2-1-1996

Optimizing text-intesive documents for on-screen viewing using the model of the Portable Document Format

Erin Hickey

Optimizing Text-Intensive Documents for On-Screen Viewing Using the Model of the Portable Document Format

by

Erin K. Hickey

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Science in the School of Printing Management
and Sciences in the College of Imaging Arts and Sciences of the
Rochester Institute of Technology

February, 1996

Thesis Advisor: Professor Frank Cost

School of Printing Management and Sciences
Rochester Institute of Technology
Rochester, New York

Certificate of Approval

Master's Thesis

This is to certify that the Master's Thesis of

Erin Hickey

name of student

With a major in Graphic Arts Publishing
has been approved by the Thesis Committee as satisfactory
for the thesis requirement for the Master of Science degree
at the convocation of

February 1996

date

Thesis Committee:

Frank Cost

Thesis Advisor

Marie Freckleton

Graduate Program Coordinator

C. Harold Goffin

Director or Designate

Optimizing Text-Intensive Documents for On-Screen Viewing Using the Model of the Portable Document Format

I, Erin Hickey, hereby **deny** permission to the Wallace Memorial Library of R.I.T. to reproduce my thesis in whole or in part.

Date 2/20/96

Acknowledgements

I would like to extend thanks to Romano Padeste, Jin Park, and Christian Wittwer, who were especially helpful throughout the program both in and out of the classroom. To Matthew King, your sacrifices and support will never be forgotten. You are a catch.

Table of Contents

List of Figures

List of Terms

Ascender–The segment of a lower case character that extends above the x-height.

Capital Height–The height of the uppercase letters in relation to x-height

Contrast–The difference between the thick and thin elements of a letterform.

CRT–Cathode Ray Tube; the technology behind most illuminated display devices, including computer monitors and television sets.

Descender–The segment of a lower case character that extends below the baseline.

Fit–Describes the spacing between characters in a font.

Joins–The way in which different elements of a letterform come together.

Leading–The space between lines of type.

Navigation–The process of a user finding his or her way through an interactive document.

PDF-Portable Document Format; a non-proprietary file format developed by Adobe that enables documents to retain all elements of formatting regardless of the computer platform they are viewed on or printed from.

Pixel–Picture Element; the smallest addressable unit of a CRT screen.

Portable Documents-Any document that retains its original look and feel as it travels between computer platforms.

Right Justify-The same as justify, in typographic terms; any text that is flush with the right and left margins in a document.

Serifs-Small strokes at the ends of the stems of characters.

Weight–The thickness of the stroked elements that make up a character in a font. Light and Bold are examples of font weights.

X-Height–The area of a character that lies between the mean and baselines. Generally determined by the height of the lower case x.

Abstract

Document portability programs transform electronic documents into a state that allows information to be viewed, annotated, and printed by any computer system, regardless of the original computer platform or software application used to create the primary document. In addition, portable documents maintain formatting, fonts and graphics as they appear in the original.

Despite the unique opportunity these programs offer for distributing information, most portable document developers do not use the technology effectively. Poor font rendering and page sizes too large for easy navigation or comfortable monitor viewing make most portable documents impractical for pure electronic use. When a document is presented on screen, it no longer has the same properties as a printed page. Though the information contained within it may not have changed, the reader has less control over the conditions under which the document will be read. It becomes the responsibility of the creator to present that information in a useful manner, if he or she wishes the information to reach its audience.

The purpose of this study was to determine whether it is possible, through simple formulaic reformatting, to create highly legible text intensive documents for on-screen viewing using a document portability program, specifically Adobe's *Portable Document Format*. This objective was achieved by determining the factors that contribute to legibility and creating and testing various documents based on those findings.

Three experiments were conducted to determine whether the portable document format is a viable medium for viewing text intensive documents on screen. It was found that though the portable document format has revolutionary specific uses, and if documents are formatted specifically for the medium users prefer them over non-optimized documents, users still prefer to read text intensive documents on paper.

Chapter 1

INTRODUCTION

Statement of Problem

What is a page? Traditionally a page is either side of the pieces of paper bound in a book. A page can be any size, but its shape is generally rectangular and vertically oriented. In our day-to-day lives, a page is the smallest physical element of a document, a magazine, term paper, or project report, usually 8.5″ x 11″, again vertical in nature. But in the computer age, what defines a page?

The default page size in word processing programs is 8.5″ x 11″, the standard output size for most printers. But electronic documents do not use paper; the substrate becomes the computer monitor and the size is no longer recorded in inches, but in pixels. The pixel, or picture element, is the smallest addressable area of a monitor. In general, monitors have 72 pixels per inch, a significantly lower resolution than that found in a laser-printed page, which generally has a resolution between 300 and 600 dots per inch.

The standard computer screen size is 13 inches, or 640 x 480 pixels, positioned horizontally. (Despite Apple's claim that its standard monitors are growing–from 13 to 14 and now 15 inches–the base number of pixels in the monitor has not changed.) Using the monitor as a "page" forces us to reevaluate our definition of a page, in terms of both its size and orientation. As a result, we must revise our output as well.

A problem arises when information intended to be viewed on a computer screen is designed according to the standards of the printed page. Because printed docu-

ments are generally vertical and cannot be viewed in their entirety on most monitors, standard page sizes, particularly 8.5″ x 11″ documents, are not effective means of distributing electronic information.[1] Document portability programs effortlessly transform existing documents into a portable state. As a consequence many developers do not consider the design issues that arise as a result of moving a document from one medium to another. This oversight has led to a proliferation of portable documents that are inappropriate for on-screen use.

It is important to note that not all portable documents are intended to be viewed on a monitor. The file formats are designed to display *and* print documents exactly the way they originally appeared. This study, however, is concerned only with those documents that are distributed specifically for on-screen, not printed, use.

The graph below illustrates the difficulty of viewing an 8.5″ x 11″ page on a standard monitor:

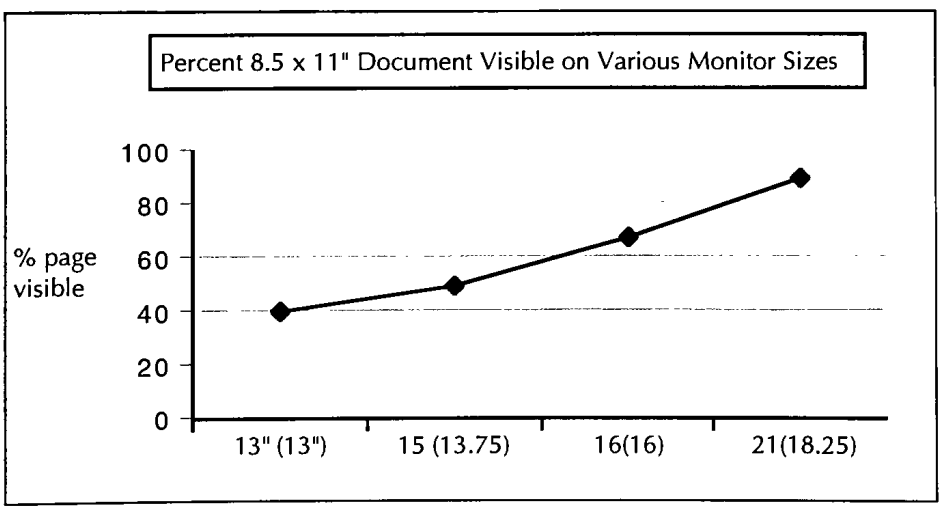


Fig. 1 Percent page visible of an 8.5″ x 11″ document on various monitor sizes.

Background and Significance

HISTORY OF PORTABILITY

For years computers of all platforms have been able to indirectly exchange ASCII (American Standard Code for Information Interchange) encoded text information through telecommunication networks. ASCII has only ninety-five printable characters, limited formatting ability, and no support for graphics.[2] Documents are prepared in one standard font and cannot include characters beyond the standard ninety-five, making transmission of tables, formulas, and data in foreign languages quite difficult. Using portable documents in place of ASCII removes all those limitations. Spreadsheet data, graphs, any font and any image can be directly incorporated into the document. If compression options are used effectively, the size of a portable document–including images and embedded fonts–need not be drastically larger than the same document created in ASCII.

With the introduction of the PCExchange extension for Macintosh, Macs can directly communicate with PCs in ways beyond the simple transfer of ASCII information. The extension allows a Macintosh to recognize a PC-formatted floppy disk and read certain file types in Macintosh applications. Even so, this interchange occurs only in one direction and in a limited capacity.[3] Not all document types can be translated, fidelity in formatting is not guaranteed, and the effects of font substitution cannot be anticipated.

CHANGES IN INFORMATION ACCESS

The explosion of the personal computer market and growing public and commercial use of the Internet have greatly changed our access to information. In minutes we can scan the resources of nearly any library in the world, order flowers and airplane

tickets on-line, or see museum collections displayed on-screen in our own homes. It is no longer necessary to open a book to learn how a computer program works. On-line databases and hypertext links can take us to the exact paragraph we need within seconds.

There has been some discussion about publishing mainstream magazines in electronic form–specifically in the portable document format. Instead of distributing magazines throughout offices, a company would purchase a license to distribute a number of electronic copies from a server. Libraries could place periodicals on-line instead of on the shelves.[4] For this proposition to be truly practical, however, a radical redesign in a magazine's layout and typography is necessary. If an on-screen document is illegible and awkward to navigate, the possibility of widespread acceptance will be low.

A recent Gartner Group report stresses the emerging importance of the client/server environment in electronic publishing.[5] The proliferation of networks provides a convenient way for members of organizations to communicate with each other. Aside from e-mail–an ASCII-based operation–the flow of documents from one user to another is still hardware and software dependent. While networks allow users to exchange information freely, which can greatly increase productivity, an incompatible file is useless. Until all hardware and software are compatible, there must be a way for documents to travel between computer platforms. One of these ways can be through the use of portable documents.

Document portability programs are at the forefront of information interchange in the evolving world of computing. Their ability to present a document as it originally appeared in any application, using any formatting and any computer system offers an edge no other technology has. But to optimize this advantage, certain standards must be adhered to.

Reasons for Interest

Document portability is an important emerging technology, one that will change the way people communicate in their personal and professional lives. Society has become dependent on visual communication and as more and more people use personal computers to access information, it must be presented in ways that meet expectations. Portable documents provide a tremendous breakthrough in information interchange. One can create a document in any application on a Unix, Macintosh, DOS or Windows-based computer and read it in any of those environments with its fonts, formatting, and graphics intact, providing a visually attractive alternative to traditional methods of exchanging electronic data.

As the use of portable documents has grown in popularity, few developers have recognized the differences between the media, that design elements effective in print may not translate well to the computer screen. While the documents they create may be visually attractive, the text is often illegible. The immediate access offered by electronic documents can be more convenient than traditional texts, but only when the documents are designed to be read on-screen.

CURRENT USE

Apple, the computer manufacturer, produces a monthly newsletter, "Information Alley," in PDF format that is available free of charge from their Internet server. While the information included in the newsletter is useful and its appearance is eye-catching, it is not easy to read. At twenty pages in length–with several graphics and a good deal of color–it is doubtful many readers will output the document on their personal printers in order to read it. Yet the developers insist on using an 8.5″ x 11″ layout and 10 point italic type.

Making the document portable so that any user can read it with all the original formatting intact is a wise publishing decision. However, ignoring the medium in which the document is viewed is a problematic oversight. Not only is it difficult to navigate through, in places it is simply illegible.

PSINet supplies a PDF user manual to subscribers of their Internet access services. The document uses a horizontal 11″ x 8.5″ layout. While the orientation is correct, the size of the pages is still much too large for full-screen display. In addition, the type is a very thin, condensed 10-point, there are no navigational tools, and the document is over fifty pages long. It is completely impractical (See Appendix A).

Portability programs should succeed, if only because they are easy to use. Creating a portable document is no more difficult than sending a file to a printer. Distributing information electronically is cheaper (and in many cases faster) than printed material. Portable documents can be more legible and attractive than ASCII text, any electronic document can be made portable and document portability programs break down the barriers set in place by incompatible computer formats. But if portable documents aren't created according to a set of design standards–and users find them difficult to read or to navigate–the technology will not catch on. The ability to exchange information openly between computer platforms is to everyone's advantage. With a set of standards designed to enhance this ability, the technology will be more effective and catch on faster.

Endnotes for Chapter 1

[1] Dillon, Andrew, et al. "The Effects of Display Size and Text Splitting on Reading Lengthy Text From Screen," vol 9 no 3, *Behaviour and Information Technology*, May 1990, p. 215 gives a summary of two reading comprehension studies supporting this statement.

[2] Xenakis, John J. "Arrivederci ASCII," *Information Week*, February 25, 1991, p 14

[3] While peripherals such as Macintosh cards for the PC and PC cards for the Macintosh are available, they are quite expensive and not widely used.

[4] For further information see P. N. Smith, et al. "Electronic Publishing with Acrobat: the CAJUN Project," *Proceedings of the International Conference on Electronic Publishing, Document Manipulation and Typography*, vol 6 no 4, 1993, p 481-494

[5] Gartner Group, "Integrated Document Output & Management," Gartner Group Continuous Services study, 11/01/94

Chapter 2

THEORETICAL BASIS AND REVIEW OF LITERATURE

For many centuries printed text documents have maintained a consistent form and style. From the Gutenberg bible to the pages of MacWorld, information is presented in virtually the same manner.[1]

In most legible documents, text is arranged on a vertical page, surrounded by margins and graphics in a way that is easy for a reader to digest. As we move into the electronic age, the definition of a page changes, and so must the way textual information is displayed.

A large body of research was developed, mostly in the 1980's, concerning the relationship between electronically displayed text, reading speed and comprehension. Most of these studies illustrate the difference between printed text and text on a video display terminal. Unfortunately, scientists are not typographers and most typographers are not scientists. Many elements often considered obvious when determining legibility–such as optimal type style, size, and leading–were not factors in most testing processes.

LEGIBILITY AND COMPREHENSION STUDIES

In "The Visible Word," (1969) Spencer conveniently analyzes significant print-based legibility studies, from the mid-17th century to the 1960's. Based on several comprehensive studies he summarizes:

> Words set entirely in capitals are considerably less legible than words in lower case. Italics reduce legibility, but provided the counters of the letters are open, bold face does not. Semi-bold types are preferred by many readers. . . . Excessively long lines cause a sharp increase in the number of regressions [backtracking]. Short lines, on the other hand, increase the number of fixation pauses. . . . Leading permits line length to be extended without loss of legibility. . . . Unjustified setting does not decrease legibility. [2]

He also notes:

> The most reliable investigations all show that the commoner type sizes, 9 to 12 point, are of about equal legibility. Larger sizes reduce reading efficiency. . . . In their pursuit of optimal type size many researchers seem to have disregarded the influence of reading distance: a 12 point type read at 18 inches is the equivalent of a 10 point type at 15 inches.[3]

This is particularly relevant, considering most users view their computer monitors at a distance of 18–24 inches. There is no discussion about the legibility of type styles, for example serif versus sans serif.

With a basic set of parameters in place for creating legible printed type, a similar understanding of legibility in on-screen viewing is necessary. In 1987, Gould, et al, found that despite many earlier studies to the contrary, including one of his own, reading from monitors can be as fast as reading from paper:

> The explanation centers on the image quality of the characters. Reading speeds equivalent to those on paper occur on CRT displays containing character fonts that resemble those on paper (rather than dot matrix fonts, for example), that have a polarity of dark characters on a light background, that are anti-aliased (i.e., contain grey level), and that are shown on displays with relatively high resolution.[4]

Previously, studies were conducted on monitors with positive polarity, or colored type (usually orange or green) on a black background, with little regard to fonts, leading, and proper line length.[5] The viewing circumstances Gould identifies are similar to

those commonly used today; anti-aliasing of characters is implemented by Adobe Type Manager and most monitors default to black-on-white, or allow the user to choose the colors used for display.

Document portability programs have fixed maximum page sizes. Unlike most applications that display ASCII documents, document portability programs do not permit the user to continuously scroll through lengthy files. This limitation is not necessarily a deficiency. In 1983, Schwartz, et al, studied user response to scrolling and paging in electronic documents. It was found that novice users prefer paging, though with experienced users both methods produced similar results.[6] In a similar study, Mills and Weldon (1985) found no quantitative differences in the two viewing methods.[7] Related studies show that readers "establish a visual memory for the location of items within a printed text based on their spatial location both on the page and within the document."[8] This is an important consideration when creating lengthy text documents. Readers increase comprehension by remembering information based on its spatial relationship to other elements on a page. Such a relationship is difficult to create when scrolling through information.

Dillon, et al (1990) studied the effects of display size and text splitting on reading comprehension. Testing was carried out using a journal article with an approximate line length of eighty characters on two different monitor sizes–twenty (standard) and sixty (similar in size to A4 paper) lines per screen. There was not a significant difference in comprehension between the two. The effects of text splitting, or dividing sentences, were more apparent. Subjects tested with text-split documents were twice as likely to flip between pages.[9] Viewing text on-screen does not provide the reader the luxury of easily returning to previous sections. Eliminating sentence breaks reduces the necessity of turning back pages, and should be considered when developing text for on-screen use.

Galitz (1993) gives a list of recommendations for presenting type on video displays:

- •Include no more than 40-60 characters per line
  - –A double column of 30-35 characters separated by 5 spaces is also acceptable;
- •Do not right-justify;
- •Separate paragraphs by at least one blank line;
- •Use paging (not scrolling).[10]

Concerning typefaces he states, "Generally, sans serif typefaces are recommended if the type is less than 8 points in size . . . or if the display environment is less than ideal."[11] His assertion is not documented. However, in Kingston (1995) subjects preferred Palatino (serif), followed closely by New York (serif) and Geneva (sans serif). Kingston found 18-point type to be the favored type size, though this would seem rather impractical for lengthy text documents.[12]

Based on the literature it seems evident that for portable documents intended for on-screen use to be effective, they must be specifically designed for that medium.

DIGITAL TYPE

Well-designed screen fonts are an integral part of developing legible documents for digital display. The first typefaces designed for computer use were developed along with the computer, in the 1940s. It was not until the 1960s, with the introduction of 8-bit computers, that both upper and lower case characters could be used in a digital font. But text was displayed as a series of dots, forced into shape by the limitations of the display medium. It was not until the introduction of the graphical user interface, allowing for a fully addressable screen area, that type was able to appear in a wide variety of designs and weights on-screen. Ink jet and laser printers further contributed to the development of digital type by providing an output device capable of producing high resolution, low-cost results.

Over the past decade, as the terminal was replaced by the graphics-based desktop computer, an entirely new medium was created, replacing paper as the ultimate destination of the material displayed on-screen. According to Kahn, et al: "The information on the screen is no longer a surrogate for the real information on the printed page. The surface of the computer screen is the page. The screen fonts are no longer the approximation of the type our readers will see–these screen fonts are the type we must use to communicate our ideas."[13] To be effective, digitally-displayed type must approach the legibility of type on the printed page.

The Lucida family of typefaces, designed in the mid-1980s by Charles Bigelow and Kris Holmes, was the first full type family designed specifically for low-resolution devices. Lucida is described as a "font-independent design." Based on a mathematical analysis of highly legible typefaces, the elements of the letterforms were tuned specifically for low-resolution devices before the design or style of the letters was introduced. Font bitmaps were hand edited to conform to the limitations of the display devices, specifically CRT screens and laser printers. "Font-independence" simply means the principles used to design Lucida are primarily dependent on mathematics, not a specific artistic style. The authors ". . . sought to tune the letterforms of Lucida to digital image processing and reconstruction."[14] Bigelow and Holmes identified seven critical areas that could be tuned to optimize it for low resolution use.

Weight refers to the ratio of stem thickness to the x-height of a character. Most popular typefaces have a weight ratio between 5:1 and 6:1, with a higher ratio producing a more delicate font. A common problem with screen fonts is "rounding off" of the character weight when the ratio falls between the boundaries of pixels. Rounding up adds a pixel and causes a font to look too bold, while rounding down

can result in the loss of small details. Lucida has a weight ratio of 5.5:1, which reduces the margin of error in displaying fonts at smaller sizes and lower resolutions.

Contrast is the difference between the thick and thin elements of a character. Low contrast typefaces appear sturdy and are generally easier to read. Thin joins, serifs and hairlines tend to erode or expand disproportionately under poor conditions. A contrast ratio of 2:1 for the basic Lucida designs was chosen to increase legibility and to prevent the characters from "breaking up."

Join placement describes the way in which different elements of a letterform join, or how the serifs, stems and bowls come together. For Lucida, the join was placed relatively deeply in the stems, so that any filling in would not completely conceal the shape of the counterform, or the white space between two adjoining elements.

The size and shape of the *serifs* are an important consideration. Serifs that are too small will tend to "round down" and disappear, while larger serifs may expand and overpower the design of a character. At higher resolutions complex serif shapes may result in much greater file sizes as well as longer processing times. Lucida has short, polygonal serifs that can accurately be represented as vectors at high resolutions, yet round off to slab serifs at smaller sizes without appearing too heavy.

Much of what determines the ease with which a typeface can be read lies in the way the letters *fit* together. Consistent fitting as well as a harmonic balance with the counters, or white spaces within the letters, plays a major role in typeface legibility. An ideal fit is difficult to achieve in low resolution devices, because rounding off forces characters into unintended positions. Regular, open spacing was used for Lucida to increase the probability of harmonic display.

Capital height describes the height of uppercase letters in relation to x-height. In low resolutions, uppercase letters often overpower the lowercase, according to the

authors, "for retrograde reasons left over from monocase terminals and printers."[15] Their apparent size and abundance of stems tend to round up, adding increased emphasis especially at smaller sizes where a difference of one pixel is noticeable. To reduce their prominence, Lucida capitals are slightly shorter than the height of the ascenders. A weight ratio similar to the lower case was chosen, as well as narrower proportions, to lessen the effect further.

The height of the lower case x, or the *x-height*, holds most of the information communicated to a reader. As a result, the complex middle sections of lower case letters require greater resolution than the ascenders and descenders. A large x-height gives the appearance of a larger font, as more information can be relayed within that area relative to the actual size of the font. However, there is an upper limit to the size of the x-height; an excessively large x-height can reduce the size of the ascenders and descenders to such a degree that they are no longer distinctive. Characters such as "n" and "h" and "q" and "g" can be confused, greatly affecting legibility. The x-height of Lucida is 52% of the body size. This proportion allows enough space for detail within the lower case letters, without reducing the significance of the ascenders and descenders.[16]

The growth of multimedia applications and personal computer use has dramatically increased the demand for CRT-optimized fonts. Harold Grey of the International Typeface Corporation states, "We get a lot of requests from software developers who want to use one of our fonts for either on-line doc[ument] distribution or CD-ROM distribution." While ITC is often criticized for producing fonts with large x-heights, he feels this growing design trend makes ITC faces "quite good for on-screen reading." Defining characteristics of these fonts are the wider font width, greater x-height, rounded open bowls and shorter ascenders and descenders.

While the fonts have not been designed specifically for use with monitors, as was Lucida, their suitability for such use is intentional.[17]

THE PORTABLE DOCUMENT FORMAT

The PDF (Portable Document Format) file "language" is an important factor in this study. It is what makes Acrobat documents portable. Though not a true computer language, PDF is modeled after the Postscript language and uses a geometric coordinate system to describe a page and its composite elements. This results in resolution and device independence. Images and graphics can be incorporated into a document much in the same way they are included in any Postscript file.[18]

As a result of Adobe's efforts to make the Portable Document Format a standard, PDF files can be viewed by any user, without the need to purchase any special software application. The "Acrobat Reader" is a viewing application available for DOS, Windows, Macintosh and Unix that is included with many new software applications. It can also be downloaded from Adobe at their Internet site.[19] The Reader allows users to view and navigate freely through any PDF document.

Creating a PDF document can be as easy as sending a file to a printer–easier, actually, because the user doesn't even need a printer. The process is similar to creating a Postscript file; instead of producing hard copy, the "PDF Writer" (a Chooser extension or printer driver) creates a PDF file. This file is immediately available for viewing on any system with an installed PDF viewer, either Acrobat Reader or Acrobat Exchange. Additional functionality, such as hypertext links and automatic zoom, can only be added in the Exchange program (which is not free) but any added functions can be used within either viewer.

Fonts are incorporated into PDF documents by three different methods: full embedding, selective embedding and no embedding. Embedding is accomplished by including font matrix information as part of the PDF page description. Matrix information is included only for the individual characters used, not the entire font.

If full embedding is chosen, a font matrix for every character in a document is included. While this ensures that a PDF file will look exactly like the original, it greatly increases the size of the file. Selective embedding allows a developer to choose specific fonts to embed. It is useful when the end-user's font library is known, or if a document contains system and non-system fonts, such as a trademark typeface. A document with no embedding relies on the user having the fonts used in the document installed in his or her system. If a user has a font installed, the PDF reader will access that font when displaying the portable document. If a font is not available, two multiple master fonts supplied with the PDF viewers will interpolate the information and display a font as accurately as possible, based on a rudimentary "font description" included with each document. The multiple master fonts sometimes produce illegible results, hence fidelity with the original document cannot be assured. They are assisted in rendering by a mini-version of Adobe Type Manager (also free).

One strength of electronic documents is their ability to be accessed by multiple users and viewed from a server or downloaded to an individual computer over a network. Because a network is often an information bottleneck, several compression options are available for PDF documents.

Because portable documents are not editable, most document portability programs support annotation, generally in the form of electronic "sticky-notes." Users can add comments to documents, similar to writing in the margins of printed pages.

Text can be copied and pasted into any text-editor, but font and formatting information is lost.[20] Most programs also allow users to copy graphics, which by using the same tool text can be made into a graphic. It then retains all formatting, but is no longer editable.

For the purpose of this study, the most relevant features of portable documents include their ability to retain all formatting of the original, remain fully searchable and support hypertext links, allowing a user to immediately access the exact information he or she needs when reading through lengthy text on-screen.

ERGONOMICS

The effects of extended computer use on the human body must also be considered when assessing the value of properly designed portable documents. Numerous studies have determined that spending hours in front of a computer is extremely taxing on the body. Eye strain, neck and shoulder aches and repetitive stress injuries all result from staring at the monitor, pounding on the keyboard, and sitting in one position for hours on end. Documents appropriately prepared for monitor viewing could have an impact on reducing some of the stresses associated with computer use.[21]

Endnotes for Chapter 2

[1] McLean, Ruari. *The Thames and Hudson Manual of Typography.* (London: Thames and Hudson, 1980) p. 47

[2] Spencer, Herbert. *The Visible Word.* (New York: Hastings House, 1969) p. 55

[3] Spencer, 1969. p. 35

[4] Gould, John D. et al. "Reading from CRT Displays Can Be as Fast as Reading from Paper," vol 29 no 5, *Human Factors*, 1987 p. 497

[5] Two such studies are: Gould, J. D. and Grischkowski, N. "Doing the Same Work With a CRT Terminal and With Hardcopy," *Proceedings of the Human Factors Society 26th Annual Meeting*, 1983, p. 165-166 and Kak, A. V. "Relationships Between Readability of Printed and CRT-Displayed Text," *Proceedings of the Human Factors Society 25th Annual Meeting*, 1981, p. 137-140

[6] Schwartz, Elmar et al. "A Comparison of Paging and Scrolling for Changing Screen Contents by Inexperienced Users," vol 25 no 3, *Human Factors*, 1983, p. 279-282

[7] Schwartz describes this study in vol 25 no 3, *Human Factors*, p. 279

[8] Dillon, Andrew, et al. "The Effects of Display Size and Text Splitting on Reading Lengthy Text From Screen," vol 9 no 3, *Behaviour and Information Technology*, May 1990, p. 215 gives a summary of two reading comprehension studies supporting this statement.

[9] Dillon, 1990 p. 226

[10] Galitz, Wilbert. *User-Interface Screen Design.* (Wellesley, MA: QED Publishing, 1993) p. 109

[11] Galitz, 1993. p. 252

[12] Kingston, Kenneth. *Standards and Guidelines for Aesthetics in Design and Typography for Interactive Multimedia Programs.* Master's Thesis, Rochester Institute of Technology, 1995

[13] Kahn,. et al. "Typography for the Computer Screen: Applying the Lessons of Print to Electronic Documents," *Seybold Report on Electronic Publishing*, July 5, 1993

[14] Bigelow, Charles and Holmes, Kris "The Design of Lucida: an Integrated Family of Type for Electronic Literacy" in *EP86: Text Processing and Document Manipulation,* J.C. van Vliet, ed (Cambridge: Cambridge University Press, 1986, p. 6).

[15] Bigelow and Holmes, p.12

[16] A full description of the process and reasoning behind the design of Lucida can be found in *EP86*, p. 1-17.

[17] Grey, Harold. Personal communications with the author, September 1995.

[18] Bienz, Tim and Cohn, Richard. *Portable Document Format Reference Manual.* (Menlo Park, CA: Addison-Wesley Publishing Company, 1993)

[19] Adobe's Internet address is http://www.adobe.com

[20] PDF supports Rich Text Format (RTF) which should allow a copied document to retain formatting; however, as of 11/2/95 I have not been able to implement it.

[21] Gendron, Marie. "Labor Dept: Workplace stress illnesses skyrocket," *The Boston Herald*, Second Edition, December 22, 1994. See also Sheedy, James."VDT's and Vision Complaints: A Survey," vol 8 nos 4-5, *Information Display*, April, 1992, p. 20-23; Bureau of National Affairs, "OSHA's Draft Ergonomics Standard," *Daily Labor Report*, March 21, 1995

Chapter 3

HYPOTHESIS

If documents are originally designed for printed output,
then they must be reformatted to be effective for on-screen viewing.

The fundamental deficiencies in today's portable documents lie with developers failing to identify the differences encountered in viewing a document on-screen and viewing it on paper. This study is concerned with the creation of effective portable documents for on-screen use. Page sizes and font choices play a major role in the legibility of a document; it is the goal of this thesis to determine whether through simple reformatting procedures, carried out in a reasonable amount of time, it is possible to customize a document for effective use on a computer monitor.

Chapter 4

METHODOLOGY

Legibility and comprehension are very complex areas of study. It is impracticable to test all the elements that affect the legibility of a document. But the basic rules of typography and design, as outlined by Tinker and Spencer, should apply to any medium.

The two factors that most affect legibility in any document, page design and typography, are particularly important for portable documents. The low resolution of the monitor and it's non-standard "page" size create special problems and limitations that do not exist in traditional publishing. The experiments in this study were designed to identify how these elements can be used to improve the effectiveness of portable documents.

PRELIMINARY EXPERIMENTATION

A preliminary experiment was carried out to determine what typography and design elements currently used in portable documents have an effect–positive or negative–on viewers.

Fifteen respondents were presented with five portable documents representative of those currently published on the Internet and an introduction designed by the author based on the principles outlined in Chapter 2, Theoretical Bases and Review

of Literature (See Appendix A). All respondents were familiar with portable documents, but none had significant experience viewing them. Respondents were asked to fill out a questionnaire designed to identify the agreeable and disagreeable typographic and design elements within each document. The results of this experiment, outlined in Appendix B, determined the how the document in the second experiment was formatted.

SETTING STANDARDS

The preliminary experiment pinpointed design elements and legibility issues that most affect a document's suitability for on-screen use. Based on these findings, the author applied those elements to an existing document originally intended for print, for the purpose of customizing it for on-screen use using the standards identified in the first experiment.

FINAL EXPERIMENTATION

The final test determined if the reformatting procedures were effective. Thirty respondents were presented with both the original and the reformatted document and then asked which was more effective for on-screen use. They were also asked whether they preferred to use the document on-screen or in its original printed form. Detailed results of this test, as well as the questionnaire, are shown in Appendix D.

Equipment Used

- Power Macintosh 7100/66
- Apple Multiscan 15" monitor (640 x 480 pixels)
- Adobe Acrobat Exchange, Distiller, and Reader
- QuarkXpress
- Internet account

Method of Evaluation

The truth of the hypothesis is determined by the responses of the individuals taking part in the study.

Chapter 5

RESULTS OF THE EXPERIMENTATION

The results of the three experiments used in this study are outlined below. Further details of each as well as the specifics of the documents tested can be found in the appendices.

Results of the Preliminary Experiment

The tables below outline the results of the preliminary experimentation. This data was collected to reconfirm the findings of previous legibility studies conducted by a variety of scientists, as discussed in Chapter 2. In addition, the study was used to determine whether those findings apply to portable documents, and to identify elements specific to portable documents that users liked or disliked. The data was then used to create the second test, Optimizing a Text Intensive Document for On-Screen Display. The questionnaire used in the preliminary experiment as well as more detailed results can be found in Appendix B.

OVERALL LEGIBILITY

Respondents were asked to view six portable documents and rate the effectiveness of the type face, type size, leading, line length, page size, and navigational tools used in each. After viewing the six documents independently, respondents were asked to rate the documents overall from 1-6, one being the most legible, six being the least. The best possible score was fifteen, the worst ninety. The results of these overall ratings

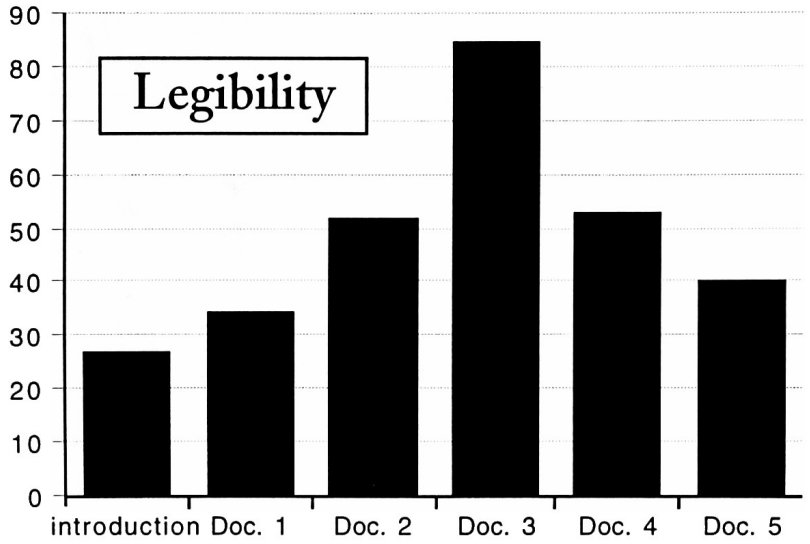


Figure 5.1 Overall Legibility

are shown in Figure 5.1, with lower numbers indicating higher legibility. The results of the studies outlined in Chapter 2 indicate that legibility is not determined by one individual factor but several factors in combination.The following tables illustrate the individual results of each element tested in this experiment. The highest scoring element within each category is not necessarily the most effective when combined with others, although in general the highest scores were received by elements that make up the best scoring documents overall. In some cases, two or more documents share similar elements; the results of those questions were averaged only for those elements.

TYPEFACE

Percentage ratings for all primary text typefaces used in the test documents are shown in Figure 5.3. Galliard, Minion, and Lucida all display the elements that make a typeface ideal for on-screen use (see Chapter 2, Digital Fonts) and all scored fairly high. Minion is separated into two categories, highlighting the effect type size has on legibility. Though 14-point Minion scored a 100% approval rating, 12-point

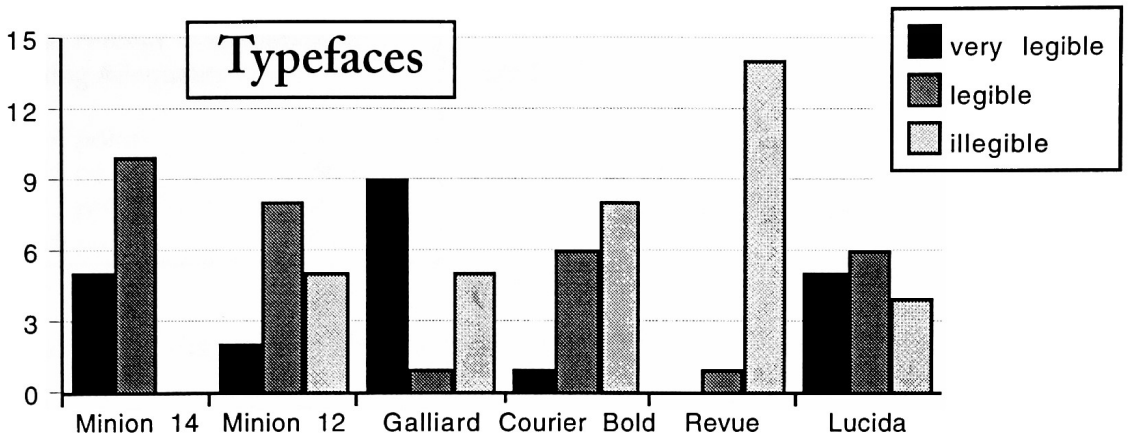


Figure 5.2 Typeface Legibility

scored only 67%. Minion was chosen as the main text typeface for experiment two based on the results of this test, combined with the high legibility rating overall of the Introduction, the document in which it was used.

Figure 5.3
Total Percent of Respondents Stating Legible or Very Legible:

Minion 14	100%
Lucida	73%
Minion 12	67%
Galliard	67%
Courier Bold	47%
Revue	7%

TYPE SIZE

The results determining ideal type size are listed here, with an average score taken for documents that contained the same type size. Fourteen-point type was selected for the second test based on its high adequacy rating as well as the mix of "too small" and "too large" responses. Results for 12-point type were split almost evenly (53% to 47%)

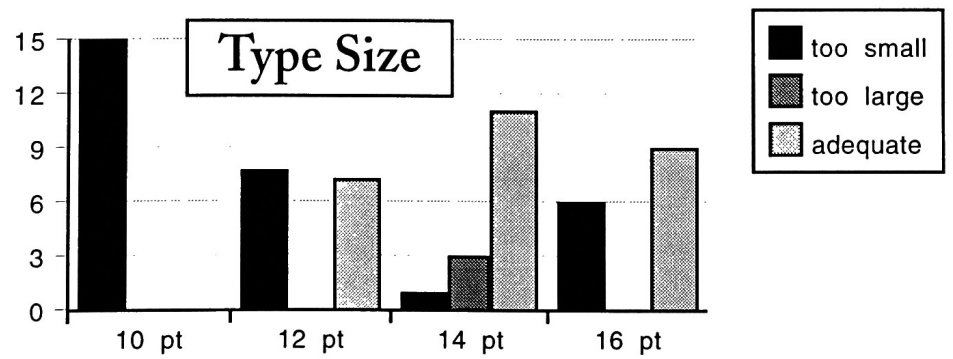


Figure 5.4 Type Size Adequacy

Figure 5.5 Total Percent of Respondents Stating Adequate:	
14 point	73%
16 point	60%
12 point	47%
10 point	0%

between "too small" and "adequate."Ten-point was rated unanimously as "too small."

The anomaly in the results for 16-point type are likely the result of respondents viewing Document 5 at the automatic zoom display of less than 100%. Figure 5.14 illustrates the user response to the automatic zoom/magnification feature. Fifty-three percent of respondents "didn't notice," however, automatic zoom reduces the display size of Document 5 to 63%, drastically affecting the display and legibility of the type.

LEADING

Three documents used standard 12-point type on 14-point leading (14%), which scored less favorably than the expanded 20 and 23% leading. The highest scoring

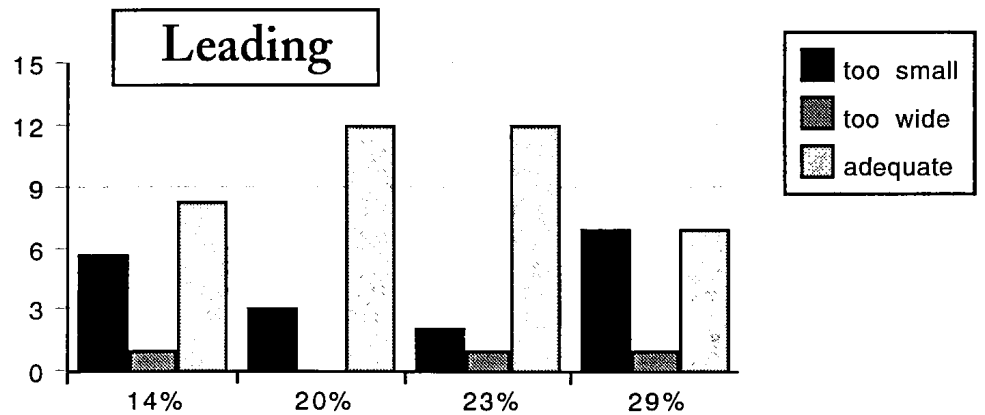


Figure 5.6 Leading Adequacy

Figure 5.7 Total Percent of Respondents Stating Adequate:	
23 point	80%
20 point	80%
14 point	55%
29 point	47%

leading widths–20 and 23%–combine with 16- and 14-point type respectively. Figure 5.6 displays the results. The scores for 29% leading illustrate how dramatically type size and style can affect the amount of leading required to achieve legibility.

Used in conjunction with 10-point type as it is in this example, 29% leading received equal numbers of "adequate" and "too small" ratings (47%), though it is significantly wider than the higher scoring samples. These results clearly show how all elements work together to affect the legibility of a document. Fourteen-point type received higher ratings in type size, while Minion scored higher in legibility. As a result of these three elements of the experiment, it was decided to use 14-point Minion with 18-point leading for the second experiment.

LINE LENGTH

Previous studies show that the ideal line length for on-screen viewing lies between 40 to 60 characters per line. The preferred line length in this experiment is within the 55-60 character range, with 80% of respondents stating "adequate" for fifty-five characters per line and 73% for sixty. Twenty-five characters per line scored third,

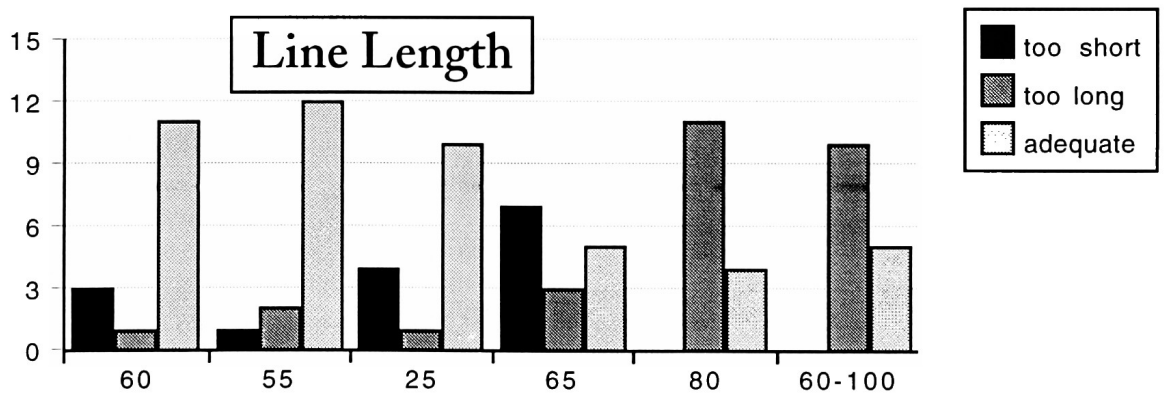


Figure 5.8 Line Length Adequacy

Figure 5.9
Total Percent of Respondents Stating Adequate:

60 characters	73%
55	80%
25	67%
65	33%
80	27%
60-100	33%

with a 67% adequacy rating. This line length was used in Document 2 in a three-column format.

Though the 25-character line length scored well, many respondents disliked the use of columns (see Appendix C). In designing experi-

ment two, it was decided that a maximum line length of 60 characters would be used with unjustified type, putting the number of characters per line within the preferred range.

PAGE SIZE

Choosing a page size was straightforward, with 80% of respondents preferring a

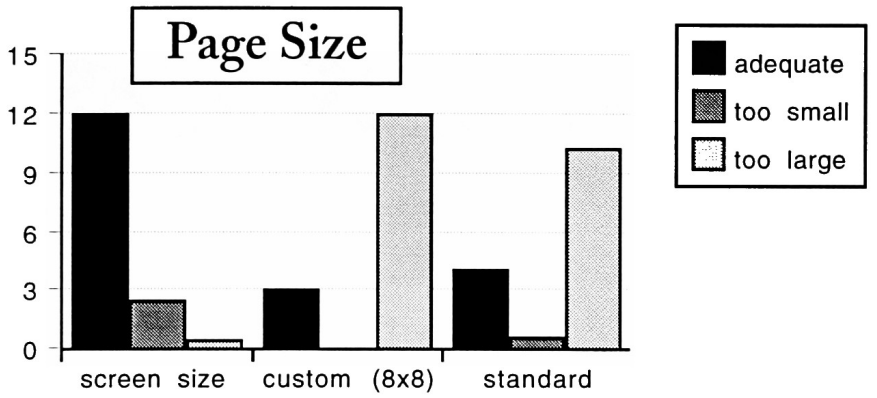


Figure 5.10 Page Size Adequacy

Figure 5.11
Total Percent of Respondents Stating Adequate:

screen size	80%
custom	20%
standard	27%

screen-size display. With the current standard being a 13-15″, 640 x 480 pixel monitor, the maximum page size that also allows space for the application interface is 7.5 x 5.2″. This was the page size chosen for the second experiment.

NAVIGATION

Choosing the most effective document navigation method was a bit more difficult. Most electronic documents–not only those tested here–use more than one method of navigation. Simple linear navigation, which gives the user only the ability to move forward and backward through individual "pages" of a document, received the highest approval. While this is also one of the highly-rated methods in major legibility

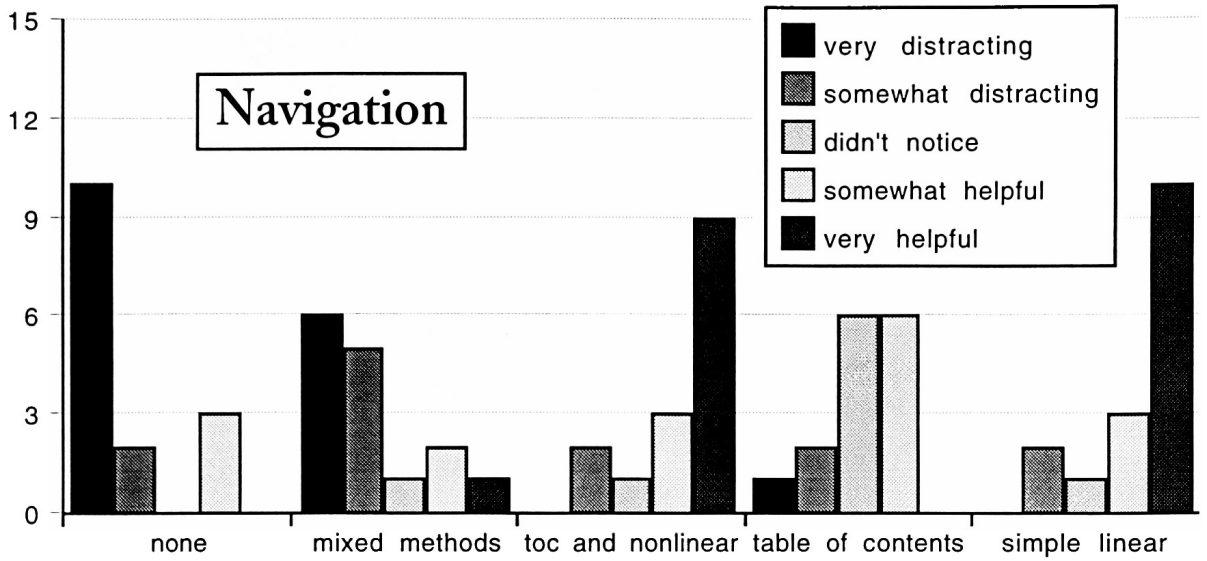


Figure 5.12 Effectiveness of Navigation Tools

studies, in long text-intensive documents, the inability to move freely between major sections is a drawback. Eighty percent of respondents replied that a hypertext table of contents combined with non-linear navigation was either somewhat or very helpful. The use of non-linear navigation is not practical with straight text–the user must have the ability to access pages in sequence. Merging linear navigation with a hypertext table of contents is the best solution, allowing users to choose between reading straight through a document or reading specific sections or chapters. The combined method was chosen for the second experiment.

Figure 5.13
Total Percent of Respondents Stating Helpful or Very Helpful:

none	20%
mixed methods	20%
toc and nonlinear	80%
table of contents	40%
simple linear	87%

AUTOMATIC ZOOM/MAGNIFICATION

The final elements tested in the preliminary experiment were *automatic zoom/magnification* and *follow article*, functions specific to Adobe Acrobat.

Testing these elements is important, as they can dramatically affect the way a document

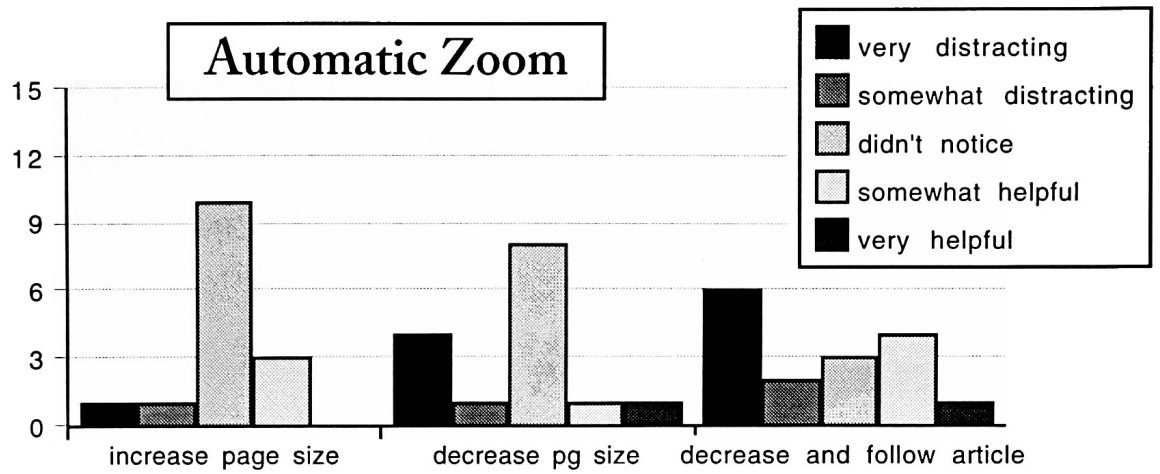


Figure 5.14 Effectiveness of Zoom Features

displays on-screen. The author of an Acrobat document can specify zoom features that cause a page to either fit the width or the entire area of the display screen. Because few documents are currently created screen-size or smaller, automatic zoom generally causes document size reduction, which in turn affects type size and legibility. On a standard monitor an 8.5 x 11″ document shrinks to 49% of its original size, making it difficult to read. The user, while given insight as to the spatial orientation of elements on a page, is required to manually magnify the page before it can be used effectively.

Figure 5.15
Total Percent of Respondents Stating Helpful or Very Helpful:

increase page size	20%
decrease page size	13%
decrease and follow article	33%

The *follow article* function provides a series of links within an article or section of a document. These links are generally applied to segments of a column, which automatically links the segments in sequence, increasing the size of each to fit the width of the monitor. While the increased size improves legibility, follow article cuts the user off from the rest of the document, leaving him or her lost within the "random" movement (see the Comments in Appendix C).

In response to the low user approval ratings outlined in Figure 5.15, it was decided to omit both the follow article and automatic zoom elements from experiment two.

Results of the Second Experiment

The design of the second experiment was based on the results of the preliminary experiment, which determined the following: page size to fit within the viewing area of the monitor, a line length of no more than sixty characters, 14-point Minion on eighteen point leading, simple linear navigation with a clickable table of contents, and no automatic zoom features.

PROCEDURE

The new document was created using an eight-page Quark Xpress newsletter designed for print. Reformatting the major elements of the document was accomplished by editing the existing style sheets, then pasting the text onto a 7 x 5.2″ page. Graphical elements were dragged from the original document and placed in the proper reference areas on the new document. The running head and foot were moved to the new master page, and simple buttons for linear navigation were created and placed on the master page. The first page displays the masthead and a full table of contents. To aid navigation users are allowed to go forward one page, back one page, or to return to the table of contents from every page of the document.

The time necessary to make the adjustments was approximately three hours, not including the time required to create the buttons. Once the new document was completed it was printed to a PostScript file, which required about 3 minutes, then opened in Acrobat Distiller. Distiller took one minute and thirty seconds to create the PDF. Creating the links in Acrobat Exchange required another 30 minutes. The final document is forty-eight pages long.

Results of the Final Experiment

The final experiment asked thirty respondents to compare a portable version of the original newsletter, Document A, with the enhanced portable document created in experiment two, Document B. The questions and responses are outlined below. The only change made to the original was to replace the masthead typeface with one readily available on the Macintosh platform. This typeface, Lucida Handwriting, was also used to build the masthead on Document B in the second experiment. The questionnaire for this experiment can be found in Appendix D.

The results of this experiment clearly show that Document B, the result of experiment two, is better suited for on-screen viewing. But it also reveals that despite all efforts to provide the best possible document for on-screen viewing, 87% of users would still prefer to view these documents on paper.

Question 1:
Which document is most effective for on-screen viewing?

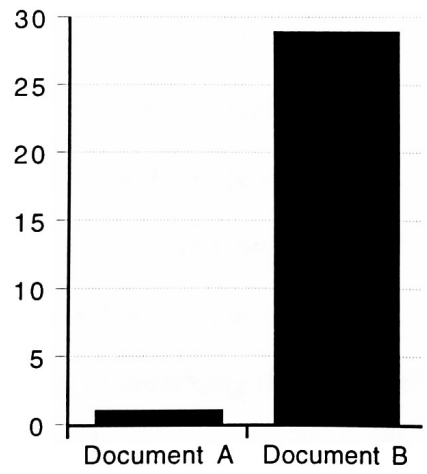


Figure 5.16 Results of Question 1

Question 2:
Would you prefer to:
1) view the more effective document on-screen
2) print out Document A and read the hard copy?

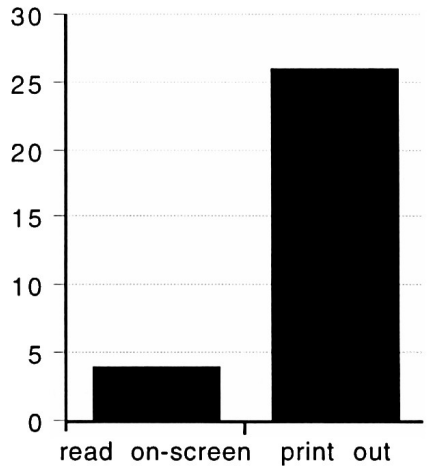


Figure 5.17 Results of Question 2

Chapter 6

SUMMARY AND CONCLUSIONS

The hypothesis of this study made the assertion that:

If documents are originally designed for printed output, then they must be reformatted to be effective for on-screen viewing.

The results of the final experiment illustrated in Chapter 5 prove this to be true. An overwhelming 97% of respondents agreed that the document created in experiment two, based on both the theoretical bases of the study and the results of the preliminary experimentation, was more effective for on-screen viewing than a document not optimized for on-screen use. However, the experimentation also revealed several other important findings.

87% of those tested would still prefer to read a hard copy. While the reformatting was effective in making a portable document legible on-screen, a text-intensive portable document cannot compete with the printed page.

Document A, the original document used in experiment two, is a simple eight-page newsletter, while the document enhanced for on-screen viewing is forty-eight pages long. Clearly the average computer user has a threshold of pages he or she can comfortably view on-screen, after which it is preferred to send the documents to a printer. Forty-eight pages surpasses that threshold.

In undertaking this study, the author believed users would prefer reading an optimized document on-screen. Recurring themes among the comments collected from

the first experiment validates this assumption (see Appendix C). Numerous references to the unsuitability of page sizes, line lengths, font sizes and styles in the documents used in the preliminary experiment all highlight a need for some type of reformatting to make on-screen documents effective. But the Portable Document Format may not be best suited for implementing these changes. Realistically, the fault lies within the medium itself. Until the resolution of the display device is equal in quality to a printed page, users will not willingly submit to reading lengthy text on-screen. Charles Bigelow's statement that ". . . practical evidence suggests that today's screen resolutions of 72 lines per inch are at least one or two decimal orders of magnitude too low to produce text of optimum visual quality" remains true, more than ten years after it was written.[1]

Where PDF and Acrobat excel today is in their ability to reproduce existing documents exactly or very near exactly the way they are, on any computer system, in an application-, font-, or operating system-independent environment. The technology making this possible is a great breakthrough in data compatibility and document transfer. However, it doesn't necessarily follow that users will want to view these documents on-screen, or that the documents are intended to be viewed that way.

As a result of the experimentation performed in this study, the author does not recommend reformatting text-intensive portable documents specifically so they can be read more easily on-screen.

ALTERNATIVES

The development of PDF is concurrent with the development and mainstream use of the Internet, more specifically the World Wide Web. While the Hypertext Markup Language, or HTML, used to program the formatting of WWW docu-

ments may seem beyond the reach of novice programmers, it is extremely intuitive and not difficult to learn. In addition WYSIWYG HTML authoring programs such as America Online's NaviPress and Adobe's Pagemill create HTML documents without requiring the user to know any HTML. In addition, mainstream applications, including Microsoft Word and QuarkXPress, plan to offer HTML authoring plug-ins or extensions, further decreasing the difficulty of creating HTML documents.

One early complaint concerning publishing on the Web (which, incidentally gave PDF publishing a slight advantage over HTML) was a lack of design control given to publishers. But HTML is a very dynamic, evolving language that is constantly offering more control to designers. As more functionality is added to the language it may become possible to create a Web document that looks very much like the printed page. But as this study reveals, that is not what *users* want.

Ultimately, this study points out a need for change in the way "pages" are presented in on-line documentation. As was highlighted in Chapter 1, in the on-line arena a page is no longer a vertically-oriented 8.5 x 11˝ piece of paper, but a 640 x 480 pixel monitor. For a document to be successful it must use those measurements as its canvas, and recognize the design limitations of the medium.

RECOMMENDATIONS FOR FURTHER STUDY

Bitmap recently developed TruDoc, a new digital font display technology to compete with the Portable Document Format. An interesting study could be conducted comparing the technical differences in the ways PDF and TruDoc display, in conjunction with a user-preference survey determining whether there is a perceptual difference between the two.

The relationship between HTML, SGML, and PDF has been the source of some controversy since Acrobat was introduced. A useful project (and product) would be to develop a translator for each language that could transform a document to any of the formats, depending on its intended end-use. The current study, and others like it, could help determine the best applications for each of the document formats.

Adobe and Netscape are in the process of releasing Acrobat Amber, a plug-in that will allow PDF documents to be displayed in-line on Web browsers. It would be interesting to follow the evolution of this product and determine whether Web page designers simply distill documents developed for print (such as brochures and other promotional products) into Web pages, or if, following the advice of the current study, a "Web-specific" page size and design is developed.

Endnotes for Chapter 6

[1] Bigelow, Charles. "Font Design for Personal Workstations," *Byte*, January, 1985, p. 256

Bibliography

Bibliography

Bienz, Tim and Cohn, Richard. *Portable Document Format Reference Manual.* (Menlo Park, CA: Addison-Wesley Publishing Company, 1993)

Bigelow, Charles. "Font Design for Personal Workstations," *Byte*, January, 1985, p. 256

Bigelow, Charles and Holmes, Kris "The Design of Lucida: an Integrated Family of Type for Electronic Literacy" in *EP86: Text Processing and Document Manipulation,* J.C. van Vliet, ed (Cambridge: Cambridge University Press, 1986, p. 6).

Bureau of National Affairs, "OSHA's Draft Ergonomics Standard," *Daily Labor Report*, March 21, 1995

Dillon, Andrew, et al. "The Effects of Display Size and Text Splitting on Reading Lengthy Text From Screen," vol 9 no 3, *Behaviour and Information Technology*, May 1990

Galitz, Wilbert. *User-Interface Screen Design.* (Wellesley, MA: QED Publishing, 1993)

Gendron, Marie. "Labor Dept: Workplace stress illnesses skyrocket," *The Boston Herald*, Second Edition, December 22, 1994

Gartner Group, "Integrated Document Output & Management," Gartner Group Continuous Services study, 11/01/94

Gould, J. D. and Grischkowski, N. "Doing the Same Work With a CRT Terminal and With Hardcopy," *Proceedings of the Human Factors Society 26th Annual Meeting*, 1983

Gould, John D. et al. "Reading from CRT Displays Can Be as Fast as Reading from Paper," vol 29 no 5, *Human Factors*, 1987

Grey, Harold. Personal correspondence with the author, September 1995.

Kahn,. et al. "Typography for the Computer Screen: Applying the Lessons of Print to Electronic Documents," *Seybold Report on Electronic Publishing*, July 5, 1993

Kak, A. V. "Relationships Between Readability of Printed and CRT-Displayed Text," *Proceedings of the Human Factors Society 25th Annual Meeting*, 1981

Kingston, Kenneth. *Standards and Guidelines for Aesthetics in Design and Typography for Interactive Multimedia Programs*. Master's Thesis, Rochester Institute of Technology, 1995

McLean, Ruari. *The Thames and Hudson Manual of Typography*. (London: Thames and Hudson, 1980)

Schwartz, Elmar et al. "A Comparison of Paging and Scrolling for Changing Screen Contents by Inexperienced Users," vol 25 no 3, *Human Factors*, 1983

Sheedy, James."VDT's and Vision Complaints: A Survey," vol 8 nos 4-5, *Information Display*, April, 1992

Smith, P. N et al. "Electronic Publishing with Acrobat: the CAJUN Project," *Proceedings of the International Conference on Electronic Publishing, Document Manipulation and Typography*, vol 6 no 4, 1993

Spencer, Herbert. *The Visible Word.* (New York: Hastings House, 1969)

Xenakis, John J., "Arrivederci ASCII," *Information Week*, February 25, 1991

Appendix A

Appendix A

PORTABLE DOCUMENTS USED IN THE PRELIMINARY EXPERIMENT

Examples of the portable documents used in the preliminary experiment can be found in the following pages. Each document is represented by a "screen shot" that has been rotated ninety degrees. The screen shot gives a fairly accurate representation of the resolution and viewing area of each document as it appeared to the respondents during the experiment. The "page" edge of each document is shown where space allows.

Introduction

PORTABLE DOCUMENT programs have introduced a new means of publishing. The ease with which portable documents can be created leads many developers to forget that any document must be optimized for a specific output device, in this case the computer monitor or CRT screen.

This experiment exposes the respondent to a number of portable documents that typify PDF publications currently available on the Internet. These particular documents appear to be intended, either by their length or unsuitability for printing on a desktop printer, to be viewed on screen.

While the intent of this research is to pinpoint attributes that either hinder or increase document legibility, this initial test also is designed to discover user "likes and dislikes" in terms of portable document layout and design.

Andersen Consulting

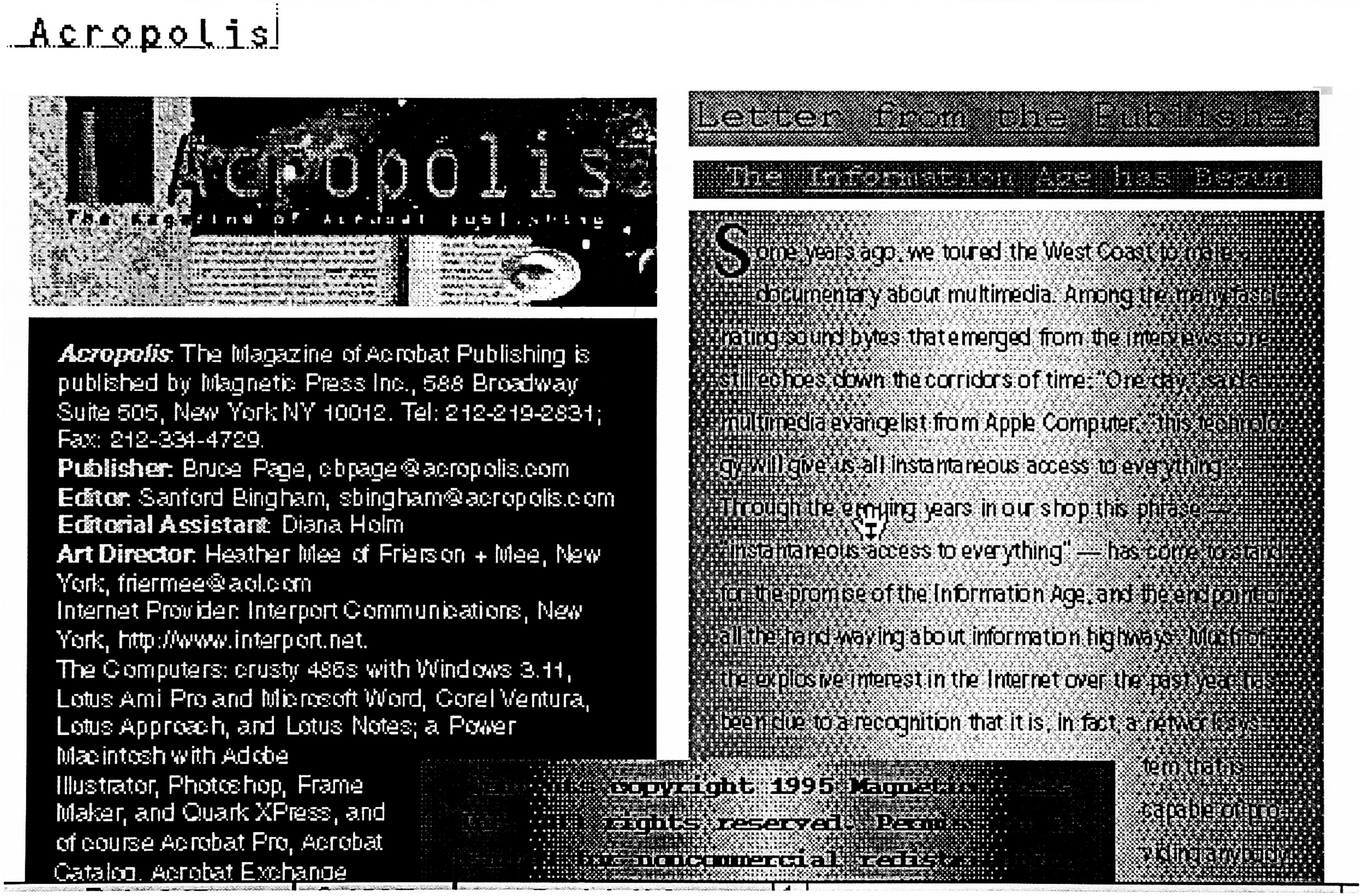
With faster and faster product cycle times, companies relying on paper-based communication face an enormous challenge coordinating the creation, distribution and annotation of documents with functional groups that need access to the same documents at the same time. To make documents more productive and accessible to its clients, Andersen Consulting has established a Document and Complex Data Management consulting service, capable of developing and installing local, national and global solutions.

As a component of its custom document management solutions, Andersen Consulting has employed Adobe™ Acrobat™ software along with products from other software solution providers. Other services include Document Management Business Case Development; Project Planning and Management; Process Re-engineering; and Integration/Development assistance with structured editing and authoring, work flow management, database publishing, configuration management, and document distribution and retrieval.

ANDERSEN CONSULTING

Andersen Consulting
801 2nd Avenue, Suite 900
Seattle, WA 98104
(206) 623-8950
Fax: (206) 386-8675

Document 2


Acropolis

Acropolis: The Magazine of Acrobat Publishing is published by Magnetic Press Inc., 588 Broadway Suite 505, New York NY 10012. Tel: 212-219-2831; Fax: 212-334-4729.
Publisher: Bruce Page, cbpage@acropolis.com
Editor: Sanford Bingham, sbingham@acropolis.com
Editorial Assistant: Diana Holm
Art Director: Heather Mee of Frierson + Mee, New York, friermee@aol.com
Internet Provider: Interport Communications, New York, http://www.interport.net.
The Computers: crusty 486s with Windows 3.11, Lotus Ami Pro and Microsoft Word, Corel Ventura, Lotus Approach, and Lotus Notes; a Power Macintosh with Adobe Illustrator, Photoshop, Frame Maker, and Quark XPress, and of course Acrobat Pro, Acrobat Catalog, Acrobat Exchange

Letter from the Publisher

The Information Age has Begun

Some years ago, we toured the West Coast to make a documentary about multimedia. Among the many fasci-nating sound bytes that emerged from the interviews one still echoes down the corridors of time: "One day," said a multimedia evangelist from Apple Computer, "this technolo-gy will give us all instantaneous access to everything."

Through the ensuing years in our shop this phrase — "instantaneous access to everything" — has come to stand for the promise of the Information Age, and the endpoint of all the hand-waving about information highways. Much of the explosive interest in the Internet over the past year has been due to a recognition that it is, in fact, a networ[k] sys-tem that is capable of pro-viding anybody

Thoughts from the Alley Cat (Editor)

Online Availability and Master Index Information

By Janet Christian

We regularly receive requests for information about where the ***Information Alley*** is available and where to find a master index for Volume I and Volume II. We upload the ***Information Alley*** to the following locations. These locations maintain all back issues and all formats, an index to back issues, and a master list of all other online services and bulletin boards (we know of) that maintain copies of the magazine.

Each of the following sites also maintains a master list of all other locations where you can find the ***Information Alley*** (file name: **InfoAlley.Where to Find Online**), along with an index to back issues for Volume I (file name: **InfoAlley.V1.Index 5/95**) and for Volume II (file name: **InfoAlley.V2.Index 6/95**). (The month/year information changes as appropriate.)

World Wide Web

Apple Computer – World Wide Web (WWW) Server. Enter this Universal Resource Locator (URL) to your WWW browser: **http://www.info.apple.com/info.alley/info.alley.html**

INTRODUCTION

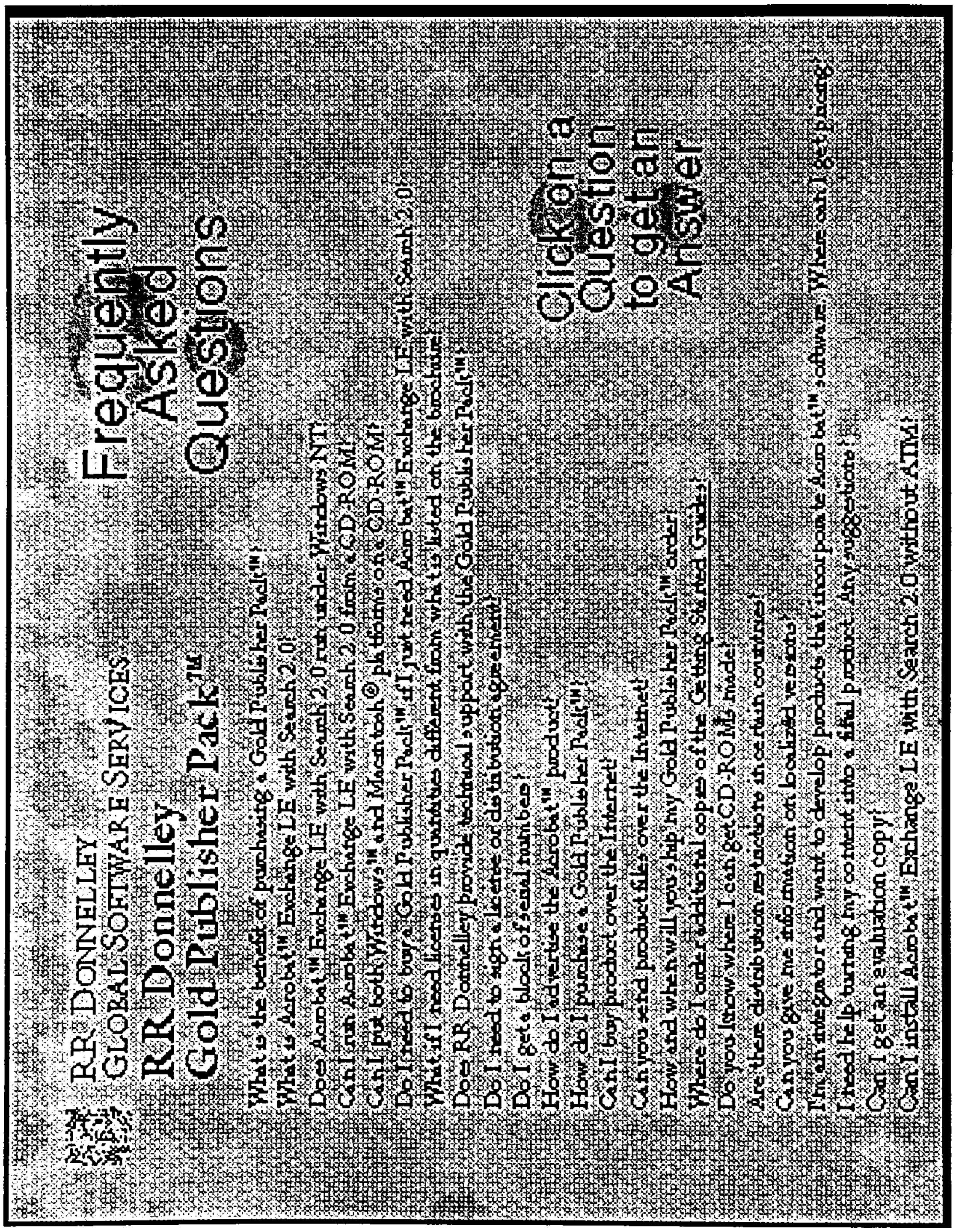
InterRamp READ ME

This manual is written to help you initially configure your system to work on the Internet. It is written in a general fashion and should be used in conjunction with your TCP/IP software documentation. In many cases, a local consultant, corporate MIS or network specialist will help you configure InterRamp. In all cases - done once and backed up - you'll never have to look at this manual again.

About InterRamp

InterRamp provides a simple, inexpensive way to access the Internet via a V.32bis modem or ISDN for the individual. InterRamp allows you to access computers on the Internet from local access points located at PSI Points-of-Presence (POPs) located throughout the U.S. Your InterRamp account can be used on either the InterRamp ISDN ports or the InterRamp V.32bis ports. This allows you to travel and still use your InterRamp account with the V.32bis ports when you are away from your home ISDN connection.

Document 5


R.R. DONNELLEY
GLOBAL SOFTWARE SERVICES
RR Donnelley
Gold Publisher Pack™
Frequently
Asked
Questions
What is the benefit of purchasing a Gold Publisher Pack™?
What is Acrobat™ Exchange LE with Search 2.0?
Does Acrobat™ Exchange LE with Search 2.0 run under Windows NT?
Can I run Acrobat™ Exchange LE with Search 2.0 from a CD-ROM?
Can I put both Windows™ and Macintosh® platforms on a CD-ROM?
Do I need to buy a Gold Publisher Pack™ if I just need Acrobat™ Exchange LE with Search 2.0?
What if I need licenses in quantities different from what is listed on the brochure?
Does RR Donnelley provide technical support with the Gold Publisher Pack™?
Do I need to sign a license or distribution agreement?
Do I get a block of serial numbers?
How do I advertise the Acrobat™ product?
How do I purchase a Gold Publisher Pack™?
Can I buy product over the Internet?
Can you send product files over the Internet?
How and when will you ship my Gold Publisher Pack™ order?
Where do I order additional copies of the Getting Started Guides?
Do you know where I can get CD-ROMs made?
Are there distribution restrictions in certain countries?
Can you give me information on localized versions?
I'm an integrator and want to develop products that incorporate Acrobat™ software. Where can I get pricing?
I need help turning my content into a final product. Any suggestions?
Can I get an evaluation copy?
Can I install Acrobat™ Exchange LE with Search 2.0 without ATM?
Click on a
Question
to get an
Answer

Appendix B

Appendix B

RESULTS OF THE PRELIMINARY EXPERIMENT

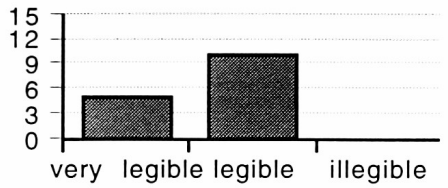
The following pages illustrate the answers given by respondents to the questionnaire for the preliminary experiment. A graphical representation of the answers given for each question is provided, as well as a sample questionnaire.

Results of Preliminary Experimentation: Introduction

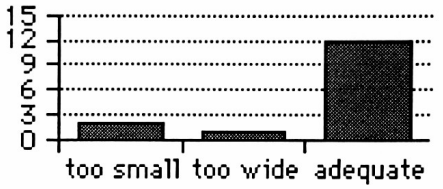
STATISTICS:

- 14 pt. Minion on 18 pt. leading
- 7″ x 5.2″ page dimensions
- 60 character maximum line length
- Simple linear navigation

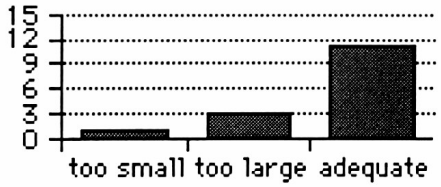
TYPEFACE



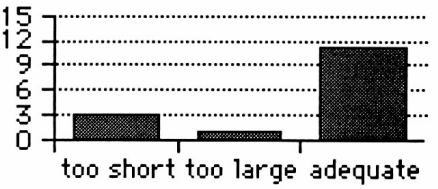
LEADING



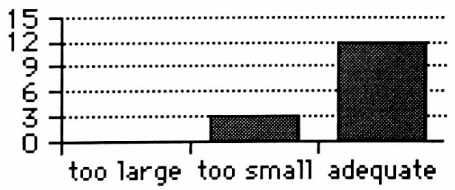
TYPE SIZE



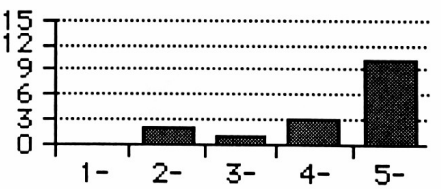
LINE LENGTH



PAGE DIMENSIONS



NAVIGATION



*key for navigation chart

1-very distracting
2-somewhat distracting
3-didn't notice
4-somewhat helpful
5-very helpful

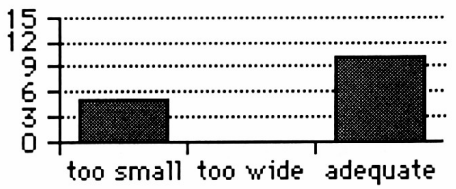
Results of Preliminary Experimentation: Document 1

STATISTICS:

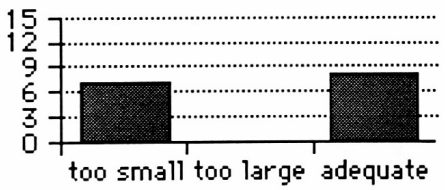
- 12 pt. Adobe Minion on 16 pt leading
- 5˝ x 7˝ page dimensions
- fit to page auto zoom increases document size to 107%
- 55 charcter maximum line length
- simple arrows and hypertext table of contents

TYPEFACE

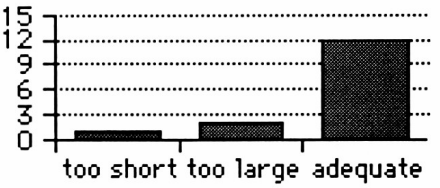
LEADING



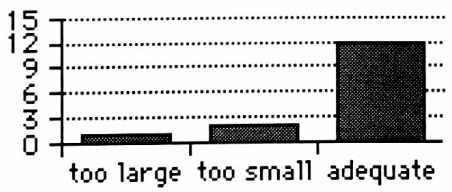
TYPE SIZE



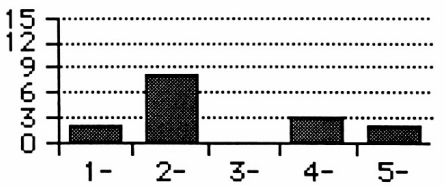
LINE LENGTH



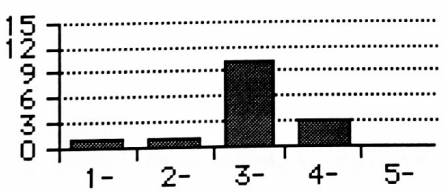
PAGE DIMENSIONS



NAVIGATION



AUTO ZOOM/MAGNIFICATION



*key for navigation/automatic zoom charts

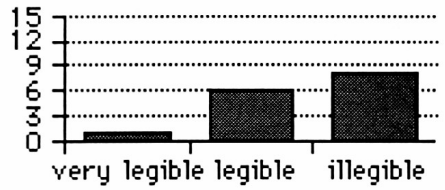
1-very distracting
2-somewhat distracting
3-didn't notice
4-somewhat helpful
5-very helpful

Results of Preliminary Experimentation: Document 2

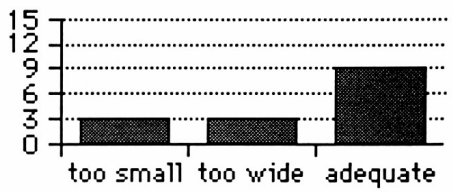
STATISTICS:

- 12 pt Courier Bold on 14 pt leading
- 8˝ x 8˝ custom page dimensions
- complicated navigation with cryptic clickable table of contents
- 25 character average line length
- fit to page auto zoom displays document at 69%
- Includes "follow article"function which displays a column at page width

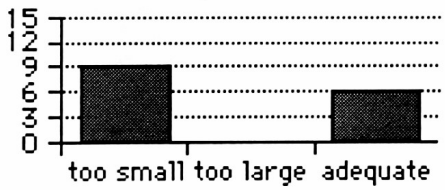
TYPEFACE



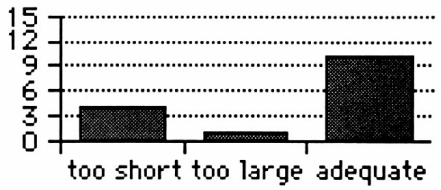
LEADING



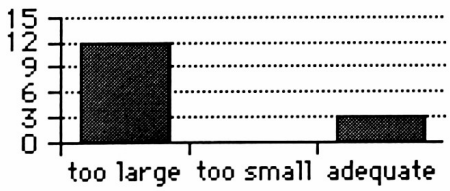
TYPE SIZE



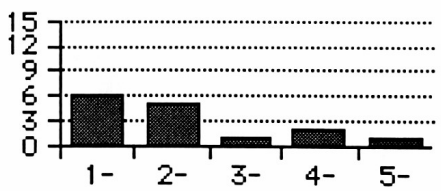
LINE LENGTH



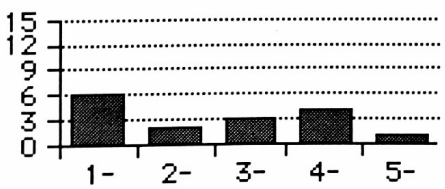
PAGE DIMENSIONS



NAVIGATION



AUTO ZOOM/MAGNIFICATION



*key for navigation/automatic zoom charts

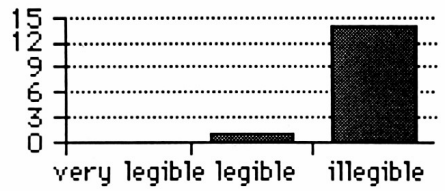
1-very distracting
2-somewhat distracting
3-didn't notice
4-somewhat helpful
5-very helpful

Results of Preliminary Experimentation: Document 3

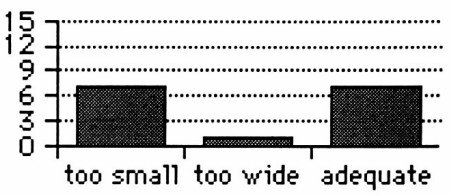
STATISTICS:

- 10 pt Revue (sans serif) on 14 pt leading
- 8.5˝ x 11˝ standard landscape page
- 65 character average line length
- Scrolling only; no document-based navigation

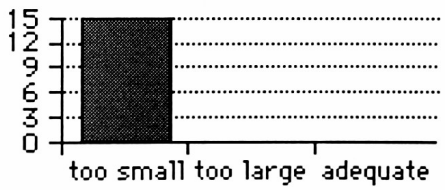
TYPEFACE



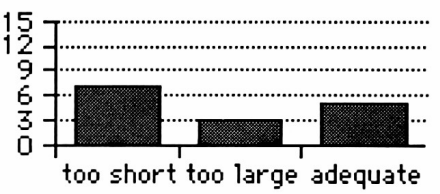
LEADING



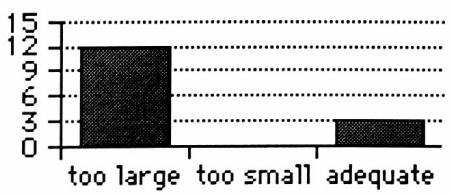
TYPE SIZE



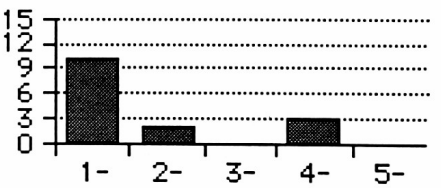
LINE LENGTH



PAGE DIMENSIONS



NAVIGATION



*key for navigation chart

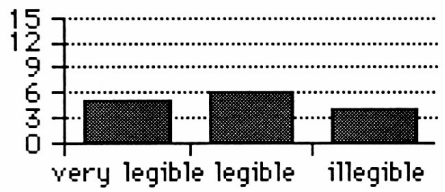
1-very distracting
2-somewhat distracting
3-didn't notice
4-somewhat helpful
5-very helpful

Results of Preliminary Experimentation: Document 4

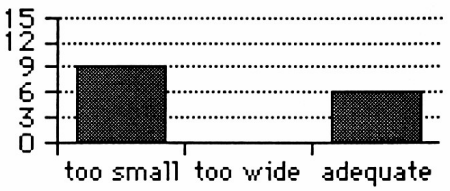
STATISTICS:

- 12 pt Lucida on 14 pt leading
- 8.5˝ x 11˝ standard page dimensions
- 80 character average line length
- Hypertext table of contents and scrolling

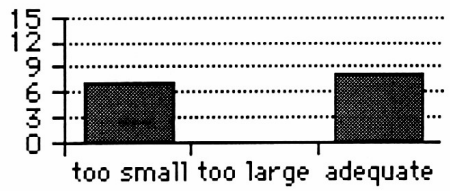
TYPEFACE



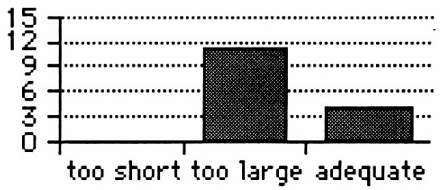
LEADING



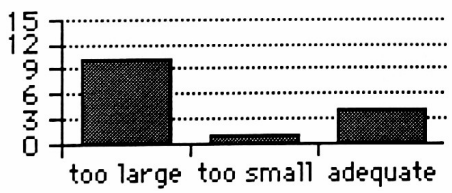
TYPE SIZE



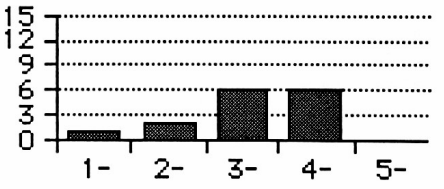
LINE LENGTH



PAGE DIMENSIONS



NAVIGATION



*key for navigation chart

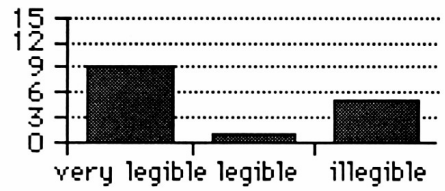
1-very distracting
2-somewhat distracting
3-didn't notice
4-somewhat helpful
5-very helpful

Results of Preliminary Experimentation: Document 5

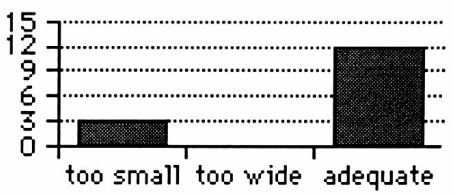
STATISTICS:

- 16 pt Galliard on 20 pt leading
- 11˝ x 8.5˝ standard landscape page
- Automatic zoom displays page at 63%
- 60-100 character line lengths
- Hypertext table of contents and clickable buttons

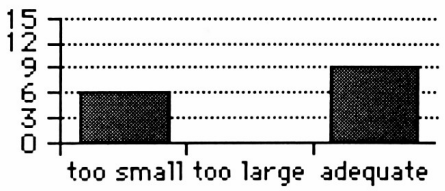
TYPEFACE



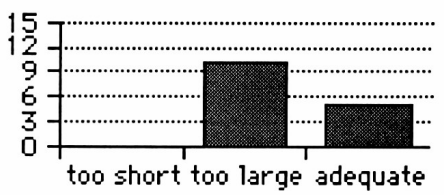
LEADING



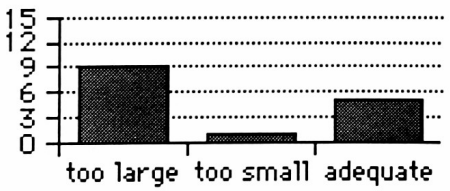
TYPE SIZE



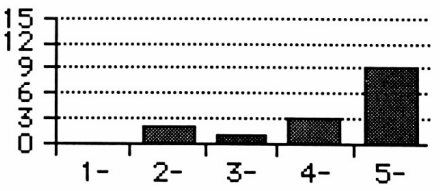
LINE LENGTH



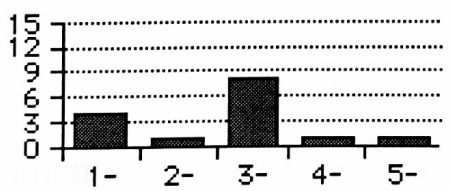
PAGE DIMENSIONS



NAVIGATION



AUTO ZOOM/MAGNIFICATION



*key for navigation/automatic zoom charts

1-very distracting
2-somewhat distracting
3-didn't notice
4-somewhat helpful
5-very helpful

Questionnaire for Preliminary Experimentation

INTRODUCTION

Typeface: Minion 14 point
Leading: 18 pt
Line length: 60 characters
Page Dimensions: 5.2 x 7
Navigation: simple clickable arrows

Typeface–

very legible	5
legible	10
illegible	0

Leading–

too small	2
too wide	1
ok	12

Type size–

too small	1
too large	3
ok	11

Line length/column width–

too short	3
too large	1
ok	11

Page Dimensions–

too large	0
too small	3
ok	12

Use of Navigation—

Rate the effectiveness of the navigation tools used. Please add what you liked or disliked to the comments section.

1-very distracting	0
2-somewhat distracting	2
3-didn't notice	1
4-somewhat helpful	3
5-very helpful	10

Comments (if you need more space, continue on reverse):

Document 1:
Adobe Guide to Acrobat Products and Services

Typeface: Minion 12pt
Leading: 16 pt
Line Length: 55 chars
Page Dimensions: 5.2 x 7
Navigation: simple arrows and hypertext linked TOC

Main Text Typeface–

very legible	2
legible	8
illegible	5

Leading–

too small	5
too wide	0
ok	10

Type size–

too small	7
too large	0
ok	8

Line length/column width–

too short	1
too large	2
ok	12

Page Dimensions–

too large	0
too small	1
ok	7

Automatic Zoom/Magnification–

1-very distracting	1
2-somewhat distracting	1
3-didn't notice	10
4-somewhat helpful	3
5-very helpful	

Use of Navigation—

Rate the effectiveness of the navigation tools used. Please add what you liked or disliked to the comments section.

1-very distracting	2
2-somewhat distracting	8
3-didn't notice	0
4-somewhat helpful	3
5-very helpful	2

Comments (if you need more space, continue on reverse):

Document 2:
Acropolis: The Magazine of Acrobat Publishing

Typeface: Courier bold 12 pt
Leading: 14 pt
Line Length: 25 characters
Page Dimensions: 8 x 8"
Navigation: follow article, clickable TOC; various clickable pages

Main Text Typefaces*–

very legible	1
legible	6
illegible	8

Leading–

too small	3
too wide	3
ok	9

Type size–

too small	9
too large	0
ok	6

*Because this document has several typefaces, please rate their overall impression and add comments about typefaces in specific articles/pages to the reverse.

Line length/column width*–

too short	4
too large	1
adequate	10

*Again, because of the varied page design, please note specific likes/dislikes on the reverse.

Page Dimensions–

too large	12
too small	0
ok	3

Automatic Zoom/Magnification–

1-very distracting	6
2-somewhat distracting	2
3-didn't notice	3
4-somewhat helpful	4
5-very helpful	1

Use of Navigation—

Rate the effectiveness of the navigation tools used. Please add what you liked or disliked to the comments section.

1-very distracting	6
2-somewhat distracting	5
3-didn't notice	1
4-somewhat helpful	2
5-very helpful	1

Comments (if you need more space, continue on reverse):

Document 3:
Interramp User's Guide

Typeface: Revue 10 point
Leading: 14 pt
Line Length: 65 characters
Page Dimensions: 11 x 8.5
Navigation: none

Main Text Typeface–

very legible	0
legible	1
illegible	14

Leading–

too small	7
too wide	1
ok	7

Type size–

too small	15
too large	0
ok	0

Line length/column width–

too short	7
too large	3
ok	5

Page Dimensions–

too large	12
too small	0
ok	3

Use of Navigation—

Rate the effectiveness of the navigation tools used. Please add what you liked or disliked to the comments section.

1-very distracting	10
2-somewhat distracting	2
3-didn't notice	0
4-somewhat helpful	3
5-very helpful	0

Comments (if you need more space, continue on reverse):

Document 4:
Information Alley: Apple Computer's Digital Newsletter

Typeface: nlmnma+lucida 12 pt main, 10 pt tabular
Leading: 14 pt main, 18 pt tabular
Line Length: 80 characters
Page Dimensions: 8.5 x 11
Navigation: hypertext TOC

Main Text Typeface–		Leading–		Type size–	
very legible	5	too small	9	too small	7
legible	6	too wide	0	too large	0
illegible	4	ok	6	ok	8

Tabular Typeface–		Leading–		Type size–	
very legible	2	too small	10	too small	11
legible	3	too wide	0	too large	0
illegible	10	ok	5	ok	4

Line length/column width–

too short	0
too large	11
adequate	4

Page Dimensions–

too large	10
too small	1
adequate	4

Use of Navigation—

Rate the effectiveness of the navigation tools used. Please add what you liked or disliked to the comments section.

1-very distracting	1
2-somewhat distracting	2
3-didn't notice	6
4-somewhat helpful	6
5-very helpful	0

Comments (if you need more space, continue on reverse):

Document 5:
R.R Donnelley's FAQ and Guide to Acrobat Products and Services

Typeface: Galliard 16pt
Leading: 20 pt
Line Length: 60-100 chars
Page Dimensions: 11 x 8.5
Navigation: hypertext links, clickable buttons

Main Text Typeface–

very legible	9
legible	1
illegible	5

Leading–

too small	3
too wide	0
ok	12

Type size–

too small	6
too large	0
ok	9

Line length/column width–

too short	0
too large	10
ok	5

Page Dimensions–

too large	9
too small	1
ok	5

Automatic Zoom/Magnification–

1-very distracting	4
2-somewhat distracting	1
3-didn't notice	8
4-somewhat helpful	1
5-very helpful	1

Use of Navigation—
Rate the effectiveness of the navigation tools used. Please add what you liked or disliked to the comments section.

1-very distracting	
2-somewhat distracting	2
3-didn't notice	1
4-somewhat helpful	3
5-very helpful	9

Comments (if you need more space, continue on reverse):

Appendix C

Appendix C

Appendix C

COMMENTS COLLECTED FROM THE PRELIMINARY EXPERIMENT

The following are comments collected from respondents to the preliminary experiment, listed by document number.

INTRODUCTION:

some letters too close, others too much s p a c e. How can I use the abc tool?
very easy to navigate.
-Definitely the best of the documents in terms of legibility and navigation.
-I liked the look of the page, but there could be more on it and it would still be legible.
-In general I would like to be able to read a document when it is displayed full size on a 15" monitor! (fit page) All other documents are too distracting and too slow.
-no comment. The document was very easy to read.
-Simple, but effective.
-I found the introduction to be laid out in an easy-to-follow manner. Type seemed to be "right" as for column width and point size were concerned.
-good, clean, simple solution
-The kerning of the letters was distracting
-Very nice, short and to the point. Not confusing at all.
-Very basic, not very interesting but was easy to read and could navigate comfortably. Kind of boring, seems okay for a very small document.
-Pages are too empty looking.

DOCUMENT 1:

-I would read that again.
-(Navigation) okay but placement should be consistent. Arrow moves from justified right to a justified left. Needs a button that will take you back to index.

-I felt that Doc. 1 was a bit tricky to navigate at first. Lots of text. Perhaps larger images (graphics would help liven it up. Or maybe I just have a short attention span!)
-Arrows to get back to main screen are missing. Bad. Either include all navigation tools or use the ones of the program. Maybe arrows should have text, too. Letter spacing seems to vary significantly. Some text only show as grey bars at 100%. Bad.
-The arrows on the page don't look like navigation buttons, rather a part of the design itself. I did like the page numbering from the hyperlinks because I feel it is most important to give a user a sense of where they are located at at all times.
-The move forward" arrow seems to be misplaced=it's hard to find. The design except for the arrow is quite good.
-Again simple at to the point. Not confusing or distracting I like the layout and design of it.
-The main body text is legible although the type does not seem as legible as it could be if it were printed. The screen font doesn't seem very "readable." The bullets on the contents page could have been better chosen. They don't seem like "listed" bullets. The type size in the index was practically illegible.
-extremely easy to navigate, not frustrating at all. Letter spacing is inconsistent. Letters are not crisp. Italic letters are extremely annoying.
-The navigation tools are somewhat hidden (the user has to look for them) and incomplete. The size of the typeface would seem to be ok but the legibility isn't that great.
-Couldn't get back to Intro page. Font was very jagged but I liked the organization.
-The type was legible, but looked unevenly spaced between characters. Why?
-Good design, but the navigation tools are confusing.

DOCUMENT 2:

-In the electronic publishing arena, I've noticed that the variation in page views can become VERY distracting and annoying. When you pick up Time or Rolling Stone, it only comes in one size. If you are unsure of you intended audiences viewing preference or ability then this is a good idea. Although the point of periodicals is to target a specific audience, you should know what size and colors are appealing to them. It's difficult to view this electronic documents due to the varied viewing formats. If you zoom out the text is too small and can't be read. If you zoom in the text and leading is too large making for a great deal of eyestrain. I found the navigation tool distracting because it made type, columns and leading too large. BUT I could read the type. Some color combinations of text and backgrounds makes for difficult legi-

bility. "I HATE REDRAWS!"
-Navigation frustrating. letter spacing is good. Light green text is hard to read. Off white background is easier on the eyes than white. Script is illegible. Difficult to refer back to beginning of article. I would like the ability to reduce the pg. size-in order to see where I am in the article.
Re: The Growing Industry- the background is slightly distracting. Letters are crisp.
-I tried to read the article about Acrobat Capture. The "follow article" function is very annoying, the text is way too big and I used the mouse every other second. At the end of the story, there is a dead end-difficult to get back!
-Pages were too big and very difficult to navigate. Moving between pages was even worse. The mixed fonts were confusing. Some fonts, for example on the masthead page, were illegible. The elements of page layout and design are meaningless in this document because the integrity of "the page" has been lost. The document is very ineffective because it cannot be viewed as it was created to be viewed. On the "letters" page scrolling down from one column to another caused the page to jump and get lost, then it came back and so on. Very ironic that a magazine about PDF so grossly reveals the potential flaws of PDF!
-Instead of 3 only 2 columns! Takes too long to display background. Too much color. Awful design/color strategy.
-This page sucks! Ugly colors, Perhaps proving (?) that Acrobat is not the paperless solution. YUCK!
Given no clues to navigation.
-Good design, but could be easier to surf through.
-Definitely not a document for viewing on screen; too slow.
-Navigation is very poor. Typefaces at the end of document were hard to read because of size and weight. Column size is too short in the beginning and gets better at end.
-Scrolling often took me to the next page sooner (faster) than I intended.
-Text partially illegible, with backgrounds, crowded layouts a la "Wired," net. It's WRONG to just put pages on a screen. Auto zoom very helpful (I hate to see only sections of a page). Link-spots are not obvious. Time to build up a page is much too big! (too many graphics). Don't like mixing of styles/fonts.
-Navigation was very limited. I found myself clicking on patterns and underlined text to see if these items were hypertext links. Color was used all over the place. I didn't mind most places, but the few places that had dark background patterns and dark text were straining my eyes. I really liked the text on pg. 125 for titles. The body text on pg. 124 was also nice.

-"letters to the editors"-Courier?!?! Only some pages had navigation tools. The auto zoom is terrible because not much detail can be seen. Navigation somewhat distracting-because not all had them.
-Design: yuck!

DOCUMENT 3:
-Cramped boring document. Suggestion: print out and line my cat's litter box.
-Very bad document.
-Headlines are okay/Body copy too small. Leading needs to be this large because the type is difficult to read. Needs something for direction.
-Really tough to read- even at 200%. Very dry. Needs graphics (more of them, and colorful ones too.)
-Font choice is poor.
-Arrows or page numbers would have greatly improved this document. The typeface was really too tight looking. Much more tracking is also needed.
-The type is very difficult to read in this-and it's ugly too. No real navigation tools. Overall, this is terrible.
-Navigation-there was none. An arrow would have been helpful as opposed to clicking on the vertical scroll bar. Table of contents at 59% too hard to read. Somewhat boring, but yet is was more readable overall because of very little choices. Let me clarify, all you could do was turn the page while some electronic publications give you too many choices. Screen fonts very poor. Even at 110%.
-Would like the ability to enlarge the document. Navigation is simple. This document at 63% is useless, at 100% still useless. I like the fact that there is not a lot of distracting noise in the background.
-Navigation tools--which ones? I guess somebody must have been thinking something when he/she designed this page. But on a 29" monitor, why not?
-Didn't guide me through with icons. I doubt this document would be legible even if it were in printed form. A joke all in all. I tried zooming, but lost all reference to the page or where I was in the document because it wasn't marked in any way. A table of contents the worked the the bookmarks would be useful in all these documents. Even when I zoomed and could read the font I
didn't like it on screen or off. Sans serif is no good for any body type.
-Navigation?
-I miss the red integrated navigation buttons on this document!
-No clues or originality to navigation. Not interesting.
-Almost impossible to read!

DOCUMENT 4:

-It's okay.
-page too large
-I'm getting sick of looking at these TOO big documents.
-I liked that the document guided from one page to another. Line width is too wide. Couldn't easily tell where I was in the document but at least I could tell where on page ended and another began.
-This document seems to be designed for ink on paper and not for a monitor.
-Would like to see a key that would take me back to the table of contents. Uneven letter spacing-not as distracting as document 1 and Intro.
-Navigation not helpful after leaving the comments section. Screen font seemed more legible. Columns too wide.
-No real navigation tools. Designed well compared to the previous document.
-I liked the table of contents page with clickable page numbers. However, once in the document, I felt like I lost browsing control.
-Multi column layout is very bad, you have to scroll up and down!
-Overall-rather easy to read, navigate and absorb. Could use some more graphics.
-Line length on page two is really bad, too short. Page 3 is too long. Navigation okay but slow. Type size and leading wat the easiest to read. But line length (and navigation, scrolling not buttons) and page size mad it frustrating. Hate to scroll and read!
-Good looking document (?) But with bad type. Body type too small. My poor eyes!

DOCUMENT 5:

-Very nice. Liked it all. Simple yet complex.
-Needs some more leading-not much. Line length-it's distracting when you have to scroll to read the text. Page much too big. Navigation helpful--but tool must be this large because the page is hard to navigate because of its size-it is a relief to find the button that will take you out of there.
-Page too large, depending on zoom factor. Where to click?
-Very good. Easy to follow, navigate, and absorb. Helpful layout. Seemed very "user friendly."
-At 100% hints on navigation do not show. Didn't realize that one can click on the questions. Background kills legibility of type.
-I liked the magnification on this example because I always knew where I was at. In order of pdf's to work, they must be created in a way that the user doesn't constantly have to figure out where they are. This page did an excellent job of doing it.

-Could have used navigation tools embedded in the document.
-Thin type is difficult to read against blue background. Bold type better and yellow on red is best read.
-light blue background is easy on the eyes. Letter spacing not bad.
-Navigation with this document is very good but the font is too small. The type is hard to read at the auto zoom magnification.
-The questions are barely legible, the answers are ok (not great) the navigation is straight forward. Probably the "best" to the five documents but still not too exciting.
-Color background is awful. Too much color.
-Ugly colors make it hard to read. The page size isn't as offensive at the others, but it's still too big.
-Page too large. Liked navigation.
-Good combination of design and function.

Appendix D

Appendix D

RESULTS OF THE FINAL EXPERIMENT

The following page illustrates the questionnaire presented to respondents for testing the final experiment. The questionnaire includes the number of responses received for each question.

Questionnaire for Final Experimentation: Optimizing Text Intensive Documents for On-screen Viewing

This study is being conducted to determine how users prefer to view text intensive portable documents. Both documents contain the same information. Document A presents a newsletter in its original format while Document B has been optimized for onscreen display. Please browse through both documents then answer the two questions below. Feel free to add comments to the end of the questionnaire. Any input is appreciated.

1. Which document is most effective for onscreen viewing:?

1. Document A	1
2. Document B	29

2. If given the choice, would you prefer to:

1. view the more effective document on-screen?	4
2. print out Document A and read the hard copy?	26