers, when using different print sizes.

Summary

Problem

One of the primary objectives for individuals with low vision is to maximize their ability to receive and perceive greater quantities of the environment through the visual sense in the most effective manner. Three important

considerations in any attempt to facilitate this process are, (a) the individual person, (b) the characteristics of the stimulus, and (c) the nature of the stimulus.

Since reading provides one of the chief avenues to information within the public school setting, it follows that printed materials occupy a position of major importance in the educational process. The quality of these materials and/or the manner in which they are utilized, may therefore contribute significantly to the relative effectiveness of their use by the reader.

Purpose

The purpose of this study was to seek objective information regarding the relative effectiveness of standard and large print, used with and without magnification, in facilitating the reading skills of visually impaired elementary age print readers.

Specifically the study sought to determine whether reading speed, accuracy and comprehension scores of visually impaired elementary age print readers would differ when reading standard and large print with and without magnification.

Additional information was sought regarding the influence of preference, age, intelligence and acuity level.

Methodology

Sample.--Sixty-four visually impaired elementary age print readers were included in this study. All children could read twelve point print and had attained at least a first grade reading level.

Materials.--Four parallel forms of the Gray Oral Reading Test, reprinted in twelve and eighteen point print, were utilized. The Ednalite Masterlens was used to provide magnification.

Procedure.--The equal representation of test forms, conditions and order of presentation were controlled by the use of a graeco-latin square.

Illumination was standardized and an effort was made to control such factors as noise and interruption.

The children were individually tested by the examiner and the entire interview was recorded.

Performance Measures.--The children read three paragraphs under each of the four test conditions. Comprehension questions followed each paragraph. Reading speed, accuracy and comprehension scores were tabulated.

Analysis of Data

The hypotheses concerning each of the three dependent variables were tested by two-way analysis of

variance. The remaining three hypotheses were analyzed by use of dependent sample T-tests.

Conclusions

The hypotheses which predicted that there would be no difference between performance on large and standard print as measured by reading speed, accuracy and comprehension, were all accepted. It was concluded that visually impaired elementary age print readers, as a total group (when no differentiation is made for acuity level or eye defect) perform equally well on standard and large print.

The six hypotheses which predicted that there would be no difference in performance as measured by reading speed, accuracy and comprehension, when children read either standard or large print and standard print magnified, were all rejected. It was concluded that magnification of standard print was less effective than either large or standard print without magnification. This conclusion also was arrived at through consideration of visually impaired elementary age print readers as a total entity without making any allowance for possible sub-group differences.

The prediction that there would be no difference between performance under preferred and alternate test conditions as indicated by measures of reading speed, accuracy and comprehension, was accepted. It was concluded that the subjective judgment of visually impaired

elementary age print readers was not to be relied upon as an indicator of the best reading material or reading condition.

The supposition that age, intelligence and acuity level would significantly affect performance could not be proven. Some supporting evidence was found to suggest that acuity and eye defect may be factors which do influence performance.

Recommendations

This study sampled the reading skills of subjects through the use of continuous reading material. However, the reading tasks were not of sufficient lengths, which would predispose toward fatigue. Consequently no attempt was made to measure or to analyse the possible effects of this variable. The results must be viewed bearing in mind these limitations until such time when effects of fatigue are better known.

Further research is needed which would take into account the possible influence of fatigue during periods of extended reading.

Evidence in this study suggests that large print may be marginally better than standard print but that it is not significantly so. Since this study followed sampling procedures similar to most earlier studies in dealing with a wide range of acuity levels and eye defects, it may well have foundered because of this. From the information

gathered in this study, it would seem that the appropriate question is not whether large or standard print is suitable for visually impaired children. Instead we need to ask for which segment of visually impaired elementary children is a particular print size appropriate.

The children selected for study included only visually impaired print readers, with the consequent exclusion of those who might become print readers through the use of various low vision aids and/or low vision training. It is not known to what extent similar results might have been obtained on certain measures for this excluded group.

It is recommended that future research on print size focus on determining the needs of particular groups and subgroups in contrast to dealing with a cross-section of visually impaired readers.

The investigation regarding the effect of magnification in this study was limited to simple enlargement of standard print. The study was further limited by the short periods of adaptation to magnification allowed by the testing procedure. It is not known what effect longer practice periods with the magnifier might have had on the test results. While it is useful to know that magnification as used in this study has little or no value for a majority of visually impaired print readers, it is equally important to note that a small segment of this population can benefit from its use.

Further research which takes into account different levels of magnification and varying periods of adaptation is indicated. The findings in this study with respect to magnification give additional support to the earlier suggestion that particular rather than global needs of the visually impaired children require attention.

It has been appropriately stated that,

> If we are to do justice to the individual we must seek for him the level and kind of education which will open "his" eyes, stimulate "his" mind and unlock "his" potentials. We should seek to develop many educational patterns--each geared to the particular capacities of the student for whom it is designed.[128]

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APPENDIX A

Sample of Twelve and Eighteen Point Print Used in This Study.

One bright summer day twin brothers walked to a lake with their uncle to fish. They sat still for a long time waiting for the fish to bite. Finally one boy got a bite. He became so excited that he dropped his pole into the water. The fish quickly swam away with it. Soon the pole disappeared. The surprised boy looked at his uncle and then laughed.

One bright summer day twin brothers walked to a lake with their uncle to fish. They sat still for a long time waiting for the fish to bite. Finally one boy got a bite. He became so excited that he dropped his pole into the water. The fish quickly swam away with it. Soon the pole disappeared. The surprised boy looked at his uncle and then laughed.

APPENDIX B

DO YOU KNOW SOMEONE WHO HAS DIFFICULTY READING REGULAR PRINT?

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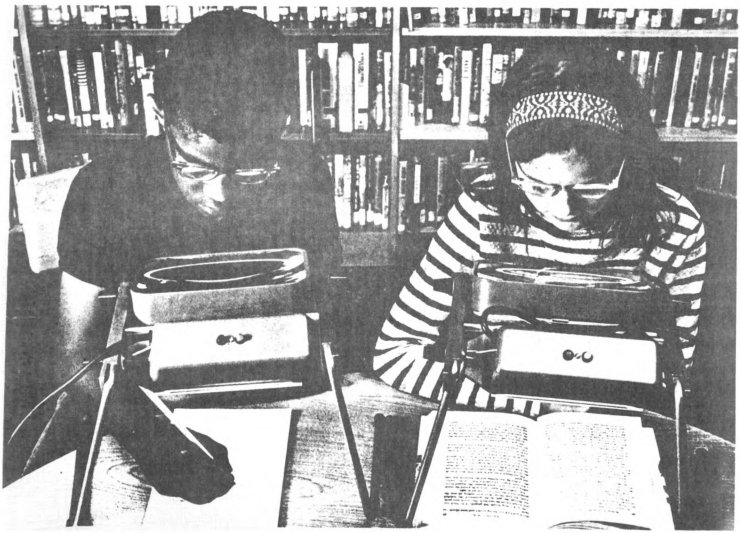

APPENDIX C

RAW SCORES

Subjects	Std. Print			Std. Print Mag.			Large Print			Large Print Mag.		
	Speed	Acc.	Comp.	Speed	Acc.	Comp.	Speed	Acc.	Comp.	Speed	Acc.	Comp.
01	107	20	18	078	14	22	107	22	16	116	21	13
02	056	09	18	000	00	00	083	12	22	000	00	00
03	140	21	24	117	20	22	132	20	23	130	23	24
04	094	17	20	106	20	22	105	23	18	122	19	20
05	077	22	24	000	00	00	056	13	22	000	00	00
06	104	17	24	000	00	00	108	18	23	000	00	00
07	161	21	24	055	06	18	154	22	22	120	19	21
08	080	17	20	071	18	23	077	17	23	065	13	22
09	083	21	24	036	14	24	070	22	24	081	20	23
10	047	13	20	050	14	24	053	23	16	057	20	20
11	102	22	14	075	10	12	105	23	16	093	20	16
12	030	09	12	000	00	00	042	07	22	000	00	00
13	102	14	24	069	15	22	103	20	20	089	16	22
14	090	22	22	119	24	22	098	21	20	112	18	24
15	057	12	24	045	17	18	043	15	20	050	18	22
16	042	15	14	000	00	00	056	20	16	000	00	00
17	108	19	14	092	19	20	102	20	24	086	17	24
18	101	21	22	000	00	00	164	24	24	000	00	00
19	112	18	14	076	13	22	094	16	24	081	14	21
20	120	20	22	053	15	22	143	22	18	112	19	23
21	108	16	24	053	14	23	130	17	24	068	10	24
22	068	08	24	070	15	24	075	12	24	065	11	24
23	120	21	24	000	00	00	141	23	24	000	00	00
24	091	19	22	000	00	00	122	23	17	000	00	00
25	095	20	16	076	22	12	091	18	18	087	22	20
26	048	14	12	058	10	20	065	14	24	054	10	24
27	048	20	20	035	17	22	058	18	19	047	21	15
28	058	23	24	049	22	22	059	19	20	052	18	22
29	054	19	16	000	00	00	056	22	22	000	00	00
30	078	21	20	000	00	00	084	23	24	000	00	00
31	044	16	22	029	06	21	050	11	22	031	03	24
32	112	18	14	076	13	22	094	16	24	081	14	21
33	172	22	22	135	07	24	178	19	24	137	20	24
34	134	16	21	110	14	24	102	18	24	090	11	24
35	108	20	22	066	16	18	111	20	24	105	22	20
36	084	17	24	055	12	16	092	18	22	072	15	27
37	107	24	21	000	00	00	118	22	16	000	00	00
38	069	18	22	057	19	16	068	21	24	049	19	22
39	048	20	24	074	20	20	055	21	23	062	23	20

Raw Scores Continued.

Subjects	Std. Print			Std. Print Mag.			Large Print			Large Print Mag.		
	Speed	Acc.	Comp.	Speed	Acc.	Comp.	Speed	Acc.	Comp.	Speed	Acc.	Comp.
40	068	16	22	000	00	00	094	24	19	000	00	00
41	141	24	24	090	24	24	113	22	22	117	21	24
42	082	08	23	078	15	22	085	13	22	082	12	22
43	065	12	20	000	00	00	077	13	24	000	00	00
44	055	10	21	000	00	00	049	14	22	000	00	00
45	142	21	09	126	19	11	124	18	07	123	16	12
46	061	18	18	047	13	16	075	15	23	053	16	12
47	132	19	22	000	00	00	141	21	24	000	00	00
48	096	16	18	073	12	24	112	16	24	069	14	24
49	029	09	22	000	00	00	063	20	22	000	00	00
50	144	20	18	149	19	18	154	20	22	150	21	16
51	086	03	20	079	11	24	083	09	24	065	02	24
52	129	21	22	000	00	00	136	22	20	000	00	00
53	122	22	20	000	00	00	125	23	20	000	00	00
54	058	14	18	069	12	23	070	20	18	058	10	20
55	093	17	24	090	19	24	128	22	24	108	20	24
56	116	21	22	096	11	22	128	20	24	108	16	20
57	091	15	22	098	18	20	087	14	18	075	11	24
58	063	11	24	000	00	00	068	17	24	000	00	00
59	078	11	24	085	07	21	077	15	18	086	16	14
60	114	22	22	000	00	00	099	17	24	000	00	00
61	106	20	20	077	15	20	078	21	24	082	18	22
62	103	20	20	086	10	22	104	18	22	120	19	16
63	077	23	20	078	14	20	077	21	14	095	24	24
64	053	19	20	033	12	20	057	18	24	044	18	22