27. TEXT DESIGN

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This chapter is divided into six sections as follows:

1. Some typographical considerations
2. Text layout: structure and access
3. Text difficulty
4. Text design for readers with special needs
5. How textbooks are used
6. Future directions in textbook design

My aim in each section has been to present a particular argument, supported by references to empirical research. In addition, I hope that these references will enable interested readers to follow up the issues raised more widely, should they wish. Regrettably, I have decided that there is no one clear theoretical perspective that I could take in writing this chapter so, accordingly, none is offered. References to particular paradigms in text design are, however, made where appropriate.

One important aspect of text design that is omitted in this chapter is that of the design and positioning of elements such as tables, diagrams, and figures. These issues are discussed in Chapters 16 and 26.

27.1 SOME TYPOGRAPHICAL CONSIDERATIONS

27.1.1 Page Sizes

Printed materials come in many shapes and sizes. There are no specific rules or guidelines that might suggest to writers, designers, or printers why they should choose one page size in preference to any other. The research literature on legibility and textbook design offers little help, for page size is not an issue that features in many books on text design. Why then do I choose to start this chapter by discussing page sizes?

Many people expect a chapter on textbook design to begin with issues such as type sizes, typefaces, and line lengths. However, it is important to realize that the choices for these variables are already constrained by earlier decisions. Clearly, we do not expect to find large type sizes in a pocket dictionary or a single column of print in a daily newspaper. These examples are extreme, but they illustrate the point. The choice of page size comes first, and this affects the choices that are available for subsequent decisions.

The size of the page (and, these days, the electronic screen) determines the size of the overall visual display. The reader needs to be able to scan, read, and focus on both the gross and the fine details of this display (see 16.11). The size of the page (or screen) constrains the decisions that writers and designers make about these details.

The choice of an appropriate page size is not always easy. A number of factors contribute to decisions about which size to employ. Perhaps the most important one is some knowledge of how the information is going to be used. Others are reader preferences, the costs of production and marketing, basic paper sheet sizes, and, more generally, the need to conserve resources and avoid waste (Hartley, 1994a; Spencer, 1969).

27.1.2 Standard Page Sizes

The page sizes that we commonly see are cut from much larger basic sheets that have been folded several times. The present-day variety in page sizes results from the manufacturers using different sizes for their basic printing sheets and folding them in different ways. If the basic printing sheets were all one standard size, however, and the method of folding them allowed for little if any wastage at the cutting stage, then great economies could be achieved.

The need to rationalize paper sizes has long been discussed in the history of information printing. In 1798, for example, the French government prescribed a standard for official documents based on the proportion of width:height as 1:1.41, with a basic printing sheet of 1 square meter in area. In 1911, Wilhelm Oswald proposed the ratio 1:1.414 (that is, $1:\sqrt{2}$) as the "world format." In 1922, the German standard, DIN 476, was published. For this standard, the ratio of width:height as $1:\sqrt{2}$ was retained, with a basic printing sheet size of 1 square meter. This German standard, together

with the A, B, and C series of sizes, was adopted in 1958 by the International Organization for Standardization (ISO). Today the ISO series is recommended by the 50 or more national standards bodies that together make up the ISO.

The dimensions of the sizes in the ISO A series are set out below. In the United Kingdom, the A series is used widely, especially the A4 and A5 sizes.

ISO SERIES OF TRIMMED PAPER SIZES

A Series	
Designation	**Size (mm)**
A0	841 × 1189
A1	594 × 841
A2	420 × 594
A3	297 × 420
A4	210 × 297
A5	148 × 210
A6	105 × 148
A7	74 × 105
A8	52 × 74
A9	37 × 52
A10	26 × 37

The unifying principle of the ISO-recommended range of sizes is that a rectangle with sides in the ratio of $1:\sqrt{2}$ can be halved or doubled to produce a series of rectangles, each of which retains the proportions of the original. A rectangle of any other proportion will generate geometrically similar rectangles only at every other point in the process of halving or doubling (see Fig. 27-1).

As the pages of a book are made by folding the larger basic printing sheet in half—once, twice, three times, or more—all the pages made from a standard-size basic sheet will be in the ratio of $1:\sqrt{2}$. Basic sheets that do not conform to this standard do not exhibit this property of geometric similarity when folded, and this can create waste.

We may note at this point, of course, that documents can be arranged in a vertical (portrait) or horizontal (landscape) style and bound at the top (notebook style) or on the left. These variations allow for a variety of page layouts (see Fig. 27-2).

It is considerations such as these that come first when designing instructional text. When these decisions have been made (but not necessarily finalized), the designer can begin to think more about the details of typography. The next step is to consider the widths of the columns and the margins.

27.1.3 Margins

In many books, the margins appear to be planned like a picture frame around a rectangle of print. Tinker (1965) reported that the space devoted to margins in this way could sometimes occupy as much as 50% of the page. However, if we take a functional approach rather than an aesthetic one, it seems to be fairly well agreed that a margin of about 10 mm is necessary at the top and the bottom of the page. However, the inner or binding edge margin is a special case. Here, thought needs to be given to factors that suggest the need for a wider margin. For example, the printed page may be copied at some time and the copies punched for filing with other material. The binding system itself may involve the punching of pages, or it may be of the kind that causes some part of the edge of the page to be hidden from view. Indeed, the binding system may be such that text or diagrams printed too close to the binding edge may curve inwards and be difficult to read. So, since text appears on both the front and the back of the page, a margin of about 25 mm is usually necessary for both the left- and the right-hand margins.

27.1.4 Column Widths

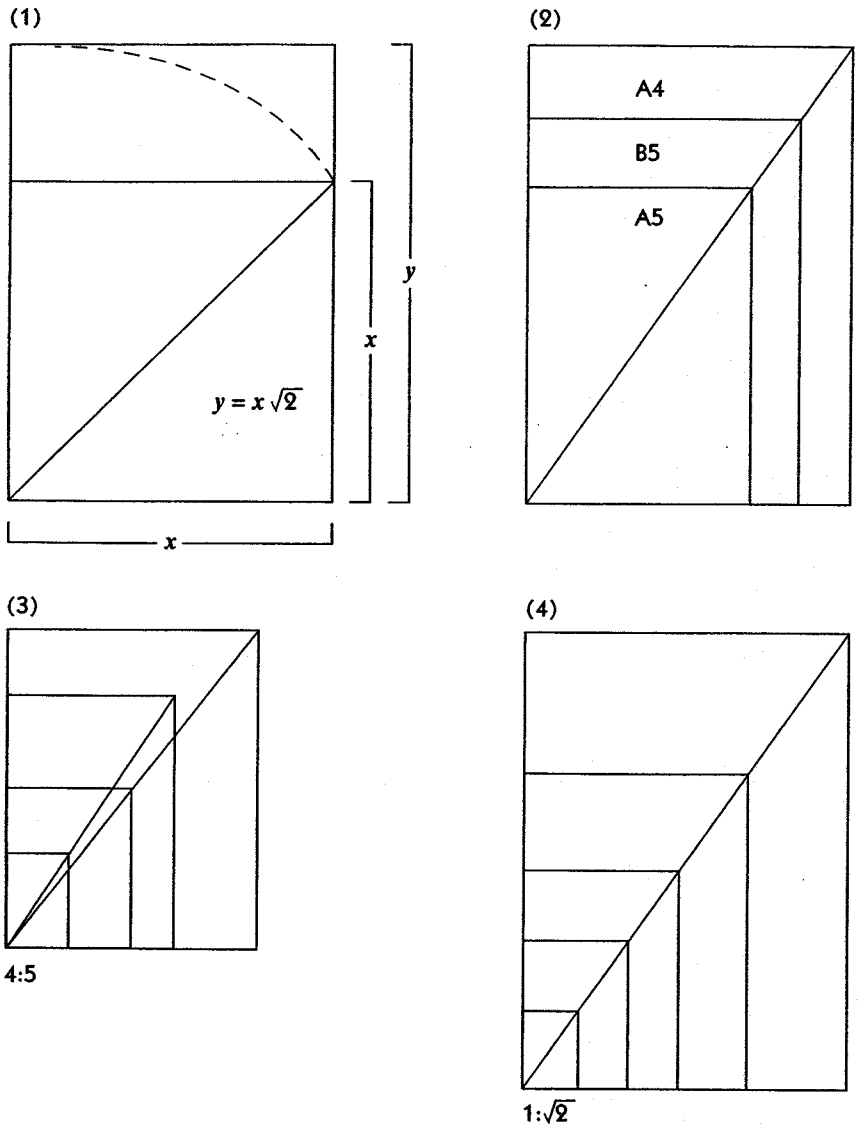
The choice of column widths also depends on the size of the page, the widths of the margins, and the nature of the text. For printed text, it is normal to consider one, two, or even three columns of print (depending on the page size). A decision to use three columns of print may be appropriate for text that is not very complex (typographically speaking). Other variations, such as one wide column and one narrow one, are possible with larger page sizes, and this is sometimes useful to consider when planning the size and positioning of illustrative materials (see Misanchuk, 1992, for a fuller discussion).

27.1.5 Type Sizes

Several researchers have made suggestions concerning appropriate type sizes for reading matter and have given advice on related issues such as line length and line spacing. Tinker (1963, 1965) and Watts and Nisbet (1974) provide good summaries of the earlier literature in this respect, and Black (1990) provides a more up-to-date account.

Unfortunately much of the early research was not very helpful to designers of instructional text. This was principally because the variables such as type size, line length, and interline space were not studied in the "real-life" context of instructional material. Most early researchers, for example, considered issues of type size with short, simple settings of continuous prose (e.g., see Paterson & Tinker, 1929). Furthermore, the generalizations that emerged from this research did not take into account the difficulties that arose from the fact that different typefaces with the same designated type sizes do not, in fact, look the same.

There are many different measurement systems used in the printing industry, but, with the advent of desktop publishing, these will undoubtedly be rationalized. One measure that is likely to remain, however, is that of the "point." (A point measures 0.0138 inches.) Typical type sizes in textbooks are 10, 11, and 12 point. The "small print" (in legal documents, for example) may be 6 or 8 point, but this is too small for most people to read with ease. Larger sizes (such as 14, 18, and 24 point) are used for headings and display purposes. In this text, the typographic setting of the text is 10 point on 12 point. This indicates that there is an extra space of 2 points between the lines of print to facilitate reading. The main text headings are set in 11-point bold, and the chapter headings in 22-point bold.



1. This diagram illustrates the principle of construction and shows that the ratio of the sides of the rectangle is the same as that of the side of a square to its diagonal.
2. This illustrates the fit between the A and the B series of sizes. For example, B5 falls between A5 and A4 and is geometrically similar.
3. A rectangle of nonstandard proportions. Note that the process of halving generates two geometrically dissimilar series of rectangles.
4. A rectangle of standard proportions. This case is unique in that halving generates geometrically similar rectangles at each point in the series.

Figure 27-1. The principles underlying the recommended page sizes of the International Standards Organization.

However, as noted above, a confusing aspect of past research in this field has been the tendency to recommend the use of specific type sizes without proper regard for the fact that the specified size of a particular typeface (say 12 point) does not refer to the size of the image of the printed characters as seen by the reader. The specified size refers instead to the original depth of space that was required by a line of metal type when it was set with minimum line-to-line spacing. Letters were originally carved on the top of the metal shanks that took up this space. Consequently, the size and style of the letters on top of a shank could vary, although the measure of the shank always remained the same.

Figure 27-3, for instance, shows the same sentence printed in one size of type but in five different typefaces. As can be seen, at best, type size is but a first approximation to image size.

The effect is more dramatic when whole paragraphs, rather than single sentences, are considered. This particular paragraph is printed in 10-point Times Roman. The following paragraph is printed in 10-point Bookman to illustrate the effect.

> It is not my intention here to recommend specific type sizes for use in printing instructional materials. However, I would like to outline one approach to the problem of choosing a type size for a text. At root, this concerns choosing a maximum permissible line length that, when related to the type size, will not obstruct the proper and sensible phrasing of the information.

Designers need to examine their text carefully to look for problems that can arise if they choose too large a typeface. For example, in childrens' reading books, the maximum per-

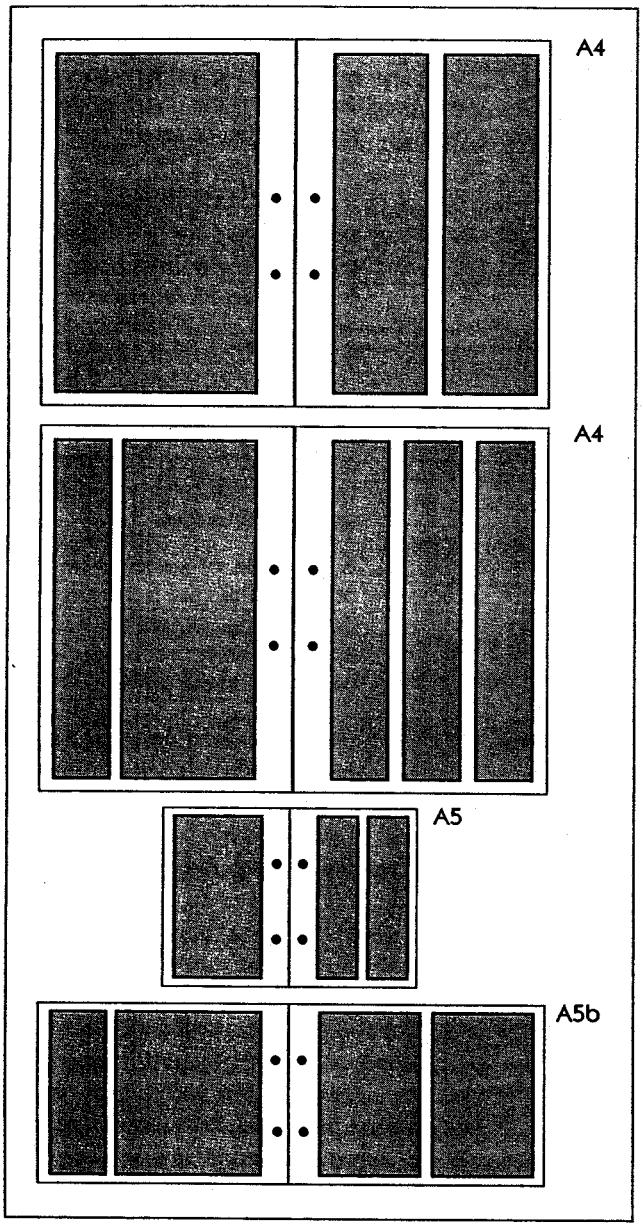


Figure 27-2. How a standard-size sheet can be arranged to provide a variety of page layouts.

This is 12-point Times Roman

This is 12-point Palatino

This is 12-point Helvetica

This is 12-point Century Schoolbook

This is 12-point Bookman

Figure 27-3. How different typefaces with the same designated type size actually differ in size.

missible line length is often limited by the use of large type sizes to three or four words long. Often, in this case, it is difficult to group syntactically the words in the lines. Indeed, some children think that sentences are completed at the end of each line (Raban, 1982). Thus, as shown in the Bookman paragraph, one of the primary dimensions to be considered when thinking about type sizes is the width of the character groups and syntactically structured word strings, and not the vertical dimension of the characters per se.

27.1.6 Typefaces

One particular source of confusion for novice designers is how to choose an appropriate typeface from the bewildering range of typefaces currently available. For example, one encyclopedia of typefaces published in 1930 listed over 2,350 entries. Today, it is estimated that by now there must be several thousand typefaces available. Many desktop systems offer their users a huge variety of choice, so how does one decide?

In practice, as Black (1990) points out, choosing a typeface really means:

1. Considering the purpose of the text
2. Making sure that the chosen sizes and weights required for the text (e.g., light, medium, bold) are available
3. Making sure that the character set contains not only the commonly used signs but also any additional special characters called for by the text
4. Considering how well particular typefaces will withstand repeated copying

Certain typefaces seem more appropriate in some situations than others. Neither Gothic, for example, nor Balloon would seem very helpful for instructional text. Typefaces such as these have emotional connotations (see Lewis & Walker, 1989; Tannenbaum, Jacobson & Norris, 1964), and Spencer (1969) provides a review of earlier studies in this respect. Certainly some readers have personal preferences (see Misanchuk, 1992). These individual differences suggest that it may be wiser to stick to conventional and familiar typefaces than to employ idiosyncratic ones. Black (1990) provides a useful full-length treatment of these issues.

One way of classifying familiar typefaces is in terms of those that have serifs (finishing strokes at the ends of letters) and those that do not (sans serifs). For example, this paragraph is printed in Times Roman, a face with serifs. The following paragraph is printed in Futura, a sans-serif face, to illustrate the effects.

The available research gives no clear guidance on which typefaces are best. Some designers recommend that faces with serifs be used for the body of the text and that faces without serifs be used for headings or for other purposes (such as to differentiate examples from the body of the text). Others consider that typefaces without serifs are more legible in the smaller sizes (e.g., 6 and 8 point) and go on to argue that such sans-serif typefaces are better for text that is not intended for continuous reading (e.g., ref-

erence works, tables, catalogs, etc.). Others suggest that sans-serif faces are more appropriate for older readers.

Berger (1991), Black (1990), Misanchuk (1992), and Spencer (1969) review the relevant literature in this field. They conclude that one has to make decisions here that are based on good practice and common sense. I would add, too, that there are so many different typefaces within each group (serif or sans serif) that it makes little sense to generalize in terms of comparing faces with serifs with those without them; it is far better to consider how different typefaces compare and to specify which ones are being discussed.

27.1.7 Capital Letters

Words printed in capital letters contain less-distinctive information per unit of space than do words set in lowercase characters of the same type size (Tinker & Paterson, 1928).

> THUS IT IS GENERALLY BELIEVED THAT WHOLE PARAGRAPHS OF TEXT SET IN CAPITAL LETTERS ARE MORE DIFFICULT TO READ THAN ARE PARAGRAPHS SET IN NORMAL UPPER- AND LOWERCASE LETTERS. THE USE OF STRINGS OF WORDS IN CAPITALS FOR MAIN HEADINGS (OR SMALL CAPITALS FOR SECONDARY HEADINGS) MAY BE SATISFACTORY BECAUSE SUCH HEADINGS ARE NORMALLY SURROUNDED BY SPACE THAT AIDS THEIR PERCEPTION. ON THE WHOLE, THOUGH, THE USE OF CAPITAL LETTERS SHOULD BE KEPT TO A MINIMUM. APART FROM SPECIALIZED USE IN MATHEMATICAL WORK, CAPITAL LETTERS ARE BEST RESERVED FOR THE FIRST LETTER OF A SENTENCE (INCLUDING HEADINGS), AND FOR THE FIRST LETTER OF PROPER NOUNS (see Tinker, 1965).

27.1.8 Italicized Letters

Sloping or "italic" characters were originally introduced into printed books in the 16th century as a means of setting more characters to the line, the style of letters being more compressed than the vertically drawn and rounded forms of the normal lowercase character set. Again, it is commonly believed that continuous italic text is harder to read than the more conventional typographic settings. (See Misanchuk, 1992, for further discussion.) Today, italicized characters are often used in instructional text for emphasizing words, for book titles when these appear in the text or in bibliographic references, and sometimes for setting summaries or abstracts.

27.1.9 Color

Color can be used in textbooks in many different ways. Sometimes, for example, colored headings are used simply to make the text more appealing. In other situations, subtexts may be set in a different color in order to differentiate them from the main content.

There is actually a considerable amount of research on the effectiveness of color in printed instructional text (see Dwyer, 1978; Tinker, 1965), and this is an issue that is also prominent in current work with multimedia (e.g., see Clarke, 1992, and Chapter 29). As it happens, there appear to be few clear generalizations that one can make, but it does seem that:

- Readers have color preferences.
- Readers like additional color.
- Color can help learning (see Dwyer, 1978).
- Extra colors have to be used sparingly and consistently if they are not to confuse the readers.
- Certain combinations of colored inks on colored papers are more legible than others. Thus, for example, black ink on white or yellow paper is generally preferable to red ink on these colors, and black ink on dark-red or purple paper is generally to be avoided. (See Clarke, 1992; Dwyer, 1978; and 16.4.3 for further details.)

It must be remembered that young readers, of course, cannot be expected to know automatically why any change from the traditional norm has taken place. This particularly applies to the printing of individual words in bold, capitals, italic, or in color. Early readers need to be taught these conventions. And, in addition, we need to remember that all of these devices need to be used sparingly, as they can lose their significance when they are used in combination or to excess (see, e.g., Foster, 1979; Hartley, 1993a; Hershberger & Terry, 1965; Welsh et al., 1993).

Finally, we should also note in this section that it is not wise to present readers with text that continually changes its size, its spacing, and its typeface. A brief rule of thumb might be that there is no need to use three or more additional cues when one or two at most will do.

27.1.10 Spacing the Text

One of my main arguments in this chapter is that the way in which the designer uses the space on the page greatly affects how easily the reader can understand and retrieve the information from it. Although the text is important—one cannot do without it—I want to argue that the clarity of the text can be enhanced by a rational and consistent use of the "white space" (Hartley, 1994a).

But first a bit more history. Most people today know what a textbook looks like and how it is arranged. But, as Small (1997) points out, books originally began as vertical rolls. The concept of a page did not exist, and there were no page breaks or page numbers. Furthermore, in Classical Greek times, there were no breaks between words, sentences, or even paragraphs. (The paragraph as a unit of text on the page did not appear until the 16th century.) Cross-references were very vague, like "see above" and "see below." The letters forming the words were of the same height and often of the same width. Line lengths were equal, and words were wrapped around the ends of lines without hyphenation. Figure 27-4 simulates what such text used to look like. It is clear to our

BOOKXXXIVCONTENTSCOPPERMETALKINDSOFCOPPERC
ORINTHIANDELIANAEGINETANONBRONZEDINGCOUC
HESONCANDELABRAONTEMPLEDECORATIONSOFBRON
ZEFIRSTBRONZEIMAGEOFAGODMADEATROMEONTHEO
RIGINALSTATUTESA

Book XXXIV. Contents: Copper metal. Kinds of copper: Corinthian, Delian, Aeginetan. On bronze dining couches; on candelabra; on temple decorations of bronze; first bronze. . . .

Figure 27-4. Shown schematically in the top illustration is the original way of presenting Classical Greek text. The bottom illustration shows the conventional way of presenting text today. Note that the original text would also have been in handwriting, which would have made it even more difficult to read. [Figure based on illustrations from Small (1997) and reproduced with permission.]

modern eyes that punctuation and spacing, together with upper- and lowercase letters, make such text easier to read.

Space thus plays an important role in clarifying text. It is space that separates letters from each other. It is space that separates words from each other. It is space (with punctuation) that separates phrases, clauses, and paragraphs from each other; and it is space (with headings and subheadings) that separates subsections and chapters from one another.

There is some evidence from eye movement research that shows that these spatial cues are important aids to understanding text. It is argued, for instance, that with increasing maturity and experience, readers come to rely more heavily on such spatial cues to enhance their reading and search efficiency (Fisher, 1976). It has been found that the beginning of a line—and not its end—has a marked effect on eye movement fixations, and that text which starts in an irregular manner, such as poetry, produces more regressive fixations (look-backs) than does regularly spaced text (Carpenter & Just, 1977).

In this chapter, I maintain that consistent spacing helps readers to:

1. See redundancies in the text and thus to read faster
2. See more easily which bits of the text are personally relevant for them
3. See the structure of the document as a whole
4. Grasp its organization

27.1.10.1 Vertical Spacing. The spacing of a page can be considered from both a vertical and a horizontal point of view. Let us consider vertical spacing first. The argument here is that the underlying structure of complex text can be made more apparent to the reader by the consistent and planned use of vertical spacing. In practice, this means that predetermined increments of line space can be used consistently to separate out such components of the text as sentences, paragraphs, and sub- and major headings.

One simple way of using line space in this way is to use it in a proportional system. One can, for example, separate paragraphs by one line space; separate subheadings from paragraphs by two extra lines above and one below; and one can separate main headings from text by four extra lines above and two below. With more complex text, one can even start each sentence on a new line within each paragraph.

What is the effect of such an approach? Figure 27-5a shows a traditionally spaced piece of text, and Figure 27-5b shows a revised version using the system described above. Such a proportional system is an effective way of determining that the amount of space between the component parts of a piece of text is consistent throughout the work. Other systems (not proportional, but equally consistent) can be used. Indeed, for even more complex text, one might wish to introduce indentation into the text to convey further substructure.

Research has shown that readers usually prefer lengthy paragraphs to be set in a more open manner (e.g., see Hartley, Trueman & Burnhill, 1980). Readers thus generally prefer text set in the style of Figure 27-5b to that of Figure 27-5a.

Finally, in this section on spacing the text, we should note that if the vertical spacing between the components of the text is to be consistent throughout the text, then this leads to the idea that the text will have what is called a *floating baseline*. This means that, in contrast to the method used in this handbook, the text does not stop at the same place on every page, irrespective of its content. With a floating baseline, the stopping point on each page is determined by the content and the structure of the text rather than by the need to fill the page.

General

This section describes the care, maintenance, and inspection of insulating rubber blankets. This section is reissued to delete reference to the KS-13602 cleaner; this has been superseded by the B cleaning fluid (AT-8236).

Description

An insulating rubber blanket is made of flat, flexible sheets of black rubber. These sheets do not contain either beaded edges or eyelets. The blankets are approximately 36 inches square, 1/10 inch thick, and weigh approximately 7 pounds. The electrical, weather, and chemical resistance properties of the blanket are very good.

Rubber-stamped on each blanket is a "return for test" date. Blankets must be returned for testing by that date to the Western Electric Company or other authorized agent. The blankets should be returned in rolls (3 1/2 inches in diameter) and wrapped properly so as to avoid damage. A replacement blanket will be made available when a blanket is returned for testing.

Figure 27-5a. A traditionally spaced piece of text.

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A replacement blanket will be made available when a blanket is returned for testing.

Figure 27-5b. A revised version of Figure 27-5a with a proportionally based spacing system.

As a rule of thumb, we can say that each page of the text should have a specified number of lines, plus or minus two. This flexibility allows the designer to accommodate "widows" and "orphans"—where a page starts with the last line of a previous paragraph or ends with a heading or the first line of a new paragraph—without changing the underlying spacing of the text. In traditional settings, as in this chapter, the internal spacing is sometimes stretched or squeezed to force the text to finish at the same point on each page. Normally this has little effect in pages of continuous prose, but Hartley (1991) provided an illustration of where such a policy could mislead the reader.

27.1.10.2. Horizontal Spacing. One can consider the horizontal spacing of text in much the same way as we have considered the vertical spacing. That is to say we can also look to see how we can use the horizontal spacing to separate and to group components of the text, and how we can vary the stopping point of horizontal text in accord with its content, rather than using arbitrary rules about line lengths.

In this handbook, all the lines of text are set "justified." This means that all of the lines within the columns are of equal width, and that the columns have straight left- and right-hand edges. These straight edges are achieved by varying the spacing between the words on each line and, occasionally, by hyphenating or breaking words at the ends of the lines. Indeed, in text that has very narrow columns (e.g., in newspapers or advertising copy), the spaces between the letters forming the words are also often varied in order to force the text to fit a given length of line.

A different approach to setting the text is to provide a consistent space between each word. Such a procedure produces "unjustified" text, i.e., the same amount of space between each word, and usually no word breaks (or hyphenation) at the ends of lines. Consequently, the text has a ragged right-hand edge.

There has been much debate over the relative merits of justified and unjustified text. Muncer et al. (1986) and Misanchuk (1992) provide representative reviews, and Kinross (1994) provides an interesting historical footnote. It would appear that it does not matter much which setting is used as far as understanding conventional text is concerned: The decision concerning which format to use is largely a matter of choice. There is some evidence, however, that unjustified text might be more helpful for less-able readers, be they younger children or older adults (see Hartley, 1994b).

Nonetheless, it is doubtful whether the studies reviewed by Muncer et al. and by Misanchuk fully considered all of the possible advantages of unjustified text. One clear advantage is that one does not have to fill up each line with text; one can consider (as with vertical spacing) where best to end each line. With unjustified text, for instance, it is possible to specify that no line should end with the first word of a new sentence, or that if the last word on a line is preceded by a punctuation mark, then this last word should be carried over to the next line. And, of course, it is possible to consider the starting points of each line too. Figure 27-6a shows a piece of justified text; Figure 27-6b shows what happens to this text when space is used to show the underlying structure of the text. Research has shown that readers often recall more from text set in the manner shown in Figure 27-6b than they do from text set in the manner of Figure 27-6a (see Jandreau & Bever, 1992, for a review of this literature). And, curiously enough, when asked to write out their recalls of short texts set in these different formats, most readers write them out in the formats they are presented with (Hartley, 1993b).

27.1.10.3. Combining Vertical and Horizontal Spacing. So far I have discussed vertical and horizontal spacing as though they are separate issues—which, of course, they are not. For all texts, interrelated decisions need to be taken

Now the sons of Jacob were twelve. The sons of Leah; Reuben, Jacob's firstborn, and Simeon, and Levi, and Judah, and Issachar, and Zebulun. The sons of Rachel; Joseph, and Benjamin: And the sons of Bilhah, Rachel's handmaid; Dan, and Naphtali. And the sons of Zilpah, Leah's handmaid; Gad, and Asher. These are the sons of Jacob, which were born to him in Padan-aram.

Figure 27-6a. A piece of text with a traditional *justified* setting.

Now the sons of Jacob were twelve.
The sons of Leah;
    Reuben, Jacob's firstborn,
    and Simeon, and Levi, and Judah,
    and Issachar, and Zebulun.
The sons of Rachel;
    Joseph, and Benjamin:
And the sons of Bilhah, Rachel's handmaid;
    Dan, and Naphtali.
And the sons of Zilpah, Leah's handmaid;
    Gad, and Asher.
These are the sons of Jacob, which were born
to him in Padan-aram.

Figure 27-6b. The same text with an *unjustified* setting. Note here that in this case both the settings of the beginnings and the endings of the lines are determined by syntactic considerations. Normally, of course, it is only the endings of the lines that are unjustified.

which depend on the nature of the text. If the text consists of nothing but continuous prose, then (on a smallish page) a single-column structure with normal paragraph indentation may be perfectly acceptable. If, however, the text consists of numerous small elements, many of which start on new lines, then using traditional indentation to denote new paragraphs can be misleading. It is for reasons such as these that I generally advocate the use of line spacing rather than indentation to denote the start of new paragraphs in instructional text (Hartley, Burnhill & Davies, 1972).

If the text contains a mixture of text, diagrams, instructions, and other typical material, then one has to think much harder about the appropriate way of presenting it. The key point here, of course, is that instructional text should not be designed on a "let's put this here" basis for every page. Decisions concerning the vertical and the horizontal spacing of the full text have to be made in advance of keyboarding it, and these decisions have to be adhered to throughout. Many designers advocate using what is called a "typographical reference grid" in this respect (e.g. see Crouwel,1979; Hartley, 1994a; Miles, 1987; Swann, 1989.) Using such a procedure—in which spacing decisions are mapped out in terms of grid modules—leads to a regular and consistent layout that will not confuse the reader.

27.2 TEXT LAYOUT: STRUCTURE AND ACCESS

So far I have discussed matters of typography that I believe help readers to find their way around a text and to grasp its underlying structure. I now turn to discuss those devices that are specifically used by writers and designers to further help readers in this respect. I have called this section "structure and access" because these devices—perhaps unwittingly—both clarify the structure of the text and also help the readers gain access to it. Readers do not simply read instructional text from the beginning to the end: they skim, search, reread, etc. Devices that help them do this include titles, contents pages, summaries, outlines, headings, and subheadings, and numbering systems. In addition, authors use such linguistic devices as "signals" to help readers follow the organization of their arguments (Waller, 1979).

27.2.1 Titles

Titles aim to describe the content of a text in the fewest words possible; but these are often supplemented with a subtitle. Such succinct descriptions help to focus attention and expectations, and studies have shown that titles affect the readers' perception and interpretation of ambiguous text (e.g., Bransford, 1979). However, it is to be hoped that instructional text will not be ambiguous! So one would hardly expect titles to have much effect on the comprehension of instructional text, although they may aid later recall of what the text was about. Unfortunately, I know of no research on typographic variables connected with the setting of titles (e.g., type sizes, typefaces, weights, etc.) and none on the more interesting problems of using different title formats (e.g., statements, questions, quotations).

27.2.2 Summaries

Summaries in text can have different positions and roles. Beginning summaries tell the readers what the text is about; they help the readers decide whether or not they want to read it, and they help the readers who do read it to organize their subsequent reading. Interim summaries summarize the argument so far, and indicate what is to come. End summaries list or review the main points made, and thus aid the recall of important points in the text. End summaries can use the more technical vocabulary introduced in the text; beginning summaries might not. Research on the effectiveness of author-provided summaries has been reported by Hartley and Trueman (1982), Reder and Anderson, (1980), and Sherrard (1988). Research on the effectiveness of reader-generated summaries has been reported by, among others, Annis (1985) and Kirby and Pedwell (1991).

Summaries can be typeset in many different ways: in medium, bold, or italic, in large or small type, boxed in, etc. There is no research to my knowledge on the effect of such typographic variables in this context, although there is some indication that readers dislike journal abstracts set in a smaller type size than the main body of the text (Hartley, 1994c).

27.2.3 Outlines

Outlines can have much the same function as a summary, although it is likely that outlines depict the structure of the text more clearly. Often outlines are provided in a graphic

form, sometimes in the form of a tree diagram or flowchart (Guri-Rozenblit, 1989). Such displays facilitate understanding and recall in at least two ways. Firstly, readers can see the organizing structure of the text all at once. Secondly, readers can follow different routes within this structure—comparing and contrasting different parts—in the order of their choice: The argument is no longer linear, and it is not obscured by lengthy paragraphs of text. Research reviewing the effectiveness of outlines has been reported on and summarized by Glover and Krug (1988); Glynn, Britton, and Muth (1985); Hall, Dansereau, and Skaggs (1992); and Lambiotte and Dansereau (1992).

27.2.4 The Role of Boxes

Authors frequently seek to extend the reader's comprehension of the main ideas in instructional text by including supporting material, such as examples, anecdotes, and bibliographies. Often one way of handling such material is to treat the information as a figure, to box it off from the main body of the text, and to use a different typeface and/or typographic setting. Presumably the idea here is that, by being separated from the main text, the information in the box is seen as separate and adjunct, and that it is less likely to interfere with either the author's presentation or the reader's comprehension of the main ideas.

Some authors have provided interesting comments on the problems of dealing with this ancillary material (e.g., Armbruster & Anderson, 1985; Schumacher, 1985), but I know of no research inquiry into the effectiveness of such procedures. However, if one examines what writers and reviewers of instructional text have to say on the matter, one can discern some unease among them. Consider, for example, this extract from James Thomas's (1984) review of four introductory psychology textbooks:

> On the negative side the text includes many boxed inserts presenting "Critical Issues" and "Applications." I object to this common approach for two reasons. First, these inserts disrupt the logical flow of the running text. If the application or issue is important enough for it to be boxed, why not include it in the running text and avoid breaking the reader's train of thought? Second, the boxed inserts exaggerate the importance of single, nonreplicated research findings. In many cases, these boxes report unusual, unexpected, or sensational research or applications that have not been adequately evaluated. Their appearance in an introductory textbook, especially in a highlighted position, seems to legitimize these findings and applications, whereas they should still be regarded as tentative. These concerns apply to three of the texts under review."

27.2.5 Headings

Headings may be written in the form of questions, statements, or (like here) with one- or two-word labels. Headings may be placed in the margin or in the body of the text.

In a series of experiments with 12- to 14-year-old school children, Mark Trueman and I investigated the role of different kinds of heading (questions versus statements) and their position (marginal versus embedded). We concluded that headings significantly aided search, recall, and retrieval, but that the position and the kinds of heading that we used had no significant effects with the texts that we employed (Hartley & Trueman, 1985). More studies still need to be carried out on factors such as the:

- Nature of the text (technical versus semiliterary)
- Frequency of headings
- Typographic denotation of headings of different levels (primary, secondary, tertiary)

Additional research indicating the effectiveness of headings has been provided by Spyridakis and Standal (1987), Townsend et al. (1990), and Wilhite (1989)

27.2.6 Questions

Questions may be interspersed in the text itself, or presented in a list at the end of a chapter to provide material for exercises. There is some indication that readers ignore questions given at the ends of chapters, so it might be more appropriate to consider how best they can be embedded in the text. It appears that factual questions, placed in a passage before paragraphs of relevant material, often lead to specific learning, whereas similar questions placed in the passage after the relevant content will sometimes lead to more general learning as well (see Allington & Weber, 1993; Hamaker, 1986; Hamilton, 1985). The level of difficulty of these questions, too, may be important (Allington & Weber, 1993; Armbruster & Ostertag, 1993; see also 30.6, 31.2.13).

Some of our earlier research suggested that headings in the form of questions were particularly suitable for less-able readers, but our more recent (better-designed) studies failed to confirm this (see Hartley & Trueman, 1985). None the less, it might be important to consider headings in this form for certain texts.

27.2.7 Sequencing

There has been little research on the sequencing of sentences or paragraphs within instructional text, apart from work with programmed instruction (see Chapter 20). Some of this work suggested that violations in natural sequences provided little difficulty for most readers. However, just what is a "natural sequence"? Posner and Strike (1978) contrast 17 different ways to show that sequencing is not a simple matter, and Van Patten et al. (1986) develop these issues further.

There are some situations, however, where we might all agree that the sequence used is unhelpful. Take, for example, this odd sequence of instructions I once found for using an electric razor:

1. To gain access to the heads for cleaning, press the button on the side of the appliance (see Fig. 4).
2. To remove the razor from its packaging. . . .

Readers find it easier to follow a sequence in which the events match the temporal order in which they occur. Compare "Before the machine is switched on, the lid must be closed and the powder placed within its compartment" with "The powder must be placed in its compartment and the lid closed before the machine is switched on."

27.2.8 Sequencing Lists

It is fairly common in instructional writing to find sentences containing embedded lists of items such as this:

> Five devices that aid the reader are (i) skeleton outlines for each chapter, (ii) headings in the text, (iii) an end summary, (iv) a glossary for new technical terms, and (v) a comprehensive subject and author index.

However, research suggests that readers prefer text that has such lists or numbered sequences spaced out and separated, rather than run on in continuous prose. The above example would be better thus:

Five devices that aid the reader are:

- Skeleton outlines for each chapter
- Headings in the text
- An end summary
- A glossary for new technical terms
- A comprehensive subject and author index

27.2.9 Numbers in Text

Numbers are often used to signal the structure of a piece of text. Lorch and Chen (1986) showed that when making a series of points within paragraphs it was helpful to list and enumerate them. Commentators suggest that it is best to use Arabic numbers when there is an order or sequence in the points being made: "Bullets," as used above, are perhaps more appropriate when each point is of equal value.

The structure and organization of a piece of text can often be made clearer for the reader by the use of numbered paragraphs. Such numbering systems can be used to organize information in many different ways, e.g., the heading numbers in this book. There has been little research on the effectiveness of such systems. Many people undoubtedly feel that they are valuable, particularly for reference purposes. But such systems can be abused if they are overdone, and they can lead to extraordinary confusion (see Smith & Aucella, 1983; Waller, 1980).

27.2.10 Verbal Quantifiers

When numerical data are presented in text, prose descriptions often seem more comfortable to readers than do actual numbers. Everyday words that act as rough quantifiers, e.g., "nearly half the group," seem adequate for most purposes and are handled with reasonable consistency by most people (Moxey & Sanford, 1993). Young children, of course, may have greater difficulties with some of these terms (Badzinski, Cantor & Hoffner, 1989).

Research by Hartley, Trueman, and Rodgers (1984) suggested that the following phrases can be used with confidence with adults:

Numerical Value	Suitable Phrases to Be Conveyed
above 85%	almost all of . . .
60–75%	rather more than half of . . .
40–50%	nearly half of . . .
15–35%	a part of . . .
under 10%	a very small part of . . .

None the less, it may be better (or at least clearer for the reader) if more exact verbal equivalents of numbers are given. For example:

Numerical Value	Suitable Phrases to Be Conveyed
100%	all of . . .
75%	three-quarters of . . .
50%	half of . . .
25%	a quarter of . . .
0%	none of . . .

Verbal descriptions of probabilities are also more comfortable for most people than are actual probability statements. People are less consistent, however, in their interpretations of verbal descriptions of probability than they are in their interpretations of verbal descriptions of quantity (Moxey & Sanford, 1993). If precision is required, actual quantities can be given with a verbal quantifier. For example, one can say "nearly half the group—43%—said . . ." or "There was a distinct chance ($p < 0.06$) that. . . ."

27.2.11 Signaling

A rather different way of making text organization more explicit is to use verbal "signals." Signals have been defined by Meyer, Young, and Bartlett (1989) as "noncontent words that serve to emphasize the conceptual structure or organization of the passage." Words and phrases such as *however*, *but*, or *on the other hand* signal to the reader that some form of comparison is to be made. Similarly, words and phrases such as *firstly*, *secondly*, "three reasons for this are . . ., a better example, however, would be. . ." signal the structure of the argument (and comparisons with subsections). Likewise, words and phrases such as *therefore*, *as a result*, *so that*, *in order to*, *because* signal causal relationships. Studies have

shown that such signals help readers grasp the underlying structure of the author's argument (e.g., see Rice, Meyer & Miller, 1989). However, there may be some confusion in the future over the use of the term *signal*. I now find it being used to cover devices such as headings, overviews, and summaries (Lorch, Lorch & Inman, 1993).

27.2.12 Conclusions

This section on structure and access has shown that there is a good deal of research available on the variety of methods used to help readers grasp the structure of a text and to gain access to it. However, most of this research is uncoordinated and atheoretical. Most researchers focus on one device or another, and few consider the effects of several such devices in combination. Few, too, carry out lengthy programs of research that aim to investigate systematically the myriad factors affecting the effectiveness of particular devices. (Some exceptions to this criticism are Dwyer's work on illustrations, Dansereau's work on outlines, Meyer's work on signals, and possibly my own on headings.) Such theories as there are are thus buried below a welter of specific instances rather than being subjected to any rigorous analysis that might, in the long term, lead to deeper understanding.

27.3 TEXT DIFFICULTY

A separate area of research relevant to text design concerns itself with assessing how difficult a text might be for its intended readers and, indeed, whether or not difficulty per se is a bad thing. The title of a book by Chall and Conard (1991) puts the question succinctly: *Should Textbooks Challenge Students? The Case for Easier or Harder Books.* The area of text difficulty has been examined from numerous points of view (e.g., see Davison & Green, 1987; Schriver, 1989). Here I want simply to report on some of the issues and findings.

Again, if we start with an historical perspective, it is probably true to say that the instructional materials of today are not only more spaciously arrayed but also contain shorter paragraphs, shorter sentences, and shorter words than did texts published some 50 years ago. What can research tell us about these features of text difficulty?

27.3.1 Paragraph Lengths

Few researchers have commented on the effects of long chapters and long paragraphs on readability. It would seem, other things being equal, that short chapters, and short paragraphs within them, will make a text easier to read. In addition, the ways in which new paragraphs are denoted may be important. One problem is knowing how best to format paragraphs without unduly breaking the readers' flow. In an early study, Hartley, Burnhill, and Davies (1978) suggested that different methods of paragraph denotation can affect the speed and accuracy of location and access, as well as the recall of information.

27.3.2 Sentence Length

It is generally considered that long sentences—such as this present one—are difficult to understand because they often contain a number of subordinate clauses that, because of their parenthetical nature, make it difficult for readers to bear all of their points in mind and, in addition, because there are often so many of them, make it harder for readers to remember the first part of the sentence when they are reading the last part. Long sentences overload the memory system; short sentences do not.

I once wrote:

> As a rule of thumb, sentences less than 20 words long are probably fine. Sentences 20 to 30 words long are probably satisfactory. Sentences 30 to 40 words long are suspect, and sentences containing over 40 words will almost certainly benefit from rewriting.

Perceptive readers will notice that many of my sentences in this chapter contain more than 30 words—but at least they have been scrutinized! Furthermore, the sentence above ignores the advice given by many other commentators (e.g., see Berger, 1993) that sentences (and paragraphs) should vary in length if they are to entertain the reader.

27.3.3 Word Length

Long words, like long sentences, also cause difficulty. It is easier to understand short, familiar words than technical terms that mean the same thing. If, for example, you wanted to sell thixotropic paint, you would probably do better to call it nondrip! One author on style quoted a letter writer in *The Times* who asked a government department how to obtain a book. He was "authorized to acquire the work in question by purchasing it through the ordinary trade channels"—in other words "to buy it." Concrete words and phrases are shorter and clearer than abstract ones.

27.3.4 Difficult Short Sentences

It does not necessarily follow, of course, that passages written in short sentences and short words will always be better understood. Alphonse Chapanis (1965, 1988) provides many examples of short pieces of text that are difficult to understand. The one I like best is the notice that reads:

> PLEASE
> WALK UP ONE FLOOR
> WALK DOWN TWO FLOORS
> FOR IMPROVED ELEVATOR SERVICE

People interpret the notice as meaning "to get on the elevator I must either walk up one floor, or go down two floors," or even "to get on the elevator I must first walk up

one floor and then down two floors." When they have done this, they find the same notice confronting them! What this notice means, in effect, is "Please, don't use the elevator if you are only going a short distance." Chapanis's articles are well worth studying. They are abundantly illustrated with short sentences that are hard to understand and (in some cases) potentially lethal.

27.3.5 Ambiguities

Many short (and indeed many long) sentences can turn out to be ambiguous. Consider "Then roll up the three additional blankets and place them inside the first blanket in the canister." Does this sentence mean that each blanket should be rolled inside the other, or that three rolled blankets should be placed side by side and a fourth one wrapped around them? (An illustration would clarify this ambiguity.)

Ambiguities, or at least difficulties, often result from the use of abbreviations or acronyms (strings of capital letters that form words, e.g., PLATO). I once counted over 20 such acronyms in a two-page text distributed by my university computer center. Chapanis (1988) provides additional examples, also from the field of computing. The meanings of acronyms may be familiar to the writer, but they need to be explained to the reader. Furthermore, readers easily forget what an author's abbreviations stand for when they are not familiar with the material.

27.3.6 Clarifying Text

Generally speaking, text is usually easier to understand when:

1. Writers produce few sentences containing more than two subordinate clauses. The more subordinate clauses or modifying statements there are, the more difficult it is to understand a sentence. Consider, for example, the problems posed for an anxious student by this examination rubric: "Alternative C: Answer four questions including at least one from at least two sections (1-5)."
2. Writers use the active rather than the passive voice. Compare the active form, "We found that the engineers had a significantly higher interocular transfer index than did the chemists" with the passive form, "For the engineers, as compared with the chemists, a significantly higher interocular transfer index was found."
3. Writers use positive terms (e.g., "more than," "heavier than," "thicker than") rather than negative ones (e.g., "less than," "lighter than," "thinner than"). Compare "The rain is heavier today" with "The rain was lighter yesterday."
4. Writers avoid negatives, especially double or triple ones. Negatives can often be confusing. I once saw, for example, a label fixed to a machine in a school workshop which read, "This machine is dangerous: It is not to be used only by the teacher." Harold Evans (1972) provides another example. Compare "The figures provide no indication that costs would have not been lower if competition had not been restricted" with "The figures provide no indication that competition would have produced higher costs." Negative qualifications can be used, however, for particular emphasis and for correcting misconceptions. Negatives can make imperatives (e.g., "Do not . . . unless . . .") easier to understand.
5. Writers personalize texts. In one study that Cathryn Brown and I conducted we compared two medical audiotapes. The first tape began:

   Welcome to the Health Department's Medical Directory. This tape is about multiple sclerosis: what causes it, and what you can do about it.

   The second tape began:

   Welcome to the Health Department's Medical Directory. My name is Nick and I want to tell you about multiple sclerosis. I am able to do this because I am suffering from the disease. In this tape I will tell you about what causes multiple sclerosis and what you can do about it.

   Both tapes contained the same information, but while the first tape was formal, the second tape conveyed the information in a more personal way. Students listening to this tape recalled more information from it than they did from the first one. Similar results have been reported by Rook (1987). Personalizing instruction, of course, can take many forms. It is possible to insert the appropriate names of people and places in computer-generated texts, and problems can be tailored to students' backgrounds. For example, the same mathematical problems can be presented in different contexts for nursing, teaching, and psychology students (e.g., see Davis-Dorsey, Ross & Morrison, 1991). Again, age and ability differences are important considerations in this field. Bracken (1982), for example, found that personalizing stories helped less-able fourth-graders but had no effect with those of average ability.
6. Writers make text more interesting. Lively examples and anecdotes cannot fail to make the text more memorable—or can they? Research has indicated that vivid anecdotes and the like can indeed make text more interesting, but this is often at a cost. Apparently many readers tend to recall these "seductive details" at the expense of the main information in the passage (Renninger, Hidi & Krapp, 1992).

27.3.7 Measuring Text Difficulty

There are many readability formulas available that attempt to predict the age at which the reader, on average, will have the necessary reading skills and abilities to understand a piece of text. Most readability formulas are not in fact as accurate at predicting this as one might wish, but the figures that they provide do give a rough guide. Typical readability formulas combine two main measures (with a

constant) to predict reading age. These are: (1) the average number of words per sentence, and (2) the average length of the words in these sentences (usually measured in syllables). Thus, the longer the sentences and the more complex the vocabulary, the more difficult the text is rated.

Many readability formulas can be calculated by hand. One of the simplest, the Gunning Fog Index, is as follows:

- Take a sample of 100 words.
- Calculate the average number of words per sentence in the sample.
- Count the number of words with three or more syllables in the sample.
- Add the average number of words per sentence to the total number of words with three or more syllables.
- Multiply the result by 0.4.

The result is the (American) reading grade level.

A better-known formula, but one that is harder to calculate by hand, is the Flesch Reading Ease (RE) formula. This is:

$RE = 206.835 - 0.846w - 1.015s$, where w = number of syllables per 100 words; s = average number of words per sentence.

In this case, the higher the RE score, the easier the text.

The relationship between RE, difficulty, and suggested reading ages is as follows:

RE Value	Description of Style	Required Reading Skill
90–100	Very easy	5th grade
80– 90	Easy	6th grade
70– 80	Fairly easy	7th grade
60– 70	Standard	8th–9th grade
50– 60	Fairly difficult	10th–12th grade
30– 50	Difficult	13th–16th grade
0– 30	Very difficult	College graduate

Today, with word-processing systems, it is much easier to apply the more complex readability formulas. For example, the readability program on my word processor can be applied to text to provide three sets of readability data derived from three different formulas. When this program was run on some 50 sentences of this chapter, the outcomes were as follows:

	Formula	Reading Age
1	Flesch	15–16 years
2	Kincaid	15 years
3	Gunning	18 years

It can be seen that the predictions from the four formulas vary slightly and only give a rough estimate of reading difficulty. Such readability formulas have other obvious limitations. Some short sentences are difficult to understand (e.g., "God is grace"). Some technical abbreviations are short (e.g., DNA) but difficult for people unfamiliar with them. Some long words, because of their frequent use, are quite familiar (e.g. *communication*). The order of the words, sentences, and paragraphs is not taken into account, nor are the effects of other aids to understanding such as illustrations, headings, numbering systems, and typographical layout. Also, most importantly, the readers' motivation and prior knowledge of the topic are not assessed. All of these factors affect text difficulty. (See Davison & Green, 1987, for a fuller discussion.)

Nonetheless, despite these problems, readability formulas can be useful tools for having a quick look at the likely difficulty of text that is being produced, and also—provided you use the same measure—for comparing the relative difficulty of two or more pieces of text. Comparison studies of original and revised texts have shown advantages for more-readable text in:

- Examination questions
- Scientific papers
- School textbooks
- Correspondence materials
- Job aids
- Medical instructions
- Insurance policies
- Legal documents
- Fairy tales! (Britton et al., 1993)

The difficulty with readability measures arises when people attempt to use them to change the way text is written. Text that has short, choppy sentences can be difficult to read (Armbruster & Anderson, 1985). Critics of readability formula have had fun producing "more readable" versions of such famous texts as the Declaration of Independence or the Lord's Prayer to highlight the limitations of readability formulas in these respects. Davison and Green (1987) provide one of the best critiques of readability formulas currently available. Studies by Beck and her colleagues are also interesting to note in this connection (e.g., Beck, McKeown & Worthy, 1995; Loxterman, Beck & McKeown, 1994). Here the more-readable texts in these studies score as less readable on readability formulas.

27.3.8 Revising Written Text

There are numerous guidelines on how to write clear text and also on how to revise one's own text, or text written by someone else (e.g., see Bellquist, 1993; Kahn, 1991). In my own work with 11- to 13-year-old school children, I have used the guidelines given in Figure 27-7. These guidelines are based on theoretical work conducted by psychologists and others on the nature of the writing process.

27.3.8.1. Computer-Aided Revision. Several computer programs have now been developed to help writers revise both technical and conventional text (e.g., see Hartley, 1992). Many of these programs were originally designed to be run when the text had been written, to analyze it and to make suggestions for improvement. Today, however, we may expect writers to use such programs concurrently with their writing. Such programs point to potential difficulties and offer on-screen advice. Figure 27-8 provides an illustration of the advice given to an author who had a "dangling modifier" in her text.

One typical suite of such programs at the time of writing is Grammatik 5. The number of facilities available is currently

1. Read the text through.
2. Read the text through again but this time ask yourself:
   - What is the writer trying to do?
   - Who is the text for?
3. Read the text through again, but this time ask yourself:
   - What changes do I need to make to help the writer?
   - How can I make the text clearer?
   - What changes do I need to make to help the reader?
   - How can I make the text easier to follow?
4. To make these changes you may need to make:
   - Big or global changes (e.g., rewrite sections yourself).
   - Small or minor text changes (e.g., change slightly the original text). You will need to decide whether you are going to focus first on global changes or first on text changes.
5. Global changes you might like to consider in turn are:
   - Resequencing parts of the text
   - Rewriting sections in your own words
   - Adding in examples
   - Changing the writer's examples for better ones
   - Deleting parts that seem confusing
6. Text changes you might like to consider in turn are:
   - Using simpler wording
   - Using shorter sentences
   - Using shorter paragraphs
   - Using active rather than passive tenses
   - Substituting positives for negatives
   - Writing sequences in order
   - Spacing numbered sequences or lists down the page (as here)
7. Keep reading your revised text through from start to finish to see if you want to make any more global changes.
8. Finally, repeat this whole procedure some time after making your initial revisions (say 24 hours), and do it without looking back at the original text.

Figure 27-7. Guidelines for revising text.

Contents | Search | Back | History | << | >>

'BETWEEN' and 'AMONG'
Use 'between' when referring to two people or items, 'among' when referring to more than two. Because this distinction relates to content, it is one you should observe.

References:
Gowers, 'The Complete Plain Words', pp. 107–108
Greenbaum and Whitcut, 'Longman Guide to English Usage', p. 37

DANGLING MODIFIERS
A dangling modifier is an error that occurs when the implied subject of one clause clashes with the stated subject of another. For instance, according to the following sentence,
'Standing in front of the old house, the memories came flooding back'

the 'memories' were standing in front of the old house.

According to this sentence,
'Although only fifteen inches long, the nurse declared that the infant was in good health'

Figure 27-8. Grammatik's tutorial system.

being expanded, but Figure 27-9 lists some of them. One difficulty here is whether the novice writer can cope with all the information provided. Another appears to be that writers often need to understand sophisticated grammar in order to follow the advice offered by the authors of such programs! Evaluation studies of different programs are now beginning to appear (e.g., see Kohut & Gorman, 1995).

In 1984, I published a report of how useful one such set of computer-aided writing programs (The Writer's Workbench) had been to me in revising a particular article.

I compared the suggestions made by nine colleagues with the suggestions made by the computer programs. The human and the computer aids to writing differed in two main ways. My colleagues were more variable than the computer programs: Different colleagues picked on different things to comment on. None made comments in all of the (14) categories of comments that I derived in the inquiry. The computer programs were more thorough and more consistent than my colleagues, but this was over a narrower range of (six) categories. The programs picked up every misspelling; they drew attention to every sentence that was over 30 words long; they indicated that I had missed out a bracket, but did not say where; and they provided me with 85 suggestions for better wording! Thus the computer programs were excellent at doing the donkey work of editing; my colleagues excelled at using their knowledge to point out inconsistencies, errors of fact, and to suggest better examples. The final version of the article thus benefitted from the combined use of both sources of information.

Programs that indicate grammatical errors:

- Adjective errors
- Adverb errors
- Article errors
- Clause errors
- Comparative/superlative use
- Double negatives
- Incomplete sentences
- Noun phrase errors
- Object of verb errors
- Possessive misuse
- Preposition errors
- Pronoun errors
- Sequence of tense errors
- Subject-verb errors
- Tense changes
- etc.

Programs that indicate mechanical errors:

- Spelling errors
- Capitalization errors
- Double word
- Ellipsis misuse
- End-of-sentence punctuation errors
- Incorrect punctuation
- Number style errors
- Question mark errors
- Quotation mark misuse
- Similar words
- Split words
- etc.

Programs that indicate stylistic errors:

- Long sentences
- Wordy sentences
- Passive tenses
- End-of-sentence prepositions
- Split infinitives
- Cliched words/phrases
- Colloquial language
- Americanisms
- Archaic language
- Gender-specific words
- Jargon
- Abbreviation errors
- Paragraph problems
- Questionable word usage
- etc.

Figure 27-9. A sample of computer programs available in Grammatik 5 from Apple Macintosh.

In 1993, I replicated this study with a journalist colleague (Dorner & Hartley, 1993). The conclusions that we reached were much the same, despite the advances made in computer-aided writing programs.

27.4 TEXT DESIGN FOR READERS WITH SPECIAL NEEDS

In this section, I turn to consider issues of text design for two sets of readers with special needs: the elderly and the visually impaired. These two sets of people can, of course, overlap.

27.4.1 Instructional Text and Older Readers

The proportion of older people in society has gradually been increasing throughout the 20th century. Life expectancy at birth in the U.K. has increased by 50% in this century, and 4 in every 10 British adults are now over 50. In the United States, currently 12% of the population is 65 years of age or older, and the number of Americans over the age of 65 years is expected to double to 65 million by 2030. Thus people are living longer, and the number of elderly people in the community is getting larger. Consequently, there are more older people reading traditional texts, and more texts being produced especially for them.

The research on the effects of aging can be described in terms of three overlapping areas: physiological, cognitive, and social. Physiological research looks at the biology of aging and its physiological correlates. Most people, for example, experience a sharp decline in eyesight. Cognitive research on aging focuses on changes in memory, learning, and judgment. Such effects have implications for work on text design. Social research on aging examines how, for example, societies expect their older members to function. Studies of "ageism," for example, focus on how commonly held attitudes and beliefs about what old people should and should not do determine to a considerable extent what, in fact, they do do.

It is difficult to summarize in a few lines the main findings of studies of aging and their implications for text design. (Fuller expositions can be found in Birren & Schaie, 1990, or Craik & Salthouse, 1992.) Here, for the sake of argument, I would like to suggest two main points that I think it is helpful to bear in mind when thinking about these issues. These are:

- Working memory capacity (i.e., information held and used in ongoing tasks) declines as people get older.
- The more difficult the task and the older the person, the more disproportionately difficult the task becomes.

Studies of memory for text suggest that a number of possibilities can occur (Meyer et al., 1989). Evidence has been provided in different studies indicating that older people:

- Remember the main ideas but forget the details
- Remember the details but forget the main ideas
- Forget both the main ideas and the details

These different outcomes may result from different investigators focusing on different issues in their studies. The findings suggest that older people may not have much difficulty reading or working with text that is relatively simple (in terms of its typography) or familiar to them. However, text that is typographically complex and which deals with unfamiliar material (like how to operate a video recorder) may cause middle-aged and older people considerable problems.

Thus, one might not expect differences between older and younger readers when the verbal ability of the readers is high, when they have good prior knowledge, and when the texts are well presented. However, as Meyer et al. (1989) suggest, differences might well be expected to emerge with less-able readers, less-familiar materials, and poorly designed text.

27.4.1.1. Improving Typographically Simple Layouts. Generally speaking, the literature reviewed above suggests that text will be easier for older people to use if their perceptual and memory-processing loads are reduced. I would want to argue that this can be achieved by, for example:

- Using larger type sizes
- Using more readable text
- Using clearer layouts
- Clarifying the structure of the text by, for example, using summaries, headings, and "signals"

Unfortunately, there are insufficient studies in this area to support or reject these hypotheses. In a separate review (Hartley, 1994b), I have summarized the results from some 16 studies that examined varied aspects of text design with older participants. These studies used what I called relatively simple typographic layouts: mainly continuous run-on prose. Table 27-1 shows how, except for the area of type size, there are insufficient studies for anyone to make any clear generalizations from their findings.

TABLE 27-1. THE NUMBER OF STUDIES WITH OLDER PEOPLE FOUND FOR EACH ASPECT OF TEXT DESIGN LISTED IN THE TEXT

Number of Studies	Text Design Feature
5	Type size
2	Unjustified text
2	Underlining
2	Improving readability
2	Advance organizers
1	Questions in text
1	Signals
1	Text structure and organization

However, all five studies on type size did suggest that larger type sizes were more suitable for older readers. It appears that—ignoring my earlier caveats about measuring type sizes—that 12- or 14-point type seems more appropriate for older readers.

The two studies with unjustified text suggested that there were advantages for unjustified text with *less-able* older readers when the line lengths were short (seven to eight words).

The two studies on underlining and the two on advanced organizers had mixed results: one positive and one neutral in each case. The two studies on improving readability showed that this had no effect with age. However, there were age effects for the studies with questions, signals, and variations in text structure: Older readers did less well than younger ones, but high-ability readers were helped by the textual variable being considered.

My review highlighted three issues in this research:

1. There were ability effects rather than age effects in about half of these studies. The more-able participants did better than less-able ones, irrespective of age.
2. Less than half of the 16 studies used a control group of younger participants: Most were done with a single group of older persons. So it was not possible to see if the variable in question was additionally helpful (or not) for older readers.
3. Very few of the investigators reported working with text that was appropriately designed for visually impaired older readers (although one or two did check that their participants could read the texts). Thus, one might argue, many of the older readers in these studies were probably working under an additional handicap.

27.4.1.2. Typographically Complex Texts. So far I have discussed research with older readers and texts that have had a relatively simple typographic structure. I now turn to consider more complex materials. These include, for example, bus and train schedules, labels on medicine bottles, food packaging, and government forms. Regrettably, there are very few studies in this context.

Six studies that I did find suggested, as noted earlier, that more complex text presents greater difficulties for older readers. These studies involved readers completing income tax forms (James, Lewis & Allinson, 1987), following diagrams (Lipman & Caplan, 1992), using an analogous model (Caplan & Schooler, 1990), reading prescription information (Morrell, Poon & Park, 1990), following instructions for completing assembly-type tasks (Morrell & Park, 1993), and using flowcharts to aid decision making (Michael, 1988).

In these studies, the younger participants always did better than the older ones, and the devices used to aid the readers here proved more helpful for the younger readers than for the older ones in the studies by Caplan and Schooler (1990), Lipman and Caplan (1992), Morrell and Park (1993), and Michael (1988). Indeed, I drew the tentative conclusion in my review that devices used to help readers in these situations actually *hindered* older readers.

Clearly, more work needs to be done in this area of instructional design. One useful suggestion that did emerge from these papers was that it might be wise to ensure that older people are included in initial evaluation studies of textual materials. It can be argued that designing a text for an older reader may not confuse a younger one. However, designing a text for a younger reader may confuse an older one.

27.4.2 Text Design for the Visually Impaired

During 1986/87, the U.K. Royal National Institute for the Blind (the RNIB) conducted a survey of the needs of blind and partially sighted adults in Britain, and a final report was published in 1991 (Bruce et al., 1991). A similar report on the needs of blind and partially sighted children was published in 1992 (Walker et al., 1992). And although these reports describe the situation in the U.K., we can anticipate that the problems are similar in other developed countries and worse in developing ones.

The 1991 U.K. report indicated that there were approaching 1 million (960,000) blind and partially sighted adults in Great Britain, many more than those actually registered (239,000). The prevalence rates (for those registered) were as follows:

3 per 1,000 among 16- to 59-year-olds
23 per 1,000 among 60- to 74-year-olds
152 per 1,000 among those over 75 years of age

Thus, one person in seven aged 75 or over was blind or partially sighted, and this prevalence rate was almost certainly higher among those over 80 and those over 85.

It is, of course, important to realize that the great majority of these people are not completely blind but are, in fact, partially sighted. The RNIB 1991 report estimated that only 20% of "blind" people are completely blind (and this number includes people who can perceive light but nothing more). Thus, 80% of the blind have varying degrees of visual impairment, and, as we shall see below, many can read large print.

Similar findings were presented in the 1992 report on blind and partially sighted children. It was estimated that there were at least 10,000 children in Great Britain with significant visual impairments, and possibly as many as 25,000. As many as 80% of the children in the sample were reported to have had their sight problem from birth.

For some children (and adults for that matter), spectacles, contact lenses, and other magnifying devices mean that they can in fact read and write using print rather than Braille. In this children's sample:

- Over 80% used tape recordings for learning and/or entertainment.
- 40% could read normal-sized print.
- 63% were using microcomputers in school.
- 36% were using microcomputers at home.
- 90% liked listening to the radio and listening to and watching television.

The RNIB reports point out that the needs of blind and partially sighted are complex. Many of them have additional disabilities, and many cannot use Braille or computers because of additional learning or physical difficulties.

27.4.2.1. Large Print. The RNIB considers that 10-point type (as used in this handbook) is too small for many readers, not just the blind and partially sighted. They recommend 12-point type for most documents and 14 point as the minimum type size for material intended for the blind and partially sighted. Other recommendations are given in Figure 27-10. Similar guidelines have been produced in the United States by the American Association of Retired Persons (1986) and by the Civil Rights Division of the U.S. Department of Justice (1988). These guidelines share some common characteristics: They make good sense but occasionally imply too strongly that they are based on known research findings.

It is important to remember, as noted earlier, that with large print the width of the text expands, as well as the depth. This may make it difficult to perceive the syntactical groupings of words if the page size stays the same. So, simply enlarging a text may not always be a sensible solution to the problem: One might take the opportunity to reconsider its design (see Hartley, 1994a).

- Contrast. There needs to be good contrast between the type and the paper on which it is printed or photocopied. Contrast is affected by paper color, print color, type size, and weight. Black type on white or yellow paper gives a very good contrast. Pale-colored papers provide better contrast than dark ones. Black or very dark-colored print can be used if the paper is very pale. The print should not run across photographs or illustrations.
- Type sizes. 14 or 16 point is acceptable when printing for the partially sighted (see the text).
- Type weights. Avoid light typefaces, especially in small sizes. Medium and bold type weights are more appropriate in this context.
- Typefaces. Most typefaces in common use are suitable. Avoid bizarre or indistinct typefaces. Numbers need to be printed clearly: Blind and partially sighted people can easily misread 3, 5, and 8 in some faces, and even 0 and 6.
- Capital letters. Avoid long strings of text in capital letters; they are harder to read than lowercase.
- Line lengths. These, ideally, should be in the range of 50 to 65 characters. Blind and partially sighted people may prefer shorter lines than this. Avoid hyphenation at the ends of lines.
- Spacing. Keep to regular word spacing: Do not stretch or condense lines of type; that is, avoid justified type settings. Allow the line spacing to be equivalent to the type size plus the word spacing. Use a line space between paragraphs, and use space to show the underlying structure of the text. Additional lines or "rules" may help keep separate unrelated sections. Do not fit text around illustrations. (It is also worth noting that blind and partially sighted people often need more generous space on forms for handwritten responses, as their handwriting tends to be larger than average.)
- Paper. Print on glossy paper can be difficult to read. Very thin papers also cause problems, because text can show through from the reverse.

Figure 27-10. Recommendations to follow when designing text for the visually impaired. Guidelines adapted from RNIB (1993). *See It Right: Clear Print Guidelines*. Fact Sheet 2. Reproduced with permission of the RNIB.

There have been few actual studies of designing printed texts for the partially sighted. Those that have been carried out have mainly been concerned with the setting of children's reading books rather than with material for adults. Shaw (1969) provides a good review of the earlier literature and reports on a detailed study with adults. Shaw asked her participants to read aloud short passages that varied in typefaces (Gill & Plantin), type sizes (from 10 point to 24 point), weight (bold and medium), and various spatial settings (see Fig. 27-11).

Shaw reported that an increase in type size achieved a 16% improvement in reading performance, an increase in weight 9%, and a change from Plantin (a serif face) to Gill Sans (a sans-serif face) a 4% improvement. (This typeface change was particularly helpful for readers over 50 years of age.) These results must, of course, be considered with caution in view of the fact that the participants were asked to read the texts out loud and that the texts themselves, as shown in Figure 27-11, were very odd.

27.4.3 Presenting Text in Braille

The Braille system—in which each character is conveyed by one of six embossed dots in a 2 × 3 matrix—is well known to many and is illustrated in Figure 27-12. Braille text was originally produced on thick card, but today it is more likely to be produced by a thermoform system with heated, paper-thin, plastic sheets. This system also allows one to produce tactile maps and line drawings.

To the sighted reader, a page of Braille may look like a large and cumbersome equivalent of a piece of conventionally printed text. But this would be naive. Completely blind readers cannot see the top and the bottom of the page simultaneously; they have to work out which is which. They cannot see headings and subheadings at a glance. They cannot see at a glance how many paragraphs there are on the page, and thus how dense the text is. They cannot tell until they start whether the language of the text is going to be easy or difficult. To discover what is there, blind readers must start at the beginning and work through to the end without knowing (for the most part) when the end is coming.

In this chapter, I have described how instructional text can be improved by paying attention to the typographic layout, to the wording or language of the text, and to the use of headings, summaries, numbering systems, and other such devices. Much of the research I have described would seem applicable to the setting of Braille text. Despite the fact that many Braille texts seem to be devoid of clear spatial cues—perhaps because of the assumption that there is no need to include space because blind people cannot see it—it would

Face: GILL
Weight: ROMAN
Size: 12 POINT

Main floors escape special loads. Foreign glories arrange careful bills. Returning fathers concern large merchants. Valuable shadows know frequent corn. Lower money beats straight diseases. Last oils enjoy

Spacing: "normal"

Wild life claims perfect witnesses. Loud beauties move demanding chairs. Sad wages attract silent populations. Exact spaces please ideal dinners. Appointed plates see lost farms. Deep newspapers expect square

Spacing: extra space between letters and words

Next season allows set companions. Modern banks paint vain trade. Brave adventures marry extreme churches. Ancient machinery shoots future currents. Important stories take late posts. Black clubs seize twenty

Spacing: extra space between words only

Noble ways sing other bread. Long stores perform second teeth. Religious fashions compose wide factories. Excellent officials appear usual towns. Sorry coals walk five defences. Numerous flowers speak wrong

Spacing: extra space between lines only

Figure 27-11. An example of the materials used in Shaw's experiment. (Figure reproduced with permission of the U.K. Library Association.)

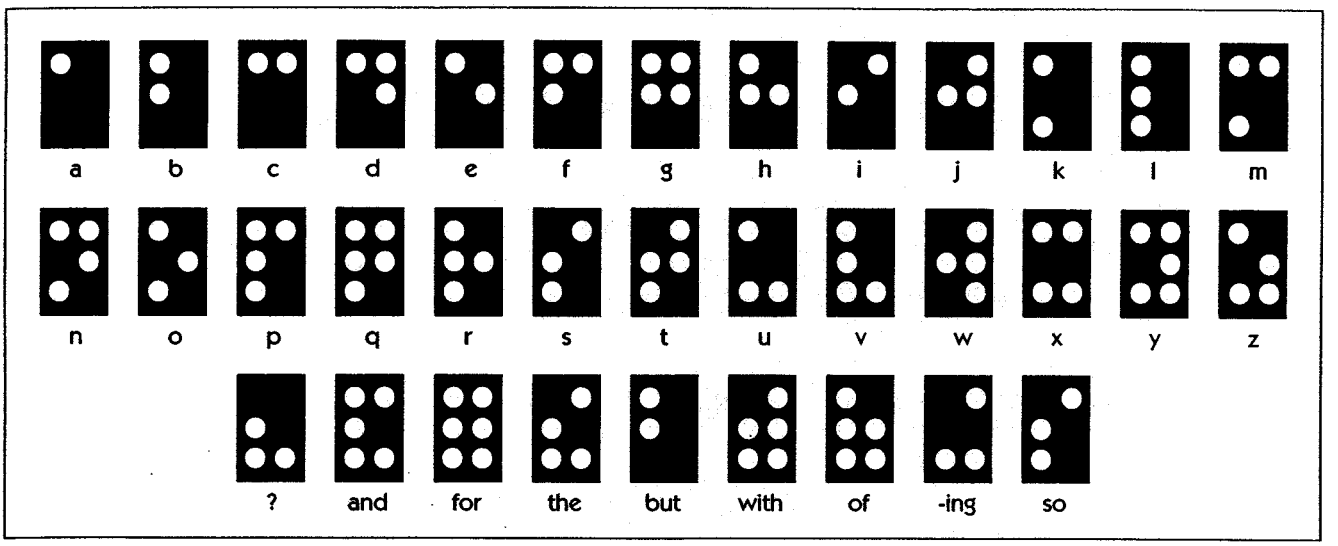

Figure 27-12. The Braille code.

seem to me that the structure of Braille texts could be clarified by the methods discussed above. My observations of skilled Braille readers indicate that they can indeed "look ahead" by quickly scanning (with both forefingers), and that they welcome devices such as headings (Hartley, 1989).

Blind readers require practical information (e.g., telling them how long an article is going to be) and contextual information (e.g., the use of overview summaries). If headings are numbered and phrased in the form of questions (e.g., who, what, when, where, why, how), then blind and visually impaired readers can read with such questions in mind, and they will know when they have reached the end of particular sections. Overview summaries and headings enable readers to "look ahead" more easily and thus to reduce their memory load while reading.

In addition, it might also be profitable to think of how one can convey information differently without the array of typographical devices available in printed text. In Figure 27-13, for instance, I contrast the traditional sequence used in presenting references in a scientific journal with what might be appropriate in a Braille version. In Version A—the traditional setting—the text is continuous, and different sections of the references are denoted by different typographic cues. In Braille versions of this material, it is conventional to follow this continuous sequence of the printed version. In Version B, however, I have shown how by resequencing the elements, and by placing the key elements on different lines, the text is easier to search, even though it has no typographic cues. Clearly making changes such as these may be costly in terms of the additional space required, but such changes may be more cost effective if readers find the resulting text easier to read.

At present, of course, we do not know whether respacing traditional Braille settings would be of value to blind readers: It may make little difference to those blind from birth. However, it is likely that those who become blind in later life and who wish to learn to read Braille do carry with them a repertoire of expectations about text layout that is currently not realized in Braille.

27.5 HOW TEXTBOOKS ARE USED

In this penultimate section I want to turn from discussing textbook design, where design is taken to be the equivalent of typography and layout, to considering the situation where design is taken to be synonymous with manipulation. In short, I am interested in how one might use the knowledge we have gained from the studies described in the earlier sections in order to manipulate text so that learners can read and use text more effectively.

One aspect of this research that is of interest here is to find out what readers actually value in different text design features, both separately and in combination. For example, Thompson and Maniam (two of my undergraduates) asked a group of university students to indicate their preferences for four various designs for tabular layouts presented by Ehrenberg (1977) and illustrated in Hartley (1994a). Strong support was found for Ehrenberg's personal judgments. In another study, Kim Little (another undergraduate) asked 87 adolescents aged between 12 and 16 for their preferences for various features of the design of textbooks. Table 27-2 indicates the results. Access structures were clearly appreciated, but devices that required work (tables, graphs, questions, and suggestions for further reading) were clearly not so popular. (See also Weiten, Guadagno & Beck, 1996.) Such findings have implications for textbook writers, particularly those who want to encourage deeper text processing and/or improve the quality of textbooks (e.g., Jones, 1988).

There has been surprisingly little research on how students and teachers actually use textbooks, and on which features they appreciate. Newton (1984) describes some early British studies with university students and with teacher-trained college students reading science textbooks. In his 1984 report, he outlines the results he obtained from

Version A

Kanski, J. J. and Packard, R. B. S., **Cataract and Lens Implant Surgery**, Churchill Livingstone, 1985, 60pp, £26.00, ISBN 0 443 03205.

Gilbert, P., **Mental Handicap: a practical guide for social workers**, Community Care, 1985, 130pp, pbk £3.95, ISBN 0617 00447 1.

Dechesne, B. H. H, Pons, C. and Schellen, A. M. C. M. (eds.), **Sexuality and Handicap: problems of motor handicapped people**, Woodhead-Faulkner, 1985, 234pp, pbk £19.95, ISBN 0 85941 231 8.

Holloway, C. and Otto, S., **Getting Organised**, Bedford Square Press, 1985, 70pp, pbk £4.95, ISBN 0 7199 1162 1.

Version B

Cataract and Lens Implant Surgery,
Kanski, J. J. and Packard, R. B. S.
Churchill Livingstone, 1985,
60pp, £26.00, ISBN 0 443 03205.

Mental Handicap: a practical guide for social workers,
Gilbert, P.
Community Care, 1985,
130pp, pbk £3.95, ISBN 0617 00447 1.

Sexuality and Handicap: problems of motor handicapped people,
Dechesne, B. H. H, Pons, C. and Schellen,
A. M. C. M. (eds.),
Woodhead-Faulkner, 1985,
234pp, pbk £19.95, ISBN 0 85941 231 8.

Getting Organised,
Holloway, C. and Otto, S.,
Bedford Square Press, 1985,
70pp, pbk £4.95, ISBN 0 7199 1162 1.

Figure 27-13. Version A shows an excerpt from a list of references as typically presented in the *British Journal of Visual Impairment.* Version B shows the same text using space rather than typographic cueing to show the structure of the entries in the list. The argument is that Version B would be more helpful in a Braille setting than Version A.

examining how 12th-grade pupils used textbooks in physics, chemistry, and biology. Basically Newton found that, in these British studies, it was rare for students to read the complete texts. It appeared that on average just over one-third of the physics text was read, slightly less than half of the chemistry text, and just over one-half of the biology text. In all cases, it was common for the texts to be read after the appropriate lessons rather then before them, and there were great variations in the amounts read by individual students. The main uses that the students made of the texts were to help them answer specific questions, to help them revise, and to provide supplementary reading. Newton concludes that the main role of the textbook in this study was to act as "a surrogate teacher" and a provider of supplementary reading.

There have been more detailed reports, with case histories, of how students use distance learning materials (e.g., see Marland et al., 1984, 1990, 1992). These studies have tended to focus on how such students allocate their time, what sections they read (or don't read), and in what order they carry out the assignments requested of them. Marland et al. (1990) draw attention to the fact that different groups of students in their

TABLE 27-2. THE RANK ORDER OF PREFERENCES FOR FEATURES IN TEXTBOOKS (RESPONDENTS WERE ASKED TO INDICATE WHETHER THEY FOUND THE FEATURES LISTED AS HELPFUL, MADE NO DIFFERENCE, OR UNHELPFUL IN THEIR READING OF TEXTBOOKS)

		% Endorsing (N = 87)		
Rank	**Feature**	**Helpful**	**No Difference**	**Unhelpful**
1	Headings	71	28	1
2	A section to tell you what the chapter is about	69	29	2
2	Short chapters	68	29	3
4	Cartoons	68	25	7
5 =	Use of color to show important points	63	34	2
5 =	Use of underlining to show important points	63	34	2
7	Photographs	63	30	7
8	Spacious layout	54	39	7
9	Subheadings	53	41	6
10	Tables	48	40	11
11	A section to remind you what the chapter was about	47	45	6
12	Graphs	44	43	14
13	Questions at the end of each chapter	41	46	13
14	Suggestions for further reading	40	47	13

study paid attention to different features. Some focused on the course objectives, but others never looked at them; very few paid much attention to the headings. Tables, however, were inspected closely; some students were bemused by author-provided underlining; and there was little indication that any of the students sought to develop a broad, integrated understanding of the text (see also Chapter 13). Studies by Macdonald-Ross and Scott (1995) have examined the reading skills of large samples of students entering the British Open University. The results suggest that many entering students have difficulties with academic text. Findings such as these have implications for text design, which will be discussed below.

Clearly, how teachers use textbooks in class is also an important consideration. Three American studies (Alverman, 1989; Hinchman, 1987; and Zahorik, 1991) suggest that teachers, overall, appear to have three different ways of using textbooks in class. These are to provide:

- Authoritative content
- Basic material that they can embellish
- Material for discussion

Zahorik found that over 80% of the teachers in his sample said they would use a textbook when teaching a particular lesson, but over 40% said they would not have their pupils read it from cover to cover. Other investigators also provide more detailed accounts, with case histories, of how teachers use textbooks in class (e.g., DiGisi & Willett, 1995; Freeman & Porter, 1980; Garner & Alexander, 1994; Roth & Anderson, 1988).

As noted above, Newton (1984) indicates that textbooks in the United Kingdom are sometimes used as "surrogate teachers." He suggests that such a use tends to restrict the ways in which textbooks are written and designed. Authors, he writes, "can assume nothing" and "the expositional style adopted has tended to give the reader a passive role."

There is some evidence to support these notions. Schallert, Alexander, and Goetz (1988) examined the strategies designed to help students process text that had been used by the authors of five popular introductory psychology and biology textbooks. The categories listed by Schallert et al. are shown in Table 27-3, together with approximate estimates of their amount of use. Schallert et al. concluded that, despite the presence of these cues, the authors generally required little effort and activity from their readers. Schallert et al. write:

> Pictures and graphs were provided. Directed imagery, where an author might ask readers to imagine or construct a mental representation, was never used in our sample. Summaries were provided, but readers were not asked to summarize for themselves. . . . The most effort-demanding cues that were used with any substantial frequency were questions to be answered by the reader. These were usually found at the ends of chapters and may have been easily overlooked during studying.

The quality of these questions, too, may leave something to be desired (Armbruster & Ostertag, 1993; Turner, 1989).

Such a passive view of studying appears to be fairly commonplace among textbook authors. That view neglects the fact that readers vary enormously in their reasons for studying, in their ability and motivation, and in their methods of approach (see, e.g., Carbo, Dunn & Dunn, 1986; Lorch, Lorch & Klusewitz, 1993).

One particular distinction currently receiving much attention in Europe is that between "surface" and "deep" approaches to studying and reading (Entwistle, 1992; Marton & Saljo, 1984). Surface readers skim the text, retain isolated facts, and are not concerned with the overall structure or argument of the text. Deep readers, on the other hand, search for the underlying structure of the text, question it, relate ideas in the text to their own prior knowledge and experience, and so on. Table 27-4 suggests how these different study strategies may manifest themselves.

This distinction between deep and surface learning, of course, is only one of many similar ones. Whatever the

TABLE 27-3. STRATEGIES USED BY AUTHORS OF FIVE PSYCHOLOGY AND FIVE BIOLOGY INTRODUCTORY TEXTBOOKS (Data based on Schallert, Alexander & Goetz, 1988)

Proportion of Use:		
Psychology Textbooks	**Biology Textbooks**	**Strategies Used by Authors**
45%	29%	Cues that direct the reader's attention (e.g., objectives, questions, boldfaces, italics)
25%	31%	Cues to signal content and organization (e.g., headings, summaries, overviews, outlines, intertextual references, text to graphic references)
10%	22%	Cues that help the reader to elaborate (e.g., examples, paraphrases, applications, marginal comments)
5%	11%	Cues to support the communication (e.g., tables, graphs, referenced drawings, photographs)
3%	5%	Cues that relate text material to familiar information (e.g., familiar quotes, allusions to common experiences and comparisons)
6%	2%	Cues that arouse and motivate the reader (e.g., humor, unreferenced illustrations, photographs)

TABLE 27-4. OUTLINES OF STUDY ORIENTATIONS
(Reproduced with permission of P. Marland)

Characteristics	Study Orientations	
	X	*Y*
Motivation	Intrinsic, professional • Improve teaching • Improve self-knowledge • Develop understanding of teaching • Get more out of course • Put more effort into course (not concerned about grades)	Extrinsic • Obtain graduate qualifications • Achieve higher status • Get salary increment • Enhance employment prospects
Study strategies	Optimizing • Read beyond course materials • Process material three times • Generate own questions • Use textual material to evaluate own teaching whenever appropriate or interested	Satisficing • Select textual material for study that is relevant to assessment • Process material once • Complete minimal requirements • Use textual material to evaluate own teaching when required • Evaluate ideas in text when required
Student role	• Diverge from assigned or implied student role when necessary, appropriate	• Fulfill assigned or implied role
General characteristics	Information processing is generally deep Student is: • More professionally oriented • Not text bound • An optimizer (that is, tries to get the most out of study)	Information processing is generally surface unless otherwise required Student is: • Assessment oriented • Text bound • A satisficer (that is, is satisfied with getting by on what is required by assessment)

terminology used, the question being raised here is how can one design instructional text encourage readers to take a deeper and a more active approach to reading? One answer, I think, is to identify successful learning strategies for reading, and to write the text in such a way that it encourages readers to practice them.

If, as Newton (1984) suggests, we consider a book as a device to think with, and if we consider that active participation is more likely to foster understanding than is a passive role, then we must consider how, as textbook designers, we might achieve this. Newton suggests, for example, that we can use self-test questions ("not necessarily difficult ones"), outlines, and advance organizers to help pupils enter into a dialogue with the author. Also, he suggests that pupils can be encouraged to use the materials provided in an active way (for example, by constructing tables and drawing diagrams). Marland et al. (1990), in their study of distance learning materials, similarly suggest that their findings have implications for text design. They write:

> It may be helpful if writers were to: reduce the scope of the content to allow for more in-depth study of the text; be explicit about the expectations as to study strategies to be employed, level or quality of student response, and types of cognitive processes to be used when completing the in-text activity; structure the text in such a way that emphasizes a cumulative, interactive organic view of learning rather than a view of learning as the acquisition of isolated bits of knowledge; design assessment activities that require reinterpretation and integration of substantial chunks of content; use outcomes of in-text activities as prerequisite knowledge for further study; and make completion of some in-text activities compulsory.

In a paper I wrote in 1987, I listed 13 such strategies that writers, teachers, and students might use that would encourage deeper text processing. Jones (1988) similarly describes a curriculum with such learning strategies embedded within it. Thus Newton, Marland, Jones, and I are arguing, along with others (e.g., Armbruster & Anderson, 1985; Rowntree, 1992), for what we call more *coherent* texts. Such texts are written for specific groups of readers; they use language with which the readers are familiar; they include experiences that readers share; they provide meaningful examples; they ask readers questions as they go along—not just in the headings or at the end (see Walczyk & Hall, 1989)—and they provide examples and problems that readers actually have to work through in order to follow the exposition. Such texts, too, can be supplemented by other kinds of reading materials (see Lapp, Flood & Ranck-Buhr, 1995).

I have provided elsewhere two chapters that illustrate how writers can use questions that readers have to answer in order to understand the following exposition (Hartley,

1985, 1986) and other examples of more complete texts in this vein, including Bransford's (1979) *Human Cognition*, Gagne's (1984) *The Cognitive Psychology of School Learning*, and Lockwoods' (1992) *Activities in Self-Instructional Texts*. Given the preponderance of textbooks in our schools, changing the ways in which we write them can make a major improvement in instructional practice.

27.6 FUTURE DIRECTIONS IN TEXTBOOK DESIGN

In the previous sections, I have described a good deal of research on textbook design. Much of this research, however, as I noted particularly in 27.3, is uncoordinated and atheoretical. Most researchers focus on one particular feature of text design, few consider the effects of several features in combination, and few carry out carefully developed programmatic studies.

Furthermore, most researchers work within a particular framework. Researchers with a leaning towards a cognitive approach (see Chapter 5), for instance, might look, for example, at how prior knowledge affects the usefulness of headings (e.g., Wilhite, 1989). In contrast, researchers following a constructivist approach (see Chapter 7) might focus on how getting readers to generate their own outlines, headings, or questions might be more advantageous than their simply reading those provided by authors (e.g., see Foos, Mora & Tkacz, 1994; Jonassen, Hartley & Trueman, 1986; Speigel & Barufaldi, 1994). This distinction between author- and reader-provided devices occurs in research on summaries, outlines, headings, and underlining. Presumably, too, depending on one's point of view, it affects how one writes instructional text.

Furthermore, we need to remember that textbooks are constantly evolving. Weiten and Wight (1992) provide a good example of this in their historical analysis of introductory textbooks in psychology. Currently, British textbooks lag behind American ones in this evolutionary process. British textbooks use far less color and far fewer graphics. Handbooks—such as this one—also suffer from this problem. In 5 to 10 years, however, our school children and our university students will be familiar with multimedia, interactive compact discs (see Chapters 12, 14, 15, 24) that they will read on colorful computer screens. Textbooks, *as we currently know them*, may become a thing of the past.

Some people (e.g., Jonassen, 1992; Schlosser, 1994) have already predicted the demise of the textbook and described current textbooks as obsolete. Although I think they go too far, I do agree that the physical nature of textbooks may change. New technology already allows visually handicapped students to print out text in the type sizes and typefaces that they prefer. Perhaps, in the future, readers will be able to order textbooks with their preferred fonts, type sizes, line lengths, margins, etc. And, similarly, textbooks may be read on screens in whatever configuration the reader chooses. I am indebted to Thomas Anderson for the suggestion that, with the help of computer publishing, perhaps students can opt to design their own specialized textbooks by choosing not only their preferred typefaces and type sizes but choosing also between, for example, (1) inserted questions or not, (2) summaries listed before or after the chapter prose, (3) concept maps or outlines, (4) embedded or marginal headings, (5) headings written as statements or questions, and (6) particular chapters from the ones available. These choices would depend on the use that was to be made of the textbook. In other words, Anderson suggests that the future directions of textbook design may be more under the control of the readers than the authors (see Chapter 33). Research in textbook design may never answer the question "Which typeface/type size/line length is best?" for every individual occasion, but it may allow us to present readers of the future with an appropriate menu from which to choose.

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