Typography papers 7

The Graphic Information Research Unit: a pioneer of typographic research

Linda Reynolds

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Corrections

None.

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The Graphic Information Research Unit: a pioneer of typographic research

The Graphic Information Research Unit, initially known as the Readability of Print Research Unit, was set up by the typographer Herbert Spencer at the Royal College of Art, London, in 1966. Over the next 16 years the Unit carried out a variety of studies on the legibility and usability of printed and on-screen materials. Much of this work was funded by the British Library and related to issues such as the legibility of scientific and technical information, the design of bibliographies and library catalogues in print, in microform and on videotex, and the design of wayfinding systems in libraries and museums. The Unit's approach to its experimental work is of particular interest, as it utilized the combined skills of typographers and a psychologist/information scientist. The results of a number of the studies are still of practical relevance today, and it is argued that the work of the Unit and its members has reached a surprisingly wide range of interest groups. The paper includes a list of the Unit's published reports, plus other items arising either directly or indirectly from the Unit's funded research.

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The Graphic Information Research Unit played a key part in British research on legibility and information design in the late 1960s and the 1970s. Based at the Royal College of Art (RCA) in London, it developed a particular approach to research that grew out of cooperation between two designers, Herbert Spencer and Brian Coe, and myself as a psychologist and information scientist.[1] Herbert Spencer was a distinguished designer, photographer, writer and editor,[2] and Brian Coe was a typographer who had been taught by Anthony Froshaug at Watford School of Art. Herbert Spencer died in 2002 aged 77, and Brian Coe died an untimely death in 1999. As the only surviving member of the team, I offer this retrospective and re-evaluation of its work.[3]

From 'Readability of print' to 'Graphic information'

The Graphic Information Research Unit began as the Readability of Print Research Unit. It was set up by Herbert Spencer at the Royal College of Art in 1966 with a two-year grant from the International Publishing Corporation (IPC).[4] The brief was to investigate problems of legibility in what was called information publishing, and the results were published in 1969 in *The visible word: problems of legibility* (Spencer 1969) (figure 1, overleaf). Herbert designed *The visible word* himself, in accordance with the results of the research on legibility that he had summarised in the book. I think it is fair to say that this is now regarded a classic work, to be found on the bookshelves of many professional designers and still much referred to by students of typography. The IPC contract was followed by a commission from the Post Office (as it was then called) to look at various aspects of the legibility of telephone directories, including the implications of the addition of postcodes and the effects of using tinted papers.

Then, in 1971, the Unit began work on a series of studies for the Office of Scientific and Technical Information (OSTI, later to become the British Library Research and Development Department, or BLR&DD). Our work for the next 10 years was funded mainly but not exclusively by the British Library. In 1976 Brian Coe left the Unit to become Senior Tutor in charge of the newly-established MA course

1. Other members of staff at various times included Jocelyn Chaplin, David Cranch, Stephen Barrett and George Glaze.

2. See Poynor (2002) for a summary of Herbert Spencer's achievements.

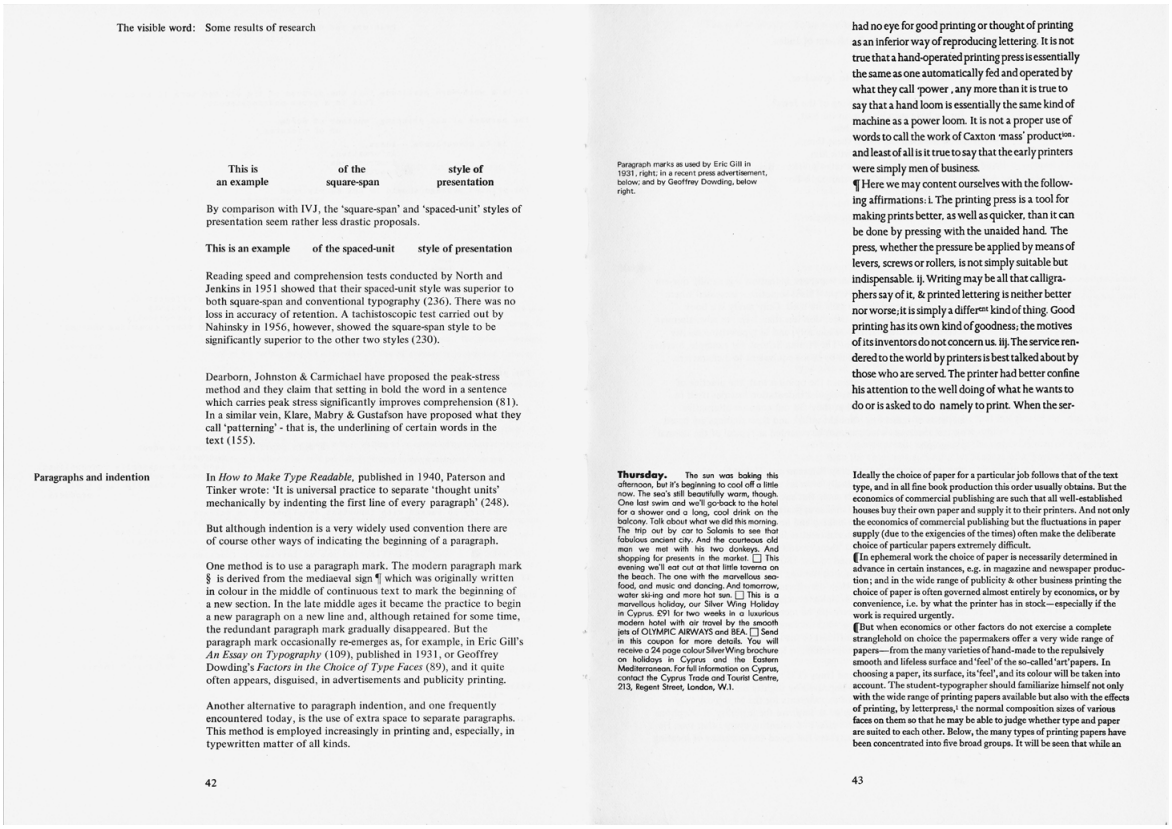
3. This paper began life as a talk given at the 'Information Design Histories' conference held at Coventry University Design Institute on 10 December 2003.

4. IPC then comprised Mirror Group Newspapers and several periodical and book publishing interests. It was taken over by Reed International in 1970.

in graphic information at the RCA, and Herbert Spencer ceased full-time involvement with the Unit in 1978 when he became Professor of Graphic Arts. I continued the work of the Unit as Senior Research Fellow until 1982, when funding from the British Library ceased.

In the course of our research for OSTI/BLR&DD we were fortunate to be able to call on the advice of several key figures from the worlds of psychology, publishing, and library science. Patricia Wright, a psychologist, was then working with the Medical Research Council's Applied Psychology Unit in Cambridge, and was particularly interested in the design of technical information. James Hartley, also a psychologist, was based at Keele University and was investigating the design of instructional materials. Their active interest in problems of legibility and information design led to a very fruitful dialogue. Sir John Brown of Oxford University Press gave a publisher's perspective on our work, and Philip Bryant of the Catalogue Research Unit at the University of Bath provided guidance on library science issues and enabled us to better understand the implications of our research for librarians and information scientists.

Our work for the British Library included experimental studies on topics as diverse as the relative legibility of alternative letter shapes, the effectiveness of different forms of typographic coding, various aspects of image quality in printed scientific and technical information, typographic and spatial coding in bibliographies and library catalogues, and the presentation of data in microform library catalogues. We also carried out major survey studies and literature reviews, which included a study of the legibility of information in microform for the BLR&DD, a major study on the legibility and readability of videotex



The visible word: Some results of research

This is an example | of the square-span | style of presentation

By comparison with IVJ, the 'square-span' and 'spaced-unit' styles of presentation seem rather less drastic proposals.

This is an example of the spaced-unit style of presentation

Reading speed and comprehension tests conducted by North and Jenkins in 1951 showed that their spaced-unit style was superior to both square-span and conventional typography (236). There was no loss in accuracy of retention. A tachistoscopic test carried out by Nahinsky in 1956, however, showed the square-span style to be significantly superior to the other two styles (230).

Dearborn, Johnston & Carmichael have proposed the peak-stress method and they claim that setting in bold the word in a sentence which carries peak stress significantly improves comprehension (81). In a similar vein, Klare, Mabry & Gustafson have proposed what they call 'patterning' - that is, the underlining of certain words in the text (155).

Paragraphs and indention

In *How to Make Type Readable*, published in 1940, Paterson and Tinker wrote: 'It is universal practice to separate 'thought units' mechanically by indenting the first line of every paragraph' (248).

But although indention is a very widely used convention there are of course other ways of indicating the beginning of a paragraph.

One method is to use a paragraph mark. The modern paragraph mark § is derived from the mediaeval sign ¶ which was originally written in colour in the middle of continuous text to mark the beginning of a new section. In the late middle ages it became the practice to begin a new paragraph on a new line and, although retained for some time, the redundant paragraph mark gradually disappeared. But the paragraph mark occasionally re-emerges as, for example, in Eric Gill's *An Essay on Typography* (109), published in 1931, or Geoffrey Dowding's *Factors in the Choice of Type Faces* (89), and it quite often appears, disguised, in advertisements and publicity printing.

Another alternative to paragraph indention, and one frequently encountered today, is the use of extra space to separate paragraphs. This method is employed increasingly in printing and, especially, in typewritten matter of all kinds.

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Paragraph marks as used by Eric Gill in 1931, right; in a recent press advertisement, below; and by Geoffrey Dowding, below right.

Thursday. The sun was baking this afternoon, but it's beginning to cool off a little now. The sea's still beautifully warm, though. One last swim and we'll go back to the hotel for a shower and a long, cool drink on the balcony. Talk about what we did this morning. The trip out by car to Salamis to see that fabulous ancient city. And the courteous old man we met with his two donkeys. And shopping for presents in the market. ☐ This evening we'll eat out at that little taverna on the beach. The one with the marvellous sea-food, and music and dancing. And tomorrow, water ski-ing and more hot sun. ☐ This is a marvellous holiday, our Silver Wing Holiday in Cyprus. £91 for two weeks in a luxurious modern hotel with air travel by the smooth jets of OLYMPIC AIRWAYS and BEA. ☐ Send in this coupon for more details. You will receive a 24 page colour Silver Wing brochure on holidays in Cyprus and the Eastern Mediterranean. For full information on Cyprus, contact the Cyprus Trade and Tourist Centre, 213, Regent Street, London, W.1.

had no eye for good printing or thought of printing as an inferior way of reproducing lettering. It is not true that a hand-operated printing press is essentially the same as one automatically fed and operated by what they call 'power', any more than it is true to say that a hand loom is essentially the same kind of machine as a power loom. It is not a proper use of words to call the work of Caxton 'mass' production, and least of all is it true to say that the early printers were simply men of business.

¶ Here we may content ourselves with the following affirmations: i. The printing press is a tool for making prints better, as well as quicker, than it can be done by pressing with the unaided hand. The press, whether the pressure be applied by means of levers, screws or rollers, is not simply suitable but indispensable. ij. Writing may be all that calligraphers say of it, & printed lettering is neither better nor worse; it is simply a differ[ent] kind of thing. Good printing has its own kind of goodness; the motives of its inventors do not concern us. iij. The service rendered to the world by printers is best talked about by those who are served. The printer had better confine his attention to the well doing of what he wants to do or is asked to do namely to print. When the ser-

Ideally the choice of paper for a particular job follows that of the text type, and in all fine book production this order usually obtains. But the economics of commercial publishing are such that all well-established houses buy their own paper and supply it to their printers. And not only the economics of commercial publishing but the fluctuations in paper supply (due to the exigencies of the times) often make the deliberate choice of particular papers extremely difficult.

¶ In ephemeral work the choice of paper is necessarily determined in advance in certain instances, e.g. in magazine and newspaper production; and in the wide range of publicity & other business printing the choice of paper is often governed almost entirely by economics, or by convenience, i.e. by what the printer has in stock—especially if the work is required urgently.

¶ But when economics or other factors do not exercise a complete stranglehold on choice the papermakers offer a very wide range of papers—from the many varieties of hand-made to the repulsively smooth and lifeless surface and 'feel' of the so-called 'art' papers. In choosing a paper, its surface, its 'feel', and its colour will be taken into account. The student-typographer should familiarize himself not only with the wide range of printing papers available but also with the effects of printing, by letterpress,[1] the normal composition sizes of various faces on them so that he may be able to judge whether type and paper are suited to each other. Below, the many types of printing papers have been concentrated into five broad groups. It will be seen that while an

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Figure 1. A double-page spread from *The visible word* (Spencer 1969, pp. 42–3).

displays for the Post Office, studies on the presentation of bibliographies on microfiche and on videotex for the BLR&DD, and the current state of directional signing and labelling in libraries and museums, again for the BLR&DD. The directional signing project led to the publication of a book for librarians on directional signing (Reynolds and Barrett 1981) (figure 2), which was published by the Library Association – though disappointingly we lost control of the design of the book itself.

The variety of projects that we were undertaking led to the change of name in 1979 from the Readability of Print Research Unit to the Graphic Information Research Unit. This variety engendered curiosity about our work in a number of different interest groups and led to requests for articles and talks, and sometimes ultimately to further research. Our reviews of legibility research and our own experiments on legibility were of interest to printers, publishers, and librarians, among others. The library catalogue work led subsequently to research on computer-generated keyword indexes for the Centre for Catalogue Research at the University of Bath (Reynolds 1985). Our studies on the use of colour on videotex displays resulted, some ten years later, in a query from the Civil Aviation Authority about colour for air traffic control displays and thence to a substantial research contract – though this was several years after the demise of the Research Unit (Reynolds 1996). The videotex and microform studies, although apparently technology-specific, had a much wider relevance, contributing as they did to on-going discussion about the influence of technology on the presentation of text (e.g. Reynolds 1980). Our work on signage in libraries and museums led to requests from both of those interest groups for talks, and for practical courses on sign design (run in collaboration with The Library Association). The Unit's activities also came to the attention of people working in medical data processing and presentation (Reynolds 1979a, Reynolds, Spencer and Reneman 1979, and later Reynolds 1989) and medical illustration; in the latter case a collaboration with the medical illustration department at the Royal Postgraduate Medical School at Hammersmith Hospital resulted in the book *Presentation of data in science* (Reynolds

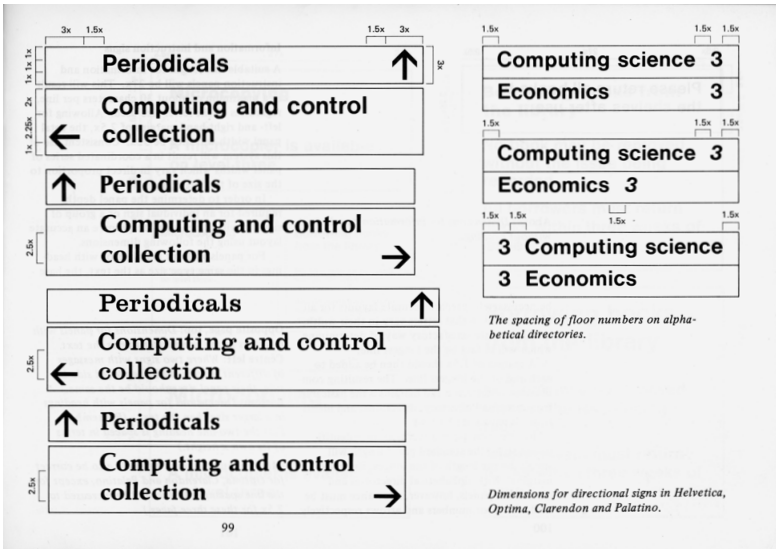


Figure 2. A page from *Signs and guiding for libraries* showing suggested dimensions for sign panels in terms of multiples of the x-height of the type (Reynolds and Barrett 1981, p. 99).

and Simmonds 1981), the most recent version of which was published in 1994 (Simmonds and Reynolds 1994).

It is the Unit's experimental work that is perhaps of greatest interest today. This is partly for methodological reasons, and partly because some of the issues we investigated addressed the relationship between visual perception and typography and are therefore still relevant. There are two groups of studies that I think represent our approach to experimental work. One group is about image quality issues, and the other is about typographic and spatial coding in complex lists such as bibliographies.

Studies of image quality

Rationale

In the early 1970s the British Library was concerned about the effects of poor reproduction and multiple-generation copying on the legibility of scientific and technical material. Our image quality studies were intended to re-create these conditions in a controlled way and measure their effects on legibility.

Our concern was always to create experimental situations that were valid for the documents under investigation, that is to say as close as possible to the normal conditions of use, but that at the same time would give reliable quantitative results. For the image quality studies we needed a valid and reliable way of measuring the legibility of continuous text. We rejected the idea of comprehension testing because comprehension is affected by many factors in addition to the visual qualities of the text, and it was only the latter that we were interested in. We decided instead to use a scanning task, where participants would be asked to scan a text passage in search of target words.[5] This, we felt, was relevant to how readers scanned scientific and technical papers looking for mention of specific concepts.

We used a series of geography texts that were carefully matched for difficulty using the Dale-Chall readability formula[6] (Dale and Chall 1948). Target words were then selected using a stratified random sampling method, to ensure that all sections of the passage and all positions on the line (beginning, middle, end) were fairly represented (figure 3, opposite). We also wanted to look at the legibility of numerals. Initially we used a transcription task where participants were asked to copy sequences of digits, writing them beside the printed version (figure 4). But this task was not entirely satisfactory, as we shall see.

The effects of image quality and background 'noise' on four different typefaces

In the first experiment of this group (Spencer, Reynolds and Coe 1975 revised 1977) we looked at the effects of thinning-down and thickening-up of the printed image, and the introduction of visual 'noise' into the background, as might happen with poor quality printing or photocopying. These effects were compared on four different Monotype typefaces: Times New Roman 327 (as an example of an old face seriffed type), Baskerville 169 (a transitional seriffed type), Rockwell 371 (a slab serif), and Univers Medium 689 (a sanserif) (figure 5, overleaf). Image degradation was created photographically

5. Scanning tasks were used successfully by Poulton (as described in Poulton 1969, for example), and Hartley *et al.* (1975) found these kinds of task to be among the more reliable methods of measuring legibility.

6. The formula provides a means of estimating text difficulty based on average sentence length and percentage of difficult words (defined as words not included in a list of words designated by Dale and Chall as 'familiar').

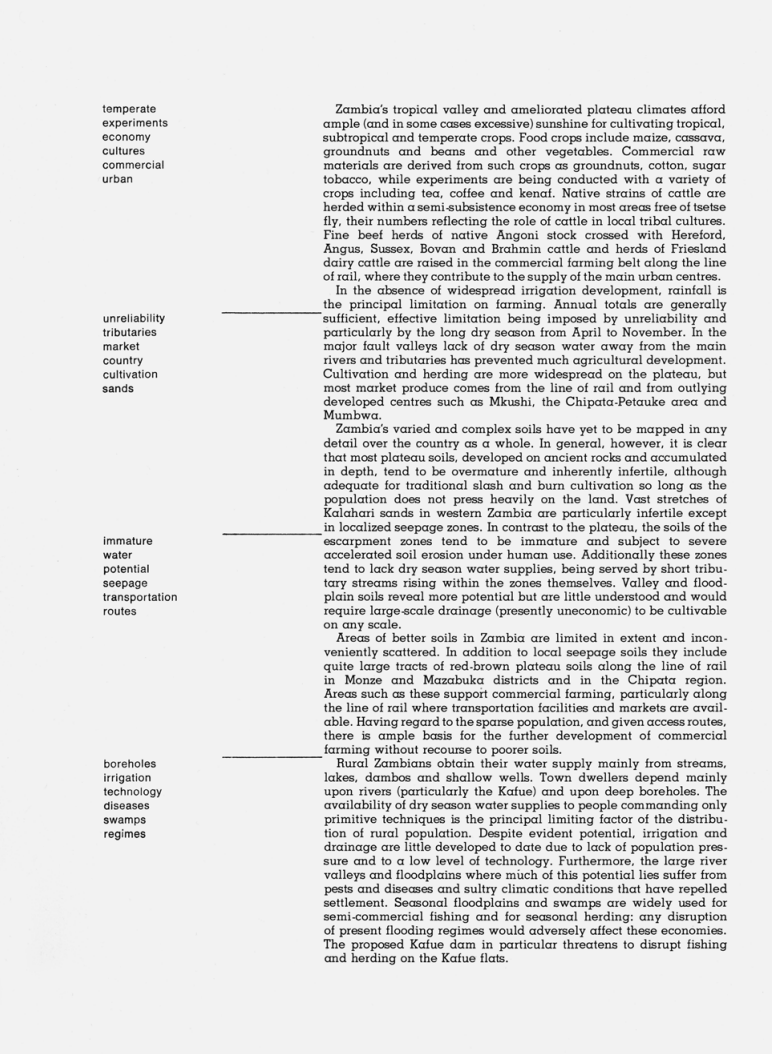
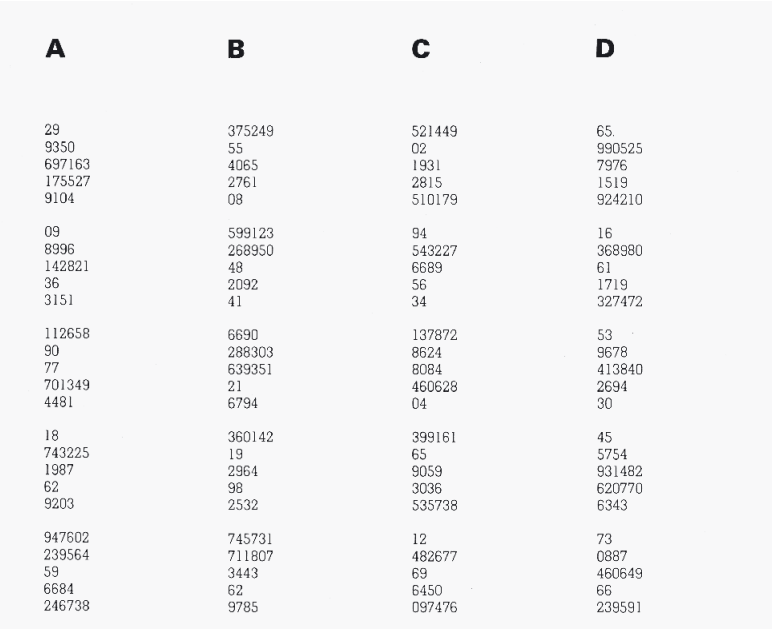


Figure 3. One of the texts used in the image quality studies. The words on the left are the target words that participants were required to find. (Spencer, Reynolds and Coe 1975, revised 1977, Appendix 2).



A	B	C	D
29	375249	521449	65.
9350	55	02	990525
697163	4065	1931	7976
175527	2761	2815	1519
9104	08	510179	924210
09	599123	94	16
8996	268950	543227	368980
142821	48	6689	61
36	2092	56	1719
3151	41	34	327472
112658	6690	137872	53
90	288303	8624	9678
77	639351	8084	413840
701349	21	460628	2694
4481	6794	04	30
18	360142	399161	45
743225	19	65	5754
1987	2964	9059	931482
62	98	3036	620770
9203	2532	535738	6343
947602	745731	12	73
239564	711807	482677	0887
59	3443	69	460649
6684	62	6450	66
246738	9785	097476	239591

Figure 4. Extracts from a numerals test sheet. Participants were asked to copy the sequences of numerals, writing them beside the printed numerals (Spencer, Reynolds and Coe 1975, revised 1977, Appendix 2).

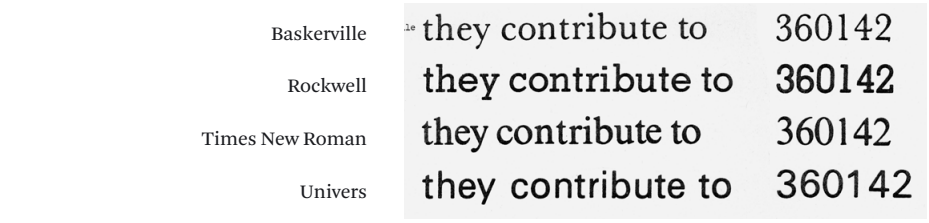


Figure 5. The four typefaces tested in the image quality experiments (Spencer, Reynolds and Coe 1975, revised 1977, figure 16).

and consisted of three levels of thinning-down and three levels of thickening-up, plus a normally printed version, giving seven levels of image quality. Four levels of visual noise (including a zero level) were created by spraying a fine mist of black ink at different densities (a skill that required practice). This gave 112 different conditions (figures 6 and 7). As we wanted each participant to work with each of the four typefaces, we also needed four different texts so that participants would not become familiar with the position of the target words. The result was 448 different pieces of test material. The material was printed using offset lithography, by a technician who was bemused at our insistence that such degraded text be printed consistently and to a high standard.

To enable us to work out how many participants would be needed, and what conditions of image degradation each of them should see and in what order, we sought statistical advice from the Imperial

Figure 6. (below, left) Extracts from some of the Baskerville texts (Spencer, Reynolds and Coe 1975, revised 1977, figure 4).

Figure 7. (below, right) Extracts from some of the Rockwell numeral sheets (Spencer, Reynolds and Coe 1975, revised 1977, figure 9).

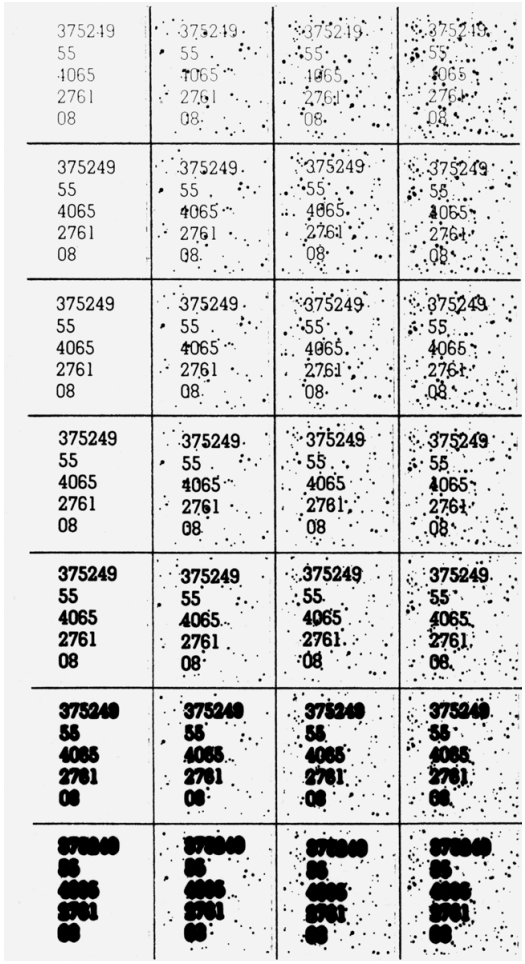


Figure 8. Brian Coe selecting items of test material to make up into booklets to be presented to participants in the tests described in Spencer, Reynolds and Coe 1975, revised 1977.

College of Science and Technology. The experimental design required 128 participants, most of whom were students of librarianship. Selecting the correct pieces of test material for each participant required great care and concentration (see figure 8). The participants were tested in groups of between twenty and thirty at a time. They were given one minute for each of their four texts in which to find and underline as many target words as possible, and one minute for each column of numerals in which to transcribe as many numbers as they could. To our surprise, all of the participants attempted to read even the most degraded material without comment or complaint.

The results are shown in figure 9, and enlarged examples of degraded text and numerals in figure 10. The legibility of Baskerville decreased rapidly with thinning-down, but was less affected by thickening-up than the other three typefaces. Rockwell, on the other hand, was badly affected by thickening-up. Times and Univers withstood both kinds of degradation to some extent, and were likely, therefore, to be good choices when the nature of any degradation was unpredictable. The results for the numerals showed a broadly similar pattern but the effects on legibility were not as noticeable at lesser levels of degradation. This was probably because the transcription task was not sensitive enough to pick up differences until the degradation became more extreme. The fall-off in legibility was then rapid because of the lack of contextual cues in the case of numerals. The effects of increasing levels of background noise were apparent with thinned-down texts, but less so with thickened-up texts, presumably because the thinned letter forms were more vulnerable to distortion by coincident noise than their thicker counterparts. The legibility of the numerals was hardly affected by different noise levels. The lack of contextual cues to help with numeral recognition may have meant that if a given level of image degradation rendered numerals illegible, increasing levels of background noise could not render them more so.

Figure 9. Graphs showing the number of words correctly underlined within the texts (left), and the number of digits correctly transcribed from the numeral lists (right) (Spencer, Reynolds and Coe 1975, revised 1977).

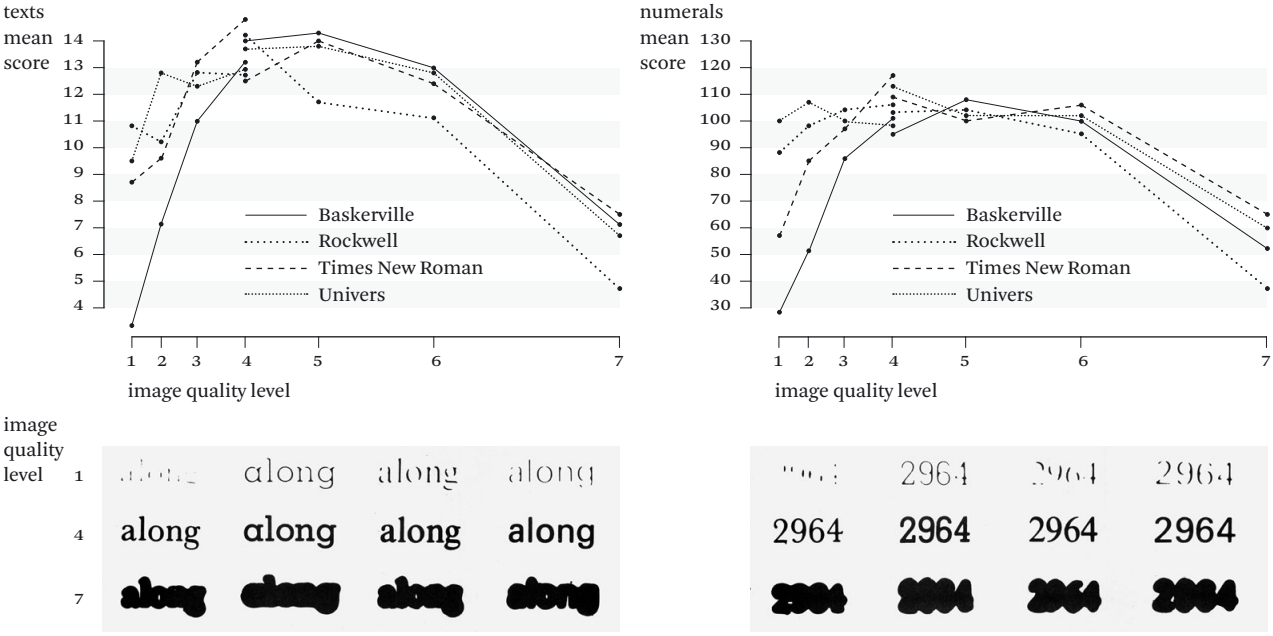


Figure 10. Enlargements of text and numerals (Spencer, Reynolds and Coe 1975, revised 1977, figure 17).

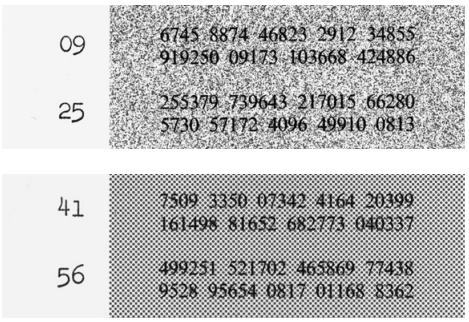


Figure 11. Extracts from numerals test sheets (random at top, regular beneath it). Participants were asked to find and circle a two-digit target sequence within the corresponding two-line block of numerals (as in, for example, Spencer, Reynolds and Coe 1977a, Appendix 2).

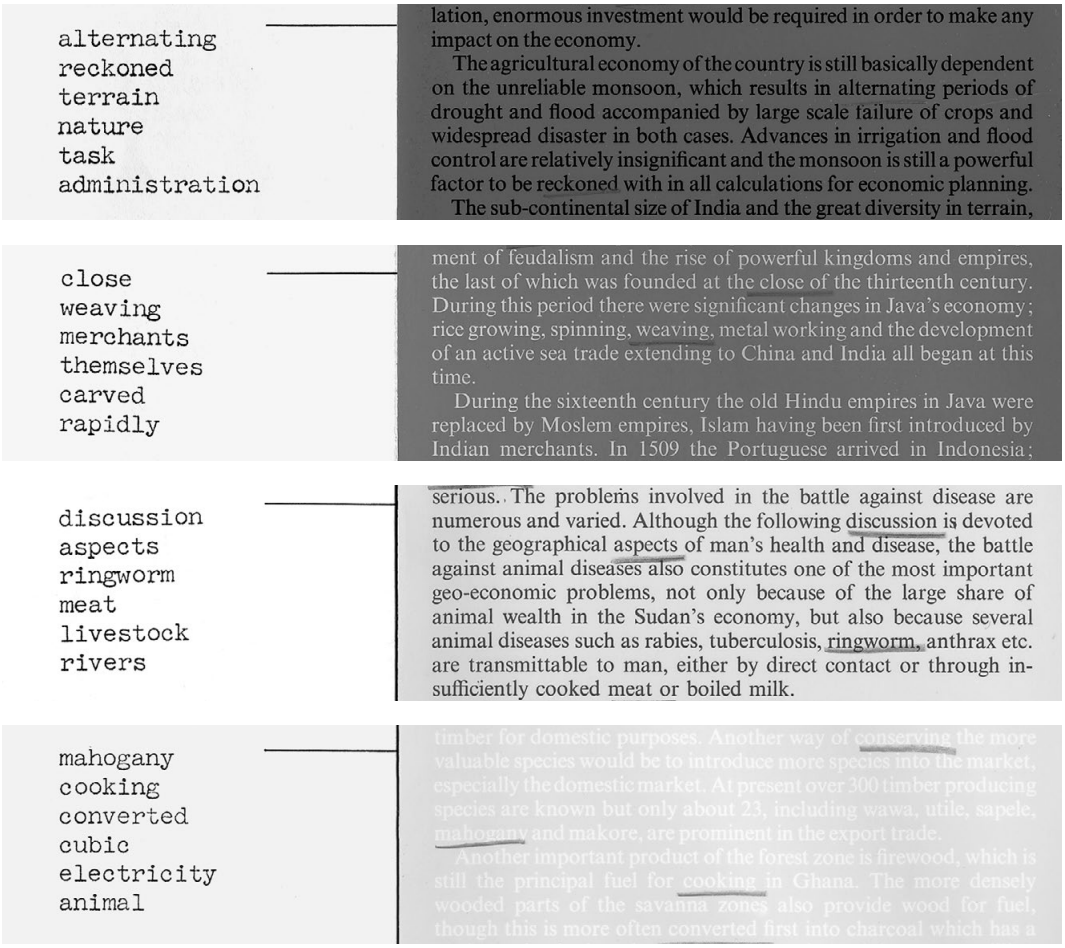
Figure 12. Extracts from material used in the image-background contrast and polarity test, as described in Spencer, Reynolds and Coe (1977b).

Other image quality experiments

Similar techniques were used subsequently to investigate other aspects of text and numeral image quality. In these later experiments, we aimed to increase the sensitivity of the numerals task by eliminating the need for participants to write anything down. A scanning task was used instead, in which participants were asked to circle a pair of target digits within a two-line block of 45 digits.

The effects of different kinds and intensities of background noise were compared using four different densities of a flat tone, a fine regular screen, a coarse regular screen, and a random dot screen (Spencer, Reynolds and Coe 1977a). The results indicated that, overall, the nature of the background had a greater effect on legibility than its density. The coarse regular screen was the most disruptive, while the effects of density were most marked on the coarse regular and random screens (figure 11).

We also investigated the effect of image-background contrast and polarity (Spencer, Reynolds and Coe 1977b). This was relevant at the time in relation to the grey printouts typically obtained from microfilm or microfiche reader/printers. Ten positive and ten negative images were produced, using a scale of five values from white to dark grey in various combinations (figure 12). Once again, the results showed amazing tolerance on the part of participants in the experiment. Legibility was not greatly affected by most of the conditions



tested, but there was a significant fall-off in reading performance somewhere below a contrast level of 10 per cent.

The final test in this group looked at the effects of show-through in double- and single-sided printing (Spencer, Reynolds and Coe 1977c). The show-through was either directly aligned with the lines being read, or between them. The results confirmed the traditional wisdom of imposing lines of text in precise alignment on backed-up pages. Show-through between lines of text presumably obscures ascenders and descenders and thereby interferes with letter and word recognition.

Studies of typographic and spatial coding in lists

Another area of major interest for the British Library was the visual presentation of bibliographies and library catalogues. In the 1970s, locally prepared bibliographies were typically printed, though videotex technology,[7] such as Prestel, was also being introduced. For library catalogues, computer-generated microforms, paper printouts or videotex displays were replacing traditional card catalogues. Each of these presented its own particular problems of typography and layout, but the basic issues were the same for all.

Bibliographies and catalogues were of particular interest to the Research Unit because their structures are similar to those of other lists and directories. They all consist of ordered sequences of entries (usually alphabetical, sometimes numerical), each of which contains a set of standard elements. Searching (as opposed to casually browsing) within these materials involves two distinct sub-tasks: finding the required entry in the sequence, and then extracting the relevant data from it. It was the relationship between these sub-tasks that we were keen to explore.

Bibliographies

In the early 1970s many libraries were still producing bibliographies using a standard typewriter, so our first study in this area was an attempt to find the most effective way of presenting typewritten lists of books arranged alphabetically by author (Spencer, Reynolds and Coe 1973). Ten alternative styles were tested (figure 13, overleaf). Each style has either spatial coding, typographic coding, or a combination of both, and the coding may serve to distinguish either between entries, or between the first word of each entry and the rest of the entry, or both. Each style was represented by a different two-page bibliography; these were carefully edited and matched for consistency of content. We devised a look-up task in which participants were asked to search a bibliography for a randomly-ordered list of twelve authors and to underline the price of the relevant book,[8] working against time. The task thus required them to search both between and within entries.

7. Computer-generated text viewed on a television screen. Characters were monospaced and each was constructed from a nine-by-seven dot matrix; horizontal spacing was in units of whole characters, and vertical spacing was in units of whole lines.

8. We were aware that underlining the price of the book in each target entry allowed participants to see which entries they had already visited and may have made the search task easier. On the other hand, this was true for all ten layouts, and it eliminated the need for participants to spend time transcribing the price.

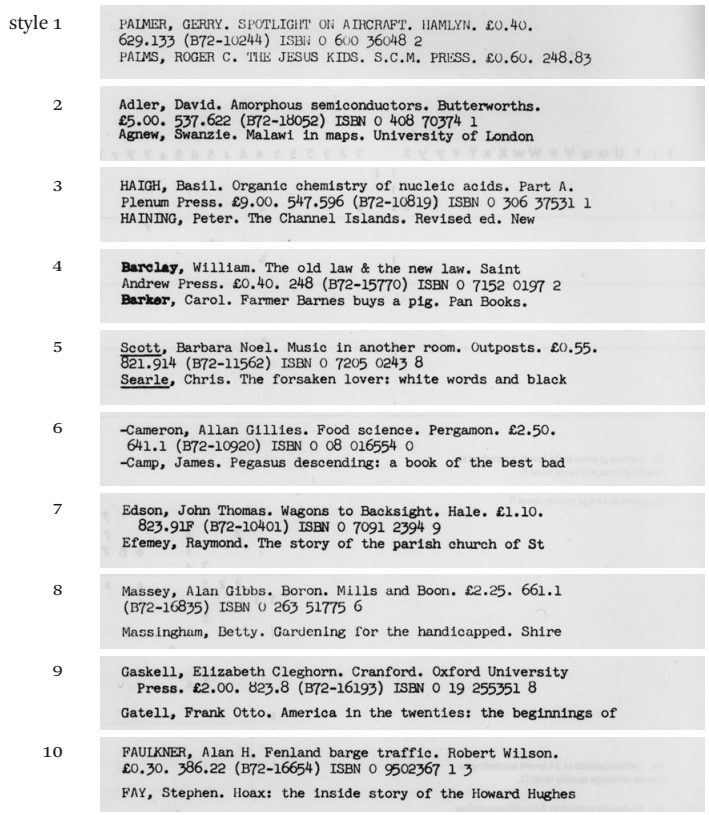


Figure 13. Extracts from the ten bibliographical styles tested in 1973 (Spencer, Reynolds and Coe 1973, Appendix 1).

Each of the ninety participants worked with all ten styles, presented in an order determined from a series of nine ten-by-ten Latin squares.[9] Brian Coe was fascinated by Latin squares, and had learned that if the number of rows and columns in the square is equal to a prime number minus one (ten, for example), the design has special properties that are particularly useful in controlling the order in which treatments are presented to participants in this kind of experiment (figure 14, opposite).

The most effective style was number 7 with hanging indents (see figure 13). As well as making a clear distinction between entries, it emphasised the first word of each entry spatially and so is likely to have facilitated the alphabetical search process. Style 7 had the advantage of being economical in its use of space and required no type variants (such as bold, italics, capitals) in addition to those available on a standard typewriter. The four next best styles were 9, 10, 4 and 8. These too make a clear distinction between entries, either spatially or typographically or both, and, with the exception of style 8, they also clearly distinguish the first word of each entry, either spatially or typographically. However, they all require more space than style 7 or, in the case of style 4, an additional type variant. It is of particular interest that style 9 appeared to offer no advantage over style 7, though one might have expected the clear spatial distinction between entries to

9. Latin squares provide a means of determining the sequence of treatments in an experiment so as to minimise bias. They are matrices with an equal number of rows and columns, each row representing a participant and each column representing a position in the sequence of treatments. The number of rows and columns is determined by the number of treatments, each treatment occurring once in each row and once in each column.

have helped with the location of the price element within the entry. It may be that the alphabetical search aspect of the task was easier with the entries closer together, masking any advantage that style 9 may have had in locating elements within the entries.[10]

While standard typewriters were still popular for preparing bibliographies, some libraries were experimenting with the IBM 72 Composer, or 'golfball' typewriter.[11] This enabled them to produce proportionally spaced type and to use italic and bold styles, resulting in output that appeared to be typeset rather than typewritten. However, each change of type style meant changing the golfball, so keying-in a bibliography using a mixture of (for example) roman and italic type could be a time-consuming process. The British Library wanted to know whether the additional time taken in producing output that included italic and bold styles was justified in terms of improved ease of use for the reader.

To investigate this, we devised an experiment (Spencer, Reynolds and Coe 1974) in which three systems of typographic coding (using capitals, italic and bold) were combined with six systems of spatial coding (using indents and line spacing), creating eighteen different styles in all (figure 15, overleaf). Eighteen carefully selected and edited bibliographies of forty entries each, arranged alphabetically by author, were compiled from British Library data and randomly assigned to the eighteen styles. Each participant looked up thirteen entries in all of the eighteen bibliographies, working against time. One group of participants was searching for names of authors and underlining them in the bibliographies; their task, therefore, was primarily an alphabetical search on the first element of each entry. A second group of participants was searching for and underlining thirteen titles in each bibliography; the titles were not, of course, in alphabetical order, so their task involved searching for and checking an element embedded within each entry. The order in which participants worked on the eighteen bibliographies was again determined by a Latin square design. Eighteen, like ten, is a prime number minus one, so we were able to achieve a satisfactory experimental design using only eighteen participants in each of the two groups.

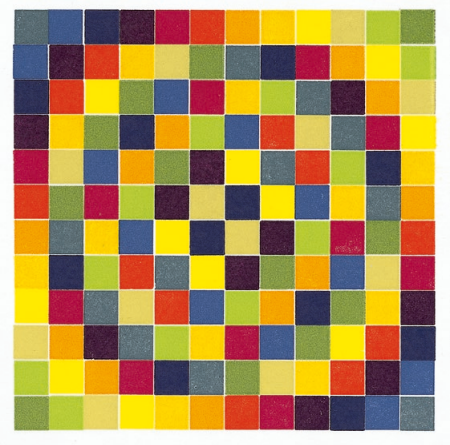


Figure 14. A coloured version of a Latin square based on a prime number minus one, showing how each colour occurs once in each position horizontally, and follows every other colour immediately once, next-but-one once, next-but-two once, and so on. This square was letterpress-printed by Brian Coe.

The results showed that regardless of whether participants were searching for authors or titles, the most effective spatial coding systems were those that made a clear distinction between entries, whether by indentation or the addition of space between entries (spatial coding systems 4, 5 and 6). The results for typographic coding indicated an advantage for authors' surnames in capitals when

10. As a footnote to this study, a group of MA Information Design students in the Department of Typography & Graphic Communication at the University of Reading recently carried out a small (unpublished) experiment in which they compared four layouts for typeset bibliographies. These were comparable with styles 2, 7, 8 and 9 as shown in figure 13. Twenty-four participants were asked to search through four bibliographies of forty entries each (arranged alphabetically by author) to find fifteen randomly ordered target entries and underline the price of each book, working against time. As in our earlier study, the results indicated that indentation had a more powerful effect than space. Performance was significantly improved by indentation regardless of whether space was used but, if an indent was used, performance was not significantly improved by the addition of space.

11. The IBM 72 Composer employed a removable spherical head that carried the letterforms and resembled a golfball. Heads were available for several different type styles and sizes.

TYPOGRAPHIC CODING

A. (1) roman caps & lowercase
(2) roman caps & lowercase
(3) roman caps & lowercase
(4) roman numerals

B. (1) roman caps
(2) italic caps & lowercase
(3) roman caps & lowercase
(4) italic numerals

C. (1) italic caps & lowercase
(2) bold caps & lowercase
(3) roman caps & lowercase
(4) italic numerals

SPATIAL CODING

1. Copy runs on. 3 space units between each entry.

ISBN 0 85292 069 5. Bajin, Boris. Olympic gymnastics for men and women. Prentice-Hall. £5.50. 796.41
ISBN 0 13 633925 5. Baker, C D. Lepard's metric reckoner: for cost per thousand sheets given price per kilogramme and weight in kilogrammes. Pitman. £4.00. 338.4367620942 ISBN 0 273 25242 9. Baldwin, Brenda. Skid prevention and control. R.W. Noon. £0.30. 629.283 ISBN 0 9502394 0 2. Ball, Alan. Alan Ball's international soccer annual No. 4. Pelham. £1.00.

Hutchinson and Co. (Publishers) Ltd. £6.00. *230.01 ISBN 0 09 108850 x.* WALTERS, PATRICK GORDON. *The Cabinet, Revised ed.* Heinemann Educational. £1.00. *354.4205 ISBN 0 435 83915 2.* WALTON, BRUCE. *Essays in social biology. Vol. 1: People, their needs, environment, ecology.* Prentice-Hall. £4.00. *301.3108 ISBN 0 13 656835 1.* WARD, WILLIAM F. *Electronics testing and measurement.* Macmillan. £4.50. *621.381 ISBN 0 333 12544 4.* WARNATH, ARTHUR WILLIAM.

Bristol and Gloucestershire. Darwen Finlayson. £3.20. *914.241 ISBN 0 85208 065 4. Ramchand, Kenneth.* **The West Indian novel and its background.** Faber and Faber Ltd. £1.70. *823.009 ISBN 0 571 10139 9. Ramsay, Anna Augusta Whittal.* **Sir Robert Peel.** Constable. £3.25. *942.0810924 ISBN 0 09 458290 4. Randall, Christine.* **Creating with papier-mache.** Crowell-Collier; Collier-Macmillan. £1.05. *745.54 ISBN 0 02 767190 9. Ranis, Gustav.* **The gap between rich and poor nations:**

2. 1st element of each entry begins a new line. 2nd, 3rd and 4th elements run on.

Pettman, Dorothy. Oral embryology and microscopic anatomy: a textbook for students in dental hygiene. 5th ed. Lea and Febiger; Kimpton. £3.80. 611.314
ISBN 0 8121 0376 9.
Philips, Francis Edward. Greek philosophical terms: a historical lexicon. New York University Press; University of London Press. £3.80. 180 ISBN 0 340 09412 5.
Piatek, Clare Gray. Perspectives in surgery. Lea and Febiger; Kimpton. £9.45. 617 ISBN 0 8121 0279 7.

GILL, JOHN. *The tenant.* Collins. £1.50. *823.91 F ISBN 0 00 221843 7.*
GILLARD, R D. *Essays in chemistry. Vol. 3: 1972.* Academic Press. £1.80. *540 ISBN 0 12 124103 3.*
GILLEN, LUCY. *Dangerous stranger.* Mills and Boon. £0.80. *823.91F ISBN 0 263 05021 1.*
GILLESPIE, IAN ERSKINE. *Gastroenterology: an integrated course.* Churchill Livingstone. £1.50. *616.3 ISBN 0 443 00854 0.*

Perraton, Jean. **Urban systems: collection and management of data for a complex model.** University of Cambridge Department of Architecture. Unpriced. *301.36094229 ISBN 0 903248 29 8.*
Perry, Eric Akers. **The Parish Church of Holy Trinity, Wickwar. New ed.** British Publishing. Unpriced. *914.241 ISBN 0 7140 0677 7.*
Perryman, Albert Charles. **Life at Brighton locomotive works, 1928-1936.** Oakwood Press. £0.90. *625.261*

3. All elements begin a new line.

Learmonth, Peter.
The houses we build.
Central Committee for the Architectural Advisory Panels.
£0.25.
721.0942 ISBN 0 9502302 0 0.
Leary, Harold W.
The PL/1 machine: an introduction to programming.
Addison-Wesley. £5.60.
001.6424 ISBN 0 201 05275 x.

SALT, JOHN.
Parents - participation and persuasion in primary education.
University of Sheffield Institute of Education. £0.15.
372.1103 ISBN 0 902831 07 6.
SANDERS, ED.
The family: the story of Charles Manson's dune buggy attack batallion.
Hart-Davis. £2.50.
301.4494 ISBN 0 246 10528 3.

Hindmarch, Jack.
Multiple choice questions for intermediate economics.
Macmillan. £0.50.
330.076 ISBN 0 333 13570 9.
Hislop, George.
Let history judge: the origins and consequences of Stalinism.
Macmillan. £5.75.
947.08420924 ISBN 0 333 13409 5.

4. All elements begin a new line. 1st element of each entry full out. 2nd, 3rd, and 4th elements sucessively indented

Emmet, Louis Emanuel.
Emmet's notes on perusing titles and practical conveyancing. 2nd (cumulative) supplement. 15th ed.
Oyez. £3.00.
346.420438 ISBN 0 85120 124 5.
Emsden, Leo.
Sound of the sea.
White Lion Publishers Ltd. £1.80.
823.91F ISBN 0 85617 894 2.

MELLISH, E MUDGE.
Rust and rot and what you can do about them.
Angus and Robertson. £1.25.
620.11223 ISBN 0 207 95436 4.
MENDELSOHN, JACOB.
Decision and organization: a volume in honor of Jacob Marschak.
North-Holland Publishing. Unpriced.
330.1 ISBN 0 7204 3313 4.

Medlen, Wolf.
The Samson riddle: an essay and a play, with the text of the original story of Samson.
Vallentine, Mitchell and Co. Ltd. £2.25.
822.914 ISBN 0 85303 152 5.
Mehmet, George Byron.
A.B.C.'s of transistors. 2nd ed. reprinted.
Foulsham. £1.25.
621.381528 ISBN 0 572 00579 2.

5. Line space between entries. 2nd, 3rd and 4th elements run on.

Fielding, A J. Internal migration in England and Wales: a presentation and interpretation of 'city-region' data. Centre for Environmental Studies. £0.50. 301.3260942
ISBN 0 901350 52 4.

Figes, Eva. Konek landing. Panther. £0.35. 823.91F
ISBN 0 586 03638 5.

Fincher, Norah M. Mingling, and other poems. Stockwell.

BAKER, HILARY. *Oakes Park, Sheffield: the historic home of the Bagshawe family since the year 1699.* English Life Publications. £0.15. *914.2746 ISBN 0 85101 057 1.*

BALDWIN, CECIL HENRY. *Teaching science to the ordinary pupil. 2nd ed.* University of London Press. £3.45. *507.12 ISBN 0 340 15583 3.*

BALL, GEORGE SAYERS. *Who is a white-collar*

Adams, Arlon T. **Topics in intersystem electromagnetic compatability.** Holt, Rinehart and Winston. £12.00. *621.38411 ISBN 0 03 085342 7.*

Adeney, Carol. **This morning with God: a daily devotional guide for your quiet time. Vol. 1.** Hodder and Stoughton. £0.40. *242.2 ISBN 0 340 15997 9.*

Adkins, Arthur William Hope. **Moral values and political**

6. Line space between entries. Each element begins a new line.

Serraillier, Ian.
The clashing rocks: the story of Jason and the Argonauts.
Carousel Books. £0.20.
823.91J ISBN 0 552 52022 5.

Seuffert, Muir.
Devil at the door.
Hale. £1.40.
823.91F ISBN 0 7091 2907 6.

CERVINE, JO.
X-Ray diagnosis positioning manual.
Glencoe Press; Collier-Macmillan. £1.50.
616.07572 ISBN 0 02 473270 2.

CHADWICK, ANGELA.
The infernal desire machines of Doctor Hoffman: a novel.
Hart-Davis. £1.95.
823.91F ISBN 0 246 10545 3.

Chamberlain, Peter.
German army semi-tracked vehicles, 1939-45.
Model and Allied Publications. £0.40.
623.747 ISBN 0 85344 136 7.

Chance, June E.
Applications of a social learning theory of personality.
Holt, Rinehart and Winston. £6.05.
155.2 ISBN 0 03 083183 0.

Figure 15. Extracts from the eighteen bibliographic styles tested in 1974 (Spencer, Reynolds and Coe 1974, p. 6). The four elements of each typographic coding (A, B, C) refer to the four consecutive elements of a single bibliographic entry.

searching for authors, and a more marked benefit from titles in bold when searching for randomly ordered titles embedded within entries. But most interesting was the observation that the advantages of typographic coding were greater when combined with the less effective spatial coding systems, and of no great advantage when spatial coding was adequate. This suggested that if space was not limited, perfectly adequate bibliographies could be produced without spending the extra time required by frequent changes of golfball. But if space was at a premium and indents or line spaces between entries were not possible, then typographic coding would be worthwhile. So this study helped to solve a practical problem, and pointed to an interesting relationship between spatial and typographic coding in complex lists.

Library catalogues

The look-up task methodology was carried over into a series of experiments on computer-generated library catalogues in microform. Although microforms have mostly been replaced by on-line catalogues, the results still have interesting implications from the point of view of accessing data. Some libraries used microfiche[12] and some used roll film, but visual presentation issues were essentially the same.

A popular layout for computer-generated microform catalogues was to present a single sequence of entries in each frame, with the various elements of the entries arranged in columns across the frame. This often resulted in large gaps between columns, and thus potential difficulties in following a single entry across the frame. We wanted to investigate the effects of different column spacings and to find ways of helping the user to read across accurately (Reynolds and Spencer 1979, experiment 1). Two indexes of 640 entries each were created, one consisting of an alphabetically ordered column of names and an associated column of three-character codes to the right, and the other consisting of a column of numerically ordered seven-digit numbers and a column of three-character codes to the right. The indexes were produced on roll film, with the frames running vertically (cine mode).

In both indexes, column spacings of five, twenty and thirty characters were used in combination with six different line attributes: set solid; double spaced; set solid with leader dots between columns; set solid with a rule after every fifth entry; set solid with a line space after every fifth entry; and set solid with a rule and a line space after every fifth entry. This gave eighteen styles in all (figure 16a, overleaf). As with the printed bibliographies, there were two groups of eighteen participants, one group working with the alphabetical index and one with the numeric index. Each participant saw all eighteen styles, in a sequence determined once again by a Latin square (figure 16b). For each style, participants were given a different list of thirty randomly ordered names, or numbers in the case of the numeric index, and asked to write down the corresponding three-character codes, working against time.

The speed with which participants were able to perform the task was significantly affected by column spacing and by line attributes. The effects were greatest on the names index. (Here the column

12. A microfiche was a sheet of film measuring approximately four by six inches. Magnifications varied somewhat, but a computer-generated fiche might hold roughly two hundred frames of data, arranged sequentially either in columns or rows.

a

6 line attributes	× 3 column spacings	= 18 styles
1. set solid	a.	1a, 2a, 3a, 4a, 5a, 6a
2. double spaced	b.	1b, 2b, 3b, 4b, 5b, 6b
3. set solid with leader dots	c.	1c, 2c, 3c, 4c, 5c, 6c
4. set solid with a rule after every fifth entry		
5. set solid with a line space after every fifth entry		
6. set solid with a rule and a line space after every fifth entry		

a.
```
Carew, Jan                  X28
Carter, James Roy           TO7
Carter, Robert Alistair     H67
Cartland, Barbara           N35
```
5 character column spacing

b.
```
Carew, Jan                                  X28
Carter, James Roy                           TO7
Carter, Robert Alistair                     H67
Cartland, Barbara                           N35
```
20 character column spacing

c.
```
Carew, Jan                                                  X28
Carter, James Roy                                           TO7
Carter, Robert Alistair                                     H67
Cartland, Barbara                                           N35
```
30 character column spacing

b participants

order of presentation

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	6a	3b	2c	1c	6c	2b	1b	4a	5c	5a	3a	5b	4c	6b	3c	2a	1a	4b
2	3b	1c	2b	4a	5a	5b	6b	2a	4b	6a	2c	6c	1b	5c	3a	4c	3c	1a
3	2c	2b	5c	5b	3c	4b	3b	6c	4a	3a	6b	1a	6a	1c	1b	5a	4c	2a
4	1c	4a	5b	2a	6a	6c	5c	4c	1a	3b	2b	5a	6b	4b	2c	1b	3a	3c
5	6c	5a	3c	6a	2b	3a	2a	3b	1b	5b	1a	2c	4a	4c	4b	1c	5c	6b
6	2b	5b	4b	6c	3a	1a	1c	5a	2a	2c	5c	3c	3b	4a	6b	6a	1b	4c
7	1b	6b	3b	5c	2a	1c	3a	4b	2b	4c	6a	4a	3c	2c	5a	1a	6c	5b
8	4a	2a	6c	4c	3b	5a	4b	1b	3c	1c	5b	6a	5c	1a	2b	6b	2c	3a
9	5c	4b	4a	1a	1b	2a	2b	3c	6c	6b	1c	4c	2c	5b	3b	3a	6a	5a
10	5a	6a	3a	3b	5b	2c	4c	1c	6b	6c	3c	2b	2a	1b	1a	4a	4b	5c
11	3a	2c	6b	2b	1a	5c	6a	5b	1c	3c	1b	4b	5a	3b	4c	6c	2a	4a
12	5b	6c	1a	5a	2c	3c	4a	6a	4c	2b	4b	3a	1c	2a	5c	3b	6b	1b
13	4c	1b	6a	6b	4a	3b	3c	5c	2c	2a	5a	1c	1a	3a	6c	4b	5b	2b
14	6b	5c	1c	4b	4c	4a	2c	1a	5b	1b	3b	2a	3a	2b	6a	3c	5a	6c
15	3c	3a	1b	2c	4b	6b	5a	2b	3b	1a	4c	5c	6c	6a	2a	5b	4a	1c
16	2a	4c	5a	1b	1c	6a	1a	6b	3a	4a	6c	3b	4b	3c	5b	5c	2b	2c
17	1a	3c	4c	3a	5c	1b	6c	2c	6a	4b	2a	6b	5b	5a	4a	2b	1c	3b
18	4b	1a	2a	3c	6b	4c	5b	3a	5a	5c	4a	1b	2b	6c	1c	2c	3b	6a

Figure 16a. The 6 line attributes and 3 column spacings that determined the 18 styles tested in the 1979 experiment on column spacing and line attributes in microform indexes (Reynolds and Spencer 1979, experiment 1).

Figure 16b. The Latin square used to determine the sequence in which participants were presented with the eighteen styles.

spacing was counted from the end of the longest name, resulting in larger overall gaps than with the numeric index.) Overall there was a decrease in speed with each increase in column spacing, especially for the set-solid and double-spaced versions. However, increased column spacing had no significant effect on scores for the other four line attributes, indicating that they were counteracting column spacing effects. The error rate was low throughout. While one might not recommend leader dots for aesthetic reasons, the study demonstrated the value of devices such as space and/or a rule after every few entries in this kind of material.

A common alternative to the single-sequence multi-column approach was a double sequence of entries in each frame, with each entry appearing as a block rather than being spread out across the frame. In addition to the issue of a single versus a double sequence in each frame, there was the question of whether the frames should run vertically (cine mode) or horizontally (comic mode). The four possible arrangements are shown in figure 17 (opposite). Logic would suggest using a vertical progression with one sequence of entries per frame, or possibly a horizontal progression with two sequences of entries per frame, and we wanted to test this hypothesis (Reynolds and Spencer

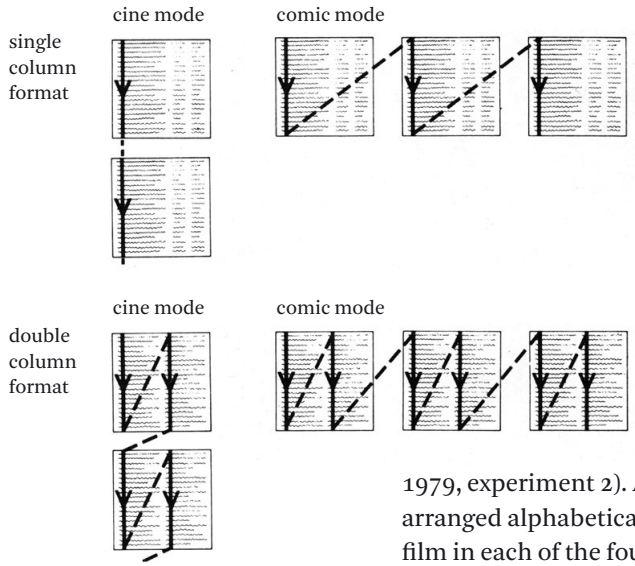


Figure 17. The four combinations of microfilm frame progression and frame layout tested in 1979 (Reynolds and Spencer 1979, experiment 2), as illustrated in Reynolds (1979b, p. 442).

1979, experiment 2). A catalogue containing 640 five-element entries, arranged alphabetically by author, was computer-generated on roll film in each of the four conditions. Twenty-four participants searched for a different set of sixty randomly ordered entries in each condition, working against time; the order in which each participant saw the four conditions was determined, as ever, by a Latin square design. On finding each entry they were asked to write down a three-character code given at the end of the entry.

Results indicated that vertical (cine-mode) frame progression was superior overall, and with this mode of progression there was no significant difference between one or two sequences of entries per frame. With horizontal (comic mode) frame progression, however, the layout with two sequences of entries per frame was markedly superior to the single sequence. This was almost certainly because when moving the film horizontally the single-sequence frames had to be exactly centred in the viewing aperture for both the author's name and the three-character code to be visible at the same time, whereas the double-sequence frames needed to be centred only to the nearest half-frame. The greater difficulty in centering whole frames when moving horizontally as opposed to vertically accounts for the superior performance of the cine mode overall. The two cine-mode versions were then tested again with target entries in alphabetical order; the intention was to minimise the time spent in locating the entry and give a better comparison of the time spent on locating the code at the end of each entry. In this case the double sequence per frame was significantly more effective than the single sequence. This suggested that for alphabetical searching it was beneficial to have the alphabetically arranged first elements of the entries as close to one another as possible for ease of comparison (as was the case with the columnar structure of the single-sequence arrangements). For searching within entries, however, the block entry shape in the double sequence meant that the eyes had less distance to travel (Reynolds and Spencer 1979, experiment 2). The choice of columnar versus block entries might therefore depend on the likely difficulty of the alphabetical search task and the size of the entries.

An application of the work on complex lists

As an example of the relevance of these studies in other contexts, in 1997 the Department of Typography & Graphic Communication at

a

diphenyl biphenyl	Xi; R36/37/38 N; R50-53	Xi;N; R36/37/38-50/53 S(2-)23-60-61 202-163-5	000092-52-4	A (I R S Cl)
2-diphenylacetylindan-1,3-dione diphacinone	T+; R28 T; R48/23/24/25	T+;R28-48/23/24/25 S(1/2-)36/37-45 201-434-5	000082-66-6	U
diphenylamine	T; R23/24/25 R33	T; R23/24/25-33 S(1/2-)28-36/37-45 204-539-4	000122-39-4	U
diphenylmethane-4,4'-di-isocyanate Note C	Xn; R20 Xi; R36/37/38 R42	Xn; R20-36/37/38-42 S(2-)26-28-38-45 202-966-0	Note 2 25%≤Conc Xn; R20-36/37/38-42 5%≤Conc<25% Xn; R36/37/38-42 1%≤Conc<5% Xn; R42 000101-68-8	U

b

dipentene
p-mentha-1,8(9)-diene
000138-86-3
R10 Xi; R38
- Xi; R10-38
- S(2-)28
- 205-341-0

25%≤Conc Xi; R38 U

diphacinone (iso)
2-diphenylacetylindan-1,3-dione
000082-66-6
T+; R28 T; R48/23/24/25
- T+;R28-48/23/24/25
- S(1/2-)36/37-45
- 201-434-5

U

diphenamid (iso)
N,N-dimethyl-2,2-diphenylacetamide
000957-51-7
Xn; R22

diphenylmethane-2,2'-di-isocyanate Note C
002536-05-2
Xn; R20 Xi; R36/37/38 R42
- Xn; R20-36/37/38-42
- S(2-)26-28-38-45
- 202-966-0

Note 2
25%≤Conc Xn; R20-36/37/38-42
5%≤Conc<25% Xn; R36/37/38-42
1%≤Conc<5% Xn; R42 U

diphenylmethane-2,4'-di-isocyanate Note C
005873-54-1
Xn; R20 Xi; R36/37/38 R42
- Xn; R20-36/37/38-42
- S(2-)26-28-38-45
- 202-966-0

Note 2
25%≤Conc Xn; R20-36/37/38-42
5%≤Conc<25% Xn; R36/37/38-42
1%≤Conc<5% Xn; R42 U

Figure 18. Extracts from two of the layouts considered for the *Approved supply list* (Reynolds 2000/01, pp. 267–81).
(a) Single sequence of entries per page, tabulated.
(b) Double sequence of entries per page, listed.

the University of Reading was asked by the Health and Safety Executive to investigate the usability of the *Approved supply list*, a listing of chemical substances dangerous for supply, and to make recommendations for its re-design (see Reynolds 2000/01).

Two of the options tested for a re-designed version were a single sequence of entries per A4 page with each element of each entry in a separate column (figure 18a), and a double sequence of entries per A4 page with each element of each entry beginning a new line (figure 18b). Twenty-four participants were asked to search for specific entries and transcribe data positioned near the end of each target entry, working against time. There was no significant difference between the two layouts in terms of speed and accuracy of use, though both were used twice as quickly as the existing design. Given the results of the microfilm experiment described above, it could be argued that the single-sequence layout (a) may have been better for the alphabetical search element of the task, while the double-sequence layout (b) may have been better for locating information within the target entries. The two effects may, therefore, have cancelled each other out. In using the *Approved supply list*, efficiency in finding specific entries and in locating data within them could be seen as equally important, so on that basis the two layouts could indeed be regarded as equally effective. The double sequence per page was finally chosen for the re-designed version because it would allow more elements to be added to each entry if this should be required in the future.

Summing up

I would argue that the work of the Graphic Information Research Unit has entered the consciousness of a wide range of interest groups, that the research was timely and of practical use when it was carried out

and may have changed the way that certain things were and are done, and that a number of the studies are as relevant now as they ever were.

Some commentators have criticised empirical research on the legibility and usability of documents, at times with justification (see, for example, Lund 1997). One argument put forward is that this kind of research has often been carried out by psychologists or others who have little understanding of the basics of typography. This was not so in our case.

A more interesting issue, in my opinion, is the extent to which experimental materials and methods are designed to control unwanted variables. The greater the level of control, the more unrealistic the materials and task tend to become, but such control may offer the possibility of identifying and even quantifying the variables underlying any observed effects on legibility or usability. Conversely, testing highly realistic materials in realistic situations is clearly more relevant to normal use but may make it more difficult to find any effects and to attribute them to particular variables. I suspect that there are underlying perceptual processes that determine many of the responses and behaviours that we see in readers. These responses and behaviours may be overlaid by many other factors 'in the wild', but I believe that there is value in trying to understand what is going on underneath. To do this, some degree of control is needed over experimental materials and situations, and we always tried to strike a balance between realism and control.

Another dilemma lies in deciding how many variables to test in an experiment. There is no doubt that typographic variables tend to interact (for example type size, line length and line spacing; see Tinker 1963), so it can be difficult or impossible to generalise from results that come from varying just one factor and holding all others constant. But testing several variables each at several levels can lead to large and expensive factorial experiments.[13] Another alternative is to make a number of changes to a typographic arrangement without testing all factors at all levels.[14] This may be the most practical approach when testing is used as part of the design process, and it can be useful in situations where it is necessary to establish initially whether typographic changes are likely to make any difference at all to the usability of a document. But finding the reason for any differences observed will almost certainly require further, more focused, experiments. We tended to favour the factorial approach (as far as we were able within the limits of our resources), but this is not to say that single-variable experiments, or experiments with several variables that cannot be isolated, are never appropriate.

No single study can explore every aspect of a problem, and I believe there is a place for a range of approaches, each contributing something different. Those carrying out research have a responsibility to publish clear and accurate descriptions of their studies, so that readers can assess for themselves the value and relevance of the results and conclusions reported.

13. For example, the study of image quality described above and in Spencer Reynolds and Coe (1975, revised 1977).

14. For example, the study of ten bibliographic styles described above and in Spencer, Reynolds and Coe (1973). We did not test all possible combinations of the spatial and typographic codings that we used as this would have resulted in an impossibly large experiment.

In appreciation

The work described here was the unique outcome of a particular mix of talents and personalities. The Readability of Print Research Unit would not have come into being without the intellectual curiosity and vision of Herbert Spencer; his concern for legibility and his almost crusading determination to make others aware of its importance were key factors in attracting funding and ensuring the Unit's continuation for some sixteen years. His analytical and aesthetically sensitive approach to typography was always apparent in discussions about projects and test material, and his calm and supportive team leadership ensured that projects were completed with a minimum of stress and to the satisfaction of sponsors. Ken Garland's obituary (2002) sums up the man as I knew him.

Brian Coe's approach to typography was in tune with Herbert's. Brian's first question on being shown any piece of design by a student was 'Yes, but what is it *for*?'. Herbert and he shared the belief that if typography functions efficiently it will also have aesthetic appeal. Brian loved logical and mathematical puzzles (hence his fascination with Latin squares), and he was also an inventor and a skilled craftsman – as evidenced by the perspective drawing machine that he designed and constructed himself in brass.

Spencer, Reynolds and Coe worked well and happily together as a team, the result of a complementary mix of skills and personality traits. Being part of that team was intellectually challenging, rewarding and enjoyable.

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