TYPOGRAPHY: THE DEVELOPMENT OF CRITERIA FOR DETERMINING THE LEGIBILITY OF PRINT

A Thesis

Presented in Partial Fulfillment of the Requirements for the Degree Master of Arts

by

Louis Anthony Treboni, B.F.A.

The Ohio State University
1966

Approved by

Edgar Dale
Adviser
School of Education
ACKNOWLEDGMENTS

The writer wishes to express his appreciation to his adviser, Dr. Edgar Dale, whose valuable advice and suggestions have helped bring this study to a successful completion. The cooperation of the writer's wife, Anna, has contributed in many ways to the furtherance of this work.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>11</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF ILLUSTRATIONS</td>
<td>vi</td>
</tr>
</tbody>
</table>

## Chapter

### I. INTRODUCTION

- Encoding Messages
- Fidelity of Printed Communications
- Importance of the Study
- Statement of the Problem
- Procedures
- Scope of the Study

### II. DEFINITIONS

- The Mechanics of Reading
- Readability and Legibility
- The Testing of Legibility

### III. FACTORS AFFECTING LEGIBILITY

- Type Style and Form
- Boldness
- Leading
- Measure
- Margins
- Color of Print
- Printing Paper
- Summary

### IV. CONCLUSION

- Limitations
- Recommendations
- Checklist of Legibility Rules
- Summary and Conclusion
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Legibility Guide</td>
<td>75</td>
</tr>
<tr>
<td>2. Picas-Inches Conversion Table</td>
<td>80</td>
</tr>
</tbody>
</table>
## LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Three Kinds of Serifs</td>
<td>23</td>
</tr>
<tr>
<td>2.</td>
<td>A Comparison of Garamond (older) and Bodoni (modern)</td>
<td>25</td>
</tr>
<tr>
<td>3.</td>
<td>Gothic (sans serif) Faces</td>
<td>28</td>
</tr>
<tr>
<td>4.</td>
<td>The Upper Half of Lower Case Letters Provides Clues to the Identification of Words</td>
<td>33</td>
</tr>
<tr>
<td>5.</td>
<td>A Comparison of Bold and Light Print of the Same Type Face</td>
<td>35</td>
</tr>
<tr>
<td>6.</td>
<td>Dimensions of Point Size and X-Height</td>
<td>40</td>
</tr>
</tbody>
</table>

vi
CHAPTER I

INTRODUCTION

A printed communication aims to convey the information, facts, and ideas to the reader which will elicit desired responses according to the particular purpose of the communication. In other words, the communicator, the one who sends the message, hopes that he will accomplish what he wants to do. A modern concept is that communication has three purposes—to inform, to persuade, and to entertain.\(^1\) The amount of printed material existing or being published today illustrates that communicators use the print medium to serve these three functions.

Library shelves bulge with overwhelming amounts of reading materials; technical journals and trade publications are being produced at such a rate that it is difficult for the scientist or businessman to keep current in his field. Advertisements fill mailboxes, newspapers, and magazines, and paperback novels flood the commercial market. Whatever the purpose of the communication, the printed message must first reach its intended destination,

and secondly, it must be read. The latter is the function of typography.

_Type_ is the primary graphic element in printed communications and its chief purpose is to be read. It is the medium for shaping words which in turn express information, facts, and ideas to the reader. Whether the printed message is presented in a textbook, an advertisement, or a novel the print in these publications should have the visual and physical characteristics that provide speed, accuracy, and ease of reading with comprehension—namely legibility.

**Encoding Messages**

In complex printed communication situations, there are many elements involved in the communication process and many factors that influence the success of the communications. Personal skills and background, for example, affect the person who sends or originates a message; the content of the message and the structure of the symbols used to transmit the message affect what is being said; the print medium itself is affected by technical and economical problems, limitations, and regulations. The people to whom the message is sent are influenced by their personal preferences and past experiences; and the total of all these factors affects the results of the communication.
This study, however, is mainly concerned with only a part of the total communication process—the structure of the symbols used to transmit the message. More specifically, this means the encoding of printed messages, the planning and specification of typography to provide optimum legibility for printed words. An explanation of the communication process has therefore been simplified to understand what is meant by encoding.

"Communication always requires at least three elements—the sender, the message, and the receiver."² In printed communications the sender, to mention only a few, may be a teacher, a copy writer, or a novelist. The message is in the form of ink on paper, and the receiver may be a student, a prospective consumer, or an individual reading for entertainment.

Before the sender's message can be shared with a receiver it must be put into code, encoded. Encoding means that the sender's information, facts, or ideas are put in the form of transmissible visual signals. The message must be decoded by the receiver before the communication is complete. A popular example will help to illustrate this.

A college student (the sender), near graduation, is

aware of a position with a respected organization. He decides to inform the company, by letter, about himself in hope of being hired. The necessary information is gathered and organized (the message). Now the student is ready to type his résumé (encoding). A typewriter with a common size and type face is selected; a new ribbon is placed in the typewriter and an attractive stationery is selected. Adequate margins, indentions, and space between lines of type and paragraphs are used and the résumé is checked for spelling and typing errors.

The letter is mailed and received by the preferred employer (the receiver). Through his sense of sight the employer reads the letter (decoding). He finds the letter is well organized, contains the necessary information, and has no spelling or typing errors. The stationery and margins are pleasing; and the type face, indentions, space between lines and paragraphs, and the clear, dark letters make it fast and easy for him to read. The communication is then complete.

All the links in the communication must work at maximum capacity in order to have efficient communication. Wilbur Schramm, a noted authority on communication, makes the following statement:

If the sender does not have adequate and clear information; if the message is not encoded fully, accurately, and effectively in transmittable signs; if these are not transmitted fast enough and accurately enough,
despite interference and competition, to the receiver; if the message is not decoded in a pattern that corresponds to the encoding; and finally, if the receiver is unable to handle the decoded message so as to produce the desired response—then, obviously, the system is working at less than top efficiency.\(^3\)

Today, the printed communication situation is more complex than the example of the student mentioned above. The development and production responsibilities of printed messages are divided among different people with different specialities. That is to say, the sender may not be responsible for encoding his own messages. The teacher, for instance, may have developed his own information to be published in a textbook, but his messages may be encoded by a typographer in a publishing firm. The copywriter in an advertising agency may have his messages encoded by a graphic designer or an art director in the same agency. However, there still are many situations in which senders do encode their own messages. But more important, persons responsible for encoding printed messages must have an extensive knowledge of typography. In other words, persons responsible for the planning, selection, and specification of type must have the necessary broad experience with type in order to encode printed messages effectively.

**Fidelity of Printed Communication**

The knowledge and experience required in good

\(^3\text{Ibid.}, p. 115.\)
typography cannot be over-emphasized for "once coded and sent, a message is quite free of its sender, and what it does is beyond the sender to change."\(^4\)

As mentioned earlier, the typographer is responsible for taking the ideas of the sender and putting them into code, expressing the sender's purpose in the form of a message. This means that the message must reflect the meaning of the sender perfectly, and that the message must be translated by the receiver with complete accuracy.\(^5\) In other words, the message must have high-fidelity.

In discussing the fidelity of electronic communication, Shannon and Weaver initiated the idea of noise.\(^6\) They define noise as factors that distort the quality of an electronically transmitted signal.

A popular concept is that noise is something audible and conflicting, that is, a sound—a sound that interferes with or detracts from a message that is intended to be heard.

Sir Cyril Burt, a leading authority on legibility-testing, states that "analogous to the audible 'noise' which interferes with the accurate transmission of the

\(^4\)Ibid., p. 114.


audible information, there is always some degree of visuo-
mental interference or 'blur', which impedes the accurate
transmission of visible information.\textsuperscript{7}

"Noise and fidelity are two sides of the same coin.
Eliminating noise increases fidelity; the production of
noise reduces fidelity."\textsuperscript{8} In evaluating or planning the
arrangement of type for printed communications we are
interested in knowing what typographical factors increase
or decrease the fidelity of a printed message. The basic
concern of this study related to noise and fidelity is the
determination of the typographical factors that affect the
legibility of printed words, which in turn influence the
effectiveness of printed communications.

**Importance of the Study**

Persons responsible for the planning and designing
of printed communications who do not have the necessary
broad experience with typography must rely on intuition,
personal preferences, and examples of commercial typesetting
on which to base typographical judgments. Such judgments
may impede the accurate transmission of visual information,
and cannot be substituted for judgments based on experience,
physiological and psychological facts. There is a need for

\textsuperscript{7}Sir Cyril Burt, *A Psychological Study of Typography*

\textsuperscript{8}Berlo, *op. cit.*, p. 41.
typographical standards of legibility based on scientific studies and the knowledge of experienced typographers.

In a complex communication situation the different responsibilities of communication are divided among many people. The design of printed materials is often the responsibility of the layout men, designers, and artists or those who purport to be layout men, designers, or artists. Often the background or education of these people has not provided the necessary broad knowledge of typography, and even less knowledge of the reading public.

Some publications produced by professional typographers or designers reveal mistakes that indicate that it is not only the inexperienced who need guidance in determining the legibility of print. One need only to review a few of the current advertisements to see new methods and devices more concerned with attracting the attention of the reader, the creation of a mood, or the artistic appearance of the printed page, than with legibility. Attracting attention, creating a mood, and aesthetics are other factors bearing on the effectiveness of printed communication, but they are secondary to legibility. The primary purpose of typography in printed communication is to be read, therefore it should be legible. This means that the design of printed material should fall within the expectations, habits, needs, comfort, and experiences of the reader.
Statement of the Problem

The purpose of this study was to develop criteria for the legibility of printed words from which judgments can be made when selecting or planning the arrangement of type, or by which an evaluation of typography in printed communications can be made, according to the established criteria.

In other words, the purpose of this study was to answer the following questions:

1. What are the factors that affect the legibility of printed words?
2. How can the factors be presented to provide a systematic approach to the judgments that must be made when selecting and planning the arrangement of type for printed communications, or when evaluating the legibility of typographical arrangements?

Procedures

This study involved: (1) a review of the literature on typography; (2) an analysis of the psychological studies on the legibility of print; (3) the development of criteria for the legibility of printed words; and (4) the presentation of the criteria to serve as an easy guide from which legibility judgments can be made, or as a guide to the evaluation of the legibility of printed words.
Scope of the Study

This study does not discuss the aesthetics of print, history and classifications of type, preparing or marking the copy for the typesetter, or the various typesetting processes. It is concerned only with the typographical factors that determine the legibility of print and that can be controlled at the time the typography is being selected or planned.

Tests have shown, for example, that lighting conditions\(^9\) or vibration\(^10\) retard reading speed, ease, and accuracy; and it is common knowledge within the print industry that the skill of the pressman affects the visual quality of printed images. These factors, however, are removed from the responsibility of the typographer; he is concerned but has no control over them.

In addition, this study will not discuss the wide variety of other kinds of legibility research that has not been specifically related to publications, for example, the legibility of road signs\(^11\), radar instrument

\(^9\)M. A. Tinker, "Cumulative Effect of Marginal Conditions Upon Rate of Perception in Reading," *Journal of Applied Psychology*, XXXII (October, 1949), 537-540.


panels,\textsuperscript{12} televised symbols,\textsuperscript{13} graphic displays,\textsuperscript{14} and automobile license plates.\textsuperscript{15}

Furthermore, some legibility studies specifically related to publications have not been included because of the methods used to test legibility. For example, investigations by Luckiesh and Moss,\textsuperscript{16} Sanford,\textsuperscript{17} and Dockery\textsuperscript{18} have relied on the visibility, distance, and short-exposure methods, respectively. The disadvantages of these testing methods and why they were not included in this study will be discussed in the next chapter.

\textsuperscript{12}William C. Howell and Conrad L. Kraft, \textit{Size, Blur, and Contrast as Variables Affecting the Legibility of Alphanumeric Symbols on Radar Displays} (Columbus: The Ohio State University Research Foundation, 1959).


Finally, this study will not discuss those typographical arrangements found in telephone directories, railroad timetables, dictionaries and the like. These kinds of typographical arrangements aid the rapid identification and location of names, numbers, and words. This study is only concerned with those typographical arrangements that aid the reading of continuous textural material.

The following chapter will discuss the mechanics of reading, difference between readability and legibility, and methods used to test legibility in order to help the reader understand what is meant by legibility.

For a quick and easy reference to technical terms, a glossary is presented in the appendix.
CHAPTER II
DEFINITIONS

The Mechanics of Reading

In reading, the eyes make rapid, abrupt movements, from left to right along a printed line alternating with pauses, called fixations. Each pause is a period of clear vision in which the printed material is perceived. At the end of the line, the eyes make a swift return to the beginning of the next line. At times, regressions, or backward movements within a line are made to re-examine the material.

A survey of photographic eye movement studies reveals that certain letters and words are perceived more readily than others because of their distinguishing features and form.\(^\text{19}\) Letters which have well-defined and unmistakable shapes or which possess descenders (parts which extend below the lines) or ascenders (parts which extend above the lines) provide additional clues to the recognition of the word as a whole. In reading, the legibility of the word as a whole or a group of words is

---

more important than the legibility of the individual letters that comprise words or phrases.\textsuperscript{20}

The number of pauses made in reading different material varies according to the skill and efficiency of the reader.\textsuperscript{21} The amount of material read by one person in a given period of time may be read five times as fast as another. Also, the familiarity, difficulty, and interest of the material determine the number of pauses made by the same reader when reading different passages. "A mature reader makes a relatively small number of pauses when reading simple material and proceeds line after line in about the same number. With difficult passages, the number of pauses may be much greater."\textsuperscript{22}

Few fixations are required for the skilled reader. Proficient readers move their eyes rhythmically in quick jerks and pauses. At each fixation words as wholes are recognized by their overall form and distinctive characteristics. "As a rule, two or three words are recognized at each fixation of the eye. At times the good reader makes a regressive movement to recognize unfamiliar words or ascertain the meaning."\textsuperscript{23}

\textsuperscript{20}Burt, \textit{loc. cit.}

\textsuperscript{21}Gray, \textit{op. cit.}, p. 44.

\textsuperscript{22}Gray, \textit{loc. cit.}

\textsuperscript{23}Ibid., p. 59.
Ineffective reading may result due to increased pause duration or to increased fixation frequency.24

Readability and Legibility

Readability is sometimes confused with legibility. With the development of the readability formulas (i.e., Dale-Chall25 and Flesch26) the two terms are often used interchangeably, especially with regard to typography. Both affect reading efficiency but readability is a broader term which includes legibility.

Readability is primarily concerned with the mental difficulties in reading, that is, with the ease of reading, human interest, and the comprehensibility of the material. The readability formulas, for instance, have stressed certain aspects such as the subject matter, theme, style of writing, vocabulary level, and sentence length and structure to affect the results readers have with the material.

Legibility, on the other hand, is concerned only with the physical difficulties in reading, that is, with


the typographical factors that affect the perception of printed material. Legibility-testing, for example, does not measure comprehension but tests have shown that typographical factors do affect ease of reading in terms of speed and accuracy. Furthermore, experienced designers and typographers have long said that the use of white space between and around columns of type creates a pleasing format and makes printed matter interesting to read. Even though typography is a mechanical element of the printed content, it also affects the results readers have with the material. This is confirmed by George D. Spache when he gives the following psychological explanation of reading:

The number of words, phrases, or letters recognized during the fixation pauses reflects the reader's familiarity with the reading matter, the difficulties which he encounters in word recognition or assimilation of ideas, as well as the physical characteristics [italics mine] of the material read.20

There is less confusion between readability and legibility if it is remembered that readability is concerned with both the mental and physical difficulties in reading, while legibility is concerned only with the physical difficulties. Dale and Chall, when defining the concept of readability agree that legibility is a part of it. They make the following statement:

__________________________
27Tinker, Legibility of Print, loc. cit.
In the broadest sense, then, readability is the sum total (including the interactions) of all those elements within a given piece of printed material that affects the success that a group of readers have with it. The success is the extent to which they understand it, read it at an optimum speed, and find it interesting. 29

Therefore, when we refer to printed material as being readable, we mean that it can be understood, it is interesting to read, and it is legible. However, when we refer to printed material as being legible, we mean that the physical characteristics of the material permit optimum reading speed, ease, and accuracy with comprehension.

The following section describes the methods used to observe the physical characteristics and physical effects of print and arrives at a more specific definition of legibility.

**The Testing of Legibility**

A number of methods have been used to determine the legibility of print. They are as follows:

1. **Visibility**—Measures the brightness-contrast between print and paper; the ease of seeing isolated letters.

2. **Distance**—Measures visibility and perceptibility, i.e., the ease of seeing letters and reading words and sentences at various distances; brightness-contrast between print and paper.

3. **Focal Variator**—Measures degree of cleanness of individual letters and digits in different type faces.

---

4. Short-Exposure--A tachistoscope, a short-exposure apparatus, measures the accuracy in reading letters and words during a single fixation.

5. Observation (Blinking and Fatigue)--Records number of eye blinks and indications of fatigue when reading continuous textual material.

6. Eye Movements--Photographic eye movements are recorded to observe fixations, fixation pauses, and regressions when reading continuous textual material.

7. Rate of Work--Records speed of reading a specific amount of print within a given period of time followed by a questionnaire to determine comprehension.

Which method is the most effective to test legibility? Burt states that "there can, we think, be little doubt that the results obtained often depend very largely on the experimental procedures used. For example, types that appear more legible than others when tested by the distance method often prove less legible when tested by speed of reading."\(^{30}\) An apparent reason, and the same can be said of the short-exposure method, in that the reading that occurs during the tests does not duplicate the common reading situation. Nor is the common reading situation duplicated when the visibility and focal variator methods are used because they measure the perceptibility of isolated letters. The reader is reminded that legibility of the whole word or groups of words are more important in reading.

\(^{30}\)Burt, op. cit., p. 4.
rather than the legibility of the constituent letters of words or phrases.

The disadvantages of the methods mentioned provide sound reasons why leading authorities on legibility, namely Burt, Paterson, and Tinker have relied on the rate of work method as their principal means of testing legibility and why the writer has relied principally on the findings of these authorities. The rate of work method has enabled the investigators to determine the relative legibility of different typographical arrangements in common reading situations. The eye movement and observation methods have been used to analyze the results of the rate of work method by observing the physical effects in reading to determine why one typographical arrangement is better than another.

What, then, is legibility? In his book, *Legibility of Print*, Tinker has provided a definition that will be used for the purpose of this study. Tinker states:

Legibility, then, is concerned with perceiving letters and words, and with the reading of continuous textual material. The shapes of letters must be discriminated, the characteristic word forms perceived, and continuous text read accurately, rapidly, easily, and with understanding. In the final analysis, one wants to know what typographical factors foster ease and speed of reading.

Optimal legibility of print, therefore is achieved by a typographical arrangement in which shape of letters and other symbols, characteristic word forms, and other typographical factors such as type size, line width, leading, etc., are coordinated to produce
comfortable vision and easy and rapid reading with comprehension. In other words, legibility deals with the coordination of those typographical factors inherent in letters and other symbols, words, and connected textual material which affect ease and speed of reading.31

The next chapter will discuss those typographical factors that affect the ease, speed and accuracy of reading with comprehension.

31 Tinker, Legibility of Print, op. cit., p. 8.
CHAPTER III

FACTORS AFFECTING LEGIBILITY

This chapter deals with the factors that affect the legibility of printed words. The factors presented will be discussed in the following order:

1. Type Style and Form
2. Boldness
3. Size
4. Leading
5. Measure
6. Margins
7. Color of Print
8. Printing Paper

The legibility research presented in this chapter has been limited to those studies which have used the rate of work method to test the legibility of continuous textual material in common reading situations. Therefore, the writer relies on the experimental evidence presented by Sir Cyril Burt, D. G. Paterson, and M. A. Tinker in association journals and three text books. In areas where no experimental evidence is available, the writer presents information based on his experience as a practicing professional in the graphic arts.

Type Style and Form

Maximum legibility is achieved by the use of the
Roman face because of its familiarity and traditional design factor. We learn to read from books printed in Roman faces; the majority of print that we are exposed to, such as newspapers, magazines, textbooks, and many other publications are set in the same face. In addition, Roman faces have unique design characteristics that assist us in reading. Figure 1 illustrates the serif, a distinguishing characteristic of all Roman faces.

In commenting on serifs, Burt points out:

... Serifs are not merely decorative. They correct the effects of irradiation ('visual spread'); and in any passage of consecutive print, they contribute appreciably towards the 'horizontal movement of the eye' (or rather of the attention), and help in combining separate letters into distinctive word-wholes. Indeed, without serifs, it is often impossible to discriminate many of the isolated characters, e.g. I, i (letter), and l (figure), and (when the reader is astigmatic) I and l.32

A test conducted by Burt to determine the speed and comprehension of reading Roman faces, compared ten different Roman faces. The results showed that, "when allowance is made for differences in visible size ... there is, for persons of normal eyesight, hardly any difference in legibility between the commoner book faces."33 The variation in design factors between the older and modern Roman book faces accounted for the slight differences

32Burt, op. cit., p. 9.
33Ibid., p. 10.
Figure 1.—Three Kinds of Serifs
in legibility.

The older faces have long ascenders and descenders; they accentuate those parts of letters that are different. Modern faces, on the other hand, have short ascenders and descenders, and accentuate similar parts of letters. The similarity of modern faces makes the letters confusing, for example, the likeness of the thick vertical strokes, diagonal strokes, and thin curves. A comparison between Garamond (older) and Bodoni (modern), seen in figure 2, will illustrate. The oblique shading of the older faces "is not only pleasanter to the eye, but easier to read."34

Type with short ascenders and descenders makes the word-form less distinctive for younger readers, but tends to increase the legibility of isolated letters. For older readers, long ascenders and descenders "spoil the characteristic unity of the words."35

The modern faces used in Burt's study were more condensed or expanded than the older faces. Condensed faces may blur the image of a word for a reader with a visual defect, such as being farsighted, and "excessively expanded faces tend to disrupt the word-form."36

In general, for the average reader, one Roman face

34 Ibid., p. 7.
35 Ibid.
36 Ibid.
Figure 2.--A comparison of Garamond (older) and Bodoni (modern)
is as equally legible as another, but "for older persons and for those with visual defects, type varying widely in the thickness of their lines, and also, though to a less extent, those with hardly any variation at all, seem to be the less legible."\textsuperscript{37}

Paterson and Tinker also compared the relative legibility of seven common book faces (all Roman) as recommended by 37 different publishers.\textsuperscript{38} However, their investigation included three radical faces: a Gothic face (i.e. sans-serif—without serifs), American Typewriter, and Cloister Black (commonly known as Old English). The results showed that there were no important differences in legibility between the seven Roman faces and the Gothic face, but that American Typewriter and Cloister Black retarded the speed of reading 5.1 and 16.5 percent respectively.

This supports the contention, held by many typographers and designers, that Gothic faces can be read just as easily as Roman faces once readers become accustomed to them. Burt, on the other hand, contends that sans serif faces are the least legible for word recognition.

\textsuperscript{37}Ibid.

\textsuperscript{38}D. G. Paterson and M. A. Tinker, "Studies of Typographical Factors Influencing Speed of Reading: X. Style of Type Face," \textit{Journal of Applied Psychology}, \textbf{XVI} (November, 1949), 605-613.
(see figure 3). First, he contends, such faces lack serifs which help the "horizontal movement" of the eyes. Secondly, the monotonous strokes of the Gothic faces (the lack of contrast between the thick and thin parts of the letters) provide a uniform line of print and confuse the reader.\textsuperscript{39} When investigating the legibility of numerals, Burt found Gill Sans (sans serif) better for short numbers, "but it was far less satisfactory for long numbers (as in mathematical tables), presumably because they do not combine so readily into distinctive groups.\textsuperscript{40}

It is interesting to note that while Paterson and Tinker found that the sans serif face was read just as rapidly as the Roman faces, they also found that readers do not like Gothic faces. They asked their subjects to rank the ten faces (ranging from the most legible to the least legible) in order of their preference or judged legibility. The Gothic face was ranked ninth, followed only by Cloister Black.\textsuperscript{41}

Later, an eye movement study was undertaken by Paterson and Tinker to determine why type set in Old English was read 16.5 percent more slowly than ordinary

\textsuperscript{39}Burt, op. cit., p. 9.
\textsuperscript{40}Ibid.
\textsuperscript{41}Tinker, Legibility of Print, op. cit., p. 49.
Figure 3.—Gothic (sans serif) faces
type faces (Roman). \textsuperscript{42} The findings reveal that Old English reduces the span of perception; increases the number of fixations, total perception time (sum of pause durations), number of regressions; and slightly increases pause duration. This obviously provides good reasons why it is nearly impossible to find Old English used in any publication produced by experienced typographers, except for extremely rare occasions when one or two words are used in headlines to attract attention or create an appropriate mood, such as, "Merry Christmas." Even this situation is a matter of preference, and debatable.

Two recent surveys indicate that professional designers still prefer Roman faces in situations where clients demand maximum legibility standards. \textit{Type Talks}, published by the Advertising Typographers Association of America, reported the results of the surveys that included a typographical analysis of 557 annual corporate reports provided by the \textit{Financial World Magazine}. The first survey of 280 annual reports revealed that serif type faces were the most popular, and Roman faces were used

\textsuperscript{42} D. G. Paterson and M. A. Tinker, "Eye Movements in Reading a Modern Type Face and Old English," \textit{American Journal of Psychology}, LIV (January, 1941), 113-114.
predominately for statistical matter, such as tables and charts.\textsuperscript{43}

One year later, a second survey of 277 annual reports revealed that serif faces still dominated the body text although there was a 22 percent decline in their usage.\textsuperscript{44} The use of sans serif faces in body text increased 100 percent (totaling 52 out of 277 reports) while their use in statistical matter decreased 24 percent. \textit{Type Talks} concludes that the increase use of sans serif faces indicates a trend that "readers have become more accustomed to these letter forms..."\textsuperscript{45} However, the results of a typographical analysis of 277 annual reports is hardly indicative or representative of what readers are accustomed to; the conclusion is merely conjectural. A more reasonable conclusion stated is that "the history of typographic evolution evidences that the designer adds good new faces to his repertoire without discarding the good old faces [emphasis mine], which endure and endure."\textsuperscript{46}

\textsuperscript{43}"Annual Corporate Reports: A Type Face Survey," \textit{Type Talks}, November-December, 1964, p. 6.

\textsuperscript{44}"Types for the Corporate Annual Report," \textit{Type Talks}, September-October, 1965, pp. 6-7.

\textsuperscript{45}\textit{Ibid.}, p. 6.

\textsuperscript{46}\textit{Ibid.}, p. 7.
Capital Letters Versus Lower Case.--Type set in all capital letters is less desirable in achieving maximum legibility than type set in lower case (e.g., CAPITALS and lower case). Paterson and Tinker report that legibility tests prove that text matter set in lower case type is read 13.4 percent faster than text set in all capitals. In a later study, to determine the specific patterns of eye movements responsible for the 13.4 percent lower reading rate of all capitals, the authors report that all capital print produces a 12.4 percent increase in the number of fixations and a 12.5 percent decrease in the number of words per fixation, reduces pause duration per fixation, and increases the total perception time.

It is clear that a greater amount of time will be spent or lost in reading all capital print. The authors contribute the loss to differences in word forms. They suggest that lower case letters are more efficient in identifying words because "lower case printing provides characteristic word forms which serve as cues to the rapid

---

47 D. G. Paterson and M. A. Tinker, "Influence of Type Form on Speed of Reading," Journal of Applied Psychology, XII (August, 1928), 359-366.

and accurate reading of meaningful material. Figure 4 illustrates that the upper half of a line of print in lower case provides more clues to the identification of words.

Three other reasons justify the use of lower case print to obtain maximum legibility. First, all capital print requires 35 percent more printing space for the same type face and size. "This alone would greatly increase the number of fixation pauses required to read the material." Secondly, since the majority of print that we are exposed to is in lower case, the novel effect of reading material in all capitals disrupts our reading habits. And finally, pleasingness ratings indicate that readers prefer lower case printing.

*Italics.*—"Text printed in italics is slightly less legible than material in lower-case letters and decreases speed of reading somewhat." It is generally believed that italics greatly retard reading speed. An experiment compared lower case text to italic text to determine

---


50 Tinker, *Legibility of Print, op. cit.*, p. 60.

51 Ibid., p. 57.

52 Paterson and Tinker, "Influence of Type Form on Speed of Reading," *loc. cit.*
New factory buildings are always available in Puerto Rico—ready to move into.

Figure 4.—The upper half of lower case letters provides clues to the identification of words.
differences in reading speed. It was found that lower case was read only 2.8 percent faster. This is a gain of approximately 15.5 words per minute.

Italics were not designed to be used for continuous textual material. Their purpose is to provide contrast to ordinary text in order to emphasize certain words or phrases. It would seem that their design would be defeated if they were used for purposes other than those intended. Furthermore, readers do not like italic text and judge lower case print to be more legible.

**Boldness**

Although there is no difference in the speed of reading boldface and ordinary lower case print, excessively bold faces may deter legibility. Burt suggests that "excessive thickening tends to reduce the size of the 'counters' (i.e., the white inner spaces) in such letters as 'a' and 'e'." This can easily be seen in figure 5 where the bold and light print of the same type face can be compared.

---

54 *Tinker, Legibility of Print, op. cit.*, p. 55.
57 *Burt, op. cit.*, p. 10.
10-POINT BENTON

ABCDEFGHIJKLMNOPQRSTUVWXYZ ABCDEFGHIJK
is change. Popular tastes in type are always in a state of flux. This has no relation to the inherent virtues of any type face. The graphic arts have always kept pace and reflected the changes in other applied arts. And Béton is a significant signpost of one of those changes in current typography. Many of the individual features of Béton that form its character may appear to the uncritical or uninformed as being merely

Light

ABCDEFGHIJKLMNOPQRSTUVWXYZ ABCDEFGHIJK
is change. Popular tastes in type are always in a state of flux. This has no relation to the inherent virtues of any type face. The graphic arts have always kept pace and reflected the changes in other applied arts. And Béton is a significant signpost of one of those changes in current typography. Many of the individual features of Béton that form its character may appear to the uncritical or uninformed as being merely

Bold

ABCDEFGHIJKLMNOPQRSTUVWXYZ ABC
Béton has that distinctive and well balanced color and form which has made the face so very popular in America and Europe. Béton expresses the progressive spirit of today. It is one type that scores consistently in outstanding typography. Its versatility is almost unlimited. Display or headings, text for advertising and comm 1234567890

Extra Bold

Figure 5.—A comparison of bold and light print of the same type face
If a boldface type is selected for the text, the size of the "counters" may be further reduced by the spreading of images due to the printing process or the skill of the pressman. Even the image of light face print can spread during the processes required in offset printing. First, a photographic negative is made of the material; then, a candle, similar to a flare, "burns" the image onto the printing plate. The spreading can occur, as the writer has observed many times, caused by an under exposure of the negative or by an "over-burning" of the plate. Unclear or heavy images sometimes may result during the actual printing. An inexperienced or careless pressman may allow an excessive amount of ink to be applied to the paper.

Type faces with a bold or heavy appearance are preferred in reading material designed for very young and very old readers. Nevertheless, a controlled experiment has indicated that average readers prefer lower case print. Like italics, boldface type is excellent for emphasizing important words or phrases; moreover, it is just as effectively used for headlines, subheads, and display matter.

Size

A quick review of an assortment of current

59 Ibid.

60 Tinker, Legibility of Print, loc. cit.
publications will leave the observer with the impression that consecutive textual material intended for easy and rapid reading is generally set in either 10 or 11-point type. However, it is not uncommon to find textbooks and novels set in 8 or 9-point type, magazine articles in 12-point, and scientific journals in 6-point. If one were to look further, 14-point set in continuous text will appear occasionally. It might be inferred that typographers or designers consider type sizes ranging from 6 to 14-points to be the minimal and maximal size limits for legibility.

Paterson and Tinker obtained a speed of reading record for texts set up in 6, 8, 10, 12, and 14-point type, set solid (no space between the lines), with the length of line held constant at 80 mm (35/32 inches or 19 picas). It was concluded that 10-point type set at 80 mm produced the fastest reading rate and was therefore the optimum size for efficient reading in comparison with the other sizes. Using 10-point as a standard, a subsequent study compared the relative legibility of 8, 9, 10, 11, and 12-point type. It was found that 8-point was read the slowest, 12-point was read slightly slower than 10-point,

---

61D. G. Paterson and M. A. Tinker, "Studies of Typographical Factors Influencing Speed of Reading: II. Size of Type," Journal of Applied Psychology, XIII (April, 1929), 120-130.

62D. G. Paterson and M. A. Tinker, How to Make Type Readable (New York: Harper and Brothers, 1940), p. 35.
9-point slightly faster, and 11-point significantly faster. The conclusion was that type size can vary without markedly affecting legibility. Small print retards legibility because of reduced visibility; large print retards legibility because the eyes must cover a greater amount of printing area. In other words, small print is difficult to see; large print requires more printing space, for instance, "fourteen point type in comparison with 10-point requires 87 percent more printing space. This means that there is a striking increase in the amount of horizontal space covered per word in 14-point. This forces the eyes to make many more fixations in covering the same amount of reading material." It would also follow that there is the possibility of reading fatigue.

In addition, large type sizes (14-point and above) do not foster quick reading and comprehension because they "cause visual attention to be directed to the letters


64 Ibid., p. 230.

65 Ibid.
themselves rather than to the form of words, and to single words rather than to groups or phrases.\textsuperscript{66}

Burt's experimental results generally agree with those of Paterson and Tinker. Burt points out that for readers with normal eyesight, the effect of small changes in size are insignificant, say from 10 to 9-point, 10 to 11-point, or from 10 to 12-point.\textsuperscript{67} This implies that it is not the numerical description of type sizes that determines legibility, but rather the \textit{x}-height of letters (see figure 6). For example, 10-point Times Roman has an \textit{x}-height of 0.62 in.—approximately the \textit{x}-height of 11-point Baskerville and 12-point Bembo. In other words, a specific point size in different type faces may vary in visual size. Nevertheless, Burt notes that the optimum size of print is determined by the reader's visual acuteness.\textsuperscript{68}

The reader is reminded that we are discussing only the legibility of various sizes of type and that there are other factors to consider before making judgments about type size—namely the spacing between lines of type and the length of the lines. These factors will be discussed respectively, in the two following sections.

\footnotesize
\textsuperscript{66} Burt, \textit{op. cit.}, p. 12.
\textsuperscript{67} \textit{Ibid.}
\textsuperscript{68} \textit{Ibid.}
Figure 6.—Dimensions of point size and x-height
Leading

The space between lines of print (leading) has an important effect on the ease of reading. Scientific opinion concerning the usefulness of leading to improve legibility generally agrees that leading is effective for improving the legibility of all book sizes of type, but has considerably less effect on 12-point or above than on smaller sizes. Burt, for instance, suggests that leading significantly improves the legibility of small print. "It aids the eye to pick up the right lines as it moves back from the end of one line to the beginning of the next."  

Tinker adds that 8-point type with 2-point leading is just as legible as 10-point set solid. The reader is cautioned not to accept the notion that leading will make smaller type more legible than larger type. It is to be remembered that with other factors being equal, 10-point type is more legible than 8-point. Tinker's statement only confirms what Burt has suggested, that leading improves the legibility of small type. However, it is plain that size is a factor to consider before determining the amount of leading.

Another factor to consider is the measure (the length of a line of print). An experiment designed to

---

69 Ibid., p. 13.
70 Tinker, Legibility of Print, op. cit., p. 94.
determine whether 1, 2, and 4-point leading of textual matter, set in a specific type size and at a specific line length, would affect legibility in comparison with the same material set solid. 71 Ten point type was used set at a line length of 19 picas. The results showed that: (1) one point leading did not help the speed of reading; (2) two point leading increased legibility by 7.5 percent; and (3) four point leading increased legibility slightly, but not significantly.

The results of the test are neither valid for other line widths of 10-point type nor for other type sizes. They only indicate that 2-point leading is most favorable for 10-point type set at 19 picas, and that the length of line is another factor to consider before determining the amount of interlinear spacing. Clearly, both the size of type and the measure affect the amount of space used between lines of print. Generally, for average type sizes and measures used in continuous textual material, "little seems to be gained by 3-point leading; 4-point leading usually diminishes legibility; like excessive letter-size, it tends to increase the number of eye movements and fixation pauses."72 In addition, excessive or

generous leading does not duplicate the ordinary reading situation, thus, reading habits may be disturbed. On the other hand, "readers definitely dislike ... material set solid."  

It appears that the most favorable condition for legibility is achieved when optimal leading is combined with optimal type size and measure.  

Burt makes the following suggestion for judging the amount of leading to be used when material is set in a specific size at a specific measure:  

Roughly speaking, the distance should be about half as wide again as the x-height—rather more with younger children, in general, say about one-thirtieth of the measure. When the type is large on its body or has long ascenders and descenders, it is essential that the lines should show a clear separation especially when a descender comes directly above an ascender.  

---

**Measure**  
The preceding section has suggested that reading is done most easily and rapidly when an optimum measure is combined with optimal leading and type size. This section discusses the length to which a line of print is set on the page and its effect on legibility. Even though line widths can vary moderately without a significant effect on reading ease and speed, excessively short

---

73 Tinker, *Legibility of Print*, op. cit., p. 106.  
74 Ibid., p. 94.  
75 Burt, *loc. cit.*
and long lines both hinder comfortable reading and increase perception time. 76

"Readers definitely dislike very short and very long lines. . . ." 77 In addition to readers' preferences, a decrease in reading efficiency occurs because of the "reader's inability to make maximum use of horizontal peripheral cues." 78 Short measures of type, especially when the type is large, prevent the reader from perceiving long phrases. Type set in this manner entails varying the spaces between words and increasing the number of hyphenations at the end of lines. 79 The reader has undoubtedly noticed such typographical arrangements while reading newspapers or scientific journals where text matter is set in extremely narrow columns. The result is that reading speed is appreciably reduced due to increased fixation frequency, pause duration, and perception time. 80

The same result occurs when reading long lines of print, especially when the type is small. Excessively long lines, like excessively short lines, increase fixation


77 Tinker, Legibility of Print, loc. cit.


80 Tinker, Legibility of Print, op. cit., p. 79.
frequency, pause duration, and perception time; but unlike short lines, long lines markedly increase regression frequency. The major difficulty is that the eye cannot pick up the following line after swinging back from the preceding line. In other words, the sheer distance of the line interrupts consecutive reading because the reader is forced to make backward movements while reading in order to find a reference point of clue words, such as words just read, that will help him locate successive lines. "It is as if the eyes, in making the return sweep, are forced to spend an undue amount of time in searching for the rest of the line."  

We have discussed excessive short and long lines, but what is considered a moderate measure? In The Legibility of Print, Tinker offers what he considers to be the limits of variation of line widths without "appreciable loss of legibility." They are noted below in relation to specific type sizes:

9 Point - 14 to 30 picas  
10 Point - 14 to 31 picas  
11 Point - 16 to 34 picas  
12 Point - 17 to 33 picas

Moderate measures for optimal type sizes, then, can

---

81 Paterson and Tinker, "Influence of Line Width on Eye Movements," *loc. cit.*  
82 Ibid.  
be considered to be between the limits of 14 to 34 picas providing, of course, that the appropriate leading is used.

Burt, on the other hand, suggests that the measure might be determined by the number of letters per line rather than in picas.\textsuperscript{64} He considers optimum line widths to be between the limits of two to three lower case alphabets, approximately from 52 to 78 letters. This alphabet rule can be applied to all sizes of type providing the alphabet length corresponds to the body size. For example, if 10-point type is cast on a 12-point body or 10-point type is set with a 2-point lead, the alphabet length of the corresponding 12-point type should be used.

Using Burt's method and converting to picas, we find longer measures than those suggested by Tinker. According to Burt, 10-point type should not exceed a width of 33 picas, whereas, as noted above, Tinker set the limit for 10-point type at 31 picas. However, Burt recommends the wider measure "for a scientific journal intended for highly educated readers, who of course tend to skim rather than read word by word."\textsuperscript{85} At this point, comprehension becomes questionable, otherwise, their recommendations seem consistent.

\textsuperscript{64}Burt, \textit{op. cit.}, p. 14.

\textsuperscript{85}\textit{Ibid.}
Some graphic designers and typographers also follow an alphabet rule to determine line widths. Based on their experience, they suggest that the minimum width of line should be one alphabet length and the maximum length should not exceed two and one-half alphabets. This holds with the scientific recommendations, and of course, is determined by the size of type selected.

Margins

Designers have often contended that ample margins invite reading, printers have recommended that margins should comprise 50 percent of the printed page, and tests have indicated that the "majority of people who use textbooks believe that margins are an important factor in legibility,"\textsuperscript{86} but whether or not margins have an effect on legibility is debatable.

Paterson and Tinker experiments revealed that printed material without margins is read just as rapidly as material having large margins.\textsuperscript{87} They point out that margins do not promote legibility and that they are justified only in terms of aesthetics.

Burt, on the other hand, states that "there can be


\textsuperscript{87}Tinker, \textit{Legibility of Print}, op. cit., p. 114.
little doubt that books with excessively narrow margins are apt to produce visual fatigue."\textsuperscript{88} He further adds, "When the type area extends nearly to the edge of the paper, the eye of the young reader is apt to swing right off the page. With adults the effect of the broader margin would seem to be chiefly aesthetic."\textsuperscript{89} Moreover, he suggests the following general rules for determining margins:

Roughly speaking, the two side margins should take up nearly one-third of the entire width of the page, i.e., half the measure. When the interlinear spacing is increased, all the margins should be increased. For younger children the proportions should be much wider, allowing plenty of room at the bottom for the thumb and at the sides for the untrained eye to swing to and fro. For infants the line should end with the end of a phrase, leaving the margins irregular.

For highly technical works . . . narrower margins can be tolerated, and . . . would even be preferable.\textsuperscript{90}

Burt's suggestion for "highly technical works" seems plausible providing the printed page lies flat while being read. However, in many thick textbooks and scientific publications the binding, near the inner or gutter margin, prevents the page from lying flat and causes the page to curve a great deal. This curvature of the printed page significantly reduces legibility. The main reason is that the visibility of word forms is reduced.

\textsuperscript{88}Burt, \textit{op. cit.}, p. 14.
\textsuperscript{89}\textit{Ibid.}
\textsuperscript{90}\textit{Ibid.}, p. 16.
"When part of a curved line of print is farther from the eyes than the other parts, the letter and word forms along the line are distorted."91 In addition, "the eyes must accommodate anew to read successive words with the change in focal distance that occurs with each eye movement to a new fixation along the curved surface."92

Except for the inner margin, it is not evident whether or not margins affect legibility. Since designers and legibility experts agree that margins are a matter of aesthetics, it would seem that an attractive page could be designed so that the inner margin of thick publications could be wider, thus preventing curved text.

Color of Print

In most publications, black print on a white background is used. However, we often find print in other colors besides black and printed over various colored backgrounds. Different color combinations between print and background, other than black on white, often raise questions concerning legibility. For example: Is black print on a white background the most legible combination? Are other combinations equally legible? Does colored

---


92Ibid.
print over colored backgrounds greatly reduce legibility? When printing over colored areas, is it important to maintain contrast between colors?

Colored print or colored print over colored backgrounds can be used effectively in publications without an appreciable loss in legibility. It is not so much the specific color of print or color contrast that promotes the ease of reading, but rather the \textit{brightness contrast} between the print and background.\textsuperscript{93} Take red and green, for example: one color is not necessarily more legible than the other; there is, of course, color contrast between the two, but the relative darkness of each color is equal. In other words, it is the dark color value of the print in contrast to the light color value of the background that determines legibility.

\textit{Brightness contrast} can be divided into three general degrees: maximum, medium, and minimum. The following list will give the reader an idea of the combinations of colored print and colored backgrounds that have different degrees of brightness contrast along with proven legibility ratings.\textsuperscript{94} Since color can vary in its value (lightness or darkness) and chroma (intensity), clue words

\textsuperscript{93}Paterson and Tinker, \textit{How to Make Type Readable}, \textit{op. cit.}, p. 121.

\textsuperscript{94}D. G. Paterson and M. A. Tinker, "Variations in Color of Print and Background," \textit{Journal of Applied Psychology}, XV (October, 1931), 471-479.
(e.g. navy, grass, etc.) have been added where necessary to help describe the intended value and chroma of the colors:

1. Maximum Brightness Contrast—Good Legibility
   Black on White
   Grass Green on White
   Navy Blue on White
   Black on Canary Yellow

2. Medium Brightness Contrast—Fair Legibility
   Rose Red on Canary Yellow
   Rose Red on White

3. Minimum Brightness Contrast—Poor Legibility
   Grass Green on Rose Red
   Orange on White
   Orange on Black
   Black on Purple

Needless to say, black print on a white background is the most legible combination. One would think that the same would hold for white print on a black background. However, an experiment revealed that white print on black decreases legibility by 10.5 percent when compared to black on white. One reason is that there is an increase in fixation frequency while reading. Another

95 Generally, in letterpress and offset printing, white ink is not printed on black. The printing plates are made in "reverse" permitting the areas surrounding the print to be covered with ink rather than the print itself, allowing the color of the background to show through the uncovered areas. To say white on black is a matter of convenience.

96 D. G. Paterson and M. A. Tinker, "Studies of Typographical Factors Influencing Speed of Reading: Black Type Versus White Type," Journal of Applied Psychology, XV (June, 1931), 241-247.

97 Tinker, Legibility of Print, op. cit., p. 131.
reason is that white on black promotes irradiation, that is, the apparent enlargement of a light object seen against a dark background.\textsuperscript{98}

When irradiation occurs the outline of letters tends to become blurred, the counters and open spaces become closed, and entire words blend together. The effects are more apparent with Roman faces and when the type is small or extended. There are hardly any effects of irradiation with 10 to 14-point, sans serif faces.\textsuperscript{99} This is seemingly due to the design characteristics of Gothic faces (see p. 27).

Those printing arrangements involving a minimal brightness contrast greatly retard legibility. A study comparing the difference in eye movements when reading a minimal brightness contrast arrangement (red on green) to a maximum brightness contrast arrangement (black on white) showed that there was a 42.6 percent loss in reading time.\textsuperscript{100} The reading of minimal brightness contrast printing arrangements tends to increase greatly the number of fixations, pause duration, number of regressions, and

\textsuperscript{98}Ibid., p. 137.

\textsuperscript{99}Ibid.

\textsuperscript{100}D. G. Paterson and M. A. Tinker, "Eye Movements in Reading Black Print on White Background and Red Print on Dark Green Background," American Journal of Psychology, LVII (January, 1944), 93-94.
total perception time while the span of perception is markedly reduced. Clearly, dark colored print on a light colored background insures maximum brightness contrast and provides good legibility. Such a printing arrangement would be preferred by readers since the most legible color combinations are the most pleasing.101

Printing Paper

Printing paper can affect legibility by its color, surface, and opacity. The use of light tinted and dark colored papers have the same result on reading ease and speed as those mentioned in the preceding section on color—the greater the brightness contrast between print and paper, the easier it is to perceive words. Black print on light-tinted paper (e.g. pink, cream, ivory, sky blue, etc.) can be read just as easily as black on white providing 10-point type or larger is used; dark-colored print on light tinted paper is just as equally legible providing the paper has a 70 percent or greater reflectance, 10-point type or larger is used, and the brightness contrast is greater than 60 percent.102

To determine the degree to which the printing surface affects legibility, a comparison was made between

101Paterson and Tinker, How to Make Type Readable, op. cit., p. 127.
102Tinker, Legibility of Print, op. cit., p. 150.
glossy and dull-finished papers. Paterson and Tinker concluded that both printing surfaces are equally legible even though there was a striking difference in the degree of gloss. However, they added:

The reader is cautioned to accept the findings as being true only for relatively short periods of reading. It is probable that relatively long periods of reading print on glossy paper will result in eye strain and fatigue.

When the page is curved, slightly wrinkled or mussed (as mail pieces often are), or slanted at a particular angle from the sight of vision, a simple observation will show the reader the extent to which print on glossy paper can interfere with reading. Furthermore, pleasingness ratings have indicated that readers prefer print on dull-finished papers. Like glossy paper, extremely glazed paper also displeases readers but it definitely does retard reading.

Although there is no evidence available, the opacity of papers assists quick and easy reading. Thick or opaque paper can prevent print on the reverse side of


104Ibid., p. 131.

105Paterson and Tinker, How to Make Type Readable, op. cit., p. 135.

106Tinker, Legibility of Print, op. cit., p. 160.
the page from showing through on the front side, either blurring words or decreasing the brightness contrast. Obviously, then, words will be more visible. Legibility is sacrificed when thin paper is selected for economic reasons (as is often the case) or to reduce the thickness of a publication.

Summary

1. Factors affecting legibility are: type style and form, boldness, size, leading, measure, margins, color, and paper. Typographical research concerning these factors has been limited to the experiments of Burt, Paterson, and Tinker.

2. Maximum legibility is achieved by the use of Roman faces. Roman faces suit our reading habits and have unique design characteristics that assist us in reading, for example, serifs which negate irradiation and contribute toward the horizontal movement of the eyes. Aside from size, there are only slight differences in legibility between Roman faces because of variation in design. Older faces have long ascenders and descenders and accentuate those parts of the letters that are different, but spoil the unity of words for older readers.

Modern faces have short ascenders and descenders and accentuate parts of letters that are similar, but makes the word form less distinctive for younger readers and tends to increase the legibility of isolated letters.
Condensed faces may blur word images for readers with visual defects while expanded faces tend to disrupt the word form. For average readers, one Roman face is just as legible as another.

3. Tests reveal that Gothic faces are just as legible as Roman faces, however, readers are not accustomed to sans serif faces. Gothic faces also lack serifs which help the horizontal movement of the eye and have monotonous strokes which provide uniform lines and confuse readers. Furthermore, Gothic faces do not combine easily into mathematical groups and are not preferred by readers.

4. Tests have proven that American Typewriter and Old English retard the speed of reading 5.1 and 16.5 percent respectively when compared to Roman faces. Eye movement records show that Old English reduces the span of perception, increases the number of fixations, total perception time, number of regressions, and slightly increases pause duration. The use of Old English to attract attention or to create a mood is a matter of preference and is debatable in terms of legibility.

5. Two recent surveys indicate that professional designers prefer Roman faces in situations where clients demand maximum legibility standards.

6. Lower case print is 13.4 percent more legible than text set in all capitals. A study revealed that all capital print produces a 12.4 percent increase in the
number of fixations, 12.5 percent decrease in the number of
words per fixation, reduces pause duration per fixation,
and increases total perception time. Moreover, all capital
print requires 35 percent more printing space than lower
case print. In addition, lower case printing has charac-
teristic word forms which serve as clues to the identifi-
cation of words. Furthermore, reading habits and readers'/preferences favor lower case printing.

7. Text printed in italics is slightly less
legible than lower case printing. There is an approxi-
mate loss of 15.5 words per minute. However, italics were
not designed for continuous textual material. Their use
is designed to provide a contrast to ordinary print in
order to emphasize certain words or phrases. Besides,
readers do not like italics and judge lower case print to
be more legible.

8. There is no difference in the speed of reading
bold face and lower case print, but excessively bold faces
may deter legibility. Excessively bold faces tend to
reduce the size of counters, the inner white spaces in
letters. There is also the possibility that counters may
be reduced during the printing process or by the inex-
perience of the pressman. Like italics, boldface print is
excellent for emphasizing important words or phrases and
is just as effectively used for headlines, subheads, and
display matter.
9. If one were to review an assortment of current publications, he might infer that typographers or designers consider type sizes ranging from 6 to 14-point to be the minimal and maximal size limits of continuous textual material to achieve legibility. However, noted legibility experts have proven that type sizes between the limits of 9 and 12-point can be read equally fast, but below 9-point and beyond 12-point speed of reading is retarded. Small print retards legibility because of reduced visibility. Large print retards legibility because the eyes must cover a greater amount of printing area; for example, 14-point type in comparison with 10-point requires 87 percent more printing space.

This means that there is a great increase in the amount of horizontal space covered per word while reading 14-point type. The eyes, therefore, are forced to make many more fixations in covering the same amount of material and there is the possibility of reading fatigue. In addition, large type causes visual attention to be directed to individual letters and words rather than to word forms and groups or phrases.

10. Between the limits of 9 to 12-point type, small changes in size are insignificant. This implies that it is not the numerical description of type sizes that determine legibility, but rather the x-height of letters. In other words, a specific point size in different type faces may
vary in visual size because x-heights may vary, for instance, 10-point Times Roman has an x-height of 0.62 in.—approximately the x-height of 11-point Baskerville and 12-point Bembo. Nevertheless, the most favorable size of type, between the limits of 9 to 12-point, is determined by the reader's visual acuteness and must be coordinated with optimum leading and measure to produce comfortable and rapid reading.

11. Scientific opinion concerning the usefulness of leading to improve legibility agrees that leading is effective for improving the legibility of all book sizes of type, but has considerably less effect on 12-point or above than on smaller sizes. Generally, for average type sizes and measures used in continuous textual matter, little is gained by 3-point leading and 4-point leading usually diminishes legibility.

Excessive leading tends to increase the number of eye movements and fixation pauses, and does not duplicate ordinary reading situations. On the other hand, readers prefer some leading and dislike material set solid. The most favorable condition for legibility is achieved when optimal leading is combined with optimal type size and measure.

12. Studies indicate that there are general rules that can be followed in order to judge the amount of leading to be used when specific type sizes are set at specific
measures. The interlinear spacing should be about one and one-half times as wide as the x-height; rather more with young children and wide measures; rather less with older children and narrow measures—about one-thirtieth of the line length. When type has long ascenders or descenders there should be a clear separation between lines especially when a descender comes directly above an ascender.

13. Measures can vary moderately without a significant effect on legibility, but excessively short and long lines both hinder comfortable reading and increase perception time. A decrease in reading efficiency occurs because readers are unable to make maximum use of horizontal peripheral cues. Short measures of type, especially when the type is large, prevent the reader from perceiving long phrases because such typographical arrangements entail varying the spaces between words and increase the number of hyphenations at the end of lines. The results of reading excessively short measures is that legibility is appreciably reduced due to increased fixation frequency, pause duration, and perception time. The same results occur when reading excessively long measures of type, especially when the type is small. In addition, there is a marked increase in regression frequency. The chief difficulty is that the eyes cannot pick up successive lines. Moreover, readers do not like very short and very
long lines.

14. Moderate measures for optimum type sizes can be considered to be between the limits of 14 to 34 picas providing appropriate leading is used and two to three lower case alphabets if the alphabet length corresponds to the body size of the type employed. Experienced typographers recommend that the minimum measure should be one alphabet length and that the maximum measure should not exceed two and one-half alphabets in relation to the size of type selected. The above considerations are generally consistent.

15. Experimental results concerning the effects of margins on legibility have not been consistent. On one hand, tests found that margins do not promote legibility. On the other hand, tests revealed that narrow margins are likely to produce visual fatigue. However, legibility experts and experienced designers agree that margins seem to be chiefly a matter of aesthetics.

16. There are general rules to consider for determining margins. The two side margins should be equal to one-third the width of the page or half the measure. The greater the leading, the greater the margins. For younger children the margins should be generous. For beginning readers the line should end with the end of a phrase, leaving the right hand margin irregular, for example:
(Right) ... in the house
and in the barn.

(Wrong) ... in the house and
in the barn.

17. Narrower margins are preferred for highly technical material providing the print page is lying flat while being read. However, many scientific publications are thick, and as a result, the binding near the inner margin causes a marked curvature of the page. When this occurs, legibility is retarded because of a reduction in the visibility of word forms. Word forms and letters become distorted when part of a curved line of print is farther from the eyes than the other parts. In addition, the eyes must constantly reaccommodate to changes in focal distance with each fixation. Since margins are chiefly aesthetic, it seems that an attractive page could be designed so that the inner margin was wider, therefore preventing curvature of the lines of print.

18. Regarding color, it is the brightness contrast between the print and background that determines legibility, that is, the dark color value of the print in contrast to the light color value of the background. There are three general degrees of brightness contrast, each having proven legibility ratings: maximum—good legibility (e.g. black on white), medium—fair legibility (e.g. rose red on canary yellow), and minimum—poor legibility (e.g. grass green on rose red).
19. Black print on a white background is the most legible color combination, however, white print on a black background decreases legibility 10.5 percent when compared to black on white. White on black reduces reading efficiency because it produces an increase in the number of fixations and it promotes irradiation. The effects of irradiation (page 52) are more apparent with Roman faces and when the type is small or extended. Seemingly due to design characteristics, 10 to 14-point Gothic faces produce hardly any effects of irradiation.

20. Tests have revealed that printing arrangements involving minimum brightness contrast produce a 42.6 percent loss in reading time when compared to a maximum brightness contrast arrangement. The former arrangement tends to greatly increase the number of fixations, pause duration, number of regressions, and the total perception time while the span of perception is markedly reduced. Dark-colored print on a light-colored background insures maximum brightness contrast, provides good legibility, and is preferred by readers.

21. The use of light-tinted and dark-colored papers have the same effect on legibility as light and dark-colored backgrounds— the greater the brightness contrast between the print and the paper, the greater the visibility of words.

22. Even though readers prefer dull-finished papers,
both glossy and dull-finished papers are equally legible. However, it is probable that eye strain and reading fatigue will result after relatively long periods of reading print on glossy paper. Nevertheless, extremely glazed paper does retard reading speed and ease and is not liked by readers.

23. No evidence is available, but opaque papers assist quick and easy reading. Opaque or thick paper can prevent print on the reverse side of the page from showing through on the front side, either blurring words or decreasing the brightness contrast.
CHAPTER IV

CONCLUSION

Limitations

The studies referred to in this work have been concerned primarily with the legibility of the continuous textual material found in book printing. Further, the subjects used in the tests have been mostly college students. The writer realizes that there are many different kinds of publications and publics that have not been covered. For example, the businessman may read different kinds of publications differently. He may not read a novel the same way he reads a business report. There are different motives, interests, and levels of comprehension involved. The typographer, therefore, must exercise caution when applying the established principles of legibility to plan the arrangement of type for publications other than books and for publics other than students.

In addition to legibility, there are other factors to consider which affect typographical judgment. If legibility were the sole criterion, all printed communications would become standardized. The result would be a drab and monotonous presentation of the material—devoid of innovation, imagination, and creativity.
First to consider are the psychological implications of typography. For example, professional designers have contended, especially those in advertising, that certain type faces and arrangements leave different impressions or "feelings" with the reader or "create a mood" for the message. Others have contended that type may be beautiful or ugly, conservative or aggressive, exciting or dull, smooth or rough, delicate or coarse, or interesting or staid. However, these contentions are debatable.

On one hand, it could be argued that the reader's background and experience determine the impressions obtained from type, or whether type is beautiful or ugly, conservative or aggressive, exciting or dull, and so on. Who is to say what is interesting or what is staid; it is a matter of individual preference.

On the other hand, designers who hold these contentions have many years of typographical experience. They have been sought as consultants to publishing firms and are regarded by their peers as experts in their field. Their many years of experience and the demand for their personal opinions indicate that there may be some basis for their contentions concerning the psychological implications of print.

Secondly, the use of other graphic devices influences the planning of typographical arrangements. For example, photographs and drawings supplement and reinforce
printed words and have an important affect on the success of printed communications. Although secondary to typog-rapy, the use of photographs and drawings is essential for the clarification of some messages, that is, they can help clarify difficult concepts that words cannot describe or which require a lengthy verbal description. But how does the use of graphic devices affect typographical judgments?

The success of printed communications depends upon the total visual presentation of the message. Professional designers have said that typographical arrangements should harmonize and balance with other graphic devices. They suggest that this accomplishes a total visual unity in the presentation. They further suggest that interesting, ex-citing, attractive, and well-organized messages are vis-ually unified and the manner in which they are unified can make a particular communication unique. These contentions are admittedly subjective, but the reader may well agree that a dull, monotonous, cluttered, or standard presenta-tion of a message may induce indifference in the reader.

Finally, there are other factors not included in this study which also affect legibility and the selection and planning of typography. The following list includes a few:

1. Economics
2. Time
3. Personnel
4. Folding
5. Ink density and coverage
6. Availability of type and printers
7. Printing process and method
8. Postal regulations
9. Texture of paper
10. Size of publication

The writer does not intend to minimize these additional factors, nor has legibility been suggested as the chief means of making typographical judgments. The information presented in this study is to be regarded rather as an aid to provide the reader with a basis for making the judgments necessary for effective printed communications.

Recommendations

The above paragraphs obviously imply the need for further and more extensive research in typography. The review of the literature indicates that typographical research has been limited to the ease, speed, and accuracy of seeing printed material. The problems studied have been those of a physical nature, that is, with the visual and mechanical characteristics of print and observations of readers' oculomotor patterns while reading.

Needless to say, there are literally over a thousand type styles and forms, a considerable number of typographical arrangements other than those found in book printing, and many different kinds of reading publics. The same problems that have been studied need to be studied more extensively, to include many other type styles and forms
in comparison with other typographical arrangements and in relation to the many different publics.

Perhaps the most neglected area of typographical research has been that of a mental nature, that is, with the aesthetics of print—the psychological implications. As mentioned earlier, experienced designers have contended that certain type faces and arrangements leave different impressions with the reader or have different connotations. In addition, some of the studies mentioned indicate that readers prefer certain type faces and arrangements over others. In this area, the following questions need rigorous study.

In what ways are readers affected by the aesthetics of print? How do demographic characteristics of readers influence typographical preference? Are the most pleasing and attractive type faces and arrangements those to which the reader has become habituated? What are the meanings which readers associate with different type faces and arrangements? To what extent are these typographical connotations related to specific publics? How can the aesthetics of print be measured?

The above questions are just a few of the typographer's concerns; the area is virtually unexplored. Until some of these problems have been resolved, we have to make typographical judgments based on available information and the experiences of others. The following section presents
information that will help the reader make such judgments.

Checklist of Legibility Rules

The following checklist has practical and important information for the reader. However, several warnings are worth considering before applying the established legibility principles. In the first place, the experiments revealed that the factors can be slightly modified without an appreciable loss in legibility, meaning, that they are flexible. Secondly, the investigators indicate that one factor depends upon the support of the other factors. For instance, Burt states:

It was found that the different characteristics—size, design, boldness, width of measure, of margins, and of interlinear spacing—necessarily condition and interact with each other, so that assessments obtained by varying just one characteristic in isolation at times may be highly misleading.  

Following his studies of nonoptimal printing arrangements, Tinker adds:

The results obtained in these studies... provide proof that the progressive introduction of undesirable variations in two or more typographical factors is accompanied by ever greater loss in legibility.

Finally, readers have different preferences and reading skills, while others have visual impairments. The checklist is obviously flexible and it should assist

107 Burt, op. cit., p. 19.
108 Tinker, Legibility of Print, op. cit., p. 168.
typographical decisions.

1. For optimum legibility, set all printed matter in Roman face, that is, display, headlines, subheads, statistical material, and especially the main body of text. Avoid condensed or extended Roman faces; they disrupt the word form or cause blurring. For young readers, select only those faces with long ascenders and descenders. For older readers, select those with short ascenders and descenders. For average readers, one Roman face is just as legible as another.

2. For optimum legibility avoid Gothic faces. However, for a novel effect or to attract attention, consider Gothic faces for display matter, subheads, cutlines for photographs, or short paragraphs of copy, realizing of course, that readers are not accustomed to them, do not like them, and that legibility is somewhat sacrificed.

3. Italics are somewhat difficult to read and are not liked by readers. Their use should be restricted for emphasizing important words and phrases.

4. Lower case print aids the identification of words, moreover, they are preferred by readers. For maximum legibility of all words, use lower case letters throughout except at the beginning of sentences and for other grammatical considerations.
5. All capital print is hard to read and requires a greater amount of printing space, hence it should be avoided, if possible. If you want the print to be large enough to be seen or to attract attention, increase the point size of lower case letters.

6. For average readers, restrict the use of boldface type to headlines, subheads, or important words or phrases within the text. For very young or very old readers, semi-boldface type is preferred—providing the point size is adequate (11 or 12-point).

7. Limit the size of all textual material to 9, 10, 11, and 12-points. Smaller sizes are difficult to see; larger sizes may cause reading fatigue.

8. Consider one-point leading adequate for short measures and as the measure becomes longer, increase the leading—not to exceed two points. Three or more points of lead does not add to legibility but does interfere with reading habits. It is important to maintain a clear separation between all lines, especially when type with long ascenders and decenders are used.

9. The line width should be kept at a comfortable reading distance. Excessively short lines disrupt reading habits while excessively long lines make it difficult to find succeeding lines. Our eyes are
accustomed to reading moderate measures of type. Moderate measures are considered to be between the limits of 14 to 34 picas, approximately 1 1/2 to 2 1/2 lower case alphabet lengths (corresponding to the body size of type), or 39 to 65 letters. Generally, use shorter measures with smaller type sizes, and increase the line width as the point size increases. (A picas-inches conversion table is located in the appendix.)

10. The purpose of margins is to frame the body of type. Roughly, the two side margins should be equal to one-third the width of the page or half the measure, and all margins should comprise about 50 percent of the page. In thick or bulky publications, the inner or gutter margin should be sufficiently large to prevent curvature of the print. For beginning readers, the right hand margin should be irregular, ending the line with the end of a phrase. For adults, the side margins should be straight or "justified."

For fast reading, the eyes require a consistent starting point from which to begin a reading and a consistent ending (reference point) to help locate the beginning of the following line. Irregular margins either on the left or right disrupt reading habits and slow reading speed. The top and bottom
margins are a matter of preference, but should be at least equal to the two side margins.

11. Black print on a white background is the most legible. Any other color of print is acceptable providing maximum value contrast is maintained between the print and the background. Select only black or those colors that are dark in value for use on light colored backgrounds, for example:

- Grass Green on White
- Navy Blue on White
- Black on Canary Yellow

Avoid reverse printing, such as white on black or light-colored print on dark-colored background. Reverse printing is difficult to read and causes the print to blur.

12. Select only light-colored, dull-finished, and opaque papers; they aid quick and easy reading and are liked by readers. Do not use glossy or extremely glazed papers. They retard reading speed and may cause reading fatigue. It is important to maintain maximum value contrast between print and paper.

13. A clear separation should be maintained between lines of print and there should also be a clear separation between headlines, subheads, and the copy. Use a greater amount of space between headlines and subheads than is to be used between subheads and the copy. In addition to size and boldness, adequate
spacing also provides contrast and emphasis for headlines and subheads. Consider indenting the first line of all paragraphs. Indentions help to separate individual thoughts. If indentions are not preferred, increase the spacing between paragraphs.

The typographical factors noted above are presented below in a guide to legibility.

**TABLE 1**

**LEGIBILITY GUIDE**

<table>
<thead>
<tr>
<th>Typographical Factors</th>
<th>Optimum Legibility Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type Style and Form</strong></td>
<td></td>
</tr>
<tr>
<td>Roman Face</td>
<td>Display matter, subheads, textual and statistical material.</td>
</tr>
<tr>
<td></td>
<td>Long ascenders and descenders for younger readers; short ascenders and descenders for older readers.</td>
</tr>
<tr>
<td></td>
<td>Avoid condensed, extended, or extremely bold faces.</td>
</tr>
<tr>
<td>Gothic Face</td>
<td>Avoid.</td>
</tr>
<tr>
<td>All Capitals</td>
<td>Avoid.</td>
</tr>
<tr>
<td>Lower Case</td>
<td>Display matter, subheads, textual and statistical material.</td>
</tr>
<tr>
<td>Typographical Factors</td>
<td>Optimum Legibility Conditions</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Italics</td>
<td>Emphasis only.</td>
</tr>
<tr>
<td>Boldface</td>
<td>Emphasis of display matter, subheads, and important words or phrases.</td>
</tr>
<tr>
<td></td>
<td>Semi-boldface for younger and older readers.</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>Nine, 10, 11, and 12-point with optimum leading and measure.</td>
</tr>
<tr>
<td></td>
<td>Eleven or 12-point for younger and older readers.</td>
</tr>
<tr>
<td><strong>Leading</strong></td>
<td>One and 2-point leading with optimum type sizes and measures.</td>
</tr>
<tr>
<td></td>
<td>One-point lead for shorter measures; 2-point lead for longer measures.</td>
</tr>
<tr>
<td><strong>Measure</strong></td>
<td>Moderate measures only: 14 to 34 picas, 1 1/2 to 2 1/2 lower case alphabet lengths (corresponding to the body size), approximately 39 to 65 letters, or 2 11/32 to 5 21/32 inches with optimum type sizes and leading.</td>
</tr>
<tr>
<td></td>
<td>Shorter measures with smaller type sizes; longer measures with larger type sizes.</td>
</tr>
<tr>
<td><strong>Margins</strong></td>
<td>One-third the width of the page or half the measure for the two side margins; all four margins comprising approximately 50 percent of the page.</td>
</tr>
</tbody>
</table>
### Typographical Factors

<table>
<thead>
<tr>
<th><strong>Optimum Legibility Conditions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Larger proportions for younger readers; irregular right-hand margins for beginning readers.</td>
</tr>
<tr>
<td>Inner or gutter margin increased substantially for thick books.</td>
</tr>
</tbody>
</table>

#### Color of Print

- Black print on white background or dark-colored print on light-colored background.
- Avoid reverse printing—white on black or light-colored print on dark-colored background.

#### Paper

- White or light-colored, dull-finished, and opaque.
- Avoid glossy or extremely glazed finishes.

---

**Summary and Conclusion**

Printed communications aim to inform, persuade, or to entertain. Type is the primary graphic element in printed communications and its purpose is to express printed messages. Regardless of the purpose of the communication, the printed message should have the visual and physical characteristics that provide speed, accuracy, and ease of reading with comprehension, in other words, legibility.

There are many elements involved in the communication process and many factors that influence the success of
the communication. However, this study was concerned only with a part of the total communication process, that is, with the encoding of printed messages, the planning and arrangement of typography to provide optimum legibility of printed words.

Knowledge and experience with typography have been emphasized for those persons responsible for the planning and designing of printed communications. Typographical judgments based on intuition, personal preference, and examples of commercial typesetting without reference to experience or physiological and psychological facts may impede or interfere with the accurate transmission of visual information. Persons responsible for the planning and designing of printed communications, who do not have the necessary broad experience with typography, need typographical standards of legibility based on scientific studies and the knowledge of experienced typographers.

The purpose of this work was to study those factors that affect the legibility of printed words and to present a guide by which decisions could be made when selecting or planning the arrangement of type or when evaluating the legibility of printed communications.

The writer concludes that the recommendations presented in this study do furnish practical and important information for the reader. However, they have limitations and need further research. The results are to be regarded
as an aid to provide the reader with a basis for making
the judgments necessary for effective printed communica-
tions. They are fruitful but not final.
APPENDIX A

TABLE 2

PICAS-INCHES CONVERSION TABLE

<table>
<thead>
<tr>
<th>Picas</th>
<th>Inches</th>
<th>Picas</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>2 11/32</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>15</td>
<td>2 16/32</td>
<td>25</td>
<td>4 5/32</td>
</tr>
<tr>
<td>16</td>
<td>2 21/32</td>
<td>26</td>
<td>4 11/32</td>
</tr>
<tr>
<td>17</td>
<td>2 27/32</td>
<td>27</td>
<td>4 16/32</td>
</tr>
<tr>
<td>18</td>
<td>3</td>
<td>28</td>
<td>4 21/32</td>
</tr>
<tr>
<td>19</td>
<td>3 5/32</td>
<td>29</td>
<td>4 27/32</td>
</tr>
<tr>
<td>20</td>
<td>3 11/32</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>21</td>
<td>3 16/32</td>
<td>31</td>
<td>5 5/32</td>
</tr>
<tr>
<td>22</td>
<td>3 21/32</td>
<td>32</td>
<td>5 11/32</td>
</tr>
<tr>
<td>23</td>
<td>3 27/32</td>
<td>33</td>
<td>5 16/32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34</td>
<td>5 21/32</td>
</tr>
</tbody>
</table>

Note:

The table includes only those measurements which are considered to be the optimum line widths for optimum type sizes.
APPENDIX B

GLOSSARY OF TERMS

Ascender
The part of a letter which extends above the x-height as in the letters "d", "l", "f", "h", "k", "t", and "b".

Brightness-Contrast
The effect of a striking difference between the color of print and background or printing surface.

Body
The whole piece of type exclusive of the printing surface.

Chroma
The intensity of color.

Counters
The inner or white spaces in letters.

Decoding
Refers to the translation of encoded messages.

Descender
The part of a letter which extends below the x-height as in the letters "g", "j", "p", "q", and "y".

Encoding
Refers to the structure of symbols used to transmit a printed message; to put the message into code or transmissible visual signals.

Fidelity
Refers to the accuracy of a transmitted message.

Fixation
The brief pauses made when reading in which letters, words, or phrases are recognized.

Gothic
A general classification of type faces referring to those without serifs—sans serif.

Irradiation
The apparent enlargement of a light object when viewed against a dark background.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leading</td>
<td>The space between lines of print, expressed in points.</td>
</tr>
<tr>
<td>Legibility</td>
<td>Refers to the physical and visual characteristics of printed words permitting optimum reading speed, ease, and accuracy with comprehension.</td>
</tr>
<tr>
<td>Measure</td>
<td>The length to which a line of print is set, usually expressed in points or picas.</td>
</tr>
<tr>
<td>Noise</td>
<td>Those factors which impede or interfere with the accurate transmission of a message.</td>
</tr>
<tr>
<td>Pause Duration</td>
<td>The time that a fixation lasts.</td>
</tr>
<tr>
<td>Perception Time</td>
<td>Total sum of pause durations.</td>
</tr>
<tr>
<td>Pica</td>
<td>A standard printing measurement, approximately 1/6 of an inch.</td>
</tr>
<tr>
<td>Point</td>
<td>A standard measurement of type: .01383 inch, 12 points to the pica, 72 points to the inch.</td>
</tr>
<tr>
<td>Readability</td>
<td>Refers to the ease of reading, human interest, comprehensibility, and legibility of printed material.</td>
</tr>
<tr>
<td>Regression</td>
<td>The backward movement made in reading to re-examine the material.</td>
</tr>
<tr>
<td>Reverse</td>
<td>A term used in printing to indicate that the areas surrounding the print are to be covered with ink rather than the type surface itself, allowing the color of the background to show through the uncovered areas.</td>
</tr>
<tr>
<td>Roman</td>
<td>A general classification of type referring to those faces having serifs.</td>
</tr>
<tr>
<td>Sans Serif</td>
<td>Meaning without serifs.</td>
</tr>
<tr>
<td>Serif</td>
<td>The cross strokes at the top or bottom of Roman type faces.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Span of Perception</td>
<td>The distance between fixations.</td>
</tr>
<tr>
<td>Value (color)</td>
<td>The lightness or darkness of a color.</td>
</tr>
<tr>
<td>X-Height</td>
<td>The vertical measurement of the body of type excluding ascenders and descenders.</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY

Articles and Periodicals

"Annual Corporate Reports: A Type Face Survey," Type Talks, November-December, 1964, 5-6.


Paterson, Donald G. and Tinker, Miles A. "Influence of Type Form on Speed of Reading," Journal of Applied Psychology, XII (August, 1928), 359-368.


Tinker, Miles A. and Paterson, Donald G. "Studies of Typographical Factors Influencing Speed of Reading: II. Size of Type," Journal of Applied Psychology, XIII (April, 1929), 120-130.
"Variations in Color of Print and Background," Journal of Applied Psychology, XV (October, 1931), 471-479.

"Eye Movements in Reading a Modern Type Face and Old English," American Journal of Psychology, LIV (January, 1941), 113-114.

"Eye Movements in Reading Black Print on White Background and Red Print on Dark Green Background," American Journal of Psychology, LVII (January, 1944), 93-94.


"Types for the Corporate Annual Report," Type Talks, September, October, 1965, 6-7.

Books


Paterson, Donald G. and Tinker, Miles A. How to Make Type Readable. New York: Harper and Brothers, 1940.


