Visible Language 32.2

Visible Language is concerned with research and ideas that help define the unique role and properties of written language. A basic premise of the journal is that writing/reading form an autonomous system of language expression which must be defined and developed on its own terms. To this must be added research and ideas that help define the presentation of information within the digital arena. The shift from page to screen is comparable in its significance to the shift from manuscript to print. Developing the knowledge base and conventions for this new media will take time and challenge our ability to move beyond the book and into more fluid and relational systems of presentation.

Advisory Board

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Abstract

Increasing refined typographic fit is possible in digitally composed documents. While micro-typography in current documents is crudely shrunk or expanded to solve problems of typographic distribution or fit, the result is both obvious and ugly. In contrast, the system presented in this article solves space problems quietly and harmoniously. Using eight interactive parameters, the author visually demonstrates and discusses the strategy for paragraph-fit, page-fit, chapter-fit and one-page-fit. These practical additions to control micro-typography increase the speed and quality of overall document production and ease the task of the reader.

Kreienoopsberg 26
Hamburg 22399
Germany

Visible Language, 32.2
Karow, 100–127
pkarow@t-online.de

Extending Control of Digital Typography

Peter Karow

Pleasant looking, easily readable text has been the aim of typographers since scribes began to write and Gutenberg perfected printing with movable type. Text transports information. But it does even more than this, its typographic appearance establishes the care with which it is presented — its authenticity and its persuasive power, for example. Usually text is presented in conjunction with images. Text flows into the areas unoccupied by images, individually column by column, in order to create a form that is comfortable to read. The transfer must be accomplished with a minimum of communication errors and with the typographic hierarchy intact. The goal is the creation of a harmony in which text, images and graphics are related in a controlled manner.

While diverse application programs let computers and their peripheral equipment replace the former typewriting, photo-composition or hot metal printing, the digital era challenges us for more automation regarding typographic composition. Today's application programs output any kind of text into given layouts which can be defined and pre-described by templates or pure sets of parameters for specific projects such as structured webpages, letters, office documents, magazine articles or book chapters. Templates or lists of preferred parameters (preference) are common to all existing word processing and text composing programs.

The general layout parameters are: 1) kerning/spacing - spacing characters horizontally, 2) expanding and condensing typefaces - writing more widely or narrowly, 3) space - spacing between words or interword relations, 4) pointsize - determining the size of printed characters in a given body text, 5) line leading - determining the vertical line distance between lines, 6) paragraph leading - determining the vertical space between paragraphs, 7) column width - determining the set width and 8) column height - determining the length of the column.[1] The last two parameters apply if a text is typeset into a rectangular shape. In other cases, e.g., run-around text for images, run-into text for arbitrary forms like circles, a larger set of parameters is given, describing the corresponding shapes; however, even those larger sets could be controlled by just two sizing parameters for the x-direction (width) and the y-direction (height).[2] In what follows, the above parameters are referred to as the 'eight parameters.'

There are many other parameters not considered here, such as: the alignment of text (aligning left or right, centered or justified), the style of a typeface (selecting a typeface; writing normal, bold, or italic; handling quotes and other details, etc.), the specific language (writing in German, English, etc.) with its hyphenation rules, as well as other language, typography or technology details.

Modern application programs can handle the so-called orphan/widow problem. They avoid orphans in text where a paragraph starts with only one line as the last line of a column, or widows of text where a paragraph ends on the first line of the next column, e.g., this can be resolved by a simple change to the height of a column in order to move the widow to the preceding (plus one line of text) or an orphan to the succeeding column (minus one line of text).

While existing features like 'shrink to fit' are found in most word processing and graphic design applications, they use the page size parameter in order to enlarge or diminish a text in a linear manner as if using a zoom lens. No new fitting occurs in the existing layout and no typographic rules are applied. The result is an unpleasant and obvious adjustment. To counter this, a method to completely avoid the orphan/widow problem is needed. This can be achieved if one can manage a situation in which all columns of an article or a chapter terminate with the end of a paragraph, generating an optimal 'column-fit.' This contributes to comfortable reading because one can pause a bit at the end of a thought (end of a paragraph), while one is turning to go on reading the next column.

As the lengths of letters, documents and similar kinds of information vary arbitrarily, a document may consist of one full column and a few upper lines on the next column, or a letter that has a full or complete column, may leave no room for salutation. This creates the need for an automatic, but typographically convincing shrink or spread for a document, a so-called 'chapter-fit.' For book work, there is a need for a chapter-fit which composes a chapter with a total length of an even number of columns and generates a last column just filling a certain percentage of the total column height, such that the chapter can start on a right column (recto) and end on a left column (verso) of reasonable length.

All these automated fits have one factor in common. They leave the various text elements in typographic harmony according to the layout parameters of paragraph, column, chapter or other document identity. Documents usually have a hierarchical order and a common layout structure, which is perceived and intuitively assumed — it would be astonishing and irritating for the reader to see big, unanticipated changes among the eight parameters within a single document.

Good typography demands a constant optical appearance of the following dimensions: 1) all lines within a paragraph, 2) all paragraphs within a column, 3) all columns within a chapter, and 4) all chapters within a book. This means that only invisible changes are tolerable. It is helpful to note that ordinary readers are not able to recognize changes of up to a few percent among the eight parameters, if they are applied individually.

The *hz*-engine (named after Hermann Zapf) uses a justification per paragraph system,[3] along with an automated kerning of characters to expand and condense characters in order to obtain margin lines for a column that are optically straight, i.e., optical margins, and achieve typeset spaces among words within lines of text that are fairly constant in order to avoid rivers and creeks. Rivers run vertically through poorly spaced words in consecutive lines of text when the spaces between the words have the same space or greater than the distance between the baselines of the text. A creek is a less severe form, where the spaces between words are accidentally too wide within one line. Usually, the spaces between words vary between the character width of an 'i' (minimum) and a 'm' (maximum).

The basic feature of the *hz*-engine is to regard all lines of a given paragraph at once — making the 'justification per paragraph.' At first, all words or syllables are distributed to the lines altogether in a manner such that each line gets a line length nearest to its given individually parametrized width (default is the column width). This optimization is controlled by minimizing the typographical demerits (addition or subtraction of space from the norm) which are obtained from a function of the actual line lengths, given line lengths, given line widths and tolerances of the layout parameters. If hyphenation is turned on, words are replaced by syllables. The *hz*-engine has to follow a lot of exceptions and to provide solutions for them, e.g., hyphenated ligatures, consecutive hyphens and bad or good locations for hyphenation within a word. This level of text/typographic detail promotes a better fit and smooths out the reader's experience.

A comparison between the *hz*-engine and today's typical composition tools demonstrates the superiority of the former (see **Figure 1.0**, Magazine Composition). It also shows its clear benefit in a case where typesetting should be done simply, aligned left (see **Figure 2.0**, Aligned Left and compare with **Figure 3.0**). (Extensive examples of the *hz*-engine, **Figure 1.0 - 7.3** follow the body of the article and begin on page 107.)

The initial idea of the chapter-fit is to apply automation of typography to chapters of text as is available for paragraphs. The *hz*-engine handles and optimizes the layout of paragraphs/lines/words/characters. The justification per chapter handles the layout of chapters/columns/paragraphs/lines in order to optimize the presentation of text at two levels higher. This is obtained by a procedure which scans all lengths of paragraphs and lengths of columns and balances them altogether in a manner such that each individual column gets an optimal amount of para-graphs which could be managed and fitted with a minimum of demerits into its given layout.

Chapter justification has never been achieved by human agency nor is it offered in today's application programs. To get this result from a person requires varying

eight parameters continuously, testing hundreds of different compositions of the same project; consequently the goal of chapter justification would be too cumbersome and too expensive.

As performance of modern computers is growing, it is possible to let run thousands of trials within seconds. Astonishingly, this is the first time that chapter justification is possible which engages the eight parameters in a manner that allows for the search of best solutions in an eight-dimensional space of possible realizations.

Chapter justification and chapter-fit consist of several hierarchical steps for text processing. After it has been applied itself, the following steps occur:
1) paragraph-hyphenation, 2) force-justify, 3) form-fit, 4) paragraph-fit, and 5) column-fit. All steps are guided by describing parameters which could be set up by templates or lists of preferences and read from them. Then, each paragraph is handed over to and handled by the *hz*-engine or other existing technics for paragraph and word composing in order to get back the resulting measures of the text for calculation of demerits.

In particular, an appropriate composing engine has to return the so-called typographic demerit for a paragraph I on a column n. This quality parameter is the sum of several weighted measures: the degrees of deviation from normal kerning, from expanding or condensing, from normal space, normal pointsize and the change in line leading. It is essential to test a shrink or spread each time by composition of the corresponding column because of the quantization effects by integer syllables which could sum up chapterwise and generate new line counts stepping by more than one line.

Paragraph-fit
Paragraph-fit works like a force-justify and composes a paragraph in a manner that its last line gets a certain desired length compared with the column width. For example, a range from 0.25 (minimum) up to 0.85 (maximum) is tolerable and results in a convenient typographic appearance of the paragraph. Lines which are shorter than the minimum are not desired because they open too large a space between paragraphs; they cause orphan paragraphs. Likewise, lines which are longer than the maximum are also not desired because they give no clear optical indication for the end of a paragraph. **Figure 4.0**, His Secret, demonstrates nicely how paragraph-fit helps while one is regarding and picking up a text as a whole.

Page-fit
At first, all lines within the paragraphs must be processed by a text composing program according to the original parameters for typesetting, such as point size, line leadings, line width, etc. Then all lines are distributed and counted. The aim of

page-fit is to end each column with the end of a paragraph under consideration of the potential for shrink or spread of each column. Some of the last paragraphs on the columns are divided into two parts, where the second part is on the next column. A paragraph is rarely separated into more than two parts. If the next column is smaller than the second paragraph part, then the second part on the next column is treated like a complete first paragraph, is hyphenated and handled as normal by the same procedure as described above.

Chapter-fit

In connection with chapter justification, chapter-fit is an option that tries to optimize the form of a chapter even more extensively. It avoids a chapter ending with a column which is too long, leaving insufficient room for footnotes, or a chapter having a last column which is nearly empty, containing only a few lines of text. Chapter-fit is engaged to obtain an even number of columns for a chapter to allow it to start on the recto and end on the verso in a case where the pages consist of one column.

The exemplary result of chapter-fit (see **Figure 5.1 - 5.6**) is obtained automatically with paragraphs having reasonable lengths of last lines formed by paragraph-fit. It has six pages which let it start on the recto and end on the verso. It was typeset with twenty-three hyphens, each page starts with a paragraph, and it has no widows, orphans, creeks or rivers. Whereas there were thirty-two hyphens using today's software along with fourteen typographical mistakes (as indicated in **Figure 6.1 - 6.7**) in order to achieve more pages.

One-Page-fit

In a special project set-up, chapter-fit aims at one page of one column or several columns on one page which is useful for webpage design and composition software. In this case, the given number N of columns is a constraint. Without caring too much about the demerits from changes to the original parameters, the goal is to fill the given space reasonably according to the design of the layout with typographical balance.

Figure 7.1 and **7.2** demonstrate one-page-fits achieved automatically by the chapter-fit program. Several constraints were followed: hyphenation was turned off, each paragraph was typeset with the option of force-justify (forming an exact rectangle) and one column had to be filled. Try to get the same result by using today's software within a day; you won't achieve the results.

Figure 7.3 demonstrates another effect of force-justify; this feature could be used to get a headline exactly as long as the column width. In the exemplary two headlines, it used a 72pt-spacing in the first and a 6pt-spacing in the second case to begin with and achieved the exact fit by changing the kerning values. No changes to the pointsize were necessary.

Summary

The *hz*-program and chapter-fit achieve micro-typography of a very high standard, more than we could get digitally in the past or by human craft. Computers are challenging the old standard, they 'eat electricity and no spaghetti.' Paragraph-fit, page-fit, justification per chapter, chapter-fit and one-page-fit are new achievements which did not previously exist. The examples presented here (**Figure 1.0 - 7.3**) demonstrate their usefulness in a convincing manner. These features belong in professional applications as well as in simple word processing software even if ordinary users aren't requesting it at this time. But similar to their purchase of cars with superior engines, they will experience the 'sound' of the *hz*-engine and enjoy text that is more readable.

References

1 Listings and explanations of 'all typesetting parameters' can be found in the literature, e.g., Martin Douglas. 1989. *An Outline of Book Design*. London: Blueprint/The Publishers Association, 21.

2 All relevant outline formats are described in detail in the literature, e.g., Peter Karow. 1994. *Digital Typefaces*. Berlin: Springer Verlag, 139.
Typefaces or fonts are mainly described digitally as PostScript fonts, and as TrueType fonts. In the same way graphic elements like rectangles, circles and other shapes are stored. All have in common stored outlines and "hints" of characters and graphic elements along with the so-called "metrics" which relate to their composition in order to form words and lines of text and to layout complete pages with imaging information.

3 Knuth, Donald E. and Michael F. Plass. 1982.
"Breaking paragraphs into lines." *Software-Practice & Experience*, 11:11, 1119-1184.

—. 1984. *The TEX Book*. Reading, Massachusetts: Addison-Wesley Publishing Company.

Figure 1.0

Magazine Composition

left two columns:

hz-program (most left) compared with today's software,

narrow columns, hyphenation on.

right two columns:

hz-program compared with today's software (most right),

narrow columns, hyphenation off which is unusual and used as a test.

Hermann Zapf 1986:

Writing is the visual reproduction of the spoken word, its primary objective being to convey a text to the reader without difficulties, or distraction, and without disturbing the flow of reading with unnecessary embellishments. The letters have no self-fulfilling purpose, neither are they a medium for self-presentation of a designer. Everything which makes reading difficult or time-consuming, or is detrimental because of its unsual form, has to be avoided.
The new technical possibilities of type composition - with all its limitations - also determined the form of the letters. The infinite possibilities provided by today's electronics are used for example to develop types of our time, without historical hangovers. Ideally, the *hz*-program comprises (1) kerning on the fly, (2) optical spacing, (3) expanding and condensing plus optical scaling from Multiple Master fonts and (4) justification per paragraph. It is the non-plus-ultra in typography.

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hz: 10 hyphens, 3 lines less

Today's software: 12 hyphens, 3 more lines, bad in line 11 and 12

Today's software: spaced out words are worst typography.

Figure 2.0

Aligned left

The hz-program sets an ideal raggedness, even if hyphenation is turned off.

Peter Karow

For over 2,000 years the tools of thought have changed little in essence; basically it has been ink, paper, and the means of applying one to the other. But the computer will surely give intellectual activity a new shape. The question is, what shape will emerge? And what form for the printed word? There are now more than five million computers in the United States, and for some time the amount of computing power has been doubling every two years. The average computer user now has access to information that would fill the Library of Congress and can control as much computing power as a large university computing center. Will this reduce the need for books, or make it unnecessary to print and distribute books in the ways of the past?

There are laser printing units using xerography that can print a complete book from the digitised type page stored in disk memory banks. Such a custom book printer can churn out pages, verso and recto, at the rate of a leaf every second. A complete book of 124 pages would be ready for binding in sixty-two seconds. It takes little imagination to envision a bookstore of a decade hence filled with 'sample' volumes only. One would need only to pick a title and the book would be printed and bound on the spot. Such a bookstore could readily keep on hand three or four times the number of titles now stocked at a fraction of present costs, since there would be no shipping charges, no overstock or understock problems, and no returns.

What does this technology have to do with books as we know them? There are many predictions abroad today the shape of things to come in a computer age that is just emerging in the first flush of a new day. Books are only one means of disseminating information and cogitative writing in the midst of an increasing plethora of electronic options. Even the Congress of the United States seeks guidance. A recent Congressional resolution has asked for a study to explore the influence of the computer and video technologies on books, reading, and the printed word.

The result of this study will be issued in, have you guessed it, a BOOK, entitled «The Book in the Future». Perhaps that is when we shall all learn what the outlook will be for this seemingly endangered species, or at least the official outlook.

Henry Stevens of Vermont once said, «Books are both our luxuries and our daily bread. They have become to our lives and happiness prime necessities.» I have pondered this saying often – «Books are both our luxuries and our daily bread». It has become a kind of motto, one that I believe is most apt for a printer... Books embody all the humanising arts that make thought tangible and give form to ideas, so that mind can touch mind over vast distances and through the ages of time itself.

Roderick Stinehour, April 1984, proceedings of the American Antiquarian Society, Vol. 94, Part I.

Figure 3.0

Aligned left

Today's software sets so ragged that the paragraphs could not easily be distinguished, if hyphenation is turned off.

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The result of this study will be issued in, have you guessed it, a BOOK, entitled «The Book in the Future». Perhaps that is when we shall all learn what the outlook will be for this seemingly endangered species, or at least the official outlook.
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Figure 4.0

His Secret

Hyphenation turned off.

To the left the hz-program: 38 lines, last lines of paragraphs ok.

To the right today's software: 40 lines, short last lines, larger spaces.

Peter Karow

What makes the Gutenberg Bible the unattainable masterpiece of the art of printing? The printing on his handpress? Can't be really, because of today's standards, the inking was not of extraordinary quality. We could order hand made rag paper also in our day. Maybe the secret of his beautiful pages is in the proportions of the columns on the paper. But this we are also able to copy. Therefore only the composition is to be considered closely.

How could Gutenberg get those even gray areas of columns without disturbing or unsightly holes between words? His secret: the master achieved this perfection by applying several characters of different width combined with many ligatures and abbreviations out of his type case. He finally created 290 characters for the composition of the 42-line Bible. An enormous time consuming job to realize his idea of good typographic lines: the justified lines of even length, compared to the flush-left lines of the works of the famous mediaeval scribes.

But with Johannes Gutenberg's unusual ligatures and abbreviations, today we can't apply this old principle for contemporary composition. Now we can get help through the versatility of modern electronic software and formats like the Multiple Masters to receive a perfect type setting in our production, to achieve Gutenberg's standards of quality: The *hz*-program, named after Hermann Zapf.

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← *a creek*

← *too short*

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Figure 5.1

Johannes Gutenberg

500 years ago, Johannes Gutenberg entered into direct competition with renowned scribes. His goal was to set his type as the scribes wrote.

When writing by hand, it is practical to vary the width of words without the writing appearing too light or too dark, consequently disturbing the reader's eye. In earlier times, handwritten lines were rarely of equal length, an art which began with the type of Gutenberg.

Gutenberg employed intelligent methods to adjust lines and spaces, such as cutting of several punches for varying widths of characters, depending upon their application. A large variety of ligatures and abbreviations were also prepared to save space according to demands of a typeset line.

These same ligatures saved considerable time by allowing compositors the luxury of setting two or more characters plus the following space with a single piece of type. In examining his alphabet below we recognize, for example, two choices for lower case a, and the same number for lower case b, not to mention eight ligatures using lower case b. A large number of abbreviations are available to save even greater space than do ligatures. Gutenberg had cast four abbreviations, looking like different accented b characters. A total of 290 unique characters were required in a single alphabet to typeset the entire 42-line Bible.

Having reviewed the font available to Gutenberg, we can more clearly imagine how he must have worked. Most likely he would have set a line of type without use of ligatures, special widths or abbreviations. If there was a reasonable «fit» to the line, he could move on to the next. If, however, a spacing problem arose, he would scan the possibilities for replacing, say, abbreviations to increase readability in keeping with reading habits of that time. When a line was too long, he could consider also ligatures or condensed characters. His lines were left with «no remainders».

Figure 5.2

Of course it is not possible today to use the variables available during Gutenberg's time. Would ligatures be practical as devices to adjust spacing in text? Experiments have been carried out. In 1991, Hermann Zapf designed ligatures for the typeface Zapf Antiqua.

It has been concluded that new ligatures for character pairs like ba, be, da, de etc. tend to disturb legibility today, word processing programs could not elegantly handle them as they currently exist. Finally, the existing and broadly distributed font formats cannot easily store them in a font without eliminating to buy a new version of these fonts.

After Gutenberg

After Gutenberg printing proliferated at a rapid rate, and with the emergence of the industrial age, printing of all kinds flooded the Western world.
Later developments mechanized printing even more with the manufacture of hot metal type. Typesetting became, so to speak, less material to a large degree with the introduction of photo typesetting techniques in recent years, and further abstracted today, with electronic typesetting developed by Rudolf Hell with his Digiset 1965 and desktop publishing, introduced by Adobe, Aldus and Apple, the three A's. Digital typesetting don't use physically existent objects called type, but instead process digital formulae, coding fonts in order to form visible characters.

Italic font typesetting was a continual problem with hot metal type. Only in the rarest cases would one attempt to reduce spacing (kern) between characters. As a common rule, you lived with whatever spacing came about through normal character spacing unless a luxurious budget would allow special setting or the use of special matrices.

Figure 5.3

Hot metal type presented no basic problem in design of various bodysizes, since separate «punches» had to be cut for every different size anyway. This was, and is still, called «optical Scaling». In relative terms, 8 point, 12 point and 18 point characters were not simply cut so that, for example, 8 point was one third smaller than 12 point or that 18 point was one and a half times larger than 12 point type. Smaller size type was tighter and more detailed than smaller sizes.

Photo typesetting provided a linear scaling for small to large size characters, unfortunately replacing optical scaling. This step backward was due largely to commercial considerations; competitive marketing coupled with user ignorance made optical scaling's partial demise a fairly short event. A definite positive characteristic of photo typesetting, however, was a freedom from any restrictions on spacing and kerning. Negative left and right side bearings became useful along with kerning tables to accomplish true and consistent kerning of characters. Typeset text became noticeably improved as a result.

Digital typesetting evolved from photo typesetting. Cathode ray tubes were used initially, then highly focused laser beams traced text forms onto film or paper. Essentially, with few exceptions, former restrictions concerning character fitting in em boxes, numbers of glyphs in a font, as well as kerning problems became meaningless.

Prices of equipment dropped significantly due to the fact that various manufacturers contributed their «piece of the puzzle» to the overall systems. Equipment used today is comprised of products from many suppliers, i.e. PCs, laser printers, typesetters, PostScript, application software, fonts, scanners, and other operating software. This industry, using all kinds of equipment and software, is quite new, so it is no surprise that many have not completely understood its implications, nor utilized new capabilities.

Remaining from Gutenberg's day, a tool is missing permitting automatically justified column setting of text in the gray value «à la Gutenberg», eliminating those annoying «rivers» of white across a printed page.

Figure 5.4

The Copying Syndrome

We should be aware of that computer publishing did nothing else than copying analogue photo typesetting so far, and that photo typesetting was copying hot metal printing in essence before. In all its consequences copying was too slavishly.

Of course, there are many good excuses. After Gutenberg, hot metal printing as it existed in the first half of this century, was driven by accelerating the conversion of news into printed information which was distributed broadly. Normal human beings are very tolerant against the various ways in which information as text is offered to them.

We know how bad our own handwritings look sometimes, e.g. the writings on the doctor's prescriptions. We know that nearly everybody excuses himself for his ordinary and sometimes ugly handwriting. Therefore, no wonder, hot metal printing got faster, but also could escape from Gutenberg's standards easily. We as consumers were not punishing the publishing companies, we were happy to get the news fast and still readable.

Then photo typesetting tried to replace hot metal printing. It did the typesetting as good, could even let touch and overlap characters, and after a short period typeshops were growing and could offer job printing. Newspapers and books were left as the domain of hot metal however, but brochures, leaflets, handouts and other smaller documents were conquered by photo typesetting.

This new technology allowed a linear scaling based only on one font for all the many possible pointsizes and played this out as its dominant feature compared with hot metal; where one had to cut punches for new pointsizes anyway which was a costly and time-consuming procedure. The participating manufacturers of photo typesetters decided to use their font production facilities rather for increasing the number of different fonts than for producing only different pointsizes.

Figure 5.5

While this happened and made people excited about it, they forgot the advantages of especially cut pointsizes, namely the implied optical scaling. Optical scaling vanished before most of us got aware of it and had a chance of sharing its reading comfort.

With desktop publishing, computers played the role of the typesetters. At first, this new technology had to gain ground, so it did copy the photo typesetting, therefore it applied its linear scaling. No typographic innovations took place during these first exciting years of desktop publishing.
All contributing people had enough to do with organizing the existing work places, tooling, and work flows into digital. Partly, they installed the historical ideals as constraints involuntarily.

All these kinds of copying and stepping into the boots of the predessors reminds to the beginning of the automobil industry. The first mobiles they did were coaches! So, the idea was to replace the horses. Well done, but narrow minded. Later, people recognized that they were able to do mobiles independently from former models.

It was Adobe Systems Inc. being aware of this fact and introducing Multiple Masters enabling optical scaling and typographic expanding & condensing of letters, besides interpolation of the weight of typefaces. This was just a first step to get rid of the limitations of photo typesetting and of hot metal printing.

The Aims

Typographically, we have in our hands the fine tuning for fonts which was achieved by Multiple Masters, but also have in hands the fine tuning of other ingredients such as pointsize, column width, leading, spacing, kerning, and hyphenation.

Figure 5.6

Basically, we know how far we can go by our typographical training. If we wanted to, we could go very far on the other hand. As an excuse we could take our own, sometimes indecipherable handwriting and tolerance against badly written documents; once already proven by hot metal printing.

We have an enormous computing power available. We can calculate the size of books, pages, and paragraphs in advance and make decisions on the results, e.g. whether to shorten or to lengthen them in order to achieve more reading comfort. Nobody could do this before. Even, after having done a composition, we can renew it without loosing money or time in order to optimize our outputs.

We can apply millions of subtle variations which only computers can do because it is not costing our sweat and time. One day, somebody expressed this as: they eat only electricity, but no spaghettis.

Since and before Gutenberg typographers, printers and designers were always concerned with the answer to following questions: What is helping the flow of reading? What is the best way to layout a text for the reader? The answer seems to be simple:

- write no hyphens,
- layout justified text,
- start each page
  with a paragraph,
- start a chapter recto,
- end it verso.

We have modern computers which can do a lot of virtual trials of typesetting and which let us choose from the best and most convenient solutions for a given page of text.

We can apply subtle changes which the readers can't see; meaning that they are not disturbed during reading. The rules of good typography could and should be kept as they are delivered by Johannes Gutenberg.

Figure 6.1

Johannes Gutenberg

500 years ago, Johannes Gutenberg entered into direct competition with renowned scribes. His goal was to set his type as the scribes wrote.

When writing by hand, it is practical to vary the width of words without the writing appearing too light or too dark, consequently disturbing the reader's eye. In earlier times, handwritten lines were rarely of equal length, an art which began with the type of Gutenberg.

orphan paragraph

Gutenberg employed intelligent methods to adjust lines and spaces, such as cutting of several punches for varying widths of characters, depending upon their application. A large variety of ligatures and abbreviations were also prepared to save space according to demands of a typeset line.

creeks

These same ligatures saved considerable time by allowing compositors the luxury of setting two or more characters plus the following space with a single piece of type. In examining his alphabet below we recognize, for example, two choices for lower case a, and the same number for lower case b, not to mention eight ligatures using lower case b. A large number of abbreviations are available to save even greater space than do ligatures. Gutenberg had cast four abbreviations, looking like different accented b characters. A total of 290 unique characters were required in a single alphabet to typeset the entire 42-line Bible.

widow paragraph

Having reviewed the font available to Gutenberg, we can more clearly imagine how he must have worked. Most likely he would have set a line of type without use of ligatures, special widths or abbreviations. If there was a reasonable «fit» to the line, he could move on to the next. If, however, a spacing problem arose, he would scan the possibilities for replacing, say, abbreviations to increase readability in keeping with

Figure 6.2

reading habits of that time. When a line was too long, he could consider also ligatures or condensed characters. His lines were left with «no remainders».

Of course it is not possible today to use the variables available during Gutenberg's time. Would ligatures be practical as devices to adjust spacing in text? Experiments have been carried out. In 1991, Hermann Zapf designed ligatures for the typeface Zapf Antiqua.

widow paragraph

Peter Karow

It has been concluded that new ligatures for character pairs like ba, be, da, de etc. tend to disturb legibility today, word processing programs could not elegantly handle them as they currently exist. Finally, the existing and broadly distributed font formats cannot easily store them in a font without eliminating to buy a new version of these fonts.

After Gutenberg

After Gutenberg printing proliferated at a rapid rate, and with the emergence of the industrial age, printing of all kinds flooded the Western world. Later developments mechanized printing even more with the manufacture of hot metal type. Typesetting became, so to speak, less material to a large degree with the introduction of photo typesetting techniques in recent years, and further abstracted today, with electronic typesetting developed by Rudolf Hell with his Digiset 1965 and desktop publishing, introduced by Adobe, Aldus and Apple, the three A's. Digital typesetting don't use physically existent objects called type, but instead process digital formulae, coding fonts in order to form visible characters.

Italic font typesetting was a continual problem with hot metal type. Only in the rarest cases would one attempt to reduce spacing (kern) between characters. As a common rule, you lived with whatever spacing came about through normal character spacing unless a luxurious budget would allow special setting or the

Figure 6.3

widow

use of special matrices.

Hot metal type presented no basic problem in design of various bodysizes, since separate «punches» had to be cut for every different size anyway. This was, and is still, called «optical Scaling». In relative terms, 8 point, 12 point and 18 point characters were not simply cut so that, for example, 8 point was one third smaller than 12 point or that 18 point was one and a half times larger than 12 point type. Smaller size type

widow paragraph

was tighter and more detailed than smaller sizes.

Photo typesetting provided a linear scaling for small to large size characters, unfortunately replacing optical scaling. This step backward was due largely to commercial considerations; competitive marketing coupled with user ignorance made optical scaling's partial demise a fairly short event. A definite positive characteristic of photo typesetting, however, was a freedom from any restrictions on spacing and kerning. Negative left and right side bearings became useful along with kerning tables to accomplish true and consistent kerning of characters. Typeset text became noticeably improved as a result.

Digital typesetting evolved from photo typesetting. Cathode ray tubes were used initially, then highly focused laser beams traced text forms onto film or paper. Essentially, with few exceptions, former restrictions concerning character fitting in em boxes, numbers of glyphs in a font, as well as kerning problems became meaningless.

Prices of equipment dropped significantly due to the fact that various manufacturers contributed their «piece of the puzzle» to the overall systems. Equipment used today is comprised of products from many suppliers, i.e. PCs, laser printers, typesetters, PostScript, application software, fonts, scanners, and other operating software. This industry, using all kinds of equipment and software, is quite new, so it is no surprise that many have not completely under-

Figure 6.4

widow
widow paragraph

stood its implications, nor utilized new capabilities.

Remaining from Gutenberg's day, a tool is missing permitting automatically justified column setting of text in the gray value «à la Gutenberg», eliminating those annoying «rivers» of white across a printed page.

orphan paragraph

The Copying Syndrome

We should be aware of that computer publishing did nothing else than copying analogue photo typesetting so far, and that photo typesetting was copying hot metal printing in essence before. In all its consequences copying was too slavishly.

Of course, there are many good excuses. After Gutenberg, hot metal printing as it existed in the first half of this century, was driven by accelerating the conversion of news into printed information which was distributed broadly. Normal human beings are very tolerant against the various ways in which information as text is offered to them.

We know how bad our own handwritings look sometimes, e.g. the writings on the doctor's prescriptions. We know that nearly everybody excuses himself for his ordinary and sometimes ugly handwriting. Therefore, no wonder, hot metal printing got faster, but also could escape from Gutenberg's standards easily. We as consumers were not punishing the publishing companies, we were happy to get the news fast and still readable.

Then photo typesetting tried to replace hot metal printing. It did the typesetting as good, could even let touch and overlap characters, and after a short period typeshops were growing and could offer job printing. Newspapers and books were left as the domain of hot metal however, but brochures, leaflets, hand-outs and other smaller documents were conquered by photo typesetting.

Figure 6.5

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creek

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Today's software page 5

Figure 6.6

The Aims

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Peter Karow

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Figure 6.7

widow

• end it verso.

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widow paragraph

32 hyphens

Figure 7.1

hz-program: hyphenation off, force justify, one-page-fit, more text

Fifteen years ago, Adobe and Aldus developed the software that launched the desktop publishing revolution and literally changed the way the world works. Today, as one company, they are uniquely positioned to make a further dramatic impact not only on how society creates information, but also on how it delivers and manages that information in the Digital Age.

The new digital world is one rich with color, movement, sound, images, text and other elements of human expression. People receive information in printed forms such as books, periodicals, brochures and reports; in projected forms such as overheads and slides; and in broadcast forms such as film and video. And because it can all be delivered electronically, the information reaches a vast, global audience in real time.

Moreover, the recipients are far from passive. They increasingly control not only what they experience, but also how, when and where they experience it. And they have access to software that enables them to create information with a level of visual sophistication once provided only by graphics professionals.

Over time, individuals and organisations will accumulate entire libraries of electronic documents and presentations, using and reusing them continuously. To satisfy this growing need to access and exchange information at will, electronic content must transcend and outlive the constraints, networks and operating systems now and in the future.

This communications picture is quickly coming together. And essential pieces are provided for defining and shaping it. More than any other developer of personal software, Adobe offers products that enable people to use the computer to express and share their ideas in imaginative and meaningful new ways, whether the choice of media is static, dynamic or a combination of the two.

Peter Karow

Figure 7.2

hz-program: hyphenation off, force justify, one-page-fit, less text

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Figure 7.3

Fit This Headline to Column Width
Fit Headline to Column Width

Writing is the visual reproduction of the spoken word, its primary objective being to convey a text to the reader without difficulties, or distraction, and without disturbing the flow of reading with unnecessary embellishments. The letters have no self-fulfilling purpose, neither are they a medium for self-presentation of a designer. Everything which makes reading difficult or time-consuming, or is detrimental because of its unsual form, has to be avoided.

Today's software has a problem.

Peter Karow

Fit This Headline to Column Width

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Both headlines are fitted with the hz-program using force-justify.

Fit Headline to Column Width

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Peter Karow, Ph.D.

is a founder and partner in URW Software & Type GmbH in Hamburg, Germany. While his dissertation was in high energy physics, digital typography became his life's work. Contact with type designers, particularly Hermann Zapf, led to his development of the IKARUS program for digital type founding. Since 1988 he has worked on the hz program which uses the power of computers to improve the micro-typography of texts. Along with several books, journal articles and international presentations, he has fourteen patents for DTP related methods.

Karsten Lücke

Abstract

Articles dealing with documents on demand tend to presume a static digital format, i.e., a scanned page. In contrast, this article discusses a flexible document format subject to user specification based on particular reading needs or habits. The author argues for digitally created masters which ensure access to old, rare, out-of-print or otherwise inaccessible information at the same time they authenticate the accuracy of the data. Issues relating to format construction, the implications for the user/reader and the publisher/service bureau are explored.

Schloßstraße 50
45711 Datteln
Germany

Visible Language, 32.2
Lücke, 128–149

Customized Digital Books on Demand
Issues in the creation of a flexible document format

Karsten Lücke

Imagine you want to buy a book — not a bestseller that any bookseller has in stock, but something more special, maybe the latest title on a special subject like typography or a biography of a French poet, one that has been out of print for about forty years. Perhaps you are looking for anything written by a special author: books, articles, forewords for others' books or articles from technical journals. You enter a bookstore. You take a seat at one of the computers and type the subject, or a more or less complete book title, maybe the year of publication, or just the author's name, and at worst you're shown a number of titles with the one that you were looking for among them. (A well conceived, clearly structured and well designed graphic user interface is taken for granted.) Perhaps you can see on screen that there are still copies of the hardback edition left in stock that you may order. That's about what you can get today, though you normally must not touch the only computer in the store, at least in the little bookstores I know. Especially when asked for older books — the clerk often says: I'm very sorry, it's out of print for several years.

However, you scroll through the list of books and articles. More detailed information on each of them can be shown if wanted; moreover, you might have a look inside and leaf through the pages virtually, on screen, to judge whether the writing(s) would fit your particular needs. Imagine you find one or a few of them interesting enough for further study. You mark a book or an article or set up a compilation of some articles, choose one of many offered book designs, perhaps modify diverse layout parameters such as page format, margins, typefaces and size, paper, cover paper or kind of binding. You, as the reader, may to a certain degree of course, define what you want. Depending on these factors the book price is calculated, and if you still want to have the publication, you give the command for printing and binding.

.....

Of course, I do not want to hide my sources — a text influenced me. Some months ago I read Umberto Eco's *Das Buch, ein technisch vollendetes Meisterwerk (The book, a technically completed masterpiece)*. Here is a quick translation of the relevant paragraph: "Let's assume all books of all great libraries would be scanned (and one might start with one, well

equipped library): its content, complete with typography and make-up, were stored in a central computer. First advantage: these books are protected from destruction of the paper they would have been printed on — many contemporary editions will turn to dust within a few centuries. Anybody who needs a special book simply goes into the next state library, studies the catalog, finds the desired book, and the computer advises a high-end printer to produce a copy that looks like the original, all within just a few minutes, including stitching or binding. If the original had been printed in small Fraktur or Textur letters, and you want to read it more easily, you give a command and the machine produces a copy set in any typeface you want. You pay for the print-out, plus automatically calculated percentages for author and publisher (this prevents piracy) and take your copy home. If there is a reference book with many volumes, you might print excerpts. And if you don't need it any more after reading, you just throw it away — you can print out a new one if needed."[1]

Obviously, Eco was himself influenced by something he may have seen at Stanford University or at Xerox, I do not know; he introduces his own vision, quoted above, with: "At present, one innovation is studied at Stanford University in California and supported by Xerox. I do not want to discuss here the current situation, but what it could look like in the future, if some not inconsiderable technical problems are solved." I cannot say how much of his writing is his own idea or how much he describes what he has seen.

Just recently, in Ruari McLean's *Typographers on type*,[2] I read an article by Roderick Stinehour describing something similar: "There are laser printing units using xerography that can print a complete book from the digitized type page stored in disk memory banks. Such a custom book printer can churn out pages, verso and recto, at the rate of a leaf every second. A complete book of 124 pages would be ready for binding in sixty-two seconds. It takes little imagination to envision a bookstore of a decade hence filled with 'sample' volumes only. One would need only to pick a title and the book would be printed and bound on the spot. Such a bookstore could readily keep on hand three or four times the number of titles now stocked at a fraction of present costs, since there would be no shipping charges, no overstock or understock problems and no returns."[3] Today, I'd say such a bookstore could get you not three or four times as many titles immediately, but *any* title once digitized.

.....

The whole thing sounds interesting — never mind exactly what is real and what is fiction. I like the idea of a book printed on demand. Often it is not very easy to get a copy of an older book — even if it has been printed only nine or ten years ago. But if the model, the master copy of a book was digital, a copy could be made at any time and as often as it was needed. Alas, even the idea of printing documents on demand itself is nothing new — every layout created digitally is a document to be printed on demand.

(A short diversion) Today's copiers can stitch or glue sheets, to give them a booklet-like appearance. I am aware that it is not possible to automatically produce single or small numbers of hardbacks in acceptable quality at the moment. But in my opinion paperbacks will do as well, not just for the present, though the glueing quality of copiers must be improved. At this point, I just wanted to make it clear that I am talking primarily about paperback books.

However, recent developments seem to work with fixed layouts — no wonder — today document format is static. Even Eco and Stinehour consider only a fixed layout in their descriptions. Eco writes about scanning existing books to set up a digital library and Stinehour about "digitized type pages," whatever "digitized" means here.

This is not too exciting. But, almost incidentally, Eco mentions it could be useful to change the typeface, e.g., if "the original" had been printed in broken script. And this, though it does not fit the context of his writing (Eco speaks of scanned pages, and therefore of static pages saved as images only), could lead to a really fascinating and exciting invention: The layout of a book could be flexible, mutable. Or, more precisely: The layout of its digital model could be flexible — and, from the user's point of view, almost exchangeable.

.....

Conception

To sum up the previous, it's necessary to distinguish between static pages, high resolution scans of book pages saved as pixel images, perhaps later converted into an outline format and static pages created digitally with programs like PageMaker or QuarkXPress on the one hand, and flexible and portable digital documents on the other one. There is not much to say about static documents. They exist. It is the future flexible ones that deserve attention.

I don't want to discuss the advantages of printing documents on demand in general. Here I want to roughly define a flexible document format by making some suggestions regarding such a format and its possibilities. I will start with the principal conditions for a flexible document format, and then go on with the consequences for the "user," the purchaser and reader of a Digital Book as I would call it.

Before this, I have to make one thing clear: I principally distinguish between a message and its presentation, between the text itself and its layout or book design, i.e., the arrangement of the text and other elements. This is essential for a better understanding of what follows.

.....

Document Format

The whole document format, and the environment to create and use it, must be oriented to design as well as to the text and its structure. I value the text structure more than the design, in that design, especially book design, is strongly based upon the structure of the text to be presented.

The main text In the center of all there is *one* main text object, the book. (For me, "object" is data and "document" is its presentation.) Primarily, this main text (data) is structured by the return at the end of a paragraph. Ordinary letters might have a structuring function. As in DTP (Desk Top Publishing) documents created with PageMaker, paragraph formats are used within the flexible document format. But here, more than in other DTP software, the purpose of such paragraph formats is to structure the text, indicating whether a paragraph is author/editor, book title, explanation, publisher, copyright annotation (all for title page), line in the table of contents, chapter number or title, chapter subtitle, motto, title or subtitle of a certain degree, text, list text and others. Then there are marginal notes, illustrations, captions, footnotes, running heads and feet, etc. — these do not directly belong to the main text, but are linked to it, i.e., to certain words or phrases within it. So the return at the end of a paragraph marks the beginning or ending of a collection of words or sentences. It is a hint to use paragraph format x or y, inserting an initial letter after a title, indenting the first line of a paragraph or setting a paragraph sign in running text. The last example shows that one must differentiate between groups of paragraphs: titles belong to one group, the main text paragraphs make a group and general information on the book, author, title, publisher, year of publication, ISBN and so forth form another group.

Of course, the most essential elements of such a flexible format is fixed: pure data (main text, other text elements, illustrations) must not be changed after the document has been entered and edited. Emphasizing single words or phrases by using italics, or setting small caps instead of the ordinary text setting, also belongs to the text level; here I mean an emphasis stipulated by the author (italics), or which is necessary to do justice to 'good typography' (use of small caps) — in no way should designers abuse such fixed formats for the sake of *design*.

By the way, the use of small caps for all-cap words or acronyms, as mentioned above, leads us to a general aesthetic problem. Does the person who enters and edits the text of such a Digital Book have the right to say: I want to see small caps! Or: I'd rather use regular text characters slightly reduced in size! Just to a limited degree, I would say: it is the reader who has to decide whether he prefers small caps or something else, if he *wants* to decide. So there could be a hint determining a word to be set in small caps or dropped to a smaller point size. Then the book designer makes a choice which the reader may alter later, *if the designer allows*. It is similar to the question of how to set authors' names throughout a book: in roman letters, or small caps with the initial letter being the ordinary roman letter. Maybe there can be a special hint for names, so that again the reader may have the final choice.

Word hints may also be of some interest for automated preparation of a register of names (or register of places or book references). To make such hinting easier for the typist, the name can be marked when it appears for the first time, the program will search for further appearances. Perhaps the typist's assistance is needed: if the author of a text calls someone by his or her first name (or family name) later on, and some people do have the same name, the typist is asked which one is meant — perhaps instantaneously while typing. Therefore first and family names have to be linked, but must be recognized when standing alone. There are other problems, e.g., indicating keywords for different purposes that may not be well thought over when creating such a document format. Whether a special register actually is created and printed later or not, depends on the needs of the reader.

However, to make clear what has been said above, perhaps the text must not be hinted to mark and define whether certain words are to be set in italics or small caps, rather words should be hinted to mean: "this is a title," "this word or phrase is to be emphasized," "a foreign word" (all to be printed in italics) and "this is an author's name," "this is a corporate

name" (may be set in small caps), perhaps even: "this word or phrase is a quotation." This procedure might seem too complicated and superfluous in terms of individual book design, but be of great importance for the later creation of registers or references — useful not within the single title only, but on a more general level if you were searching for any books dealing with, or just mentioning, somebody's name, then the system could test these keywords instead of searching through entire documents. This goes beyond today's ordinary DTP document format. Moreover, no concrete letters and signs to be found in a font can be used for the text — e.g., one should not type concrete quotation marks; one just might type general left and right quotation marks, regardless of whether the Swiss, French, German or English marks will actually be used.

Right at this early stage, I reach a point where text (the data that the publication is dealing with) and book design (the presentation of that data) meet. Both the text/illustration level and the layout level depend on one other, and they must be closely linked together. The text level itself cannot contain a special command such as "paragraph to be set in ITC Legacy Serif Book, in 10/12 pt; words x, y and z to be set in italics;" instead the command is: "paragraph to be treated as a whole; words x, y and z to be set in italics or (if the text is in italics) in roman."

Adjustment of paragraph formats, in terms of formatting the text, could be similar to PageMaker functions where you might say "format x to be the same as format y, but type size to be changed." But within a flexible document you must not demand "14 pt to be chosen here instead of 12 pt," but rather "two points more," or even better, "about 120-130% of the basic type size." Apart from a general structuring function, or better, as part of the construction of uniformity throughout a document, paragraph (and word/phrase) formats are organized for an overall identical appearance of different title or text levels, i.e., forcing a title to appear on a new page, or on a righthand (or lefthand) page only, or the first letter after a certain title to be an initial. Here one can recognize that layout functions are primarily text based or closely linked to the text at least.

Other basic elements Illustrations, like text, are in no way flexible. But perhaps there might be a function to suit line drawings to the typeface automatically by making the pen strokes thicker or thinner, following Tschichold who once wrote that the thinnest strokes of an illustration must not be thinner than the hairlines of a typeface, and the thickest not heavier than the stems.

Pagination is linked to the main text indirectly via the special book design or layout. When text and layout come together and the actual page make-up is done, general references to passages on other pages (just being hints on the text level) are replaced by actual numbers, e.g., from the register of names to the pages where the names appear, or from one page to another. So the page number in the sentence "for further information also read pages x and y" depends on the later layout and page make-up. The same is true for running heads and feet whose content is taken from special paragraph layouts as chapter titles or headlines and for hints to illustrations and their captions. (Illustration and captions will be returned to later.)

The possible text-layout relation When text and layout come together, they need a relation. I would suggest the following structure. a) The text is structured by hints. The simplest kind of a hint is the return after each paragraph; other hints indicate quotations, references, etc. b) Then there is typography which has to represent the structure of the text. Within typography, we can distinguish between micro-and macro typography. The first is about smaller units like letters, tracking, wordspacing and leading; the latter is about proportions and arrangement of paper format, type area, columns, titles and text. (Micro-typography is automated to a high degree. Nevertheless, both the designer and the reader might set up their own micro-typographic rules. And it's for the reader to say: Whatever the designer suggests, filter these out and replace them with my own specification: I always want indentations unless in the first paragraph after a title, put some space before ;:!? and so forth.) c) Without question, text structure and design are related to one another. To realize these relations, I can imagine a third instance which is to define the hints and thus the meaning of the hinted text elements (to be a head line or title, chapter, text paragraph, quotation, emphasis) — this is a 'semantics of typography.' It says *what* a certain text passage is or means, its function and gives rough instructions on *how to handle* it typographically. It pre-determines the means of handling test elements. (The designer gives these means a more concrete though not final form on the level of typography.)

An example: When the reader creates his actual layout, he defines paper format and margins, thus automatically the column width and height — *macro-typography.* He chooses a typeface and size, automatic leading, which is then fine-tuned in interaction with column height — *micro-typography and macro-typography.* Typeface, size and leading cause a special tracking and wordspacing, and in interaction with the

column width, they determine the number of characters per line — *micro-typography and macro-typography*. Now the resulting line break produces too many widows (last line of a paragraph at the head of a page) and orphans (first one or two lines of a new paragraph at the bottom of a page) throughout the text — *text and micro-typography*. Then leading is automatically altered, and type size (and automatic tracking, leading, etc.) and line breaks might help — *micro-typography*. As internal references are updated with each page make-up, the changing numbers (sometimes two, sometimes three figures long might cause further make-up — *text and macro-typography*. The 'semantics of typography' then insist that a title is distinguished from the normal text setting, i.e., space, typeface, size or weight. It says that there must be even more emphasis on a title of a higher degree. Or, that footnotes should visually subordinate to the text. This also means that the actual typographic form of each text element needs a reference: you cannot determine one without affecting the others; a possible title or footnote setting depends on how the ordinary text typography is set, or the other way round. It is the 'intelligence' of the system which limits the means of possible designs once a choice is made. This quick and not very detailed example might give an impression of the complexity of "cause and effect," if one might still use this paradigm. It's a real texture of interdependencies between the levels.

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Here another distinct aspect appears: the software needed for creating text and design (book publisher), and for searching for — and compiling — books and modifying them in terms of layout (bookseller and customer). For each purpose there's a different program or module.

Flexible document (development) tools Text is entered and edited within a special editor. For creating layouts there has to be another module. It is obvious that both of them belong together: with the text editor hints are set that have an effect on the layout, and the layout effects the actual page number that a passage may refer to. So the modules have to be developed in close connection, perhaps as *one* program first. But for later use, related but separate programs for author and book designer — or at least a special stand-alone program limited to text editing functions for the author who should be forced to concentrate on his text and must not play typographer. Maybe the author can create a simple "private layout" to get a proper overview of the text and its structure, but that's it. Being able to link sentences or words to others is useful for the author

who, during the process of writing, may more easily find passages that are related to others. The layout module might have full control over the text, so that the book designer can change incorrect hints or inconsistently structured text or title levels. This layout (and editing) module may also be available for designer-writers.

Next there has to be a book browser/purchaser for the customer, which is connected to a layout browsing and modifying module. (Perhaps the browser can be distributed to everybody at no charge, as Adobe Acrobat is now. People might download it from the Internet or a CD ROM to search for a title and, after paying for it or promising to pay, order a copy.) There might be ambitious people who want to design books on their own. For them one could create a layout module limited to page layout without access to any text.

Text editor As already mentioned, the text is edited within a special editor. Here any modifications are made that should be globally evident, independent from the later layout; e.g., book titles are indicated to be set in italics later, all-cap words are set in small caps to better fit the rest of the text; a more precise description of this has been made earlier.

In the text editor, footnotes and marginal notes (marginalia) are displayed to the right and left side of the main text, perhaps in color to stand out from the main text. The first line of a footnote should be on the same height as the footnote number in the text, and the first line of a marginal note is on the same height, as is the appropriate keyword or phrase. This is all for greater clarity in the writing stage.

In the same way, figures or illustrations are bound to their corresponding text passages. If possible, they will appear on the same page later;

and if this is not possible, the text itself may refer not only to the figure number, but also to the page number (this addition is to be avoided when both are on the same page). In the editor, illustrations are displayed by a symbol, within the main text or to the left or right side of the column and can be opened with a double click.

The numbering of footnotes and figures must be automated. (Whether numbering is started anew in every chapter or not is defined by the chosen layout.)

In principle, everything should be as easy to handle as possible for the author. His writing activity differs from that of today only in that he does not click a button for 'italics' or 'small caps,' but a button for 'emphasis,' 'title' or 'quotation' after he has marked the text passage concerned.

If he inserts a quotation, he clicks a button 'footnote' and a routine opens asking for whether the source is a book or article and requests other bibliographic details. After input the footnote is shown beside the main text and can be altered with additional comments on the citation given in the text. (In an advanced edition of Digital Book, the quotation might be taken via drag and drop from another Digital Book and all the information fit automatically.)

The browser The book list shows authors, titles, information on the publisher, the year of publication, edition, etc. in small caps, italics and roman. Additionally, for better recognition, the different kinds of information could be colored, e.g., author in blue or green small caps, book or magazine title in red italics, article title in red roman with the rest in black roman.

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Now I will say a few words on the layout itself which before was mentioned only when affected by the text and its structure. While the text is the "object" as defined earlier, the real data or the message to reach the reader, the layout is the "document," the container of the data, determining the kind of presentation (film and sound are examples of other kinds of presentation). I do not think well of technology that conflates the function of both "object" and "document." By defining the roles of message and presentation carefully, giving it all a clear structure, the conception or technology of a flexible document becomes possible — at least it simplifies the whole matter. So the unchangeable text is

the object and the flexible layout is the document in which the objects (and related objects such as illustrations and their captions marginalia, footnotes) are embedded.

Flexible typography I think of a hierarchical structure of layouts and layout elements. On top of all there is the relation-based principal layout structure; holding information on general relations between typeface, size, length of line, word and letter spacing, leading and so forth. Next come pre-prepared (but still relation-oriented) principal layouts for different classes of printed matter such as books and journal/periodical articles. These principal layouts make several relations more concrete, e.g., by defining relations between book page and type area (as the 2:3:4:6 or 1/9 - 2/9 rule) more specifically. The different layout aspects such as single micro-and macro-typographical relations needn't be put in one layout on this level; they might be independent from each other first, but depend on each other in the completed layout — it might be useful to set up a kind of construction kit. Now the first really concrete layouts putting these diverse elements together, leading to prepared sample layouts using the actual typeface names and number measurement happens. In this way one moves from the general to the specific as a tree is structured with a trunk, branches and twigs — vaguely defined relations take concrete shape.

The page layout should be as flexible as the printer allows, so the weight and size of paper to be processed or the number of colors are limited only by the equipment. Nevertheless, within all typographical flexibility or mutability, typographical correctness — I think Tschichold once called it "good typography" — is a must, and can be achieved, primarily by restricting the number of parameters the reader may alter; and secondarily, by carefully hinting the document format for a broadly automated calculation of the parameters that the reader normally doesn't even recognize, e.g., the adjustment of micro-typography to the actual page make-up.

Principally, any aspect of page make-up might be altered, e.g., paper format and relation between paper height and width (paper height first, then its relation to paper width), model of margin relations, size of text area (roughly — to be refined for avoiding rivers), indentions or not, initials or not, setting of headlines, marginal notes or comments or running head or feet, type styles and sizes of different kinds of text elements and other factors. This is just to get a picture of how flexible a layout could be and by virtue of what changeable elements.

Just to avoid misunderstandings: I want to offer a system that allows individual layouts, but this does not mandate that anyone who wants to buy a book must create his own layout. I think rather of readily prepared layouts (with the abstract relation-based principle layout structure here made concrete through actual numbers) that may be altered. Of course, one may create his own book design using free software tools and basic layouts as described later in this text. Too much freedom in terms of book design might confuse the customer and the reader. Too much influence over the printed matter should be avoided, rather the reader might be free to alter a few parameters and even then only choose from about three to five alternatives which best fit his or her particular needs. Choices might include: paper format, margin proportions, hidden or viewable marginalia, position of marginalia if viewable. The designer's task is to offer means (and limits) for possible designs.

To realize the above mentioned "good typography" now, all the named and unnamed factors have to relate to each other — changing one factor affects many others. If you have determined the book size and margins, and therefore the size of the main body of text, the number of typeface sizes is limited. Depending on the chosen typeface, type size (optical sizing), length of lines, etc., parameters such as tracking, wordspacing and leading are adjusted, i.e., less tracking for shorter lines and larger type sizes and so forth. For automatic calculation of optimal leading the character of the typeface is important and needs consideration. Moreover, for the purpose of automated micro-typography, the internal measurement of typeface size should be perfected — a relative type size ought to be calculated considering x-height, H-height, ascenders and descenders. Any micro-typographical refinement such as slightly letterspacing the small caps, must be done automatically without frightening the reader (or the publisher's book designer) with such "minor" problems that he perhaps is not aware of — and doesn't want to be. Everything should be as simple to handle as possible. The customer of flexible book technology might make his personal choice and get what he wants without recognizing anything of the underlying technology.

What is necessary is not just a flexible document format, but a program behind it all that, based upon the actual modifications, automatically changes the whole page make-up including line breaks, syllabication, etc., a program that can handle titles of one line or more (the main text must always fit the grid), or the embedding of initials. Especially creating a program to do a proper line break without producing rivers all over the text or incorrect divisions seems to be a problem that has to be solved;

common DTP programs and word processors do not do a good job here. Also inconspicuous things have to be respected, such as increasing paper width towards the inner margin depending on the number of pages of the publication and on the weight of paper used. What is needed is fully automated typography — and this means more than typesetting with the computer.

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User (Reader) Consequences

With such a flexible document format, and with a digital library offering anything that ever has been published, one might have easy access to the books one wants to read, and even an influence on the form of these books. Does one read at home sitting at a desk, or does one read in bed or in the train while traveling? Does one demand broad outer margins for personal notes? Is a larger typeface needed to read without glasses?

Digital book formats At the beginning of the last section, I mentioned two basic forms of Digital Book: the static and the flexible. To be more precise in terms of the last one: there are, from the reader's point of view, two kinds of flexible books: the first uses the publisher's design, wearing an unmistakable cover layout and more or less unmistakable interior layout, and is only as flexible as the publisher allows; the second uses the original text and illustration data, but not the publisher's layout. Publishers might be free to submit as many layouts as they want, but the customer, or reader must be free to choose the layout wanted. (If no particular layout is desired, then the publisher's basic layout is automatically used.)

Protection of data It must be guaranteed that both bookseller and customer cannot change text or illustration data, or make illegal copies of a whole text or extracts. Any printout must carry a copyright note and information on the original publication, whether in the form of footnotes or an extended running head or foot. Especially when single articles are printed at home, it must be impossible to copy the text into a wordprocessor. Perhaps a copyright note is shown on every sheet of paper.

Moreover, text itself may be edited by authorized parties only and is locked against tampering once completed. Even when creating a new edition, the original text cannot be changed; here an authorized copy is opened to be corrected or enlarged. At any rate, manipulation of original material must be impossible.

Karsten Lücke

User interface The whole thing asks for a suitable (graphic) user interface for all modules — text editor, layout editor and browser. The browser/purchaser could be divided into special parts: a list of all books available and a search tool, a list of books chosen and a tool to compile them, then a tool for choosing and adjusting the layout. Proper presentation of all functions is one of the most important factors in a complex system like this. The browsing/purchasing and layout software (customer layout software) does not allow access to basic text and illustration data. It should be as plain as possible.

How to use Finally the whole thing could work as follows: with the browser/purchaser program you choose a book, modify its layout and print it out with the bookstore or library printer, or with your own printer at home if you need just a short article and do not mind perfect binding. If you have advised the central digital library via the Internet, the book will be printed, bound and covered at your nearest library or bookstore and posted to your address.

The advantage is first that you might print books and articles from books or journals/periodicals on demand. Second, you might give these books, journals, articles or compilations of articles forms that fit your purpose. Moreover a book, if available at any time, cannot be out of print. Once all books are digitized, one could have access to all existing knowledge. From a publisher's perspective there is no overproduction. And for scientific work, students won't need to waste their time copying page by page from a printed model. This also protects old or rare volumes from getting damaged or destroyed. (Old and typographically extraordinary titles also should be available as scanned reproductions of the original.) One could create one's own series of books using an identical or similar design, perhaps just changing the cover paper. Therefore one might be allowed to save book designs on a disk to carry home, or within a public database.

Book and screen Though marginal, there is one more thing I would like to touch upon here. The Internet will be a medium to allow access to a central digital library one day. This leads to reflection on the relationship between Digital Books and the general use of the Internet, or more generally, the difference between page and screen.

As Eric Gill, in his *Essay on typography*, plainly states: "A book is a thing to be read,"[4] and this is valid even today — at least I hope so (there are some books that obviously are produced to make one doubt this). The medium "book" is totally different from the medium "Internet," or should I say from the medium "screen," provided by the sources Internet and CD ROM. Internet and CD ROM sites, perhaps because presenting data in the lowest resolution on a flickering screen, are not really to be read, but to be looked at. Recently, I obtained a copy of *How to submit a typeface* PDF file from a major font supplier — forty-five pages with a lot of illustrative elements repeated on each page but surprisingly little text in too large a size, looking nicely on screen but wasting paper and toner when printed out. (I feel personally offended when I have to read body text in sizes as large as 16 pt and more.) However, this example shows clearly that screen layouts and print layouts do not have much in common in terms of presentation of data, and this of course has an influence on the data that is carried. Text offered by screen often is not more than a caption or a marginal comment in a book (real information is rarely found on the Internet). In some way I am sorry about this.

A flexible document format is not only useful for printed matter, but also for creating special layouts that allow *reading* a text from the screen without scrolling to the upper or lower half of the page lying somewhere behind the glass — unfortunately, most ordinary books use the portrait format which does not do justice to ordinary landscape monitors. Publishers, especially those who principally don't sell books but information (reference books or catalogues), could offer two basic layouts once such a flexible document format was realized: one for printing and one for display on a monitor. Depending on the medium the reader uses, the correct layout could be chosen automatically. Perhaps with the help of the flexible document format, printed matter and displayed matter could come closer together.

Future book, library and bookstore Two kinds of books evolve: the book produced by the publisher and the Digital Book. The first is the beautifully printed and bound object. More than now, publishers will have to ask themselves: Could this special item be of lasting value? Is it something that readers also value by its material representation, its fine paper or special cover? Or: Can we expect sure sales? Diverse titles seem to be designed to become best sellers.

The Digital Book, as the second kind of book, may not be for those who buy books in a supermarket, somewhere between soap and food on

the shelves. But it is for those who know what they want, especially as it regards the subject, or those who have the time to browse through entire lists of titles in search of an older title from their preferred author. You can do that in a bookstore as well, but the one title you are keenly looking for they usually don't have in stock.

Bookstore and library have similar purpose then, at least they come closer together in their task. As before, the library preserves knowledge and makes it available, and the bookstore sells books as goods, but both allow access to commercial and rare material. Now both rely on the same source, the Digital Library. Is there a difference between bookstore and library in this scenario?

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What remains is the social aspect of the libray — the general idea that people can borrow what they cannot buy, either for reasons of access or due to cost. The access problem might be solved to a large extent with the Digital Library, for both bookstore and library. What about the financial aspect? Today you go to a library, and either borrow the books for a minimal fee, if any, or you make photocopies and pay your copyright fees. But when you use the Digital Library, it does not make a difference technically whether you enter via bookstore or public library. The result is the same: you are supplied with a printed and bound book that is produced especially for you to keep and thus you have to pay for it. The only difference in the output might result from the printer they use or the paper they offer. This might be one key to the problem: special copies, in cheaper materials, using an economic, though flexible typography with smaller type and margins. Or copies could be marketed as educational versions with wider margins. Otherwise the library in its recent form is not affected at all. The Digital Library might be seen as an addition, one that of course questions the classical roles of bookstore and library.

What is 'book' in the context of a Digital Library? So far in this writing, the word 'book' stands for the printed and bound item, for its visualization on screen and for the rather abstract digital model of the book. The Digital Book denotes the digital model (the information and first vague layout advice) as well as its representations via media on paper and screen.

Bookstore and library would get CD ROMs containing the publishers' series, or have direct access to a central digital library. Often requested material may be copied onto the bookstore's own data carrier. How this actually looks is a matter of the financial situation of the bookstore or library. As an advantage, the flexible document would not need too

much memory for storage because it consists of text and hints only; the layouts are saved independent of the data, the text information.

The central digital library is nothing but a large pool of publisher's data — centrally organized for easy access to any title and for an overview. Special organizational software could be developed not only to handle the database, but also to automate the embedding of new material into existing lists or updating editions (showing older editions in the second line). A very important aspect is that older editions always *must* be available.

Paperback and hardback The Digital Book means a "paperback book" first of all. Producing single exemplars would not pose a problem with slightly improved copying or printing machines. I think of covers like that of some publications of the Gutenberg-Gesellschaft[5] in Mainz, Germany, as there were *Gutenberg-Preis der Stadt Mainz und der Gutenberg-Gesellschaft verliehen an Hermann Zapf, Darmstadt, am 24. Juni 1974* and Hermann Zapf: *Schrift und Buch in der Welt von morgen*,[6] or Hermann Zapf and John Dreyfus: *Classical typography in the computer age*.[7] I prefer the covers of the first two publications because they have an additional paper jacket covering the actual paperback.

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Conclusion

The development of a flexible document format, the Digital Book, could be similar to the development of typefaces. At the very beginning there is the written hand, its form a result of the pen and the movement of the hand — any piece of writing, any letter, any stem and any shoulder is unique. The first printing with movable punches imitates handwriting, but here the model of the letter, finding the essence of the letter, is important. The printed matter, though manufactured in lots, still can be seen as an original because the typeset model gets destroyed after the act of printing. Photosetting imitates setting with movable type; the whole process becomes more abstract, but that's all. Hell's scanned typefaces increase the level of abstraction by translating the actual letter into digital points. Likewise it is possible for the first time to store a book model digitally for further use. As the momentary peak of development, letters are described in points and curves in between, irrespective of what kind of curve description is actually used; letters can be distorted, interpolated, etc. The digital letter is the model — the ideal — that slightly adjusts its actual face depending on the printing method in use. (Perhaps the Metafont idea marks the latest step, allowing the

highest degree of abstraction, bringing factors like pen width and movement together. Mr. Knuth makes the computer do what the calligrapher does.[8]) The main principles did not change even with digital type. (So I was surprised and disappointed when I used font production software for the first time and realized that font formats are already working with bearing marks to determine letterspacing — though this couldn't have been more than a make-shift done by the first printers when using lead type, instead of working with generally defined distances within letter groups and their combinations.) Digital typography can offer more than just an imitation of traditional techniques. Layout and page make-up need not be fixed, they can be as mutable as type. Flexibility in typography might be helpful: typography itself has to serve the reader, and if it is flexible to fit the reader's needs, so much the better.

Typographic form and its arrangement does influence the reader's mood and prepares him for what's coming. But unless he is a type designer or typographer, once reading has started, attention to the typeface and its arrangement tends to evaporate. Now legibility and readability of typeface and its setting or comfort in reading is important. Whether a book has a large or small size, whether its margins are broad or not, or whether marginalia is present, depends on the reader and his motivation for reading the book. Therefore, typography must be flexible; there is never just one solution for the typographic presentation of a text, unlike some typographers' proclamations.

Among the articles on the documents on demand idea, I found not one author claiming among the idea's assets that of a flexible layout. Everyone thinks only of scanned book pages (those might be more than sufficient for thoughtfully typeset books). But a flexible or mutable book design, as book design in general, is never really touched upon, perhaps because most of the people who work on and with documents on demand are "ordinary readers" — not typographers. And maybe they are not readers at all — or have no particular purpose to their reading.

Creating a unique layout is not the principle idea, but it may become an important factor in the future. Books and journals may get layouts conceived by the producer of the document format; following basic structural rules limits choice and makes sure that the user later might choose a different layout to suit the printed matter to his needs or aesthetic habits. For non-publishers' layouts, classical typography should be the first attempt at systematic work. Classical typography doesn't mean glorifying and thoughtlessly imitating anything older

than a hundred years or so, but structuring the text optically with a simple but aesthetic layout — turning the inside of a text out. As Bernard Newdigate wrote in his *Book production notes*: "Good printing is sane printing; and sane printing is plain printing."[9] The structural basics and therefore the layout will be simple in the beginning, but — in close connection with publishers and typographers — should be improved and extended as soon as possible.

All parties — authors, designers, publishers, and customers — must understand and accept that with the Digital Book system they won't deal in touchable, sensible goods. The participating producers will only see proofs. It is the reader who will choose his books and a design appropriate to his reading habits and demands, and will receive his personal sensible piece of printing. It is his responsibility to make the possible into the actual.

The text itself is an untouchable good. Only the design is adaptable to the reader's needs. The designer does not offer one best design solution anymore; rather he determines the means of design; he offers possibilities and thus limits possibilities. It is the designer's task to support the author in structuring his thoughts and finding possible ways of typographic representation. The Digital Book allows for contingency regarding the actual design of a book, but this actual typographic form must show continuity and certainty — and here it is both the programmed rules and the designer's care that limit means in order to keep continuity and clarity in design.

Endnotes

1 Eco, Umberto. 1995.
Das Buch, ein technisch vollendetes Meisterwerk. In Das alte Buch und das Meer. Neue Streichholzbriefe. Munich: Carl Hanser Verlag, 11-12.
[The gloss in question was written in October 1994.]

2 McLean, Ruari. 1995. *Typographers on type*. London: Lund Humphries.

3 Stinehour, Roderick D. 1984. "Books and technology: A printer's view." In Proceedings of the *American Antiquarian Society* 94:1.

4 Gill, Eric. 1993. *An essay on typography*.
Boston: David R. Godine, 105. [Reprinted from the original 1936 edition.]

5 Gutenberg-Gesellschaft. 1975.
Gutenberg-Preis der Stadt Mainz & der Gutenberg-Gesellschaft verliehen an Hermann Zapf, Darmstadt, am 24. Juni 1974. Mainz: Gutenberg-Gesellschaft.

6 Zapf, Hermann. 1970.
Schrift und Buch in der Welt von morgen. Mainz: Gutenberg-Gesellschaft.

7 Zapf, Hermann and John Dreyfus. 1991. *Classical typography in the computer age*.
Los Angeles: University of California Press.

8 Knuth, Donald E. 1982. "The concept for a Metafont." *Visible Language* 16:1, 3-27.
—. 1985. "Lessons learned from Metafont. *"Visible Language"* 19:1, 35-54.

9 Newdigate, Bernard. 1986. A blue book on printing. In *Book production notes from The London Mercury 1920-1922*. London: Tabard Private Press.

Karsten Lücke

is studying communication design

at Universitat-Gesamthochschule Essen.

His main interests are calligraphy,

type design, typography and eveything

related to it.

Abstract

This paper describes two experiments that explore the effect of line length (a factor influencing the legibility of print) and paging versus scrolling on reading from screen. Long lines (100 characters) were found to be read faster than very short lines (25 characters), while comprehension remained constant. People's judgments of the ease of reading different line lengths did not correlate with their performance. The long lines were considered least easy to read, and moderate line lengths (55 characters per line) easiest to read. When scrolling, people adopted various reading patterns which influenced reading rate. These results could not be predicted from literature on the legibility of print and suggest that designing for screen may need to be approached in a different way. The potential effects of differences between screen and paper need to be carefully considered.

Dept. of Typography & Graphic Communication
The University of Reading
Reading RG6 6AU
United Kingdom

Visible Language, 32.2
Dyson and Kipping, 150–181

M. C. Dyson@reading.ac.uk

The Effects of Line Length and Method of Movement on Patterns of Reading from Screen

Mary C. Dyson and Gary J. Kipping

Introduction

Although the demise of the printed page did not come about as forecasted in the 1980s, perhaps due to the success of desktop publishing, the relatively recent popularity of the Internet is certainly influencing reading habits. It is now relatively common for people to read text on screen. Although most users can determine the look of World Wide Web pages through setting preferences in their software browser, the integration of style sheets into HTML documents puts some control back into the hands of designers. It therefore seems to be particularly important to investigate factors that may affect read-ing performance using current display technologies. We do not yet know what are the most legible layouts for reading from screen.

There are many variables that could be tested when investigating the legibility of text on screen. For example, various display characteristics such as contrast, flicker, aspect ratio and image polarity have been considered (Gould et al., 1987; Dillon, 1992). However, from a typographical perspective, variables such as fonts, type size, line and character spacing, line length and column structure are of more interest. One way of choosing between these alternatives is to estimate their relative importance by looking at the strength of the effects that have been demonstrated in previous research.

Line length is a typographic variable that has been shown to affect the legibility of print (Tinker, 1963). Research has led to recommendations that line lengths should not exceed about 70 characters per line (e.g., Spencer, 1968). The explanation for this finding is that both very short and very long lines slow down reading through disrupting the normal pattern of eye movements.

However, reported differences in reading speed when reading from screen as opposed to paper (see Dillon, 1992 for a review) have suggested that reading from screen may be more difficult. Such differences should urge caution in simply adopting the findings of traditional legibility research for reading from screen. Although it is tempting to as ume that guidelines for the legibility of print can be generalized and applied to screen displays, this has not been verified (Grabinger and Osman-Jouchoux, 1996). As early as 1981, Kolers et al. warned that "uncritical extrapolation from printed page to electronic page may not be justified."

It is possible that some of the factors that differentiate reading from print and screen may influence the optimal line length. For example, a shorter line length on screen may assist the reader in counteracting some of the negative characteristics of the display, such as low resolution, flicker, etc. Alternatively, as we tend to sit further away from the

screen than from printed matter when reading (Gould et al., 1987), it could be argued that a longer line length is more appropriate on screen, as the visual angle may be comparable to reading print. A longer line also increases the volume of text that is presented on a single screen which may be beneficial.

Some research by Duchnicky and Kolers (1983) that looked at the effect of line length when reading from a VT100 display terminal found that the longest line length tested (about 75 characters per line) was read fastest and comprehension remained constant. This result does not agree with Tinker's proposed optimal line length for the printed page.

Research on reading from VDUs in the 1980s obviously used older technology, varying in resolution, image polarity, character shapes, etc. There is therefore, once again, a question as to how far these results can be generalized. In this instance, the relevant difference is not the medium (print versus screen), but the nature and range of graphic and typographic characteristics afforded by current interfaces, compared to 1980s displays. Nevertheless, both strands of research (legibility of print and reading from older VDUs) can provide guidance as to which typographic variables may be worth considering.

A variable that may affect reading from screen, which would not emerge from comparisons with print, is the means by which readers advance through a document (i.e., paging and scrolling). More than a decade ago, Duchnicky and Kolers (1983) identified the flow of information from display to user as an important issue in reading texts from VDTs. However, around that time, research investigating paging and scrolling did not produce any clear findings. For example, Schwarz et al. (1983) found no differences in time between the two methods on a number of tasks.

Early experiments (e.g., Kolers et al., 1981; Duchnicky and Kolers, 1983) restricted the user to continuous scrolling, whereby the document scrolled at a range of prescribed rates. Current interfaces allow users to control their speed of scrolling through documents using either a scroll bar, manipulated with a mouse, or cursor keys. These allow for pauses between movements. A further difference between older and newer technology is the speed of screen-refill. As late as 1990, Dillon et al. were using large screens which took nine seconds to refill in a paging mode. There appears to have been no recent empirical work that has compared reading performance using current paging and scrolling mechanisms.

Research that was guided by rather different objectives suggests a model for examining the way in which people scroll through a document. Harri-Augstein et al. (1982) obtained reading records through the use of a machine with text typed on a cylindrical roll of paper with the purpose of identifying reading tactics and strategies. Participants controlled the rate at which they moved through the document by operating a handle and this movement was plotted on a graph. In principle, this method of presenting text is similar

to current methods of scrolling through text on screen. Recording participants' scrolling methods at different line lengths may provide useful information on their reading patterns.

The experiments reported in this paper investigate two factors that may influence reading from a typical current screen display: line length and method of movement (scrolling and paging). The approach taken aims to identify optimal conditions for presenting text on current interfaces, rather than make comparisons with reading from paper. The legibility of the text is assessed by measures of reading rate, comprehension and perceived ease of reading. Schumacher and Waller (1985) categorize these dependent variables as outcome measures, as they provide an indication of the end result of reading.

Another way of examining reading is to capture how readers use a document, which Schumacher and Waller would regard as a process measure. With increasing interest in hypertext and alternative ways of navigating through documents, process measures are becoming more relevant (Dillon, 1992). In these experiments, some indication of the process of reading was sought by examining reading patterns at different line lengths when scrolling through text.

Experiment 1

Overview

Participants were asked to silently read a series of documents displayed on screen and the time taken to read each document was recorded. Comprehension was assessed by a number of questions on each document, for which participants had to say whether the questions were answerable or not. On completion of the reading task, participants were asked to compare a series of pairs of documents and to say which of each pair they thought was easier to read. The line lengths chosen spanned a range from a narrow column to a line length that filled the screen.

Method

▷ Equipment

A Compaq Prolinea 575 computer was used to present the experimental material on a Sony Multiscan 15sf color monitor with a video image area of 11.25" by 8.5" (14" maximum viewing image). This was set to a resolution of 800 x 600 pixels and 256 colors. The monitor was placed on a stand and adjusted to a fixed height that was intended to suit most people. Participants were able to chose where they sat in relation to the monitor, while being able to reach the keyboard. The mouse was placed out of reach as participants interacted solely via the keyboard, which was covered so as to reveal only those keys that participants needed to use.

▷ Material

A selection of documents was taken from the Microsoft Network. This source of material

was selected as typical of documents that are read from screen. The documents were chosen on the basis of their length, how interesting they appeared to be and the amount of Americanisms that were included. As the experiment was carried out in the United Kingdom, it was considered appropriate to minimize the extent of American terminology and phrases.

The documents were edited to approximately equal lengths (about 800 words[1]) by deleting text from the end, ensuring that the story line remained intact. Where necessary, the number of paragraphs was adjusted so that each document contained similar numbers of paragraphs.

Comprehension was checked by preparing questions on each document, of which approximately half could be answered by the text and the remainder could not. This technique was used by Kolers et al. (1981) and subsequently Duchnicky and Kolers (1983) to verify that people had actually read the text. It requires participants to recall the content of the document they have read while avoiding the problems of accurately assessing free recall. The level of difficulty of this task was checked in a pilot study to ensure that the questions were neither too easy nor too difficult.

▷ **Document presentation**

The two parts of the experiment involved different methods for moving through the document. In the scrolling condition, when participants pressed the down arrow key on the keyboard, the cursor moved down line-by-line and the up arrow key moved back up. It was pointed out to participants that both single key presses or holding down the key would advance the document. In the paged condition, the same down arrow key replaced the screen of text with the next part of the document, a result similar in effect to turning the page of a book. The up arrow key returned to the previous screen of text.

Documents were displayed in Microsoft Word for Windows version 7 in full screen mode. In the scrolled condition, documents were displayed in Normal view, whereas the paged condition used Page Layout view. These settings were chosen to provide a consistent interface across the two parts, whereby the same keys could be programmed to advance the text by line or by screen. Items such as tool bars, menu bars and scroll bars were removed from view.

The margin settings were adjusted to produce identical screens of text for scrolling and paging. A full screen of text contained thirty-seven lines and documents displayed at the shortest line length generally extended over a little more than four full screens. At the longest line length, the text filled one screen with a few lines on the next screen.

The text was black and positioned on the left of the screen and viewed against a white background that completely filled the screen. The font used was Arial in a size of 10 point with 12 point interlinear spacing. Paragraphs were signaled by a first line indent of 0.15

inches, but in line with typographic practice, this indent was not applied to the first paragraph of the document. The text was left aligned, with no justification or hyphenation.

Procedure

The sample of participants represented a spread in terms of age and computer experience to reflect different types of potential users. Age was recorded in bands ranging from under 18 to 64 years old. The majority of participants fell into the age range 25-34, perhaps reflecting their interest in this type of experiment and the method of recruitment. However, there were nine under 25 and eighteen people over 34. Participants rated their own computer experience from 0 = 'never use computers' to 5 = 'use computers virtually all the time.' The sample appeared to use computers fairly frequently as twenty-nine self-ratings were 3 or above and only nineteen used the lower ratings.

The experiment was divided into two parts and twenty-four participants completed each part. Each participant was asked to read six documents with different line lengths of approximately 25, 40, 55, 70, 85, 100 characters per line (cpl). **Figure 1** and **2** illustrate the two extremes of 25 and 100 cpl. The pairing of documents with line lengths and the order of presentation was determined by a Greco-Latin square balanced design. This ensured that each line length was applied to each of the documents, and participants were presented with line lengths in different orders.

On Friday doctors ruled that President Boris Yeltsin must stay under close medical supervision until the end of November, denting his foreign policy hopes and campaign plans for the December parliamentary elections.

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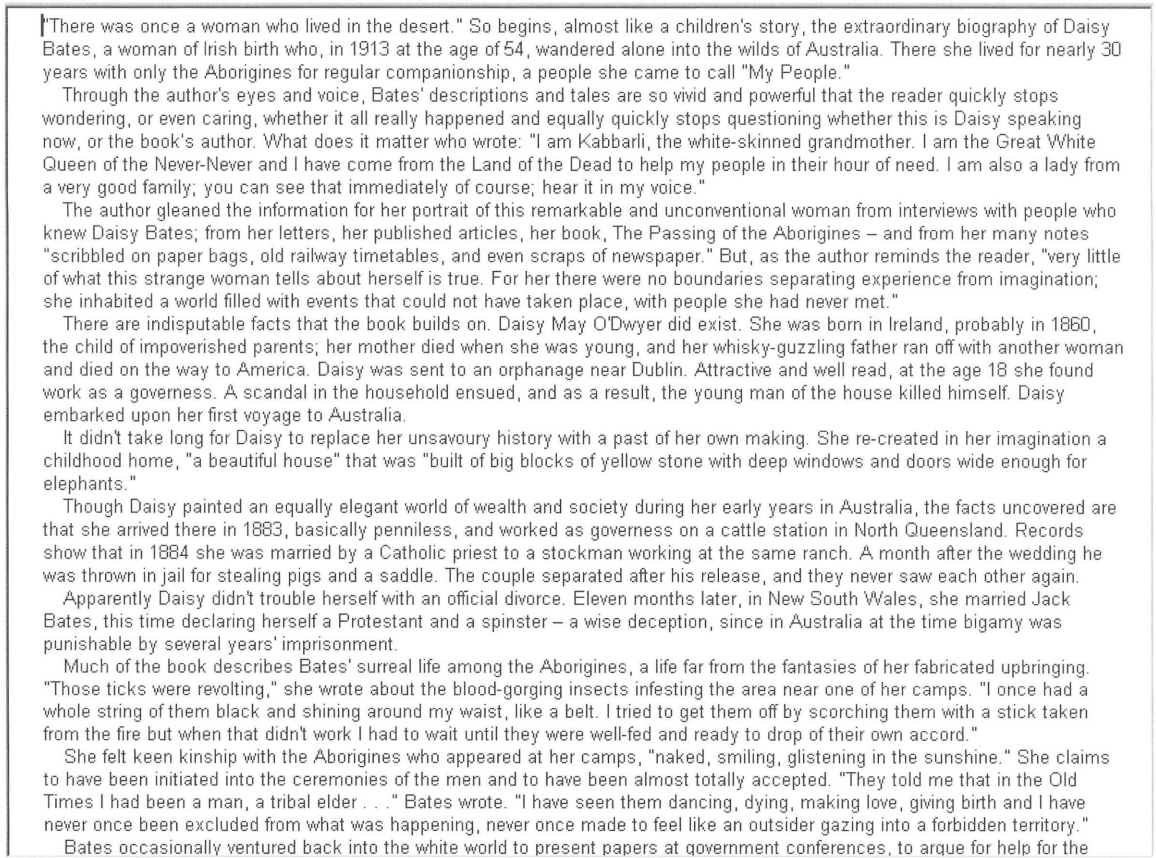
Yeltsin's press secretary, Sergei Medvedev, told the Tass news agency that the 64-year-old Kremlin leader was suffering from "an unstable blood supply to the heart." "There have been no signs of a heart deficiency up to now, and I stress up to now," Medvedev added at a later news conference. "The doctors came to the conclusion that the president will have to stay under their close supervision during October and November," he told Tass. Little real detail on the president's condition emerged, apart from Medvedev saying he had not lost consciousness since falling ill. It is however known that aides were told to stay away from Moscow's Central Clinic Hospital and only doctors and security officials were allowed near him. It was unclear if

Figure 1 75% reduction from the example of a document of 25 characters per line used in Experiment 1.



"There was once a woman who lived in the desert." So begins, almost like a children's story, the extraordinary biography of Daisy Bates, a woman of Irish birth who, in 1913 at the age of 54, wandered alone into the wilds of Australia. There she lived for nearly 30 years with only the Aborigines for regular companionship, a people she came to call "My People."

Through the author's eyes and voice, Bates' descriptions and tales are so vivid and powerful that the reader quickly stops wondering, or even caring, whether it all really happened and equally quickly stops questioning whether this is Daisy speaking now, or the book's author. What does it matter who wrote: "I am Kabbarli, the white-skinned grandmother. I am the Great White Queen of the Never-Never and I have come from the Land of the Dead to help my people in their hour of need. I am also a lady from a very good family; you can see that immediately of course; hear it in my voice."

The author gleaned the information for her portrait of this remarkable and unconventional woman from interviews with people who knew Daisy Bates; from her letters, her published articles, her book, The Passing of the Aborigines – and from her many notes "scribbled on paper bags, old railway timetables, and even scraps of newspaper." But, as the author reminds the reader, "very little of what this strange woman tells about herself is true. For her there were no boundaries separating experience from imagination; she inhabited a world filled with events that could not have taken place, with people she had never met."

There are indisputable facts that the book builds on. Daisy May O'Dwyer did exist. She was born in Ireland, probably in 1860, the child of impoverished parents; her mother died when she was young, and her whisky-guzzling father ran off with another woman and died on the way to America. Daisy was sent to an orphanage near Dublin. Attractive and well read, at the age 18 she found work as a governess. A scandal in the household ensued, and as a result, the young man of the house killed himself. Daisy embarked upon her first voyage to Australia.

It didn't take long for Daisy to replace her unsavoury history with a past of her own making. She re-created in her imagination a childhood home, "a beautiful house" that was "built of big blocks of yellow stone with deep windows and doors wide enough for elephants."

Though Daisy painted an equally elegant world of wealth and society during her early years in Australia, the facts uncovered are that she arrived there in 1883, basically penniless, and worked as governess on a cattle station in North Queensland. Records show that in 1884 she was married by a Catholic priest to a stockman working at the same ranch. A month after the wedding he was thrown in jail for stealing pigs and a saddle. The couple separated after his release, and they never saw each other again.

Apparently Daisy didn't trouble herself with an official divorce. Eleven months later, in New South Wales, she married Jack Bates, this time declaring herself a Protestant and a spinster – a wise deception, since in Australia at the time bigamy was punishable by several years' imprisonment.

Much of the book describes Bates' surreal life among the Aborigines, a life far from the fantasies of her fabricated upbringing. "Those ticks were revolting," she wrote about the blood-gorging insects infesting the area near one of her camps. "I once had a whole string of them black and shining around my waist, like a belt. I tried to get them off by scorching them with a stick taken from the fire but when that didn't work I had to wait until they were well-fed and ready to drop of their own accord."

She felt keen kinship with the Aborigines who appeared at her camps, "naked, smiling, glistening in the sunshine." She claims to have been initiated into the ceremonies of the men and to have been almost totally accepted. "They told me that in the Old Times I had been a man, a tribal elder . . ." Bates wrote. "I have seen them dancing, dying, making love, giving birth and I have never once been excluded from what was happening, never once made to feel like an outsider gazing into a forbidden territory."

Bates occasionally ventured back into the white world to present papers at government conferences, to argue for help for the

Figure 2 75% reduction from the example of a document of 100 characters per line used in Experiment 1.

Practice documents of 55 cpl were provided to ensure that participants knew how to move through documents with the cursor keys and to familiarize them with the type of questions they would be asked, having read the document.

As participants read and moved through the document with the down and up keys, the time of each key press (and whether it was up or down) was recorded by the programs controlling the experiment. The amount of time that each participant spent in scrolling through the document could therefore be calculated.[2] These figures are useful when considering the differences in reading rate (pausing + scrolling) between documents varying in line length and consequently, number of lines.[3]

On completion of the reading task, participants were given a set of five written questions to tick or cross according to whether they thought they could or could not be answered by the text. They were unable to refer back to the document.

Finally, participants were asked to give their subjective views on the ease of reading documents in different formats. A document that had not previously been read was used to generate a series of fifteen paired comparisons. Participants were asked to compare documents at each line length with every other line length and say which they thought was easier to read. As no further explanation was given, participants were free to interpret "easy to read" in whatever way they wished. The order of the two documents within the pair and the order of the pairs were randomized for each participant. Participants controlled the presentation of each document themselves by pressing appropriate keys. They were able to go back and forth between the two documents as often as they wished and move down through the document before reporting their choice to the experimenter. The methods of movement (either paged or scrolled) were the same as they had used in the reading task.

Results

The total reading time per document was used as a measure of reading rate. The key press data was used to determine the extent to which participants backtracked (using the up keys) through the documents and to examine the pattern of movements and pauses between movements. The key presses used in scrolling were translated into a set of discrete movements.[4]

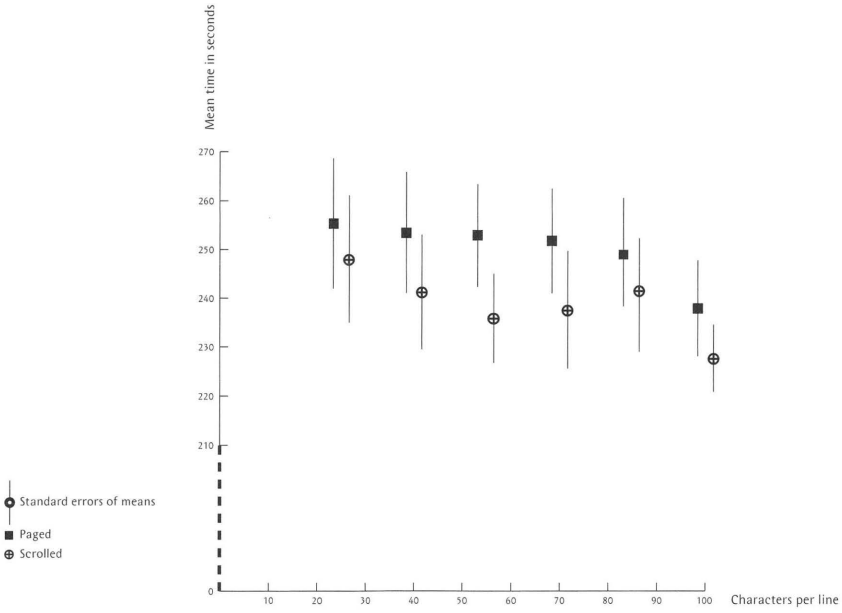
To assess comprehension, a discrimination index labeled p(A) (McNicol, 1972) was calculated from participant's responses to the questions on the content of the documents. This calculation takes bias into account, such as, for example, a bias towards saying "yes." These scores were transformed for statistical analysis (2 arcsin $\sqrt{p(A)}$).

Subjective ratings of ease of reading were analyzed by looking for agreement between participants on which of each pair was reported as easier to read.

▷ Reading rate

Mean total times for each line length using the two methods of movement are shown in **Figure 3**. The standard error bars give an indication of the amount of variability between participants.

Figure 3 Mean times to read documents across 6 line lengths and 2 methods of movement (paged and scrolled).



Analysis of variance shows that there is a statistically significant difference between the different line lengths ($F(5,230)=3{\cdot}08$, $p=0{\cdot}01$). The number of characters per line affects reading rate. There is no main effect of method of movement, so reading rates are not significantly different in the scrolled and paged conditions. There is also no interaction between line length and method of movement. A similar pattern of reading rates across the six line lengths is found in both scrolled and paged conditions.

A *post hoc* test (Duncan's Multiple Range) was used to identify which line lengths were significantly different from other line lengths. This indicated that 100 cpl is read

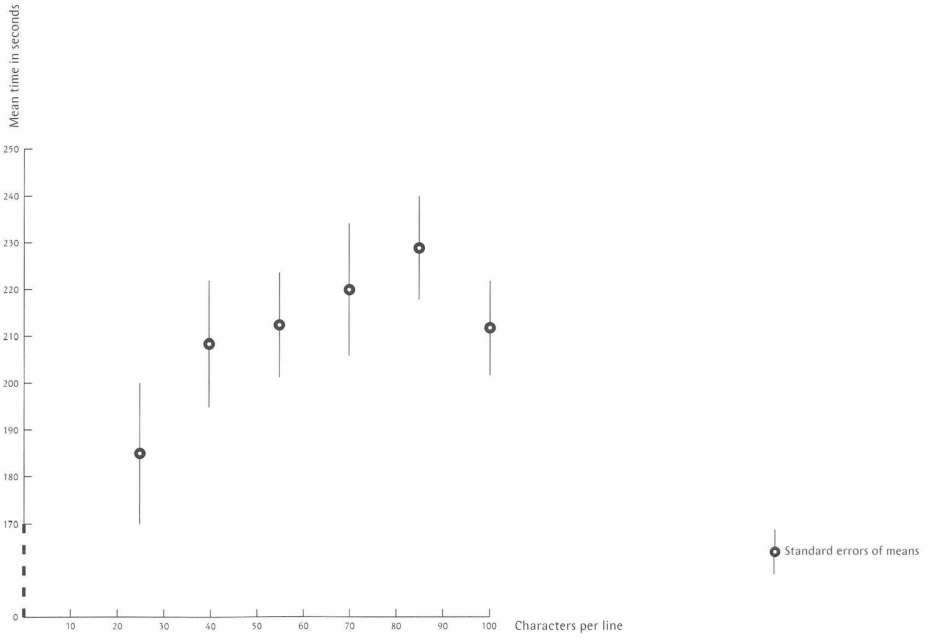
significantly faster than 25 cpl in both the scrolled and paged conditions ($p<0{\cdot}05$). No other pairwise comparisons between individual means within each method of movement were significantly different.

▷ **Key presses**

In the scrolled condition, backtracking occurred in only four documents and these were spread across four line lengths. When documents were paged, only three participants went back to previous screens and three line lengths were involved. Therefore, there does not appear to be any systematic effect of line length on backtracking.

The record of key presses can also be used to measure the amount of time participants spent in scrolling down. If this time is removed from the total reading time, the amount of time spent pausing is identified. There is a different pattern of results across line lengths (cf. **Figures 4** and scrolled condition of **Figures 3**). A one way analysis of variance shows that there is still a statistically significant difference between the line lengths ($F(5,115)=4{\cdot}4$, $p=0{\cdot}001$). However, Duncan's Multiple Range test identifies the significant difference between the line length of 25 characters and all the other line lengths ($p<0{\cdot}05$). Significantly less time is spent in pausing between scrolling movements at 25 cpl.

Figure 4 Mean total times spent in pauses across 6 line lengths.



Further examination of participants' method of scrolling reveals differences in the number of discrete (as opposed to continuous) movements. To look for identifiable patterns, participants were split into two approximately equal groups, according to the number of discrete movements they made at each line length. The time spent in movement and time spent pausing between movements is listed for each group at each line length (**Table I**).

Table I. Mean times in movements and pauses according to number of movements.

LL	NM	N	TM	TP
25	≤ 9	12	44	203
	> 9	12	82	167
40	≤ 6	12	20	230
	> 6	12	45	188
55	≤ 3	11	14	225
	> 3	13	27	202
70	≤ 3	13	11	217
	> 3	11	21	223
85	≤ 2	14	10	218
	> 2	10	14	247
100	< 2	9	8	204
	≥ 2	15	13	217

NM number of movements
N number of participants
TM total time in movement (in seconds)
TP total time in pauses (in seconds)

Figures 5 and **6** splot the mean total times spent in pauses (between movement) together with the time spent in movement at each line length. **Figures 5** represents those participants who used the least movements and **Figures 6** participants who used a greater number of movements. These graphs provide a means of comparing the relative contribution of scrolling and pauses to overall reading time across line lengths. An estimate of the amount of time required to simply scroll[5] from the beginning to the end of the documents, without attempting to read the text, is also shown on the graphs.

Figure 5 Mean total times spent in movement and pauses across 6 line lengths for participants making the least number of scrolling movements.

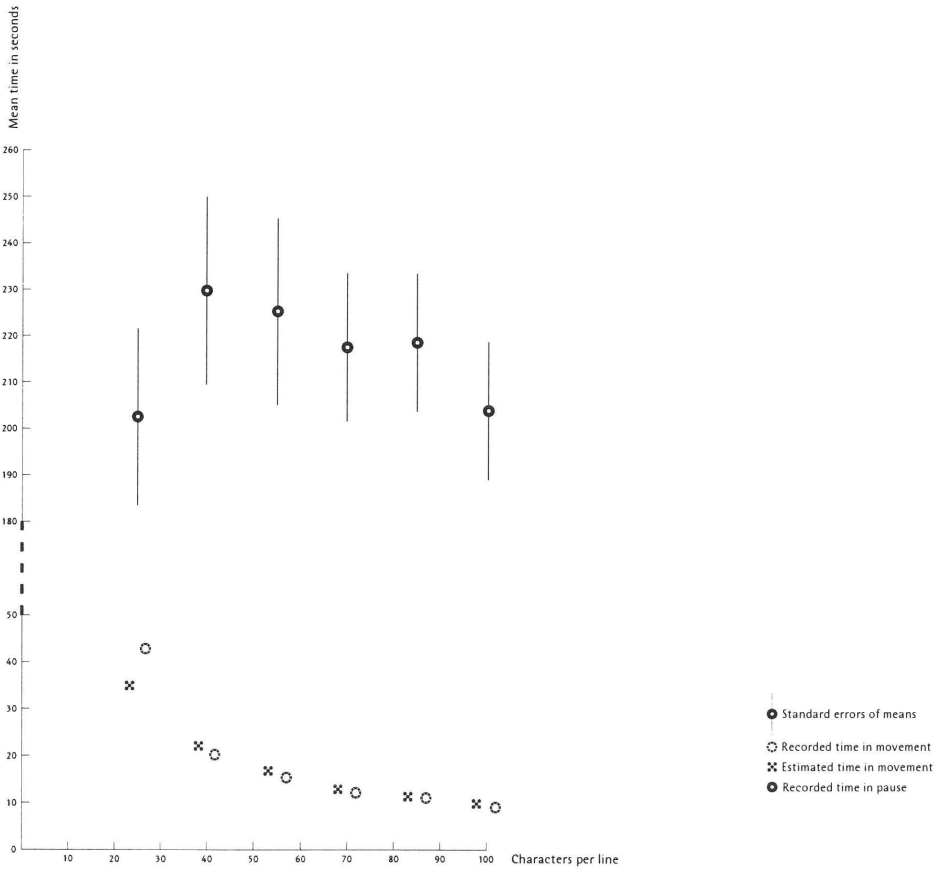
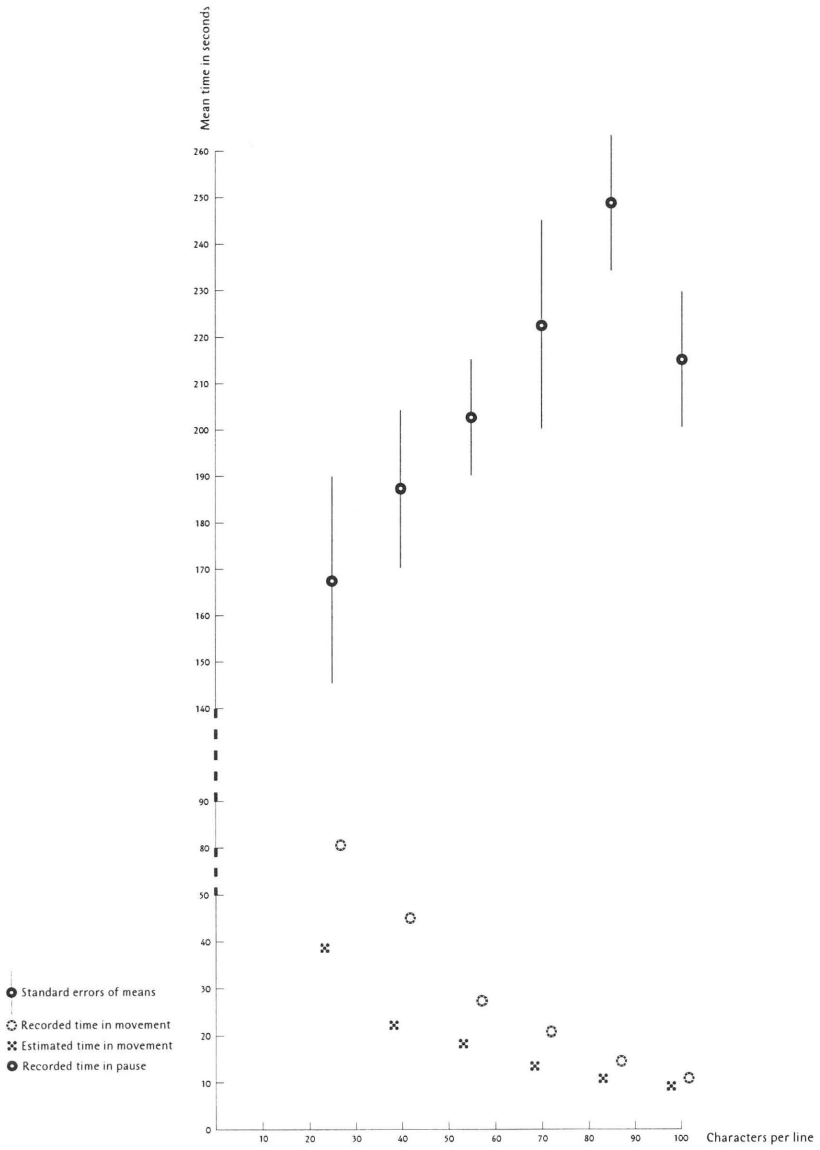


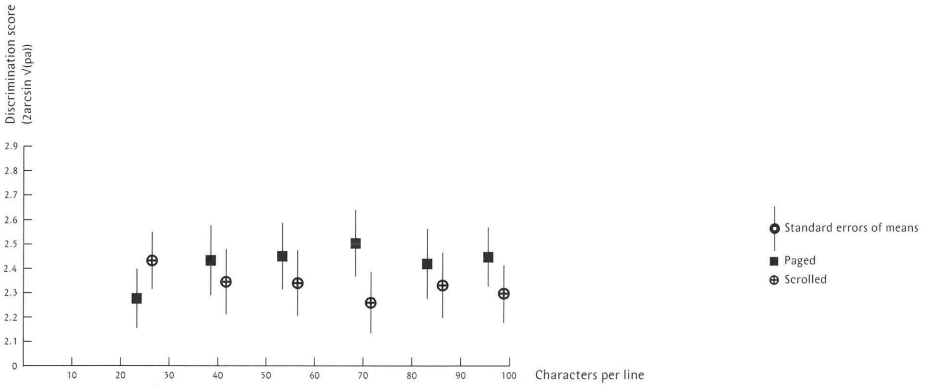
Figure 6 Mean total times spent in movement and pauses across 6 line lengths for participants making the largest number of scrolling movements.



▷ Comprehension

The average discrimination scores for each line length are plotted in **Figures 7**. The mean scores are above chance (1·57) and less than perfect performance (3·14). However, there is no significant effect of line length on comprehension, with large variation between participants, as shown by the standard errors. There is no evidence of a trade-off between speed of reading and comprehension.

Figure 7 Mean discrimination scores across 6 line lengths and 2 methods of movement (scrolled and paged).



▷ Subjective ratings of ease of reading

Documents with 55 cpl were judged as easiest to read, using scrolled or paged movement. The ranked order from easiest to read to least easy to read for scrolled and paged is shown in **Table II**. The pattern is similar, although not identical, across the two methods of movement.

Table II Ranked order of perceived ease of reading with easiest at the top.

Scrolled	Paged
55	55
70	40
40	70
85	85
25	25
100	100

There was a consistency in participants' judgments of ease of reading despite the lack of a definition. A one-way χ^2 test on the fifteen pairs was significant for both scrolled (χ^2=119·50, 15df, p<0·005) and paged conditions (χ^2=123·67, 15df, p<0·005). However, comparisons of some pairs were less clear cut where individual χ^2 were not significant. In some comparisons, participants did not agree on which of the pair was easier to read (**Table III**).

Table III Comparisons where there was disagreement over ease of reading.

Scrolled	Paged
25 vs. 85	25 vs. 85
25 vs. 100	25 vs. 100
40 vs. 55	40 vs. 55
40 vs. 70	40 vs. 70
40 vs. 85	
55 vs. 70	

Discussion

These results illustrate an interesting disjunction between participants' perceptions of ease of reading and their performance. There is no obvious relationship between participant's ranking of ease of reading and their reading rate or discrimination score. As "ease of reading" was not explicitly defined, participants were able to use their own interpretation of this phrase. The general similarity of responses between participants suggests that they may share a common understanding. However, the bases for their judgments are unclear.

A comparison of subjective judgments, reading rates and comprehension scores shows that participants are not basing their judgments on feedback from their speed of reading or degree of understanding. It is possible that they may instead be monitoring their level of comfort or discomfort when reading. Alternatively, their views of what is easiest to read may be influenced by line lengths they typically experience in reading certain types of printed material, e.g., 50–70 cpl. Although using preference rather than ease of reading as a criterion, Grabinger (1993) found an advantage for lines of 45–60 cpl over longer lines.

The finding of faster reading rates at 100 cpl compared with 25 cpl is consistent across scrolled and paged conditions (using independent groups). However, in the scrolled condition, it could be argued that 100 cpl is read faster as less time need be spent in scrolling through the documents, as there are fewer lines of text. In the paged condition, there is very little time spent in navigation as the number of key presses need only be one at 100 cpl and four at 25 cpl.

While it is undoubtedly true that less time is spent scrolling at long line lengths, the removal of scrolling time from the total time (**Figure 4**) suggests that a more complicated explanation may be required. At 25 cpl, participants are spending significantly less total time in pauses between movements. The simple explanation, that they can read documents with shorter lines more quickly, is not supported by the data from the paged condition. An alternative explanation is that participants may be choosing to read while they are scrolling, perhaps compensating for the amount of scrolling that is necessary with such formats. If this were the case, participants may be expected to scroll more slowly. A calculation of the mean speed of scrolling at each line length does indicate that the scrolling rate is slower at 25 cpl, than at longer line lengths.

Further support for the notion that participants may engage in reading while scrolling at shorter line lengths comes from dividing participants into groups according to the number of movements they made. Participants making a larger number of discrete scrolling movements pause for less time than participants making fewer movements (**Table 1**). This pattern is found only for the shorter line lengths of 25, 40 and 55 cpl.

At longer line lengths, and in the case of participants who chose to make fewer movements, there is less discrepancy between the estimated and recorded scrolling times suggesting that less reading may be taking place during movement. Scrolling time is relatively short under these circumstances and the time spent in pauses remains fairly constant across line lengths.

The shorter reading time at 100 cpl may result from faster reading during pauses.[6] A possible reason for this might be the greater volume of text that is available. In comparing two sizes of screen, de Bruijn et al. (1992) found that less learning time was required with a larger screen. They interpreted this advantage in terms of a "larger text context" helping the integration of information units. It is interesting that out of a number of measures used, time on the task revealed differences between the screens.

Another possible explanation for faster reading at 100 cpl is that this line length reduces some glare from the screen. As the documents were viewed in full screen mode with the text positioned on the left of the screen, line lengths that did not fill the screen had an area of white to the right of the text, which may have proved distracting. Glare has been reported as a problem in a comparison of different CRTs (Gould et al., 1987) and was commented on by some participants in this experiment.

These two possible reasons for the effect of line length on reading rate differ in their level of explanation. The facilitating effect of context refers to the cognitive processes involved in reading, whereas differences in the visual presentation can be categorized as perceptual (see e.g., Dillon, 1994). As differences in presentation are easily manipulated, the next experiment explored the possibility that perceptual difficulties, resulting from large

areas of white screen producing glare, may have slowed down reading. Windows of text were placed next to a gray background.

Experiment 1

Overview

This follow up experiment was designed to further examine reading patterns across line lengths and to explore whether faster reading at 100 cpl in Experiment 1 could be due to physical characteristics of the display, rather than properties of the text format. As this line length fills the screen, there were no blank areas that are present with shorter line lengths. These relatively bright areas of screen may have interfered with reading. Therefore, in the current experiment, these areas were replaced with a background color of light gray.

Three line lengths were selected to cover the same range as Experiment 1. The two extremes were included and the line length that participants perceived as easiest to read. Due to the reduction in the number of line lengths tested, it was possible to change to a within subjects design, whereby each participant used both methods of movement.

Method

The general method was the same as Experiment 1, with modifications as necessary to cater for the different conditions. Twenty-four participants read six documents at line lengths of 25, 55 and 100 cpl in both scrolled and paged conditions. The spread of ages was similar to Experiment 1 with twelve people in the range 25-34, four under 25 years old and eight over 34. Their rating of computer experience was also comparable to the previous experiment as two-thirds of the sample used computers fairly often (ratings 3, 4 & 5 where 5 = 'virtually all the time').

The text was displayed in a window positioned on the left of the screen and the width of the window varied to accommodate the three different line lengths, with a margin of about 0.5 inches on the right and left of the text. The remainder of the display, to the right of the window, was light gray. The characters were again presented against a white background. Each window filled the screen vertically and contained thirty-six lines of text. The modification to the display is illustrated in **Figure 8** which shows the shortest line length.

The documents used in Experiment 1 and the corresponding questions were re-used in this experiment, with an additional new practice document. Two practice documents were necessary to familiarize participants with each method of movement and the nature of the questions that would be asked. These were displayed at 60 cpl to avoid repeated exposure to one of the line lengths that was being tested. Documents were presented in a block of three line lengths in each method of movement. Half of the

participants started with scrolled documents and half with paged. A Greco-Latin square design was used to balance the pairing of line length with document and order of presentation, as far as was possible.

A slight modification was made to the procedure for obtaining subjective views of ease of reading. The 15 comparisons not only included pairs of different line lengths, but also pairs in which one document was scrolled and the other paged. Therefore, it was necessary for participants to move through the document to identify the method of movement, so that this factor could also be used in judging ease of reading. Pilot work indicated that participants would tend to base their initial judgment on line length alone, despite requests to move a little way through the document. In order to generate this movement, participants were asked to locate some words that were highlighted in green, which were placed sufficiently far down in the document to require movement in all conditions.

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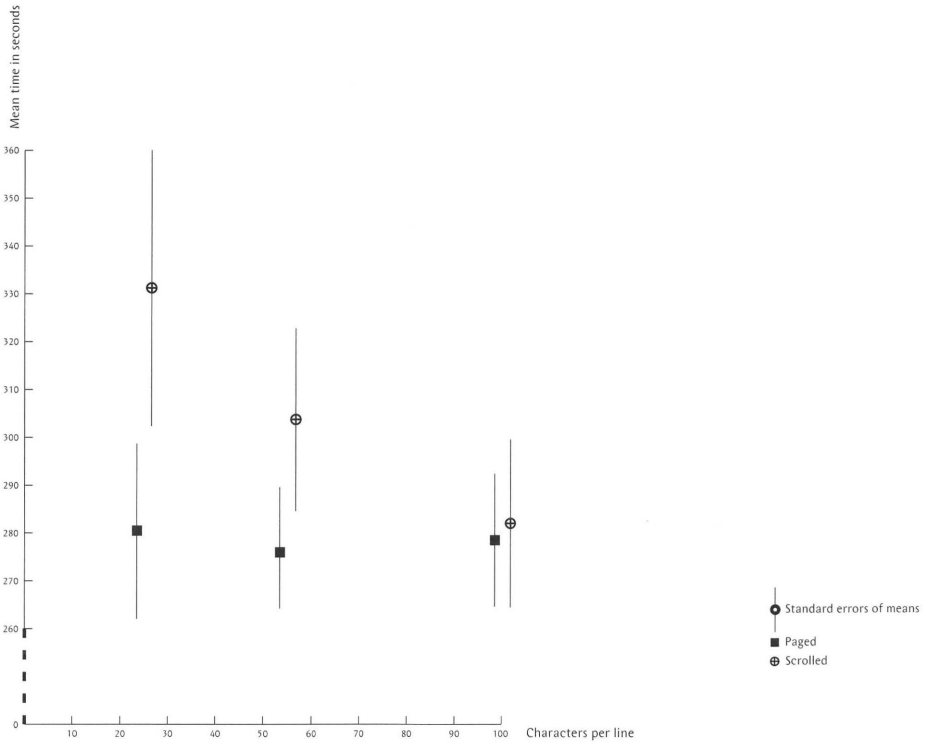
Figure 8 75% reduction from the example of a document of 25 characters per line used in Experiment 2.

Results

▷ Reading rate

Figure 9 shows the mean reading rates for the three line lengths in scrolled and paged conditions. Analysis of variance shows that there is a main effect of line length ($F(2,46)=3{\cdot}98$, $p=0{\cdot}025$). There is also a significant interaction between line length and method of movement ($F(2,46)=4{\cdot}53$, $p=0{\cdot}016$). The difference between scrolled and paged conditions just fails to reach significance ($F(1,23)=4{\cdot}22$, $p=0{\cdot}051$).

Figure 9 Mean times to read documents across 3 line lengths and 2 methods of movement (paged and scrolled).



In this experiment, any differences there are between line lengths are in the scrolled condition. Duncan's Multiple Range test confirms that there is a significant difference between 25 and 100 cpl in the scrolled condition and at 25 and 55 cpl, scrolling is significantly slower than paging ($p<0.05$).

▷ **Key presses**

Participants in this experiment went back in the document more frequently than those in Experiment 1. However, similar amounts of backtracking are found in the three line lengths.

As with Experiment 1, subtracting the time spent in scrolling through the documents from the total time produces a different pattern of results across line lengths (**Figure 10**). However, differences between line lengths are not statistically significant.

Figure 10 Mean total times spent in pauses across 3 line lengths.

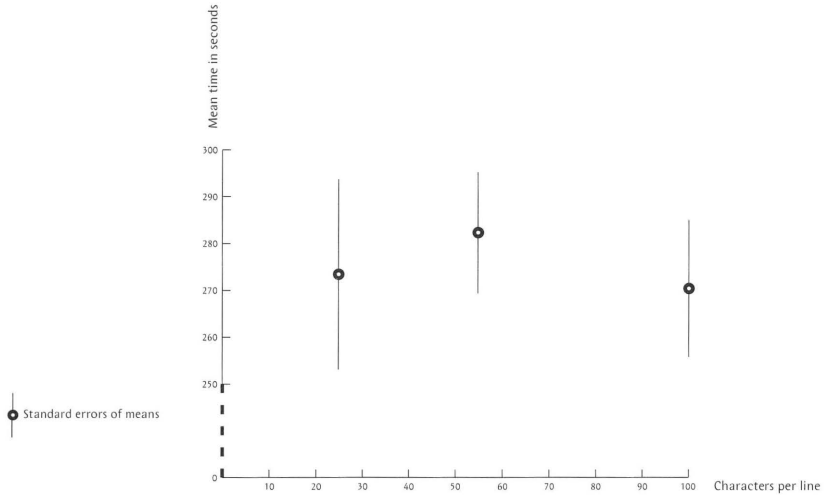


Table IV shows the division of participants' time between scrolling and pausing when participants are grouped according to the number of discrete movements made.

Table IV Mean times in movements and pauses according to number of movements.

LL	NM	N	TM	TP
25	≤7	12	28	255
	>7	12	76	292
55	≤3	13	15	255
	>3	11	29	309
100	<2	12	8	239
	≥2	12	13	300

NM number of movements
N number of participants
TM total time in movement (in seconds)
TP total time in pauses (in seconds)

The relative amounts of time in scrolling and pausing are illustrated in **Figure 11** (for participants making the least number of scrolling movements) and **Figure 12** (for participants making the largest number).

Figure 11 Mean total times spent in movement and pauses across 3 line lengths for participants making the least number of scrolling movements.

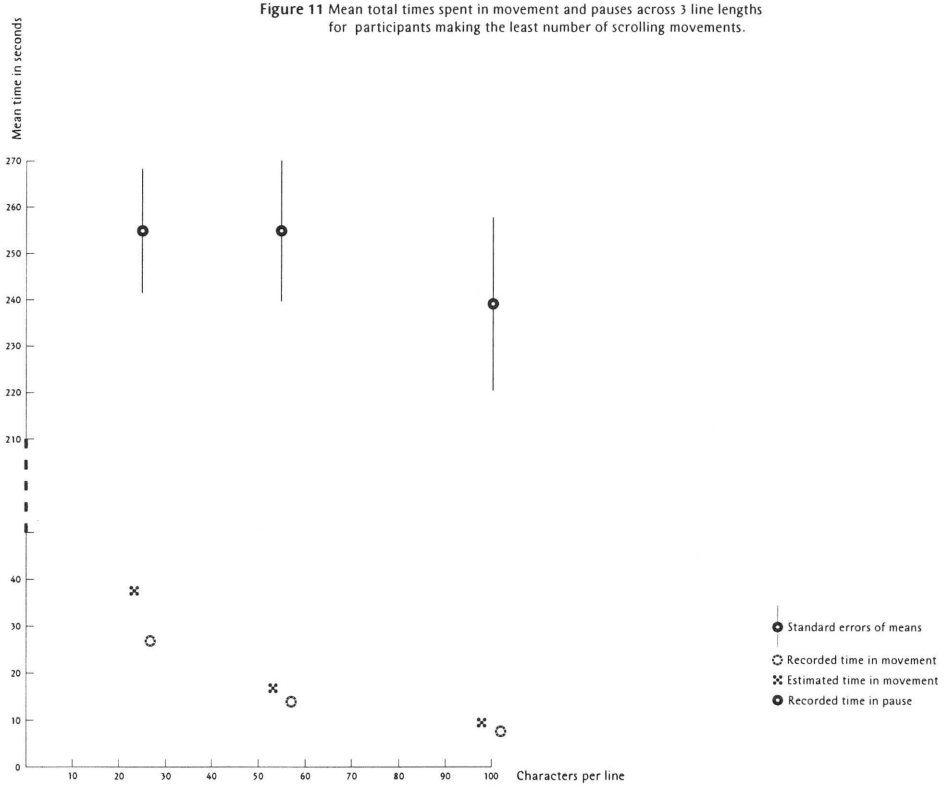
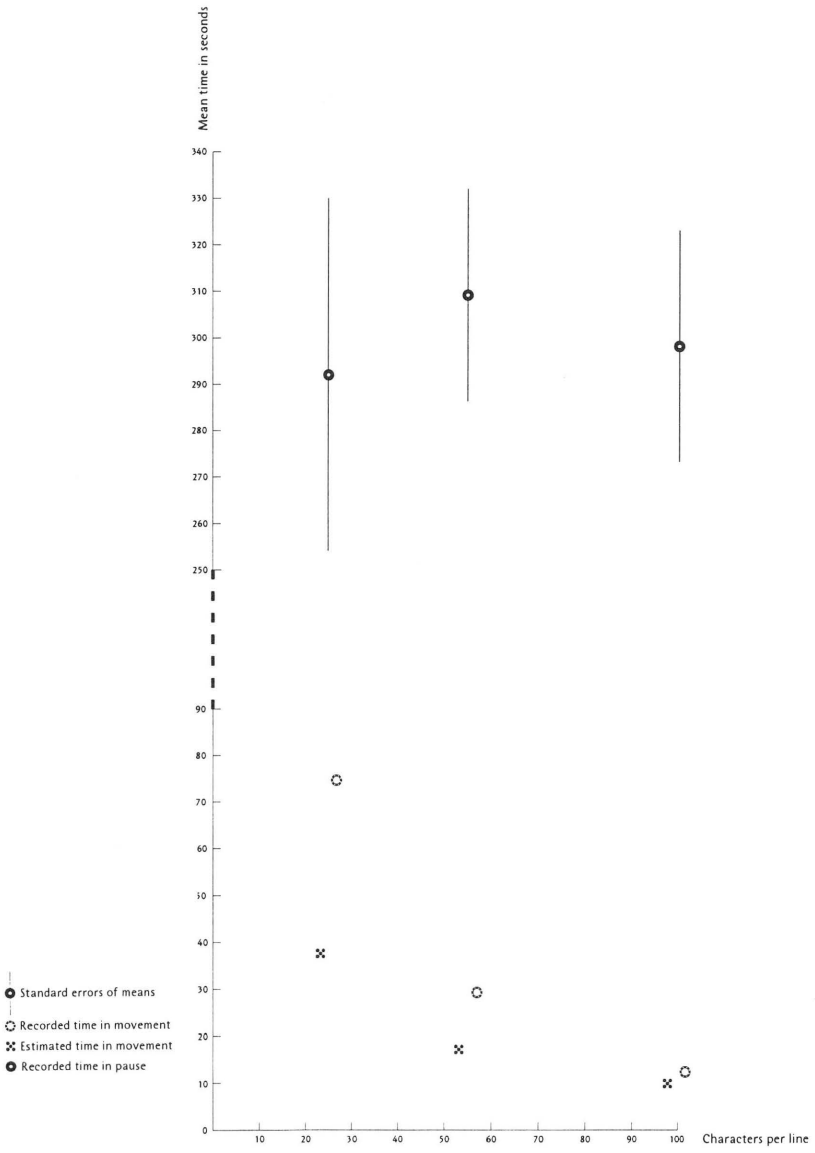


Figure 12 Mean total times spent in movement and pauses across 3 line lengths for participants making the largest number of scrolling movements.



▷ **Comprehension**

As with Experiment 1, there are no statistically significant differences between conditions in terms of discrimination scores. Faster reading rates do not appear to be at the expense of comprehension.

▷ **Subjective ratings of ease of reading**

Once again, there was a consistency in participants' judgments of ease of reading. A one-way χ^2 on the fifteen pairs was significant (χ^2=102·17, 15df, p<0·0005). Combining the results of each participant produces the ranked order in **Table V**.

Table V Ranked order of perceived ease of reading with easiest at the top.

55 paged
55 scrolled
25 paged
25 scrolled
100 paged
100 scrolled

This order suggests that line length influences judgments of ease of reading more than method of movement. Looking at the data of individual participants confirms this as ten participants used line length as their main criterion for making judgments, and only one participant was influenced primarily by the method of movement. Other participants showed no one clear criterion, but switched between the two.

There were some pairs out of the fifteen that did not show a consistent pattern across participants (**Table VI**).

Table VI Comparisons where there was disagreement over ease of reading.

25 scrolled	vs.	25 paged
25 scrolled	vs.	100 paged
55 scrolled	vs.	25 paged
55 scrolled	vs.	55 paged
100 scrolled	vs.	100 paged

The dominance of line length as a factor is also reflected in this list. When documents are the same line length, there is less agreement as to whether a scrolled or paged document is easier to read.

Discussion

These results again demonstrate a difference between participants' performance (their reading rate) and their perceptions of ease of reading. Although paged documents were read faster than scrolled documents (at 25 and 55 cpl), participants did not consider this factor as important as line length in judging ease of reading.

However in this experiment, the slower reading rate for scrolled documents is likely to be attributable to the amount of key presses required to move through the document. There were no differences between line lengths when reading paged documents and differences in total reading time of scrolled documents disappear when the scrolling time is removed (**Figure 10**).

Participants in this experiment read more slowly in both the scrolled and paged conditions than participants in the first experiment. Breaking down the time spent in movement and pauses shows that the increase in overall time in scrolled conditions appears to be due to longer time spent in pauses, as opposed to longer scrolling time. In fact, at 25 cpl, participants are spending less time scrolling in this experiment than the previous one.

This data, together with the relative uniformity across line lengths of the time spent in pauses (when scrolling), suggests that little reading was taking place during scrolling. Even when a relatively large number of scrolling movements are made at 25 cpl (**Figure 12**), there is no significant drop in the time spent in pauses.[7] There is also no trade-off between time in pauses and time in movement at any line length. The group of participants who make fewer movements, spending less time in scrolling, also spend less time pausing. Scrolling appears to add a finite time, rather than interacting with the reading task.

These results fail to replicate the results of Experiment 1, which suggested that documents of 100 cpl are read faster than 25 cpl even when the effects of scrolling are removed. It is therefore possible that by reducing the glare from the screen using a gray background, shorter line lengths are read at a similar rate to longer lines. Any differences are due to the time required to scroll through the document.

However, the data from this experiment also show a more uniform reading pattern than the previous experiment. The different experimental designs may have affected participants' strategies. In Experiment 1, participants appeared to adjust their style of reading to the line length. In this experiment, where there were fewer different line lengths and two methods of movement, participants may have had less opportunity to tailor their reading patterns. Their adjustments to the different conditions of the task may have been disrupted by the change to a different method of movement after reading only three documents.

General discussion

Participant's perceptions of ease of reading, whatever their interpretation of this variable, do not correlate with their performance. Instead, they can be interpreted as confirming our expectations of what would be the most suitable line length, if reading from paper. A medium length of 55 cpl is rated as easiest to read and either scrolling or paging is acceptable.

Research by Jorna and Snyder (1991) found a correlation between reading time and subjective judgments, when image quality was varied. However, Spencer (1968) in reviewing the results of legibility of print research, concludes that there is little correlation between preferences or opinions of readers and objective measures of legibility.

The effect of line length on reading rate is relatively small and does not appear to be entirely reliable across different experimental designs. However, this type of result is in keeping with the general nature of legibility research. Tinker (1965) has described the measurement of the legibility of print as a "delicate and painstaking job" and results are very often dependent on experimental procedure and the specific combination of typographic variables (Spencer, 1968).

Nevertheless, there is some indication that people can read a long line of 100 characters in a relatively efficient way, compared with very short lines. Some of the benefits from longer line lengths are due to the reduction in scrolling required to move through the document. However, this factor does not completely account for the differences found. It would also be misleading to remove such differences from a comparison, since this activity forms a necessary part of one method of reading from screen.

Different reading patterns may account for some of the variation in reading times. The first experiment suggested that participants may adjust their reading patterns according to the line length they are reading and the amount of scrolling required. Reading may take place while they are scrolling through documents with shorter line lengths, but not necessarily documents with longer line lengths.

At a line length of 100 characters, a minimum of scrolling movements is coupled with less time spent in reading between movements. This pattern of scrolling exploits the full size of the window, as more lines of text are read before moving further down in the document. This may be a more efficient method of reading as larger chunks of text are processed without interruption from scrolling movement. Numerous arguments have been made for the advantages of displaying more information at one time, from the mechanics of reading (Huey, 1908) to improved cognitive processing (de Bruijn et al., 1982). There is fairly general agreement among reading researchers that context is important in word recognition, although the nature of the context is debated (Gough et al., 1981). During normal reading, almost all content words are fixated, but longer fixations at the end of sentences and phrases are thought to reflect the comprehension process (Just

and Carpenter, 1980). Local context, consisting of the surrounding phrase or sentence, may facilitate word recognition by providing syntactic and semantic information.

Overall, these results are somewhat surprising given the findings of legibility of print research. Such research would predict that there would be a decrease in legibility over about 70 cpl. However, the current results are in line with early findings on reading from screen that show an increase in reading rate with a greater number of characters per line (Duchnicky and Kolers, 1983). It is plausible that factors that distinguish reading from screen from reading print, such as the dynamic aspects of scrolling text on screen (suggested by Duchnicky and Kolers), participant's position in relation to the screen and less familiarity with the process, may affect the optimal line length for text.

Conclusions

These results support the need for empirical work on the legibility of text on screen. Line lengths that are recommended as optimal for print are not the most legible on screen, when reading rate is used as a measure of legibility. This inability to generalize from one medium to another is a problem for designers who wish to apply their knowledge of designing for print to the screen. People designing screens may be placing their confidence in the tried and tested medium of books, and creating a visually similar medium in an electronic form (Benest, 1990). However, these visual characteristics may be less than optimal in a different medium.

This research suggests that we need to consider the differences between screen and paper. Kress (1998) makes a similar plea in relation to visual and verbal modes of communication, arguing for transformation rather than strict translation. Reading from screen permits a number of ways of scrolling through text which may result in a range of reading patterns. These patterns may be influenced by line length and result in varying degrees of efficiency of reading.

Generally, the results indicate that line length should be considered as a significant factor, in relation to performance (reading rate) and as a criterion for judging ease of reading. Unfortunately, these findings do not provide a clear direction for future practice. In addition to the inconsistencies between the two experiments, there is the problem that people perceive the documents they read fastest as least easy to read. It is therefore not a simple matter of translating the findings into guidelines for displaying text on screen.

If we have been conditioned to perceive the formats that we meet most often as easiest to read, then repeated exposure to longer lines on screen may reduce the mismatch between subjective judgments and performance. However, the possible advantages of long lines for faster (possibly skim) reading are only likely to be

accepted if user's experiences with this format are perceived in a more positive manner — a challenge for designers.

Acknowledgements

This research was supported by a grant from Microsoft Corporation. We would also like to thank Virginia Howlett and Simon Earnshaw for helpful comments during the course of the work.

Endnotes

1 The shortest document was 786 words and the longest 907 words, and in between two documents of 800, one of 797 and one of 814 words.

2 While keystrokes were also recorded in paged conditions, the time taken to move from one screen to another is relatively fast and therefore less likely to contribute to overall differences.

3 A document of 100 cpl had, on average, 41 lines, whereas at 25cpl, there were around 152 lines.

4 A movement was classified as discrete if there was a lapse of three or more seconds between key press. If the key was pressed within two seconds, this was considered part of the same action (cf. de Bruijin et al, 1992).

5 Single key presses were used, rather than holding down the key, so that a steady rate of movement could be measured.

6 However, it is surprising that this advantage is not also apparent with slightly shorter line lengths, i.e., 85 cpl.

7 Although the larger standard error shows that there is greater variability between participants.

References

Benest, Ian D. 1990. "A hypertext system with controlled hype." In Ray McAleese and Catherine Green. editors. *Hypertext: state of the art*. Oxford: Intellect, 52–63.

de Bruijn, David, Sjaak de Mul and Herre van Oostendorp. 1992. "The influence of screen size and text layout on the study of text." *Behaviour & Information Technology*, 11:2, 71–78.

Dillon, Andrew. 1992. "Reading from paper vs. screens: a critical review of the empirical literature." *Ergonomics*, 35:10, 1297–1326.

Dillon, Andrew. 1994. *Designing usable electronic text*. London: Taylor & Francis.

Dillon, Andrew, John Richardson and Cliff McKnight. 1990. "The effects of display size and text splitting on reading lengthy text from screen." *Behaviour & Information Technology*, 9:3, 215–227.

Duchnicky, Robert L. and Paul A. Kolers. 1983. "Readability of text scrolled on visual display terminals as a function of window size." *Human Factors*, 25:6, 683–692.

Gough, Philip B., Jack A. Alford and Pamela Holley-Wilcox. 1981. "Words and contexts." In Ovid J.L. Tzeng and Harry Singer, editors. *Perception of print: reading research in experimental psychology*. Hillsdale: Lawrence Erlbaum, 85–102.

Gould, John D., Lizette Alfaro, Vincent Barnes, Rich Finn, Nancy Grischkowsky and Angela Minuto. 1987. "Reading is slower from CRT displays than from paper: attempts to isolate a single-variable explanation." *Human Factors*, 29:3, 269–299.

Grabinger, R. Scott. 1993. "Computer screen designs viewer judgments." *Educational Technology and Research Development*, 41:2, 35–73.

Grabinger, R. Scott and Rionda Osman-Jouchoux. 1996. "Designing screens for learning." In Herre van Oostendorp and Sjaak de Mul, editors. *Cognitive aspects of electronic text processing*. Norwood, NJ: Ablex, 181–212.

Harri-Augstein, Sheila, Michael Smith and Laurie Thomas. 1982. *Reading to learn*. London: Methuen.

Huey, Edmund B. 1908. *The psychology and pedagogy of reading*. New York: Macmillan.

Jorna, Gerard C. and Harry L. Snyder. 1991. "Image quality determines differences in reading performance and perceived image quality with CRT and hard-copy displays." *Human Factors*, 33:4, 459-469.

Just, Marcel Adam and Patricia A. Carpenter. 1980. "A theory of reading: from eye fixations to comprehension." *Psychological Review*, 87:4, 329–354.

Kolers, Paul A., Robert L. Duchnicky and Dennis C. Ferguson. 1981. "Eye movement measurement of readability of CRT displays." *Human Factors*, 23:5, 517–527.

Kress, Gunther. 1998. "Visual and verbal modes of representation in electronically mediated communication: the potentials of new forms of texts." In Ilana Snyder, editor. *Page to screen: taking literacy into the electronic era.* London and New York: Routledge, 53–79.

McNicol, D. 1972. *A primer of signal detection theory.* London: Allen & Unwin, 113

Schumacher, Gary M. and Robert Waller. 1985. "Testing design alternatives: a comparison of procedures." In Thomas M. Duffy and Robert Waller, editors. *Designing usable texts.* Orlando: Academic Press, 377–403.

Schwarz, Elmar, Ion P. Beldie and Siegmund Pastoor. 1983. "A comparison of paging and scrolling for changing screen contents by inexperienced users." *Human Factors*, 25:3, 279–282.

Spencer, Herbert. 1968. *The visible word.* London: Royal College of Art.

Tinker, Miles A. 1963. *Legibility of print.* Ames: Iowa State University Press.

Tinker, M.A. 1965. *Bases for effective reading.* Minneapolis: University of Minnesota Press.

Mary C. Dyson

is a lecturer in the Department
of Typography & Graphic Communication,
The University of Reading, United Kingdom.
She is an experimental psychologist with
a background in perception and computing
and researches into pedagogical and human
factors aspects of electronic publishing.

Gary J. Kipping

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Book Reviews

Writing and Its Use

An International Handbook of International Research Volumes 1 and 2
Hartmut Günter and Otto Ludwig, editors
Compiled in collaboration with J. Baurmann, F. Coulmas, K. Ehlich,
P. Eisenberg, H. W. Giese, H. Glück, K.B. Günther, U. Knoop,
B.Pompino-Marschall, E. Scheerer and R. Weingarten
Berlin: Walter de Gruyter, 1996
ISBN 3-11- 011129-2 Volume 1: 902 pages, hardbound, illustrated,
some in color, $532.00
ISBN 3-11- 014744-0 Volume 2: 863 pages, hardbound, illustrated,
approximately 50 figures in black and white, $482.00

In the Winter issue of 1976, *Visible Language* founder, Merald E. Wrolstad establishing "A Manifesto for Visible Language," argued that writing, not speech, has been the key to understanding man's use of language for personal expression. With that he joined J.W. Firth and J. Derrida, among many others, who have challenged the primacy of speech and who have pointed to the different research domains which in total separation, either address the origin of language in human history alone, or language acquisition, its processing and organization through the human neurophysiological system. Neither of these interest domains, at that point in time, showed any interest in pooling resources or efforts to look for integrated resolution of issues that could only evolve through interdisciplinary discourse that needed to include other disciplines like sociology or anthropology, even graphology or forensic science.

In his manifesto, Wrolstad appealed to all linguistic disciplines,and those at their borders, for a dialogue in which language research could find a meeting ground in the middle, where new information generated from disciplines, usually considered not central to Western linguistics, could be openly integrated into the discourse and could possibly lead to new understandings and possibilities for the building of new models. His main goal was to find a balance to the singular argument of the primacy of speech, hoping for acknowledgment that linguistics itself can not be separated from the evolutionary loop that includes understanding the function of writing. He astutely understood that language attitudes and usage are influenced by a language's writing system and that in the evolution of customs, morals, ethics and law, language cannot be separated from its visual mode of representation. He saw writing systems and writing in itself as an expression of the true value of language in a specific culture. He recognized that the sophistication of writing systems went hand-in-hand with the sophistication of scientific and religious

thought. The accompanying socio-cultural conditions that formed the foundation for specific, sophisticated civilizations for villages, cities and states, the religious liturgies and canon laws, as well as the evolution of various professions in agriculture, experts in crop rotation and animal husbandry, or in commerce, where the production of goods was organized and streamlined for consumption and trade — owed a debt to literacy.

He encouraged the development of counter positions to mainstream thinking. He asked for the gathering of scattered evidence and dissident opinions. He looked for the recognition and acceptance that visible and audible language systems are discrete, and hoped that the new and evolving research would bring greater understanding of how each operates independently in its interface with the inner organization and control of language.

He would have been very much delighted in the fact that twenty years later others had succeeded in bringing together a diverse group of observers representing many disciplines who are sharing their information to yield a widening of scope and a deepening of understanding of the complexities of language. He would have enjoyed the breadth of interests and the use of a wide constituency, including designers, language specialists, typographers, linguists and teachers of reading and writing.

The Handbook promises and provides a broad look at a very large and complex field of overlapping interests and disciplines. In the absence of a comprehensive general theory of writing and an endemic absence of systemic interdisciplinary exchange of ideas, *Writing and Its Use* begins a shared discourse between disciplines that until now have been sparse. Research into writing and its use has been conducted within closed disciplines, in isolation, leaving the larger and integrated overview pending. The Handbook is starting to change this.

The advent of major technological changes, which alter the shaping of language and its inherent social contracts, the ways in which language can be recorded and transmitted or in which people apprehend information or in which language shapes culture, points to the need for greater understanding. Written texts control the lives of citizens with their social status dependent on their ability to participate in the necessary written discourse.

Writing and Its Use is presented in two substantial volumes. The articles are published in their author's original German or English languages, making it a handicap for those who do not have these language skills. However, it is assumed that members of these specifically represented disciplines feel at home in the languages of German and English.

Volume 1: *Writing and its Use* deals with six major categories: General Aspects of Writing and Use, Material and Formal Aspects of Writing and Its Use, History of Writing, Literate Cultures, Functional Aspects of Literacy, Social Aspects of Literacy.

General Aspects of Writing and Its Use
This chapter explores orality and literacy, semiotic aspects of writing, the histories of writing, reading, the book and reflections on writing and its use.

Material and Formal Aspects of Writing and Its Use
Here the reader finds articles on traditional writing materials and techniques, electronic reading and writing technology, archiving writing, databases, letterform development in Western alphabets, typography and calligraphy.

The History of Writing
This section presents the theory of the history of writing, pre-writing and old scripts. Particular scripts that are dealt with are: Sumerian, Accadian, Cuneiform, Hieroglyphics, North-west Semitic, old Southern Arabic, Indian, Ethiopean, Chinese (its adaptation in Japan, Korea and Vietnam), Central American. The problem of decipherment in general is also presented.

Literate Cultures
Here the reader can examine articles on oral and literate cultures, near literacy, literacy in the cultures of China, India, Ancient Egypt, Near Eastern Cunieform cultures, North-west Semitic literate cultures, Greek antiquity, Roman antiquity, Arabia, Latin in medieval Europe, vernacular cultures in Western Europe. The impact of the printing press and perspectives of literate culture is also presented.

Functional Aspects of Literacy
This section focuses on the impact of writing on: language, law, religion, trade, technology, industrialization, education, philosophy,

science, literature along with an article on the secondary functions of writing.

Social Aspects of Literacy
Orthography and its development as a norm for writing systems, diglossia, writing systems in contact, the demographics of literacy, literacy in the third world, mother tongue literacy, soviet promotion of literacy, literacy movements in Ethiopia, Central and South America, Germany, England, North America, China and among non-Chinese speaking people of East Asia are found here. Also included in this section are articles on literacy and illiteracy in modern industrial nations and the problems of censorship and copyright.

Volume 2: *Writing and its Use* expands the scope of the book into four additional categories: Psychological Aspects of Writing and Its Use, Acquisition of Literacy, Linguistic Aspects of Writing and Its Use and Special Writing Systems.

Psychological Aspects of Writing and Its Use
This chapter deals with the history of research and methods into the psychology of reading and writing, production and perception of spoken and written utterances, perception of letters and words, text processing in reading, writing as mental and linguistic process, hand writing, forensic handwriting analysis, graphology, typewriting and forensic analysis, writing with the computer, psychological aspects of spelling, influence of an alphabetic system on the reading process and cross-linguistic analyses of basic reading processes.

The Acquisition of Literacy
The chapter on the acquisition of literacy focuses on: aspects of acquisition; conditions of acquisition and teaching of reading and writing; early reading and writing; acquisition and development of reading and writing skills; acquisition of written language under conditions of multi-lingualism; written language as a means of learning spoken language; aspects and problems of the teaching of reading and writing (beginning and advanced reading and writing skills, instruction in literature and essay writing, spelling); history of didactics and methodology of instruction in reading, literature, writing, essay writing; teaching of reading and writing in English-speaking countries, Arabic-speaking countries and East Asia; acquisition of literacy outside of school; disorders in language acquisition and learning disabilities.

Linguistic Aspects of Writing and Its Use
Authors write about: language system and writing system; typology and writing systems; language change and writing; writing systems; Chinese, Japanese, Devanagari, Spanish, English, French, German; punctuation; written language: Chinese, Japanese, Arabic, French, English, German; abbreviations; constitution, production and reception of written texts; stylistics as a theory of written language usage.

Special Writing Systems
This chapter discusses the following: writing and notation; writing as a numbering and ordering system; phonetic transcription; transliteration; stenography; secret codes; Braille, hand alphabets; technical codes; modern pictography.

The two volumes of *Writing and Its Use* is, as the foregoing shows, are encyclopedic in scope and significant in its accumulated knowledge. The authors in these volumes are pre-eminant in their various sub-specialties. This is a community of scholars sharing their best research and ideas. These two books are essential additions to any visible language library whether that of an individual scholar or a university.

Reviewer Dietmar Winkler, a German ex-patriot, graphic designer and teacher, wrote this review.

User-Centered Graphic Design
Mass Communication and Social Change
Jorge Frascara
London: Taylor and Francis, 1997
ISBN 0-7484-0672-7
147 pages, softbound, illustrated, one color, $44.95

User-Centered Graphic Design moves beyond the graphic designer's traditional art-related attention to visual form and aesthetics to the social dimension of communication which seeks to alter behavior, increase understanding and add positively to the human repertory for action. The author achieves this by contextualizing communication design in a pragmatic dimension which acknowledges the importance of the social sciences to design. The argument is that design and design education pays insufficient attention to communicational and socio-cultural signification and too much attention to design as an art making opportunity. While Frascara is not against visual resolution, he is for a content-driven aesthetics.

"The act of form-giving involves at least four distinct areas of responsibility: professional responsibility (the ability to create a message that is detectable, discriminable, attractive, understandable and convincing); ethical responsibility (the creation of a communicational engagement that recognizes the humanity of the addressees); social responsibility (the visual presentation of messages that make a positive contribution to society); and cultural responsibility (the creation of an object that enriches the cultural existence of the public, beyond the operational objectives of the design)."(12)

Rather than being approached dogmatically, design process is to be actively questioned as used. The importance of identifying problems, establishing design actions that are clear and systematic, confirming empirically that each step is useful is asserted. The author is also against design process mumbo-jumbo. Frascara touches on the epistemological problem of transference of design method or social science data from one problem setting to another. A section of the book deals with the question of validity in data gathering. This is a useful overview of various social science instruments along with caveates regarding their use. While Frascara advocates clear design process and use of social science data, he also acknowledges the role of interpretation that occurs most dramatically as the leap from intellectual method to form-making is taken.

After establishing the method for user-centered design, a case study is presented which puts the method into specific use. Funded by the Alberta Solicitor General and the Alberta Motor Association, driving behavior among young men is the problem considered. This is a problem of serious societal dimension and one that has appeared to be intractable in the past, but the author and his team are undaunted. Using focus groups of repeat offenders, the reasons and values attached to risky driving behavior were uncovered. The groups also examined existing advertising design to identify characteristics that they found appealing in ads. A particular communication strategy was developed to address these young men based on the careful identification of their internal values and conflicts that gave rise to risky driving. The case study is a model of social science integration into a design process.

The communication strategy was not implemented. This is not unusual in studies of this kind. For some reason governmental

agencies and private concerns can understand the underwriting of problem research more easily than they can comprehend the need to develop prototypes for solution and the further examination and testing that will require. Nevertheless this book integrates a smart design process with indepth problem investigation, yielding a specific strategy which is prototyped though in a limited way. This is the first book of its kind from a design professional that advocates user-centeredness. One can only hope that this is the first of many explorations which will serve to build a repertory of user-centered data gathering techniques including investigations of data validity from a practical perspective, the development and testing of various prototypes and the creation of indepth case studies to challenge and inform practice.

Reviewer Sharon Helmer Poggenpohl, the editor and publisher of this journal, wrote this review.

The Footnote*

*A curious history
Anthony Grafton
Cambridge: Harvard University Press, 1997
ISBN 0-674-90215-7
242 pages, hardbound, $22.95

Having a long interest in the development of the structure of the book, I noticed the publication of Anthony Grafton's *The Footnote** with more than idle curiosity. When isolated, it appears to be a strange practice, but footnotes are essential to developing the provenance of ideas in order to give credit, demonstrate change or even challenge received wisdom. Anthony Grafton gives us a history of this device in the context of the development of professional historical scholarship. *The Footnote** as such tells a double story: it is a narrative about the development of historical perspective and a commentary on sources and citation of evidence.

Not everyone appreciates detail. (Even this journal has been criticized for being too "starchy.") Voltaire, for example, made clear his dislike of scholarly detail — the facts and dates. He preferred the construction of a grand narrative based on the belief that posterity neglects the details, but remembers the dramatic events. While footnotes are often considered the essence of academic foolishness, and they are frequently over-used to prove an author's membership

in a particular guild rather than to support a particular debatable point, they are the skeletal frame of a critical apparatus.

Footnotes perform two functions: 1) they demonstrate that a scholar has performed appropriate research, consulted primary and important sources and recognized the argument or opinion attached to different scholarly perspectives on an issue; 2) they indicate the chief sources on which the author relied.

In contrast to Grafton's discussion of their function, he ennumerates the footnote writer's sins. Among them are 1) assembling citations to authorities without noting their lack of agreement on the issue in question; 2) partial quotation used to avoid inconvenient facts or theses; 3) lack of citation for secondary sources; and 4) outright plagarism.

The author presents interesting historical bits related to the development of citation. For example, the monumental undertaking of Pierre Bayle's development of a *Historical and Critical Dictionary*. Bayle was a connoisseur of protestant theology and exegesis and a late seventeenth century editor, who described himself as a "real protestant — the sort who on principle protests everything." Bayle's dictionary was both simple and ambitious. He collected and collated historical material listing all the omissions and errors in existing reference books. "Anything the reader learned elsewhere and did not find contradicted in Bayle would be true." (193) "Bayle arrived at his new method of citation after engaging in sustained reflection and debate. Footnotes mattered to him — mattered enough not only to be compiled with endless energy and laced with sardonic humor, but also to be the object of serious epistemological effort." (211)

Historians or those with particular interest in the making of the historical record will particularly appreciate this book.

Reviewer Sharon Helmer Poggenpohl, the editor and publisher of this journal, wrote this review.

Journal Information

Editorial Correspondence

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Prof. Sharon Helmer Poggenpohl

Editor, *Visible Language*
Institute of Design, IIT
350 North LaSalle Street
Chicago, Illinois 60610

Telephone 312 595 4921
Fax 312 595 4902
E-mail poggenpohl@id.iit.edu

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