Visible Language

The research journal concerned with all that is involved in our being literate.

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Merald E. Wrolstad, Ph. D., Editor and Publisher
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Editorial

This special issue of *Visible Language* brings together papers which deal in one way or another with spatial factors in the layout and use of written/printed matter. Different writers in the past have expressed different views and many mock battles have been fought. Nonetheless, despite these, there is much agreement. The debate is with the details rather than with the general proposition that typography can be manipulated in order to improve comprehension.

As guest editors of this issue we have sought to collect together papers which vary in their approach, and we have also sought to comply with the wishes of those of our authors who have specified how their papers should be set out and treated typographically. In order to do this, of course, we have had to abandon some of the common practices of good typography–such as providing a standard layout for each article. We have done this, nonetheless, so that in some cases the printing of a paper provides an example of the ideas being discussed within it. We hope that these contrasting layouts will give the reader food for thought.

We would like to express here our appreciation to Merald Wrolstad for offering us this opportunity to put this special issue together, and to thank our contributors for providing us with their papers.

James Hartley
Peter Burnhill

Typography without words

Michael Twyman

Abstract

This paper introduces a simple notation for presenting some of the graphic variables of typography. It rests on the use of the 'x', 'o' and 'i' of the typewriter and is intended for use by anyone concerned with graphic language. It is suggested that the notation is of value in relation to teaching because it encourages serious thinking about typographic problems in conceptual terms. The rules of the notation are explained and the general approach demonstrated by the treatment of a single topic 'Headings in text'. The topic was chosen because it relates to the theme of this issue of the journal. The notation has been used over a number of years in the Department of Typography & Graphic Communication of the University of Reading in connection with the teaching of undergraduates and lay people. Apart from its use in relation to teaching, it is suggested that the notation has a value in encouraging a dialogue between research workers and typographers.

Visible Language, XV 1, pp. 5-12.
Author's address: Department of Typography, University of Reading, Reading RG6 2AU, England.
0022-2224/81/0001-0005$02.00/0

The notation presented in this paper was devised to explain, primarily to non-specialists, some of the conceptual issues that underpin typography. It was used initially some years ago to demonstrate in simple terms how principles of Gestalt psychology relate to typography and how the spatial organization of elements could be used to provide readers with some advance notice of the structure of a piece of information. A series of examples was typed using 'x's as shown in Figures 1 to 3 below and slides were made from them. A typewriter was used for the sake of convenience in production, but it was soon realized that the constraints imposed by

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   xxxxxxxxxxxxxx

xx xxxxxx
   xxxxxxxxxxxxxxxx
   xxxxxxxxxxxxxx
   xxxxxxxxxxxxxxxx
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the machine had the beneficial effect of emphasizing the essential modular nature of typography. In the context of talks to non-specialists the underlying argument presented in these and other examples needed some explanation, but in a journal such as this the examples printed below can be left to speak for themselves.

Over the last few years this simple notation has been elaborated in a fairly consistent manner and has been tried out in a number of situations. In its developed form it has been used in connection with short courses in typography organized by the Department of Typography & Graphic Communication at the University of Reading for members of staff (teachers, administrators and librarians) and in relation to courses in the theory of typography for undergraduates. It has also been given an airing at external seminars and has been tried out by other people. Modifications have been made to it in the light of experience and the time now seems right to give it a more public showing.

The rules of the notation are very simple. The basic graphic unit is the small 'x', which stands for the typographic norm in any particular instance. The norm would usually be small letters in roman (upright) form, together with capitals for proper nouns, beginnings of sentences, etc., though it might take any typographic form. The secondary graphic unit is the small 'o', which stands for the primary variation from the typographic norm. If the norm was that described in the case above, then 'o's would stand for italic, bold or all capital setting. They might also stand for a colour variation, though a typewriter with a two-colour ribbon could be used for this purpose. The letters 'x' and 'o' were chosen because they are symmetrical and of similar visual weight (though it may well be that 'noughts and crosses' and the term 'x height' played some part in the choice). The tertiary graphic unit, which has been used only occasionally, is the small 'i'; it is brought into service when a further typographic distinction is needed.

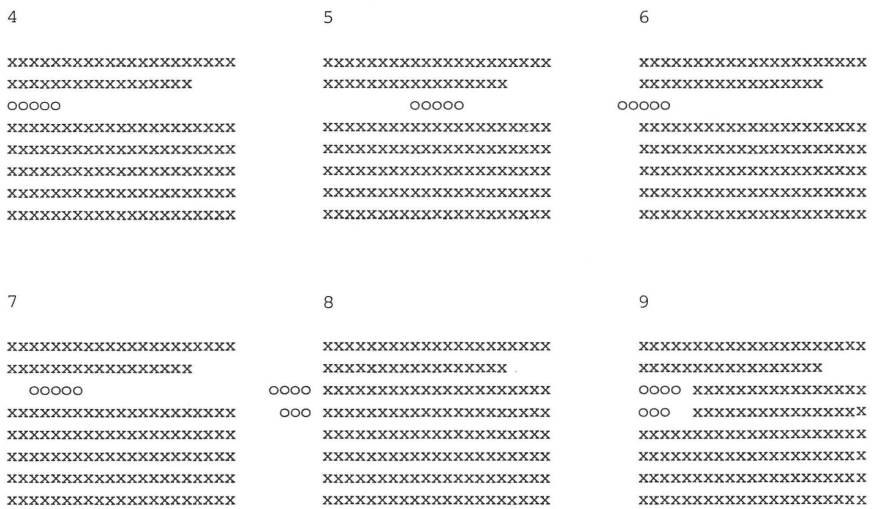
It should be stressed that these graphic units of the notation do not stand for particular kinds of typographic language (roman, italic, bold, small letters, capitals, small capitals, condensed, expanded, etc.); they stand rather for the function of the typographic language in the particular situation under discussion. Thus, in the unlikely event of a whole passage being set in capitals, with just occasional words in small letters, the notation would be exactly the same as if the reverse were the case: 'x' stands for the norm; 'o' for a variation from the norm; 'i' for a further variation from the norm. There may be a need for the rules to shift a little when dealing with particular issues; for instance, it might be helpful to use capital 'X's, 'O's and 'I's if the notation is being used to explore ways of drawing attention to the beginnings of information units, such as items in lists.

This simple graphic notation is supported by an equally simple spatial notation. Spacing on the horizontal axis is very crude indeed and can only be used to indicate such general concepts as 'centred', 'to the left of' and 'ranged right'. A row of characters stands for a line of words, the length of the row being determined not so much by any real situation as by the nature of the problem to be discussed. No indication is normally given of spaces between words, though where such distinctions are held to be essential they can be made. Spacing on the vertical axis depends on the kind of typewriter being used; but whatever line increments are available standard units of space are used to demonstrate what might be called the 'grammar of space'

in relation to a particular issue. The spatial parts of the notation can do no more than suggest first, second and third orders of vertical spacing, just as the use of 'x's, 'o's and 'i's can do no more than suggest different graphic orders.

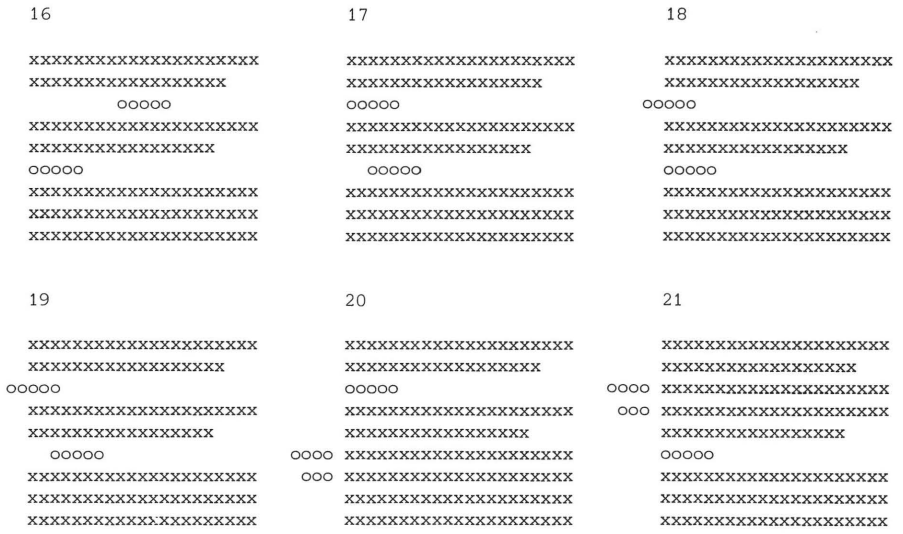
The notation described above has been used as a basis for discussing important variables of a number of typographic configurations and problem areas, including lists, tables, extracted material, notes and references, and headings in text. The case of headings in text has been selected as a means of demonstrating how the notation can be used because it seems to fit most happily into an issue of this journal devoted to spatial arrangements of text. The following examples form only part of a collection of material used in the discussion of headings in text, and it should be stressed that such an approach to the topic would always be followed by a critical look at specific items of typography. The notational approach is used to introduce general principles relating to the topic; the application of these principles to real situations and the consideration of points of detail (which often cannot be catered for by the notation) can best be considered when looking at actual examples of typography.

The first set of examples relating to headings in text shown here (Figures 4 to 9) draws attention to the major variables in terms of lateral position of the heading. Though there are other possibilities, these six examples cover the most widely adopted practices. They also point to the fact that the word 'heading' is a misnomer. Even with a schematic presentation of typographic ideas of this kind, experience has shown that it is possible to have fruitful discussions about such issues as visual effectiveness, speed and economy of production in relation to method of composition, and the consequences of varied lengths of heading and the use of numerical coding. In a teaching context such examples would be used as a means of considering general issues rather than as an aid to making decisions.



The next group of examples (Figures 10 to 15) takes just one of the possibilities shown above in relation to the lateral position of headings (Figure 4) and uses it to explore some spatial variables in a vertical direction. Clearly the approaches shown in Figures 5 to 7 could be developed in similar ways. The principal issue to emerge from this group of examples concerns what many typographers would consider one of the few fundamental 'rules' of typography: that a heading in text should be separated from its neighbouring paragraph by at least as much space as the paragraphs relating to it are separated from one another. Figures 10 and 11 aim to demonstrate that the conventions adopted for distinguishing between paragraphs in a text have a crucial bearing on the treatment of space around headings. What may work in Figure 10 clearly does not work in Figure 11 since, in the latter, only the first paragraph appears to be related to the heading. It follows from this that when space is introduced between paragraphs, at least an equal amount of space must be introduced below the heading to separate it from the following paragraph. Other figures (12 to 15) show the desirability of introducing greater space above a heading than below it. Figure 15 shows, in terms of general principles, the very least space that needs to be introduced around a heading when paragraphs are separated by units of space. All these points are well enough known to typographers, but the logic of the argument can be put across forcefully using the notation described in this paper.

Figures 16 to 21 take up again the effect of the lateral position of headings, but in relation to two levels of importance. Only a few variables of the many possibilities are presented, but they are sufficient to highlight the difficulty of establishing which is the first order heading without the additional help of typographic coding, such as size, weight, and colour. Figures 20 and 21 present particular problems in this respect, and so to some degree do Figures 16 and 17; only Figures 18 and 19 seem to be reasonably unambiguous in visual terms. In such cases of ambiguity it is clear that typographic coding would need to be introduced to establish which are the first order headings.



One of the approaches to two-level headings shown above in Figure 18 is taken further in the next set of examples (Figures 22 to 25). The first example in this group (Figure 22) shows a straightforward application of this approach with text that uses traditional indentation to mark paragraph breaks. Figures 23 and 24 illustrate that the introduction of space between each of the sub-sections has a bearing on the spacing of the primary heading; Figure 24 shows the desirability of introducing additional space above it following the argument presented in Figures 12 to 15. Figure 25 draws attention to the consequence of using space as the convention for making distinctions between paragraphs even when a simple two-level hierarchy of headings has been adopted (in this example full points have been used to make it easier to count the modules of space between the graphic units).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Figures 26 and 27 explore some ways in which four levels of heading can be manipulated when space is at a premium (Figure 26) and when it is not (Figure 27). In these examples the third graphic unit of the notation, 'i', has been used for third and fourth order headings to denote a further typographic distinction. They also show something of the notation's capacity to handle quite complex material that would be difficult to describe clearly in written language.

The major benefit arising from the use of the notation is that it encourages serious thinking about typographic problems in conceptual terms, and independently of problems associated with particular copy or composition systems. Such problems are, needless to say, of the utmost importance; but in some situations they tend to mask other issues. A further benefit claimed for the notation is that it is so simple to adopt that anyone who is prepared to take graphic language seriously can quite easily learn to use it. Many non-typographers are hesitant to put marks on paper because they feel they do not have the requisite skills to do so effectively. The notation provides such people with a means of presenting thoughts about the structure of graphic language which can look as authoritative as the marks of a skilled typographer. The notation might therefore have a special value in encouraging a better dialogue between research workers and typographers by giving psychologists a simple vocabulary, grammar and production method through which graphic concepts can be expressed. From the point of view of students, the notation seems to be useful, not only because it enables general concepts to be put across, but also because it encourages them to think visually and to develop visual arguments.

The very crudeness of the notation is, paradoxically, one of its strengths. It is applicable to all systems of verbal graphic language (writing, typing, printing, videotex) and so encourages concentration on the essential structure of a message. Typographic niceties, which are often system dependent (sometimes even typeface dependent), such as the comparative weight or size of letters and subtleties of interlinear spacing, can be considered by different means. The use of a notation such as that described here would seem to be particularly important in a period when design decisions are frequently made 'cart before horse' and typographic detailing is determined before typographic structure. Furthermore, the increasing likelihood of messages being 'translated' from one system of communication to others with quite different typographic capacities in terms of range of characters must surely lead to greater emphasis being attached to general principles of organizing verbal graphic language.

There is a danger that an approach along the lines presented in this paper might lead to the use of the notation as a means of producing a 'recipe book' of ideas. Nothing could be further from the original purpose of the notation, which was to encourage serious thinking about typographic language across a broad spectrum of people. It has been criticised because it leaves out the essential element of language, information content. And of course it does. But our culture is so strongly biased verbally that the very understandable concern for content deflects many people from making sound visual judgments. Much typography works visually only because its configuration can be worked out from the information it carries. Figure 28 illustrates this point.

28

xxxxxxxxx	xxxxxxx	xxxxxxx	xxxxx
xxxxxxx	xxxxxxxxx	xxxxxxx	xxxxxxxx
xxxxxxxxx	xxxxxxx	xxxxxxxxx	xxxxxxx
xxxxxxx	xxxxxxxx	xxxxxxx	xxxxxxxxx
xxxxxxxxx	xxxxxx	xxxxxxxx	xxxxxxx
xxxxxx	xxxxxxxxxx	xxxxxxx	xxxxxx

Figure 28 might represent a single list that has been chopped up into columns for the sake of convenience, or four separate lists displayed side by side; or it might perhaps represent a table which has to be read off along two axes. A reader would only know how to 'read' or 'read off' the information when it has to some extent been read. More attention to the visual configurations of language and the effects they have on reading strategies would surely lead to that closer relation between content and form that is the quest of all good typographers.

The effects of changes in layout and changes in wording on preferences for instructional text

James Hartley and Mark Trueman

Abstract

Judges rated their preferences for pages of instructional text which varied in terms of their layout, their wording or both of these features. Three different methods of assessing preferences were used. The results suggested that these measures could provide useful rough quantitative data but that they could not be relied upon too greatly when fine judgement was required.

Introduction

A considerable literature now documents how typographical layout can be manipulated to improve the comprehension of instructional text. The evidence shows that readers can search well-designed text more quickly than standard text, that readers prefer well-spaced text to standard text, and that spacing can be used to convey the underlying structure of the text to the reader (e.g. see Hartley, 1978a, b, 1980a, b, Hartley, *et al*, 1980).

Similarly a considerable literature now documents how text can be re-written in order to make it easier to understand. Experiments have been carried out to show, bearing in mind certain qualifications, that more readable text is read for a greater length of time and with greater understanding than is less readable text (e.g. see Klare, 1976; Hartley, 1980a, 1981b).

When it comes to methods of evaluating changes to text, however, no investigator to our knowledge has sought to partial out the contributions that changes in layout and changes in readability can make to the effectiveness of a particular text. In this paper we have tried to do this by asking readers for their preferences for versions of text which varied in terms of their layout, their readability, or both of these features.

Visible Language, XV 1, pp. 13-31.
Hartley's address: Department of Psychology, University of Keele, Keele ST5 5BG, England.
0022-2224/81/0001-0013$02.00/0

Reader preferences have traditionally received a 'hostile press' in typographic research. Hartley (1978a) wrote: ''Subjective preferences are interesting but they are not always informative. Not only does one man's meat appear to be another man's poison, but also one cannot assume that there will always be a positive relationship between preference, speed of retrieval and ease of use''. And in 1978b he said: ''This measure provides additional information but it often seems to be of dubious validity for subjective preferences are usually based on uninformed judgement.''

Today Hartley has somewhat modified these views. In some of his more recent research he has come to rely a good deal on the use of preference measures (e.g. see Hartley, 1980c, 1981a; Hartley *et al,* 1979; Hartley and Guile, 1981). This research has shown that preference data can be quite sensitive (i) to differences between expert and non-expert judges, and (ii) to the effects of training in using documents with different layouts. Furthermore, one can argue that, although from one particular point of view a judgement might be 'uninformed', such a judgement might well affect a person's initial reaction to a text, and, indeed, determine whether or not that text will be purchased or even read.

This paper explores this last consideration by asking people for their initial reaction to pages of instructional text which vary systematically in their presentation. We planned to use preference measures to enable us to assess the relative contribution of changes in layout and changes in wording to the perceived effectiveness of text. As we shall see, however, these plans were not quite as easy to realise as we expected, and thus this paper reveals some of the problems and pitfalls of using subjective preferences as a dependent measure. Five experiments are described which explore three different ways of obtaining preferences. In each of these experiments an equal number of men and women took part and the results were first analysed for sex differences. Since none were found the overall results are presented in the following account.

Experiment 1

Four versions of a page of instructional text were prepared as follows (see Figures 1a, b, c and d):
Version 1 Original Text: Original Layout
Version 2 Original Text: Revised Layout
Version 3 Revised Text: Original Layout
Version 4 Revised Text: Revised Layout

INSULATING RUBBER BLANKETS DESCRIPTION, MAINTENANCE, AND INSPECTION

1. GENERAL

1.01 The care, maintenance, and inspection of the insulating rubber blankets are described in this section.

1.02 This section is reissued to delete reference to the KS-16302 cleaner which has been superseded by the B cleaning fluid (AT-8236).

1.03 Insulating blankets are for use as a temporary insulating wrapping on poles which may come in contact with power lines during construction work. The blanket is also for use as an insulating mat on which a workman must stand while operating external derrick controls for a derrick being used in the vicinity of power lines. The use of insulating blankets is described in Section 621-205-010.

1.04 The insulating qualities of blankets are reduced when they become wet. For this reason, insulating blankets shall not be used during periods of rain or to cover pockets of water on the ground.

1.05 The insulating blanket is **not** a substitute for insulating gloves. Insulating gloves shall always be worn in conjunction with the use of the blanket.

1.06 When using an insulating blanket as a mat, care must be taken not to place it directly on sharp gravel, glass, or other sharp objects which will cause cuts. Either sweep the area to remove such objects or place boards to protect the blanket.

Figure 1a. Version 1 Original text : Original layout

INSULATING RUBBER BLANKETS

Description, Maintenance, and Inspection

1.0 General

1.1 The care maintenance and inspection of the insulating rubber blankets are described in this section.

1.2 This section is reissued to delete reference to the KS-16302 cleaner which has been superseded by the B cleaning fluid (AT-8236).

1.3 Insulating blankets are for use as a temporary insulating wrapping on poles which may come in contact with power lines during construction work.
The blanket is also for use as an insulating mat on which a workman must stand while operating external derrick controls for a derrick being used in the vicinity of power lines.
The use of insulating blankets is described in Section 621-205-010.

1.4 The insulating qualities of blankets are reduced when they become wet.
For this reason insulating blankets shall not be used during periods of rain or to cover pockets of water on the ground.

1.5 The insulating blanket is **not** a substitute for insulating gloves.
Insulating gloves shall always be worn in conjunction with the use of the blanket.

1.6 When using an insulating blanket as a mat, care must be taken not to place it directly on sharp gravel, glass or other sharp objects which will cause cuts.
Either sweep the area to remove such objects or place boards to protect the blanket.

Figure 1b. Version 2 Original text : Revised layout

INSULATING RUBBER BLANKETS DESCRIPTION, MAINTENANCE AND INSPECTION

1. GENERAL

1.01 This section describes the care, maintenance and inspection of insulating rubber blankets.

1.02 This section is re-issued to delete reference to the KS-13602 cleaner; this has been superseded by the B cleaning fluid (AT-8236).

1.03 Insulating blankets are used to provide temporary insulation around poles that might come into contact with power lines during construction work. The blankets are also used as insulation mats for workmen to stand on when they are operating the external controls of a derrick near power lines. The use of insulating blankets is described in Section 621-205-010.

1.04 The insulating quality of the blanket is reduced when it gets wet. For this reason do not use insulating blankets to cover pools of water on the ground, or when it is raining.

1.05 An insulating blanket is **not** a substitute for insulating gloves. Always wear insulating gloves when using an insulating blanket.

1.06 When using the blanket as a mat take care not to place it directly on sharp gravel, glass or other sharp objects which might damage it. Either sweep the area to remove such objects, or put down boards to protect the blanket.

Figure 1c. Version 3 Revised text : Original layout

INSULATING RUBBER BLANKETS

Description, Maintenance and Inspection

1.0 General

1.1 This section describes the care, maintenance and inspection of insulating rubber blankets.

1.2 This section is re-issued to delete reference to the KS-13602 cleaner; this has been superseded by the B cleaning fluid (AT-8236).

1.3 Insulating blankets are used to provide temporary insulation around poles that might come into contact with power lines during construction work.
The blankets are also used as insulation mats for workmen to stand on when they are operating the external controls of a derrick near power lines.
The use of insulating blankets is described in Section 621-205-010.

1.4 The insulating quality of the blanket is reduced when it gets wet.
For this reason do not use insulating blankets to cover pools of water on the ground, or when it is raining.

1.5 An insulating blanket is **not** a substitute for insulating gloves.
Always wear insulating gloves when using an insulating blanket.

1.6 When using the blanket as a mat take care not to place it directly on sharp gravel, glass or other sharp objects which might damage it.
Either sweep the area to remove such objects, or put down boards to protect the blanket.

Figure 1d. Version 4 Revised text : Revised layout

One hundred mature Open University students[1] attending a summer school at the University of Keele were each asked individually to compare two of the above versions (e.g. Version 1 with Version 2) and to state which one they preferred. The actual instructions asked them to consider "Which one you prefer, which one do you think the easiest to use, to understand, which one do you think is the clearest? When you have done this can you then give each one a mark out of ten for *clarity*." The marks allocated recorded, and sufficient data was collected to allow us to make the following comparisons:

Comparisons focussing on layout changes
Version 1 versus Version 2 (N = 20)
Version 3 versus Version 4 (N = 20)
Comparisons focussing on text changes
Version 1 versus Version 3 (N = 20)
Version 2 versus Version 4 (N = 20)
Comparisons focussing on both
Version 1 versus Version 4 (N = 20)

The results obtained are displayed in Table I. The comparisons were made using the Wilcoxon Matched Pairs Signed Ranks test (Seigel, 1956). This test gives a T value, and a z score. The z scores and their significance levels (for one-tailed tests) are reported in Table I. In almost every case changes in layout led to significantly greater preferences and, similarly, changes in wording led to significantly greater preferences, Combining the changes, however, did not lead to a wider disparity in the marks allocated: indeed the results were very similar.

[1] Open University students are very different from conventional British University students. They have much more varied backgrounds and range in age from their 20s to their 80s (see Mackintosh, 1974). As such they are more typical of the normal population than conventional university students, although clearly they are exceptional in many ways.

Table I
Medians and ranges of the marks given out of ten for each version in each comparison (Experiment 1).

Layout changes

	Median	Range		Median	Range
Version 1	5.5	2–10	Version 3	6.0	2– 8
Version 2	8.0	4–10	Version 4	8.0	4–10
z value	1.34		z value	3.02	
Significance level	n.s.d.		Significance level	p<.005	

Text changes

	Median	Range		Median	Range
Version 1	5.0	2–8	Version 2	6.0	4– 8
Version 3	7.0	4–9	Version 4	8.0	4–10
z value	2.86		z value	3.12	
Significance level	p<.005		Significance level	p<.001	

Both changes

	Median	Range
Version 1	6.0	2–10
Version 4	8.0	4–10
z value	2.95	
Significance level	p<.005	

Experiment 2

Experiment 2 was a replication of Experiment 1 (and was carried out before the results from Experiment 1 were analysed) using a different text. Again four versions of this text were prepared in the same way (see Figures 2a, b, c and d):

Version 1 Original Text: Original Layout
Version 2 Original Text: Revised Layout
Version 3 Revised Text: Original Layout
Version 4 Revised Text: Revised Layout

The main difference between the texts used in Experiments 1 and 2 lay in the nature of the changes made. In Experiment 1 the main changes were typographical: in Experiment 2 the main changes were textual. The original version of the text used in Experiment 1 had a Gunning Fog Index of 14.7 and for the revised version it was 13.5. The original version of the text used in Experiment 2 had a Fog Index of 11.0 and for the revised version it was 8.6.

Table II
Medians and ranges of the marks given out of ten for each version in each comparison (Experiment 2).

Layout changes

	Median	Range		Median	Range
Version 1	6.0	3– 9	Version 3	5.0	3–9
Version 2	8.0	4–10	Version 4	8.0	2–9
z value	2.47		z value	1.96	
Significance level	$p<.01$		Significance level	$p<.05$	

Text changes

	Median	Range		Median	Range
Version 1	6.5	2–9	Version 2	5.0	2– 9
Version 3	8.0	4–9	Version 4	8.0	5–10
z value	1.51		z value	2.97	
Significance level	n.s.d.		Significance level	$p<.005$	

Both changes

	Median	Range
Version 1	6.0	2– 8
Version 4	8.0	6–10
z value	3.55	
Significance level	$p<.0005$	

A further one hundred Open University students (50 men and 50 women) took part in this Experiment as in Experiment 1. The results obtained are shown in Table II. These results reflect almost exactly those obtained in Experiment 1.

The results from both of these experiments suggest (i) that people prefer revised versions to the original ones, whether the revisions are to the layout, to the text, or to both, but (ii) that the measure made is not sensitive to the number and to the kind of changes made. It seems that most students gave themselves a baseline of about 5 marks for the version they liked least and a ceiling of about 8 marks for the version they liked most, irrespective of the versions being compared. Thus versions 2 and 3 for example scored about 5 when they were presented as original texts and about 8 when they were presented as revisions. In short, (although clearly the revised

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Even though you may be an experienced air traveler, there are certain features of this airplane with which you may not be familiar.

AUTOMATIC OXYGEN SYSTEM

The higher altitudes at which this aircraft operates require the prompt use of the automatic oxygen system in case of any sudden change in cabin pressure. Should a decompression occur, oxygen masks will drop down. Take nearest mask and promptly place over nose and mouth. BREATHE NORMALLY (NO SMOKING PLEASE).

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Even if the "SEAT BELT" sign is turned off in flight, it is recommended that you keep your seat belt fastened, whenever you are in your seat.

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The cushion on which you are sitting is designed to keep you afloat. In the event of a water landing, grasp the cushion at the rear, pull it forward and take it with you.

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There are nine exits provided for your use. The chart below will show you the one closest to your seat. The exits over the wings are removable windows. For easy access to the window, push seat back ahead of the window forward. The two exits at each end of the cabin are doors equipped with fast operating evacuation slides. There is also a door in the rear of passenger cabin. REAR CABIN EXIT (STAIR). (If usable, will be opened by a crew member.)

Figure 2a. Version 1 Original text : Original layout

IMPORTANT INFORMATION FOR OUR PASSENGERS

Even though you may be an experienced air traveler,
there are certain features of this airplane with
which you may not be familiar.

AUTOMATIC OXYGEN SYSTEM

The higher altitudes at which this aircraft operates
require the prompt use of the automatic oxygen system
in case of any sudden change in cabin pressure.
Should a decompression occur, oxygen masks will drop
down.
Take nearest mask and promptly place over nose and mouth.
BREATHE NORMALLY (NO SMOKING PLEASE).

SEAT BELTS

Even if the "SEAT BELT" sign is turned off in flight,
it is recommended that you keep your seat belt fastened,
whenever you are in your seat.

FLOTATION SEAT CUSHIONS

The cushion on which you are sitting is designed to
keep you afloat.
In the event of a water landing, grasp the cushion
at the rear, pull it forward and take it with you.

EMERGENCY EXITS

There are nine exits provided for your use.

The chart below will show you the one closest to
your seat.

The exits over the wings are removable windows.
For easy access to the window, push seat back ahead
of the window forward.

The two exits at each end of the cabin are doors
equipped with fast operating evacuation slides.

There is also a door in the rear of passenger
cabin.
REAR CABIN EXIT (STAIR).
(If usable, will be opened by a crew member.)

Figure 2b. Version 2 Original text : Revised layout

IMPORTANT!

This aircraft has special safety features. Read this card carefully.

AUTOMATIC OXYGEN

If, during the flight, there is a sudden change in cabin pressure, oxygen masks will drop down automatically. If this happens, take the nearest mask, put it quickly over your nose and mouth, breathe normally, put out all cigarettes.

SEAT BELTS

We suggest that you keep your seat belt fastened when you are seated - even when the SEAT BELT sign is turned off.

FLOATING SEAT CUSHIONS

Your seat cushion will keep you afloat if we make an emergency landing in the sea. Get hold of the cushion at the back, pull it forward, and take it with you.

EMERGENCY EXITS

There are nine emergency exits. The chart on the back of this card shows the exit nearest to your seat. The two exit doors at the end of the cabin are fitted with chutes for sliding down. To get out over the wings you have to take out the windows. To make this easier, put the seat-back down when you are trying to get to the window. The door at the back of the cabin is labelled REAR CABIN EXIT (STAIR). This door will be opened by a crew member.

Figure 2c. Version 3 Revised text : Original layout

IMPORTANT!

This aircraft has special safety features.

Read this card carefully.

AUTOMATIC OXYGEN

If, during the flight, there is a sudden change in cabin pressure, oxygen masks will drop down automatically.
If this happens
- take the nearest mask
- put it quickly over your nose and mouth
- breathe normally
- put out all cigarettes.

SEAT BELTS

We suggest that you keep your seat belt fastened when you are seated - even when the SEAT BELT sign is turned off.

FLOATING SEAT CUSHIONS

Your seat cushion will keep you afloat if we make an emergency landing in the sea.
Get hold of the cushion at the back, pull it forward, and take it with you.

EMERGENCY EXITS

There are nine emergency exits.

The chart on the back of this card shows the exit nearest to your seat.

The two exit doors at the end of the cabin are fitted with chutes for sliding down.

To get out over the wings you have to take out the windows.
To make this easier, put the seat-back down when you are trying to get to the window.

The door at the back of the cabin is labelled REAR CABIN EXIT (STAIR).
This door will be opened by a crew member.

Figure 2d. Version 4 Revised text : Revised layout

versions were preferred to the originals) these results reflect more the problems of subjective scaling than specific differences in the texts (Poulton, 1973).

Such findings, unfortunately, prevent us from saying anything about the relative effectiveness of the layout or textual changes. To make our measure more sensitive to these differences we tried a new approach.

Experiment 3

Experiment 3 replicated Experiment 2 except that in this case each student was given *three* versions of the airline safety document to compare, and asked to put them in order of preference. The versions used were Versions 1, 2, and 4. After this each judge was asked to suppose that Version 1 had already been given a mark of 5 out of 10 for clarity, and thus to indicate to the investigator what mark he or she would allocate to Versions 2 and 4. A further twenty Open University students took part in this enquiry, 10 men and 10 women.

The results obtained are shown in Table III. These results suggest that the layout changes have little effect relative to the changes in wording. However, this could reflect the fact that Version 3 was not included in this experiment. Consequently Experiment 3 was repeated with 20 more participants using Versions 1, 3 and 4. The results obtained are shown in Table IV.

These results replicate almost exactly those shown in Table III. Compared with the results obtained in Experiments 1 and 2 both of these results now suggest that a double change is seen as more preferable to a single one, but that once again, the data from Tables III and IV suggest that they reflect the nature of the task rather than specific differences between the texts. One point of interest, however, is that in both Experiments 2 and 3 the comparison of Version 1 with Version 3 produced a non-significant result.

Table III
The median rankings given to Versions 2 and 4 (with a standard mark of 5 given to Version 1).

	Median	Range
Version 1	5.0	0
Version 2	6.0	2– 8
Version 4	8.0	1–10

Significance levels:

Version 1 versus Version 2	$z=2.64$	$p<.005$
Version 1 versus Version 4	$z=3.16$	$p<.001$
Version 2 versus Version 4	$z=2.88$	$p<.005$

Table IV
The median rankings given to Versions 3 and 4 (with a standard mark of 5 given to Version 1).

	Median	Range
Version 1	5.0	0
Version 3	6.0	3– 7
Version 4	8.0	6–10

Significance levels:

Version 1 versus Version 3	$z=1.25$	not significant
Version 1 versus Version 4	$z=3.92$	$p<.0001$
Version 3 versus Version 4	$z=3.92$	$p<.0001$

Experiment 4

So far, using mature Open University students as participants, we have seen that the method of comparing *two* versions discriminates between the pairs, but does not discriminate between the number and kinds of changes made. The method of comparing *three* versions, however, does discriminate between the number of changes, but it does not appear to discriminate between the kinds of changes (with these participants). In order to see if textual changes were preferred to layout ones (or *vice versa*) we next decided to ask students to compare all *four* versions of a particular passage and to place them in rank order. In this experiment eighty students from Bristol Polytechnic (aged between 18 and 21) acted as participants. In the first part of the experiment forty students (20 men and 20 women) used the passage on insulating blankets, and in the second part forty students (20 men and 20 women) used the passage on airline safety.

Each student was asked individually to place the four versions of one of the passages in rank order of preference. The versions were labelled p, t, d and h to remove any order effect that might be implied from labelling them a, b, c, d, or 1, 2, 3, 4. After the various versions had been placed in order, the students were asked to suppose that Version p (i.e. 1) had already been given a mark of 5 out of 10 for clarity, and to indicate to the experimenter what mark he or she would allocate to versions t, d and h (i.e. 2, 3 and 4).

The results obtained for the insulating blankets passage are shown in Table V, and for the airline safety passage in Table VI. It can be seen with the insulating blankets passage that Version 1 was significantly less-preferred to Versions 2, 3, and 4 but that there were no significant differences between the preference rankings for the latter versions. The results from the airline safety passages, however, were more striking. Table VI shows that Version 1 was the least preferred and Version 4 the most preferred. There were no significant preferences between Versions 2 and 3, although both were significantly preferred to Version 1 and significantly less preferred than Version 4.

Table V

The median rankings given to Versions 1, 2, 3 and 4 of the passage on insulating blankets by Bristol Polytechnic students (N=40) with a standard mark of 5 given to Version 1.

	Median	Range
Version 1	5.0	0
Version 2	7.0	2– 9
Version 3	6.0	1–10
Version 4	7.0	3– 9

Significance levels:

Version 1 versus Version 3	$z=3.19$	$p<.001$
Version 2 versus Version 3	$z=0.03$	not significant
Version 2 versus Version 4	$z=1.01$	not significant
Version 3 versus Version 4	$z=1.07$	not significant

Table VI

The median rankings given to Versions 1, 2, 3 and 4 of the passage on airline safety by Bristol Polytechnic students (N=40) with a standard mark of 5 given to Version 1.

	Median	Range		
Version 1	5.0	0		
Version 2	6.0	3– 9		
Version 3	6.0	1– 9		
Version 4	8.0	1–10		
Significance levels:				
Version 1 versus Version 2			z=4.11	p<.001
Version 1 versus Version 3			z=2.46	p<.01
Version 2 versus Version 3			z=1.38	not significant
Version 2 versus Version 4			z=3.08	p<.001
Version 3 versus Version 4			z=3.19	p<.001

Experiment 5

We repeated the first part of Experiment 4 (this time using as participants fifteen undergraduates, aged between 19 and 22, from the University of Keele). In this final experiment, with the passage on insulating blankets, the students were asked to suppose that a mark of 4 out of 10 had been given to version 1. These results obtained are shown in Table VII. These results clearly reflect those shown in Table VI, and suggest that those in Table V are anomalous.

Table VII

The median rankings given to Versions 1, 2, 3 and 4 of the passages on insulating blankets by undergraduates at the University of Keele (N=15) with a standard mark of 4 given to Version 1.

	Median	Range		
Version 1	4.0	0		
Version 2	6.0	5– 9		
Version 3	6.0	2– 8		
Version 4	9.0	3–10		
Significance levels:				
Version 1 versus Version 2			z=3.41	p<.0005
Version 1 versus Version 3			z=2.78	p<.005
Version 2 versus Version 3			z=0.94	not significant
Version 2 versus Version 4			z=2.47	p<.01
Version 3 versus Version 4			z=3.41	p<.0005

Concluding Remarks

These five experiments seem to point to four things:
(i) Comparisons can be made to see if any one version of a text seems preferable to another, but
(ii) the judgements will be crude and global (as shown in Experiments 1 and 2).
(iii) One can obtain more refined judgements from individuals by making the task more difficult (Experiments 3, 4 and 5), but
(iv) even here the results appear to reflect the difficulties of subjective scaling, differences between the texts, and differences between the kinds of judges employed.

It would seem that subjective preferences can provide additional information to experimenters about the effectiveness of changes to text, but that this information cannot be relied upon too greatly if fine judgement is required. It may be that a more refined technique, such as the method of paired comparisons, would prevent such difficulties, but it is not usual to use such a technique when only a small number of comparisons have to be made. The cruder methods we have used have not enabled us to separate out unequivocally the relative effects of changes in layout and changes in wording to the perceived effectiveness of instructional text. Our cautious conclusion, however, from the experiments reported here, is that with these texts neither change is seen as more effective than the other, but that both changes in combination are more effective than one alone.

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Multi-level writing in theory and practice

Don L. Jewett

Abstract

A multi-level writing style allows the reader more flexibility than traditional forms of exposition. Such a format is generally more easily written, as well. Various formats for different purposes can be used to improve printed communication if the format is tested on a sample of the intended readership; such testing is as important or more important than any particular typographical scheme. This article will cover (1) background and theory, (2) typographical methods, and (3) hierarchical ordering of multi-level writing from my perspective (which lacks acquaintance with what others have done in this regard).

Visible Language, XV 1, pp. 32-40.
Author's address: Department of Orthopaedic Surgery, University of California, San Francisco, CA 94143.
0022-2224/81/0001-0032$02.00/0

The article is written in a multi-level style, with indentations of material expressing three general levels, as follows:

Main ideas

Elaboration of main points

Parenthetic remarks

BACKGROUND AND THEORY

Books and articles, like other mass media, are characterized by a marked degree of one-way communication. For the most part we never meet our readership, nor receive a detailed reply. We write for an imagined audience.

Publishing is analogous to the broadcasting of seeds, which may or may not fall on fertile ground; the propagation of ideas is as dependent upon the characteristics of the reader as it is on those of the writer. The greater the "flexibility" of the seed/communication, the greater is the number of niches in which it may take hold, and even grow.

What really is transmitted in both the seed and the book is information – this is the central idea of Fred Hoyle's novel *A for Andromeda*.

What can be done to make written communication more adaptable? A multi-level format allows the same material to be directed to a number of different audiences, allowing *the reader* to adapt his reading to his own purposes, with greater flexibility than is possible in a standard format.

The basic idea is to present the ideas in a typographical format that allows the reader to easily choose alternative paths through the material.[1,2]

I must admit that it has been hard for me to acknowledge that most readers do not wish to read, and indeed will never read the entire product of my late night's work. A few readers may do so if they are charmed by my "inimitable" style, or if they are required to master the material by external circumstance. But others may well skim through the material and turn the page before they reach what I think is the best part! So, given the inevitable, it is probably better for an author to make the reader's job easier (at least it is an additional way to get some appreciation!); the surprise is that it can make the author's work easier too!

It can reasonably be asked why the development of a multi-level style has not occurred earlier, given the long history of printing, its profound influence on the spread of knowledge, and the change in Western culture from restricted to universal literacy. In my view there is little 'economic force' for typographical change in publishing technique.

The one-way communication inherent in publishing limits the knowledge of both publishers and authors as to the effectiveness of their products. Thus, change in publishing stems from the economics of production and distribution rather than competition in terms of user efficiency, or even convenience. Said in another way: relatively few books compete for the same economic niche. (An exception to this statement is mass-market grammar and high school texts, which also tend to be more innovative in their approach than texts that sell fewer copies, without direct competition.)

In my experience, publishers are unwilling to consider such relatively easy changes as (1) printing with brown ink on tan paper to relieve eye strain (for a good example of this technique see Kaufman's publication of Hardin's book[3]), or (2) numbering figures according to the page on which they appear so that the reader is directly referred to that page. This feature was the most popular of all textbook innovations which my students tested. Perhaps, as the typesetter is displaced by computer, such a numbering system will finally be instituted by some philanthropic computer programmer, since the present sequential numbering system is solely for the convenience of the typesetter, certainly not the reader. I see no way that readers can influence the economics of publishing to bring about such desirable format changes.

Though a multi-level format may increase the number of pages in a book and make typesetting more difficult, authors should be aware that these changes will have little, if any, impact upon the retail cost of the book.

The main determinant of the cost of a book is not the length, quality of illustrations, paper, or similar considerations about materials, but the potential size of the market.

For example, placing a cardboard front and back to make a hardcover book adds less than a dollar to production costs; paperback books are inexpensive because their production costs are distributed across a much larger number of volumes sold. Indeed, if you have followed the development of the paperback book since the 1940s, you will realize that as subject matter has become more esoteric, softcover prices have come closer to those of the hardcover versions.

Yet, despite immense advances in electronic means of communication, books are still our most efficient means of transmitting large volumes of information.

To convince yourself of this, compare books with other communication methods with regard to the following: (1) absolute size, (2) size relative to amount of information, (3) portability, (4) cost, (5) quality of illustrations and ease of reading, (6) ease of content search, (7) adaptability for different reader needs/uses, (8) ease of adding notes or underlining, (9) quality of illustrations, (10) investment required for minimum distribution, (11) adaptability to different author requirements, (12) established modes of production and distribution, (13) the ancillary equipment and power sources needed to "retrieve" the stored information, (14) restriction in use to certain locations or times of day, (15) durability and longevity, and (16) cost of upkeep/repair.

While making such comparisons, also consider the lecture as a means of communication. This more primitive ("time-honored") method survives, for possibly these reasons: 1) the size of the audience is too small for the present economics of lectures/books (including lecturer/author time) to provide a force for change; 2) the efficiency of communication may be of little concern to either the participants or the supporting institution; 3) those who are not visually oriented may not realize that although language is sequential in both spoken and written forms, the written format allows for additional communication of the author's intentions by means of layout and typography; and 4) the presence of the lecturer may motivate students. Indeed, this final factor may well be highly important for passive learners.

No matter what method of communication used, it can be improved if there is a clear feedback from the user/reader/listener to the producer/author/lecturer as to the efficacy of a specific transmittal, whether multi-level or not. (This idea is probably the most important in this paper, and yet the most easily overlooked.)

Effective feedback can be arranged in most communication methodology, even in "time-honored" techniques.

In lectures feedback can occur when the lecturer observes the audience's behavior, or receives questions from the audience (Jewett[4]). Tests can be considered a form of feedback to the teacher, though many students prefer other means of return communication. Television receives feedback by statistical sampling of audiences.

For feedback with multi-level material that has been produced on 8½″ × 11″ paper on its side, it is easy to reproduce such material on legal size (8½″ × 14″) paper so as to give extra space for students to make *line-by-line* comments back to the author. If legal size duplicating equipment is not available, typing a 7″ line along

the 11″ side of standard paper will provide space for feedback comments. In my experience such feedback will reveal the vast majority of the conceptual and presentation difficulties within two repetitions of the feedback and re-editing process, and the vast majority of improvements have been incorporated by the third cycle (if the readership groups are uniform from repetition to repetition).

The importance of user feedback was emphasized to me when I found that students did not always use my multi-level material as I had expected. I thought that students would quickly learn to judge whether they wished to read all four levels, and that most would opt to ignore the fourth level entirely because it was beyond their needs. I later found that some of the students had used the material in a different way: they read *all* the material (even though they felt the fourth level was not one of their goals), and if they understood the fourth level, they had gained, but if they didn't understand it, they did *not* go back to read it again and master it because the exam was only on the first three levels.

My greatest compliment as a teacher came from a student who had used the text to study for an exam and who, though very compulsive, had gone bowling the night before the exam because he "knew what was expected."

Indeed, I am now convinced that the communication from author/lecturer to student/reader of *what is expected* is the most important message of all, for then students can adapt their activities and study methods to the material at hand, even if it is arranged inefficiently. This insight has led to my adding small paragraph numbers to a text[5] so that other teachers can easily provide students with a paragraph-by-paragraph indication as to what that individual teacher judges important for a given course.

In my view the main message in a lecture is the indication of what is "important," i.e., what will be on the test; lecturers whose tests are not based upon their class-hour topics are usually disliked.

TYPOGRAPHICAL METHODS

The basic idea of a multi-level format is to clearly and easily distinguish, on a visual basis, different levels in the material. This can be done in a variety of ways.

Traditional techniques of distinguishing material include the use of italics, parentheses, footnotes, and appendices. Italics and parentheses are suitable only for short sections *(italics slow reading speed),* while footnotes are cum-

bersome for the reader who wishes to use them, and appendices are not integrated into the ongoing content. Multi-level writing makes the organization more apparent than is possible by these traditional techniques (which can, however, be added to a multi-level format).

The multi-level format that I have used so far[4,5] is the same as the format of this article: variable spacing from the left-hand margin, reinforced by vertical lines.

The vertical lines mimic the common practice of students in marking the margins of books for emphasis; the greater the number of lines, the greater the emphasis. The lines are especially needed when a paragraph starts a new page, since at that place there are insufficient visual cues to help in estimating the amount of indentation.

Different levels might also be distinguished on the basis of different colors of print, or of "background" color behind the printing (mimicking the use of wide felt-tip markers for emphasis).

Because I am partly color blind, these methods do not particularly appeal to me, especially since it is not readily obvious what the ranking of one color is versus another. Any typographical method will be easier to use and more easily accepted if it has an underlying 'intuitive' basis, as is the case for the vertical line markings.

Different size print may be a satisfactory means of distinguishing different levels. This could also be combined with different styles of print.[6] This method has previously been used for two and rarely three levels, but not for the four levels that are convenient for technical writing.

Symbols or letters could be used at the left hand side of the written material, with the most important material having an 'A' (or '1') at the start of a line, the next level having a 'B' (or '2'), etc.

Another alternative would be to put 'boxes' around the written material, though it is not immediately clear whether the presence of a box means that the material is more, or less, important.

Even *within a given level,* some material may deserve *additional emphasis,* which *can be expressed typographically by* the classic method of *italics,* or by *bold-face,* or by *underlining*. If important parts of rather long sentences are so indicated, shorter complete sentences can be revealed, which may aid in review of the material (as in the preceding sentence).

No matter what multi-level method is devised by the author to express his view of the material, it is of utmost importance to test the method on a sample readership.

HIERARCHICAL ORDERING

What hierarchical ordering can be communicated typographically? Of course, this depends upon what the author wishes to communicate about the material by means of the level, but there are a wide variety of possibilities.

This article illustrates one hierarchical ordering, moving left to right from 'general statements' to 'explanation of general statements' to 'personal, additional comments (not central to the general topic).' A similar pattern in a textbook[5] goes from (1) general statements, to (2) detailed teaching of the concepts stated in level 1, to (3) fine points that will be appreciated by only the most interested 20% of the class (and are not crucial to mastery of subsequent level 1 or level 2 material), to (4) detailed material included for completeness, to impress colleagues, or to serve as reference material for those who wish to study the material for reasons other than the requirements of a class.

In other circumstances, the material might be organized in the opposite manner, with the specific details to the left and generalizations to the right.

For example, a technical repair manual might be organized with the first level containing specific details to be read by every user, while the novice might read past the first level to gain understanding of the general principles of repair that could be learned from the specific example. This might be useful when it is likely that the material will be read out of sequence (depending upon what is to be repaired) rather than from beginning to end.

If the preceding (repair manual) example shows a hierarchical organization of the levels that we can summarize as specific-to-general, then the textbook example cited might be described as general-to-specific. Using similar labelling, we can then indicate other types of hierarchical ordering in a multi-level format: beginning-to-advanced, nonquantitative-to-quantitative, theorem-to-proof, content-to-critique, generalizations-to-examples, instances-to-generalizations, impersonal-to-personal, personal-to-impersonal, etc.

While the multi-level format is readily adapted to hierarchical organization, nonhierarchical separations can also be incorporated. For example, comments to different groups of readers may be typographically indicated without necessarily connoting any hierarchical differences between readers (e.g., some sections addressed to doctors, other parts addressed to lawyers). Or the separations may devolve from the content itself, e.g., a three-column story could have the stream of conciousness of one character in the left column, the simultaneous stream of consciousness of the second character in the right hand column, with the middle column reserved for that which

an outside observer might perceive, such as speech or movements of the two characters. (Spacing from the top of the page down would be used to indicate passage of time, to show which thoughts were simultaneous, and which occurred in response to outside events.)

Does the author gain from the multi-level format? For me it is much easier to write in such a style, because as I write I sense the importance of the material, and can thus indicate it easily. My textbook co-author (Martin Rayner)[5] has found it easy to adopt, and adapt to, the multi-level style.

It was surprising for me to discover what a large proportion of my previous writing time had been spent trying to indicate verbally to the reader the importance of the material. Such phrases as "an interesting side-issue," "technically speaking," "of great importance is the following," are used much less frequently when the multi-level format communicates these ideas. Furthermore, the sequence of ideas, which can also communicate their relative importance, was no longer as critical, and hence required less planning time.

Separation of the material into levels came about quite naturally and readily when I imagined lecturing to three groups simultaneously (seated from left to right): beginning students, advanced students, and colleagues. As I write, I 'face' the group I am 'speaking' to, and adjust the amount of indentation accordingly. The beginning students 'hear' my comments to my colleagues and should expect not to understand at first, but nevertheless may form the impression that there is a sound basis for the elementary statements. Simultaneously the 'colleagues' should be impressed by the good presentation of the elementary material (why else are they at the lecture?), while finding such material adequately supported by the more advanced knowledge addressed specifically to them.

The time-saving feature of multi-level writing has been so great that I routinely write reports and grant applications in two to four levels.

Moreover, the choice of multi-level format and hierarchical order does influence the writing style, most likely for the better, since a commitment to a given format is 'self-correcting' for parts that do not meet the format requirements.

For example, the general-to-specific format requires that each paragraph start with the main idea, which will be elaborated upon, or illustrated, within the subsequent lower levels. Such a 'newspaper' (most-important-ideas-first) style allows the reader to decide how to best utilize what he is about to read. The absence of a clearly stated generalization ('goal') at the start of each first level section is readily apparent when the author has made a commitment to the general-to-specific format.

Egotistically, the writer may like to hide the conclusion he is trying to reach as a 'surprise ending' to show his brilliance (or just to keep from losing the audience?), but such an effect is lost on the reader who skips over the material (and what reader has time to read all material available?).

Although it may be initially difficult to state at the outset the point that will be demonstrated in the subsequent material, the writing of the subsequent levels becomes much easier once the author has explicitly stated his intentions.

Now that you have read this article, you can test the adequacy of the levels by re-reading the text that comes to the left-hand margin. This material should form a good review of the main concepts in this paper.

The discerning reader may also note that some of the ideas that I find personally interesting and satisfying but not of importance to the main line of presentation have been 'hidden' in the third level, hence only the more 'motivated' readers are thus 'rewarded.' (This just goes to show that the basic personality of an author can emerge despite the constraints of a multi-level style!)

Finally, I leave it to the reader to decide the basis for my use of parentheses, slashes, e.g.'s, single quotation marks, and long nonrestrictive clauses set off by commas all of which are also a form of typographical communication that I have not, and probably will not, analyze.

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Typographical and spatial cues that facilitate learning from textbooks

Wayne L. Shebilske and John A. Rotondo

Abstract

Ninety-six undergraduates at the University of Virginia studied a 2866 word excerpt from a tenth grade biology textbook either in a standard typographical layout or in a special one containing typographical and spatial cues. Both groups studied the text for about nineteen minutes. **(Results of paraphrastic recall, a multiple choice test, and a questionnaire suggested that the typograpical and spatial cues facilitated learning and memory.)** Potential classroom applications were discussed.

(The format used here is similar but not identical to the one we used.) Here we used bold face letters for emphasis; in the experiment we used capital letters because it was easier on a typewriter. Here the authors determined the segmentation units; in the experiment groups of college students determined them.

The instructions for using our format are: **(The passage is printed in a special format using line spaces, brackets, and bold face letters. Line spaces set off each idea, and brackets set off the gist of each idea, whether or not the idea is important. When an idea is important, its gist is in bold print.)**

When we read a text to learn, we assilimilate its semantic core, often remembering it in our own words instead of in its original surface representation. [Whether we realize it or not, however, surface representation influences our reading and our memory for what we read.] For example, readers find answers to true-false questions faster when a text provides spatial cues about its grammatical phrase structure (Frase & Schwartz, 1979; Hartley, 1980) and sentences are reread faster when the first and second presentation have the same typography (Kolers, 1975). The latter result suggests that surface representation is an integral part of memory and sets the stage for developing typographies that facilitate memory.

[In the present study, we endeavored to develop typographical and spatial cues that would improve learning and memory of a 2866 word excerpt from a tenth grade biology textbook.]

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Shebilske's address: Department of Psychology, University of Virginia, Charlottesville, VA 22901.
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Background

[The foundation for our study was laid by a two-year project, "Learning from Math and Science Textbooks," conducted at the University of Virginia by (in alphabetical order) James Deese, Thomas Estes, John Rotondo, Wayne Shebilske, and M. Elizabeth Wetmore.] The aim of our project has been to provide a theoretical and empirical foundation for the development of better textbooks and better diagnostic and instructional techniques for teaching the kinds of reading demanded by textbooks in mathematics and science.

[The first two years were spent studying interrelationships between subject factors, formal text structures, perceived text structures, comprehension strategies, and the understanding of conceptual content in typical classroom reading assignments.]

[We will briefly review our large on-going project here, because it determined the specific typographical manipulation used in the present study.]

Our research is based on the assumption that what a reader sees in a text is as important as what an author writes in it. A major thrust in the early phase, therefore, was the development of methods for measuring perceived text structure. [**Two procedures especially important to the present study were dividing the text into idea units and rating the importance of those units.**]

Measuring Perceived Idea Units. We had one group of subjects divide our biology text according to the following instructions:

> Now that you have read this passage, we would like for you to go back through it and divide it into what we call "idea units." [**An idea unit encompasses a complete thought; and while idea units often coincide with sentences or are set off by punctuation, this is not always the case. More than one idea unit may occur in a single sentence; one idea unit may carry over from one sentence or paragraph to the next.**]
>
> Sometimes you may not be certain where one idea ends and another begins. We would like for you to make judgements despite this uncertainty. Please turn back to the passage that you just read and put slash marks (/) after each idea unit. Raise your hand if you have questions.

Figure 1 shows some of our units. [They tend to be considerably larger than those obtained by other researchers who asked subjects to divide a passage where ever it was natural to pause during reading] (Johnson, 1970; Brown & Smiley, 1977; Frase and Schwartz, 1979).

If you try to mark pausal units in Figure 1, you will see that our units often contain more than one pausal unit, and our idea units often terminate at the end of a pausal unit. You should also be able to mark larger units in Figure 1 by combining some idea

units. For example, the first four and the last two might form two groups corresponding to examples and main points. [In fact, some subjects who divided our passage according to the above instructions marked smaller or larger units than those shown in Figure 1.]

[**Despite variability in coarseness, however, idea units tended to be congruent (i.e., smaller units from fine grain analyses tended to be nested within larger units from coarser analyses) suggesting that smaller units may be used as building blocks for larger units when subjects structure an internal representation of text.**] We consider the units shown in Figure 1 to represent only one level of that whole hierarchical structure.

Importance Ratings: 1= unimportant

10= important

TWO METHODS OF CLASSIFICATION

(The basic idea of classification is not difficult to understand. We all do some informal classifying,) and almost anything may be classified--stamps, rocks, clouds, even the kinds of weather. 4

(The words in a dictionary are classified. They are classified according to their spelling--that is, alphabetically). 2

(In classifying objects we could use an alphabetical method, arranging them according to the alphabetical order of their names.) Suppose a supermarket manager arranged his merchandise alphabetically. Think of the varied goods to be found under the letter A: abalones, almonds, apples, apricots, artichokes, and many more. These would be followed by bacon, baking powder, beans, beef, beets, bread. Imagine the practical difficulties in such a system. Refrigerators for perishable groceries would have to be scattered throughout the store. 3

(Actually, in any supermarket we find that the merchandise has generally been grouped according to the nature of the product). In one section we find various kinds of canned goods; in another, fresh fruits and vegetables, in a third, meats. Moreover, each of these sections may be further divided. Familiarity with this system of classification enables the shopper to locate groceries easily and quickly. 4

(Thus WE CAN CLASSIFY IN EITHER OF TWO WAYS: ACCORDING TO LIKENESSES IN NAMES OR ACCORDING TO LIKENESSES IN OBJECTS THEMSELVES.) 8

(FOR BIOLOGICAL CLASSIFICATION NAMES OF ORGANISMS ARE CERTAINLY OF MUCH LESS IMPORTANCE THAN CHARACTERISTICS); so the alphabetical method is not satisfactory. 8

Figure 1. An excerpt from Biological Sciences and Curriculum Study, *High School Biology* (Green Version), 2nd ed., Chicago: Rand-McNally, 1963. The excerpt is printed with the following typographical and spatial cues: (1) Idea units are separated by one line space; (2) phrases and sentences corresponding to the gist of idea units are set off by parentheses, and (3) important gist statements are capitalized. Our modified format maintained paragraph indentations that were in the original. In the experiment the passage was typed on 8.5 x 11 in. pages in pica with blank 1 inch margins on all sides. Here the right margin is used to show importance ratings.

[Taking advantage of between-subjects variability in coarseness of unitizing, Rotondo (Note 1) developed a single-linkage clustering algorithm for determining the perceived hierarchical structure of a text.] In principle, we thought that it would be best to use the entire hierarchical structure in any analysis of a text.

In practice, however, we needed to choose one level of analysis to make our initial work more manageable. Rotondo therefore proposed a rationale for choosing one level of a text's hierarchical structure. [He computed the mean number of idea units used by subjects and then chose the hierarchical level that came closest to having that number of units, resulting in the units shown in Figure 1.]

[We then had a second group of subjects rate the importance of those units.]

Measuring Perceived Importance of Textual Units. Figure 1 shows some importance ratings provided by college students who were given the following instructions:

> The author of the passage you just read had main ideas that he or she wished to convey. Some of the ideas in the passage are very important with respect to the author's main points, while others are much less important. [**We would like you to tell us how important you perceive each idea to be with respect to the author's main points.**]
>
> On the following pages the ideas of the passage are listed with two rating scales next to each. The first scale is for you to say whether the idea is *important unimportant* to the author's main points. Even if you aren't sure of the choice you are making, rate each idea as either *important* or *unimportant*.
>
> A rating of *A* will mean you think the idea is *important*.
>
> A rating of *B* will mean you think the idea is *unimportant*.
>
> The second scale is for you to say how *sure* you are of your choice on the first scale.
>
> *A* will mean you are *highly sure* of your choice between important and unimportant for this idea.
>
> *B* will mean you are *sure* of your choice between important and unimportant for this idea.
>
> *C* will mean you are only *slightly sure* of your choice between important and unimportant.
>
> *D* will mean you are *unsure* of your choice between important and unimportant.
>
> *E* will mean you are *highly unsure* of your choice between important and unimportant.

By comparing ratings of college students with those of tenth graders, we demonstrated an advantage of measuring perceived text structure over the more common practice of limiting textual analysis to formal structures (e.g., Frederiksen, 1975a,b; Norman & Rumelhart, 1975; Anderson & Bower, 1973; Kintsch, 1974; Schank, 1973; Grimes, 1972). [**Tenth grade importance ratings were highly correlated with college ratings, but they deviated systematically, in that tenth graders overestimated the importance of concrete examples and underestimated the importance of abstract main points.**]

[High school teachers who inspected our results agreed with the college students' assessment of importance, and they were surprised by the tenth grade results.] The teachers had known that tenth graders have trouble determining the main points in a text, but they had not foreseen the existence of systematic differences between themselves and their students. We had not anticipated a systematic difference either, but we were enthusiastic about it, believing that we were on the right track.

Measuring Learning and Memory. [We were encouraged further when we used our normative idea units and importance ratings to analyze learning and memory.]

[Teachers often given short answer tests to determine whether or not a student understood the vocabulary, facts, main ideas, and inferences related to a text.]

[Many teachers have recognized the potential advantage of adding an open-ended question such as "Recall what you have read in your own words," but they have avoided them because of the difficulty in evaluating the answers.]

[We found that we could make good use of behaviorally defined units and importance ratings in evaluating answers to open-ended questions.]

A group of college students and a group of tenth graders read our tenth grade text in preparation for a difficult examination including both essay and objective tests. After a single study session, students paraphrased the text including as much detail as possible. In one of several recall analyses, we determined whether or not students included the gist of each idea unit. The proportion of college students recalling an idea unit was significantly correlated with importance ratings ($r = .39, p < .001$). Tenth grade recall was correlated with college recall ($r = .68, p < .001$), but it also deviated systematically. [**Specifically, tenth graders tended to recall relatively unimportant concrete examples at the expense of important abstract main points, corroborating the pattern observed in importance ratings.**]

Our finding of significant correlations between importance ratings and recall agrees with results of Johnson (1970) and Brown and Smiley (1978). [Instead of emphasizing the positive correlation itself as they did, however, we laid stress on the large amount of recall variance unaccounted for by importance ratings.] The correlations for college students accounted for only 15 percent of the variance and the correlation for tenth graders was worse. We concluded that both groups have difficulty in identifying and

recalling important ideas and we decided to do something about it by teaching the students and by improving the textbooks.

[The present study is part of our effort to enhance the communicative effectiveness of textbooks.]

Rationale

After reviewing conflicting reports on the influence of a text's layout on comprehension, Hartley (1980) called for "comprehensive studies comparing different kinds of reading tasks . . . and different layouts for different kinds of text" (p. 76). Our project provides a framework for such a comprehensive approach, but first [we need answers to the following preliminary questions: Can special typographical designs adequately portray the structures we had measured? If so, will those typographies improve learning and memory? Finally, will gains in learning and memory manifest themselves in paraphrastic recall?]

[Our first attempt at developing a special format based upon measures of perceived text structure consisted of the following manipulations: 1) Idea units were separated by one line space; 2) phrases and sentences corresponding to the gist of each idea unit were set off by brackets, and 3) important gist statements were capitalized.] Figure 1 shows the resulting format for our tenth grade biology passage.

[We compared reading rates and comprehension measures of college students who read this passage in either a standard layout or in our special layout.]

Methods

Subjects. [Subjects were 96 undergraduates at the University of Virginia who participated for pay or for partial fulfillment of a course requirement.]

Design. [We used a simple between-subjects design comparing performance of 47 students who read the standard format with 49 students who read the special format.]

[We measured reading time, paraphrastic recalls and scores on a detailed multiple choice test. We also asked students to evaluate our typographical design.]

Procedure. We collected data in a large auditorium. For practical reasons, we ran the standard group first. [Both groups read instructions for studying, read the material, wrote paraphrases of the text, took a multiple choice test, and then answered a questionaire.]

[In order to test the effectiveness of the special format itself we minimized differences in instructions between the two groups.] The instructions for studying are shown below:

> This booklet contains an excerpt from a biology textbook. Please work under the assumption that you are reading this material for a class in which you will be given a detailed examination. Specifically, the exam will include 34 multiple choice questions as well as essay questions on the material. With that assumption in mind, please study this excerpt as you would normally study such material during your first study session with it. *The passage is printed in a special format using line spaces, brackets, and capital letters. Line spaces set off each idea, and brackets set off the gist of each idea, whether or not the idea is important. When an idea is important, its gist is capitalized,* (*-* omitted for standard layout group). You may do anything you normally do when you study such as underline or take notes. Of course, you will not be able to look at your notes or the text during the test.
>
> Please proceed at whatever rate you would ordinarily use during your first study session with this kind of material. Since people vary a great deal in their reading rates, and since different booklets contain different passages, you need not worry if others seem to be going faster or more slowly than you.
>
> When you finish studying the passage, record your time, and raise your hand.
>
> If you have any questions about these instructions, please raise your hand now. If not, turn the page, record your time, and begin studying.

All other instructions and procedures were identical for the two groups.

[A large digital clock which counted from 0 to 9999 seconds was used to time each part of the experiment.] Subjects wrote the four digits displayed when they started and when they finished each part. Because of a clock malfunction, we got times for only 15 of the students in the standard layout group.

Results

[It is important to keep in mind that the results reflect the state of comprehension after an initial study session.] Most students study a homework assignment once and then return to it one or more times to review before an exam (Shebilske, Fisher & Karmiohl, Note 2). During an initial study session, students may go over material several times, but the initial session is nevertheless only part of the student's total study effort. In effect we have taken a "snapshot" of the first stage of the total study process.

[As a result scores are lower than one would expect to see for a class who had completed the entire study process.]

[**The results suggest that students who read the special layout learned and remembered the text better without spending appreciably more time studying.**] Average reading times were 18 min. 29 sec., and 19 min. 5 sec. for the standard and special layouts respectively ($t(62)=0.89$, $p>.05$). Average proportions of idea units recalled were .17 and .23 for the standard and special layouts ($t(94)=2.42, p<.01$). We will report more detailed analyses of the paraphrastic recall followed by analyses of the multiple choice test and the questionaire.

Relationship Between Importance and Paraphrastic Recall. [**The correlation between importance ratings and recall increased from $r=.39$ for the standard layout to $r=.50$ for the special layout, thus the percentage of variance accounted for by importance increased from 15% to 25%.**] Even though this increase is not statistically significant ($z=.83, p>.05$), it suggested that the special layout may have brought recall into better linear alignment with importance by improving recall to a greater extent for important material.

We analyzed this possibility by testing recall separately for unimportant (ratings less than 6) and important (ratings greater than 6) idea units. [**We found that the proportion of unimportant ideas increased insignificantly from .12 for the standard layout to .15 for the special layout ($t(94)=1.49$, $p>.05$), while the proportion of important ideas recalled increased significantly from .22 for the standard layout to .29 for the special layout ($t(94)=2.50$, $p<.01$.**]

[**A further breakdown of the analysis into ten separate importance categories showed that the special layout group did better in every category and significantly better only for idea units rated 5 (.07 vs. .11; $t(94)=3.40, p<.001$), 8 (.23 vs. .37; $t(94)=3.40, p<.001$) and 9 (.47 vs. .59; $t(94)=1.99, p<.05$).**]

[**Apparently, the typographical and spatial cues, improved learning and memory of important information without reducing the learning and memory of unimportant information.**] The same conclusion is suggested by the multiple choice test.

Multiple Choice Results. Scores on the 29 question multiple choice test were highly variable, ranging from 28% to 93% within the standard layout group and from 41% to 81% within the special layout group. Consequently, [**no differences between groups were statistically significant. The results are interesting however, because they follow the same pattern as the paraphrastic recall.**] The average score for the standard format was 59% in comparison to 63% for the special group. An item analysis revealed that of the 21 questions that tested important ideas, 15 yielded higher scores for the special format group and 6 went in the other direction. Of the 8 questions that tested unimportant ideas, four yielded higher scores for the special format group.

Again, the low scores reflect the fact that students only completed an initial study session with the material. [A comparable group of students who were allowed to take the same passage home to study and review, spent a total of 67 min. with the passage on the average, and they obtained a mean score of 75% on the same test.]

[**As most students know, they are not well prepared for a test after an initial study session. The important point here, however, is that they seem to be better prepared when the text provides spatial and typographical cues.**] The survey of attitudes towards the special format supports this conclusion.

Student Evaluations of the Special Format. Our subjects answered the questions shown in Table I and then explained their answers. Six students were eliminated because their explanations indicated that they understood "special format" to mean the whole experimental situation. Six other failed to answer the questions. Of the 36 remaining, [**a clear majority thought that the special format helped both during reading and during recall.**]

Table I

Responses to a questionaire on whether the special format seemed to help or to interfere during reading and during recall.

1. Circle the number on the scale below that best indicates how the special format influenced your ability to comprehend the text *during reading*.

	Number of students making each response
1 = Interferred a great deal	0
2 = Interferred	3
3 = Interferred slightly	3
4 = Neither helped nor interferred	0
5 = Helped slightly	11
6 = Helped	18
7 = Helped a great deal	1

2. Circle the number on the scale below that best indicates how the special format influenced your ability to recall what you read in the text.

	Number of students making each response
1 = Interferred a great deal	0
2 = Interferred	2
3 = Interferred moderately	1
4 = Neither helped nor interferred	6
5 = Helped slightly	12
6 = Helped	9
7 = Helped a great deal	6

Most of the comments were very favorable and very telling. [**The 30 out of 36 students who favored the special format during reading agreed that the typographical and spatial cues helped them allocate their processing resources more effectively.**] Some comments were as follows:

"It helped to read the text faster. I was not worried about skipping important points. It was helpful in reviewing."

"After the first time I read and studied it I could later use the format to remember the more important points. Because the major points followed a logical order so the next could be easily memorized."

"It showed a difference between thoughts and prepared me for this change in thought. I categorized the ideas which helped slightly."

"It helped in the understanding by: organizing the thoughts picking out the important parts and helping me in visualize what the process was in the reading."

The 33 students who favored the special format during recall made comments such as the following:

"I could see the pages in my head and I remembered the capitalized letters during the test."

"The capital letters stood out in my mind."

"Major ideas stood out in my mind in almost an outline form. Things were easy to recall."

"After the important points were learned, the gist of the ideas would come naturally into mind."

"The format seemed very organized. The emphasized points were recalled faster than the small detailed points."

"It again allowed my mind to concentrate only on the main and important points. It stopped the cluttering of my memory."

"Especially the words that were capitalized stood out in my memory of the text and increased my recall ability."

"I am sure that I remembered more than I would have in a first study had it not been presented this way."

[**Some of the comments suggest that the typographical and spatial cues were an integral part of memory and that subjects could improve their recall by**

visualizing the text. Other comments leave open the possibility that recall was better simply because the typographical and spatial cues helped students to study more efficiently.]

Either way, [both objective results and subjective evaluations suggest that our special format helps students learn and remember text.]

The six who were against our layout made comments such as "I like to pick out what I believe is important and not be forced to see what someone else thinks is important. Part of the learning process is figuring out what is important." [It would have been interesting to analyze data separately for those who opposed the format, but there were too few of them to make the analysis worthwhile.] Our results suggest, however, that analyses of individual differences will be an essential part of future research.

Discussion

Learning from textbooks is troublesome even for college students who are intelligent enough to master a text's content and literate enough to recognize the words and sentences (Shebilske, 1980). [We therefore hope to develop more effective textbooks and better instructional techniques for teaching the special study skills demanded.] The present experiment convinces us that typographical and spatial cues can play an important role in that endeavor.

[Our project is not sufficiently developed to support specific applications, but during this embryonic stage we must keep in mind the possibility of such applications.] With respect to printing costs, our special layout would be more practical than those requiring that texts be completely rearranged (e.g., Wendt, 1979). Measuring perceived text structure would be expensive however, and it is hard to imagine publishing houses shouldering this expense for college textbooks.[1]

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[1]The expense of measuring perceived structure could be reduced by using small panels of expert readers instead of large groups of student readers. The authors' segmentation of the present text is a step in that direction. We used intuitions that we developed by observing many student segmentations of other texts. We have not yet validated our intuitions by comparing our units with those generated by a group of naive students. We plan to do so with other passages.

This passage does not lend itself to such a comparison. It discusses various possible levels of segmentations, relationships between levels, and functional significance of levels. Asking students to segment this text might be like asking students to count how many times they think about pink elephants in the next hour. Surely this passage has perceptual units and students occasionally think about pink elephants. But how does one obtain a valid measure of either? This limitation is minor since few passages are about segmentation.

Perhaps the best application, therefore, would be in teaching younger students. [**Tenth grade science teachers might use our typographical design, along with special lesson plans, to teach students how to zero in on important points.**]

If this skill could then be transferred, students could learn to cope with upper level books printed in standard formats.

[Before any practical recommendations can be justified, however, we must increase the effectiveness of our format.] We will conclude this paper with three plans for doing so.

Training Students to Use Typographical and Spatial Cues. Other experiments on special typographical designs have provided short lessons prior to the experiment (e.g., Wendt, 1979). We did not do so in the present study because we wanted to avoid the various control groups that would have been required to ensure that improvements were caused by the typographical design instead of by the lessons. Furthermore, we did not know what to teach. What is the best way to use our typographical and spatial cues? Our questionaire indicated that individual students adopted different approaches. For example, some read all the capitalized words first and then went back to fill in details; others read the whole passage first and then reviewed only the important ideas. [**With larger samples, we hope to identify the most effective strategies. We will then be prepared to develop lessons, which will hopefully increase the effectiveness of our typographical format.**]

Portraying Perceived Hierarchies. [**Another plan is to represent more levels of the perceived hierarchical structure.**] Following the lead of Hartley and Burnhill (1976), we will vary the amount of vertical space between adjacent idea units in proportion to the frequency with which the boundary between the units is chosen as a division point by subjects segmenting the text; the larger the frequency, the greater the space separating the units. We did not represent more levels in the present study because we think this more subtle spatial cue will require prior training, which we wished to avoid for reasons already stated. In addition, we have only recently developed a procedure for measuring perceived hierarchies for individual students. Thus, we will soon learn more than we presently know about the advisability of portraying normative hierarchical structures.

Pursuing a Comprehensive Approach. [Our textbook project at the University of Virginia provides a comprehensive framework for evaluating typographical designs.] We are studying a variety of textbooks and various task demands so that we will be prepared to analyze typographical designs with respect to a wide range of conditions.

[One variable that seems especially important is discourse style, which determines, among other things, the location of critical information.] Deese (1980) points out that while any classification of text is an oversimplification, scientific texts can be classified as one of two kinds: deductively structured and inductively structured. Deductive structures state general principles at or near the beginning of a section and then explain or exemplify that principle. Inductive structures present examples first

and then bring the reader to a general principle, which is usually stated near the end. The tenth grade passage used in the present study tends to be inductive, which is the predominate style in lower level textbooks. Inductive style can be seen in Figure 1 where our special typography shows at a glance that the main points are located near the end.

[**Because our typographical design manifests style, we think it will be especially effective when used in conjuction with lessons on how to read different styles.**]

Such lessons are in the future. For now, however, [**we have taken a first step toward integrating typographical design into our total effort to improve textbooks and to teach the kinds of study skills demanded by textbooks.**]

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Information mapping: a description, rationale and comparison with programmed instruction

David H. Jonassen

Abstract

This article defines information mapping, illustrates it in practice, and presents the results from a study which compared a piece of instructional text set in map or programmed form. The results suggest that in this particular case, both forms of presentation taught equally effectively, but that it was significantly easier to retrieve information from the information map than it was from the programmed text.

Editor's note: This paper is presented here in its original "map" form, but reduced photographically to fit the page size of *Visible Language*.

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Author's address: School of Education, University of North Carolina, Greensboro, NC 27412.
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1

INFORMATION MAPPING: A DESCRIPTION, RATIONALE AND COMPARISON WITH PROGRAMMED INSTRUCTION

Introduction

Information mapping* is a method of structured writing developed just over a decade ago by Robert Horn (See Horn, 1976). It incorporates numerous techniques for explicitly structuring prose material to make it more comprehensible and easily rememberable. While its popularity as a written communication tool has grown, the mapping procedures remain largely unverified and devoid of an adequate theoretical base.

Purpose

The expressed purposes of this article are to:

- define information mapping
- illustrate its techniques (the article is mapped)
- suggest conceptual bases for these techniques
- compare its techniques with those employed in programmed instruction
- review a study comparing the two methods for structuring text
- suggest implications for information recall and retrieval

Comment

The popularity and potential of the information mapping method for structured writing is premised on a renascence of print media in the educational communications and technology field. This trend is based largely on the contemporary emphasis on cost effectiveness as a selection criterion. Many consider expensive delivery systems such as film and videotape as the nostrum of a naive and wealthier period of emerging technologies. Print media have endured throughout. We now need to consider how to make them more effectual.

*Information mapping is a trademark of Information Resources Inc.

2

INFORMATION MAPPING

Introduction

The process of transfer, decoding, and recording into memory of information is enhanced by organizing the information or content being transmitted. Cognitive psychology has repeatedly documented the advantages of explicitly structuring information in ways that facilitate accomodation to learners' cognitive structures. Information mapping proposes techniques for graphically doing this.

Definition: Basic Mapping Units

Information mapping, to this end, employs these techniques:

Information blocks - a limited amount of information about a concise unit of content, with a label describing its type or function

- introduction blocks
- definition blocks
- comment blocks
- classification blocks
- example blocks
- procedure blocks
- use blocks, etc.

Information maps - a collection of blocks related to a specific topic

- fact maps - identifies units
- procedure maps - describes sequence
- process maps - explains sequence
- concept maps - defines concept
- classification maps - relates concepts
- structure maps - describes objects
- principle maps - applies principles

Related pages - internal indexing system (cross referencing)

Structural Methods

The units used to construct information maps are organized (structured) by ...

- graphic presentation and isolation of information units
- classification of content
- prescribing empirically based thought units to relate
- specific types of content
- rules and procedures for writing maps
- formats for organizing and presenting blocks and maps

3

Uses

Information mapping can be used to produce...

Book materials

- textbooks
- pamphlets
- workbooks

Primary instructional sequences, for teaching ...

- facts
- concepts
- procedures
- principles

Reference tools

- to aid instructor
- to document information

Non-examples

Information mapping is not normally used to...

- organize speeches or presentations
- teach psychomotor (physical) skills
- document specific events

Comment

The information mapping method of analytical writing is grounded in information processing and cognitive theories, that is, an elaborate rationale can be proffered for its use.

4

RATIONALE FOR INFORMATION MAPPING

Introduction	Since little analysis of mapping variables has been done, predictions about the effects of its internal characteristics must derive from other literatures, particularly prose comprehension.
Internal Structure	Prose passages normally contain an implicit organizational structure of content. Recall of material may be a function of... • height in content structure of idea - ideas high in structure better recalled (Meyer & McConkie, 1973) • staging - the dimension of prose structure that determines the prominence of ideas within prose (Grimes, 1972) • staging - prose at higher staging levels better recalled (Clements, 1976) • signalling - non-content areas indicating level of content in structure - recall improved (Meyer, 1975)
Comment	The type of research cited above provides a rationale for the extrinsic reporting of prose structure, as occurs in information mapping (blocking and labelling).
Blocking	These effects partially result from blocking prose... • linguistic elements associated in holistic fashion • information in blocks become unitized, facilitating semantic comparison with other units (Gropper, 1970) • facilitates encoding of spatial attributes of information in memory (Christie & Just, 1976)
Labelling	Labelling of blocks probably functions as... • advance organizers, providing conceptual cues about ensuing information (Wright, 1977) • subsumers, which facilitate recall (Dahl, 1973)
Retrieval	Retrieval of information from prose passages has not been researched to any degree. Information mapping should facilitate retrieval by providing... • table of contents • predictable textual format • consistent typography • marginal labels • local indexing • blocks
Comment	Retrieval involves textual searching, a process of associating spatial cues stored in memory with their referents as they appear on the page. The same structural characteristics that facilitate recall would also serve to aid the search process, probably by allowing parallel or subject-oriented search strategies as opposed to linear searches involved in normal non-distinguished (non-labelled) text. Scanning textual passages is facilitated by these locative cues provided by labels.

5.

COMPARING INFORMATION MAPPING AND PROGRAMMED INSTRUCTION

Introduction

The attributes and advantages of programmed instruction are well documented. Since the study described in the next four maps compares the facilitative effects of its characteristics with those of information mapping, these differences ought to be outlined.

Classification

Information mapping can be distinguished from programmed instruction by making the following contrasts.

Characteristic	Information Mapping	Programmed Instruction
Basic Information Units	blocks, with marginal labels	frame
Sequencing	functional (information units labelled)	serial (rigid sequence)
Structure	superordinate general (maps) to specific (blocks)	inductive (specific to general)
Practice	occasional exercise blocks	consistent, continuous
Feedback	slightly delayed (in another map or page)	immediate (contiguous or sequential - beginning of next frame)

Comment

The primary distinction between programming and mapping can be described in terms of the psychological rationale for each. Programming suggests that repetitious, overt practice and reinforcement will consistently produce learning (behaviorism). Mapping implies that explicating content structure will facilitate accomodation into one's cognitive structure (cognitive psychology).

6

REPORT OF RESEARCH PROJECT: STUDY PLAN

Introduction

An experimental research project was conducted at the University of North Carolina at Greensboro that compared (conceptually and empirically) aspects of information mapping and programmed instruction (Jonassen & Falk, 1980)

Basic

The study was designed to...

- assess the ability of information mapping to facilitate recall
- compare its instructional effectiveness with programmed instruction
- compare the usefulness of information mapping as a retrieval tool to programmed instruction

Classification and Design of Materials

Information mapped and a programmed versions of a 2000 word prose passage, "Communication and the Teaching Process", were written. A comparison of the two versions, reflecting the technology of each includes...

Variable	Information Mapping Version	Programmed Instruction Version
Number of units	55 blocks, 18 maps	40 frames
Practice	none	multiple choice questions at end of each frame
Feedback	none	presented immediately below frames
Illustrations	two, embedded in text	two, located at end of program
Length	19 pages	20 pages
Critical Technique	content structuring and labelling	overt responding
Labelling	maps top-headed, blocks side-labelled	two units top-headed

Comment

The study described in this and the next three maps was a seminal investigation, designed to document main effects and suggest theoretical bases for comparing these instructional methods. As such, it should raise more questions than it answered.

Related Maps

Method, p. 7

7

RESEARCH METHODOLOGY

Subjects

The participants in the study included:

- 41 graduate and undergraduate students
- enrolled in an introductory media course
- attrition level of only two

Instrumentation

Criterion examination, administered before and after treatment:

- consisted of 41 four option multiple choice questions
- tested recall of content
- stem and correct answer quoted from text
- validity established by panel of experts
- reliability established by Spearman-Brown split-half technique ($r = .83$)

Retrieval examination, administered two weeks after treatment:

- consisted of 45 fill-in-the blank question
- derived from recall items with key phrases deleted
- subjects required to write in missing information and page number on which it was located
- open-book test measured retrieval ability

Comment

It was assumed that the effects of recall from the immediate post test on the retrieval test were diminished by the two week delay between administrations.

Procedure Followed

Step	Procedure
1	Pretesting during class
2	Random assignment to treatment
3	One week later, self-study materials distributed and completed at individual pace
4	Immediate posttesting with recall test
5	Two weeks later, retrieval test administered

RESULTS

8

Variables

Two dependent variables were measured by this study:

Recall = the differences between pretest and posttest scores on the criterion exam

Retrieval = the number of blanks and page numbers filled in on the retrieval test.

One independent variable was assessed: treatment method

Test Scores

Test		Map Group	Programmed Instruction Group
Pretest (Recall)	$\bar{X}$	28.28	27.84
	SD	3.51	5.37
Posttest (Recall)	$\bar{X}$	38.86	37.53
	SD	2.87	3.37
Retrieval Test	$\bar{X}$	33.90	22.94
	SD	8.16	7.76
	N	22	19

Data Analysis

- 2 x 2 (test by method) analysis of variance
- F test for homogeneity variance in retrieval scores
- t test for independent means on retrieval scores

Results

- $F\ (1,39) = 340.92$, $p < .001$, main effect for treatment
- no significant interaction (group x test)

Retrieval scores:

- $F\ (21,18) = 1.11$, $p < .05$ indicated homogeneous variables
- $t\ (21,18) = 4.14$, $p < .001$ comparing retrieval scores

Interpretations

Both mapping and programmed instruction produced significant amounts of learning (recall). No differences in effectiveness were found. A very significant difference between treatments in favor of mapping occurred on the retrieval task.

Comment

The retrieval task was independent from (not cued by) the recall task. Correlation between posttest scores and retrieval scores was low ($r = .15$) and variances were greatly different. Analysis of covariance confirmed no effect of prior learning on retrieval.

9

CONCLUSIONS REGARDING RECALL

Introduction — Both programmed instruction and information mapping produced significant amounts of learning. Both are equivalently effective presentational devices.

Comment — Without a control group (narrative prose), it is difficult to assess the benefits resulting from the structural characteristics of both techniques.

Rationale — Both information mapping and programmed instruction are methods of structured writing. The rationale for programming is firmly established. The conceptual bases for the success of mapping are suggested below:

Structural Characteristic or Mapping	Research Conclusions as Conceptual Base
Breaking down information into chunks and explicitly structuring the content	Recall enhanced by informing reader of passage structure prior to reading (Frase, 1969)
Defining function of chunks and their relationship to other chunks yields explicit organizers as conceptual tags	advanced organizers provide explicit "ideational scaffolding" for accomodating information (Ausubel, 1968)
Structuring of content in textual passages	Structural linguistic literature (Grimes, 1972; Meyer, 1975)
Explicit content structuring	Class III mathemagenic activities (those affecting visual scanning, translation, internal cognitive processing) (Rothkopf, 1970)
Structuring supplants mathemagenic activities	Supplantation hypothesis (Ausburn & Ausburn, 1977)

Comment — Additional research, considering the level and type of learning as it interacts with the characteristics employed in mapping is badly needed. Numerous studies are also possible on ways of optimizing learning by manipulating presentation strategies. If mapping is to assume the stature of a method such as programmed instruction, a great deal of verification and experimentation will be necessary.

Related Maps — Results, p. 8

10

CONCLUSIONS REGARDING RETRIEVAL

Introduction	It is obvious from the results that information mapping provides clear advantages for retrieving information from textual materials.
Important Techniques for Retrieval	The techniques involved in mapping that probably contribute to this advantage include: • marginal labels • consistent format • information blocking
Comment	The previous discussion regarding recall facilitation by mathemagenics and other methods have no implications as a conceptual basis for retrieval, since learning is not the issue of concern. Retrieval requires a different set of mental skills.
Definition Retrieval	Information retrieval, according to information scientists, is • the searching of a collection of documents to identify those which deal with a particular subject Computer specialists would define retrieval as • the recovery of information from a collection of documentation or other graphic records
Comment	These approaches, and the characteristic techniques they employ, suggest possible conceptual bases for analyzing the retrieval benefits of information mapping.
Related maps	Results, p.8

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Note

Address correspondence to: David H. Jonassen, School of Education, University of North Carolina at Greensboro, Greensboro, NC 27412.

Patterned note-taking: an evaluation

Linda S. Norton

Abstract

Patterned note-taking, as described by Tony Buzan (1974), is a technique of recording information in a spatial representation, which contrasts with the more common linear style. The effectiveness of patterned note-taking is said to depend on 1) writing down key words, and 2) being actively involved in the note-taking process. No research has been carried out which directly compares the effectiveness of patterned with linear notes. However, there is some evidence to suggest that writing down key words and actively transforming information helps retention when taking notes. Students wishing to know how to take patterned notes are advised to consider carefully before learning a strategy which has no real evidence to suggest it is any more effective than more conventional styles of note-taking. It is strongly recommended that students who do wish to proceed should consult Buzan's original study manual, for the technique is often seriously distorted by study advisors.

Introduction

Of all the empirical research that has been carried out on note-taking, very little has been concerned with the actual techniques or strategies that note-takers use, and their relative effectiveness. Out of twenty-four experiments manipulating note-taking conditions that have been traced in the literature, only two have actually compared two or more different note-taking systems (McHenry, 1969; Palmatier, 1971). Both these studies found no significant difference in the knowledge gained by any one particular system.

In spite of this lack of empirical evidence, study manuals continue to lay down specific guidelines about how students should take notes. Virtually all of these offer the same kind of advice. They recommend that students should use

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Author's address: Department of Psychology, University of Keele, Keele ST5 5BG, England.
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headings, vary their lettering, number different points, indent paragraphs, use abbreviations and so on. Such advice is traditional and goes back to the time when study manuals first appeared. The position remained largely unchanged until 1974, when Tony Buzan introduced a dramatically different approach both to studying in general and to note-taking in particular. In the book entitled *Use Your Head* (1974), Buzan advocated a system of manipulating the space on the page when taking notes, instead of taking them in the more conventional linear fashion. This method he called patterning.

How to take patterned notes

The main idea behind making patterned notes is that the student identifies the central argument or concept in the information presented and that this is represented by a key word or phrase placed in the middle of the page. From this central point it is possible to build up a structure using arrows, shapes, pictorial illustrations and lines which radiate out from the central concept in as many different directions as required. Figure 1 is an illustration of this approach, using the general theme of note-taking as a subject.

A similar method to Buzan's note-taking style was earlier described by Hanf (1971). This was called 'mapping' and was designed specifically to be a technique for obtaining information from prose material. Hanf advised breaking away from the conventional top-to-bottom and left-to-right procedures usually adopted in note-taking and suggested putting the central idea in the middle of the page and attaching subsidiary ideas concentrically. In this way, Hanf argued, it was possible to represent more complex inter-relationships than could be accomplished by the linear method. The similarities between this method and Buzan's are clear, but Buzan's contribution has been to give the notion of patterned note-taking greater impetus by extending it so that it is applicable to many different situations and not just to studying from textbooks.

Theoretical background to patterned note-taking

The rationale behind Buzan's method is that although we are accustomed to information being presented in a linear sequence in speech and in print, the brain itself does not function in the same linear way. Any one word or image will produce a wealth of associations that are unique to an individual. The brain is, therefore, making complex

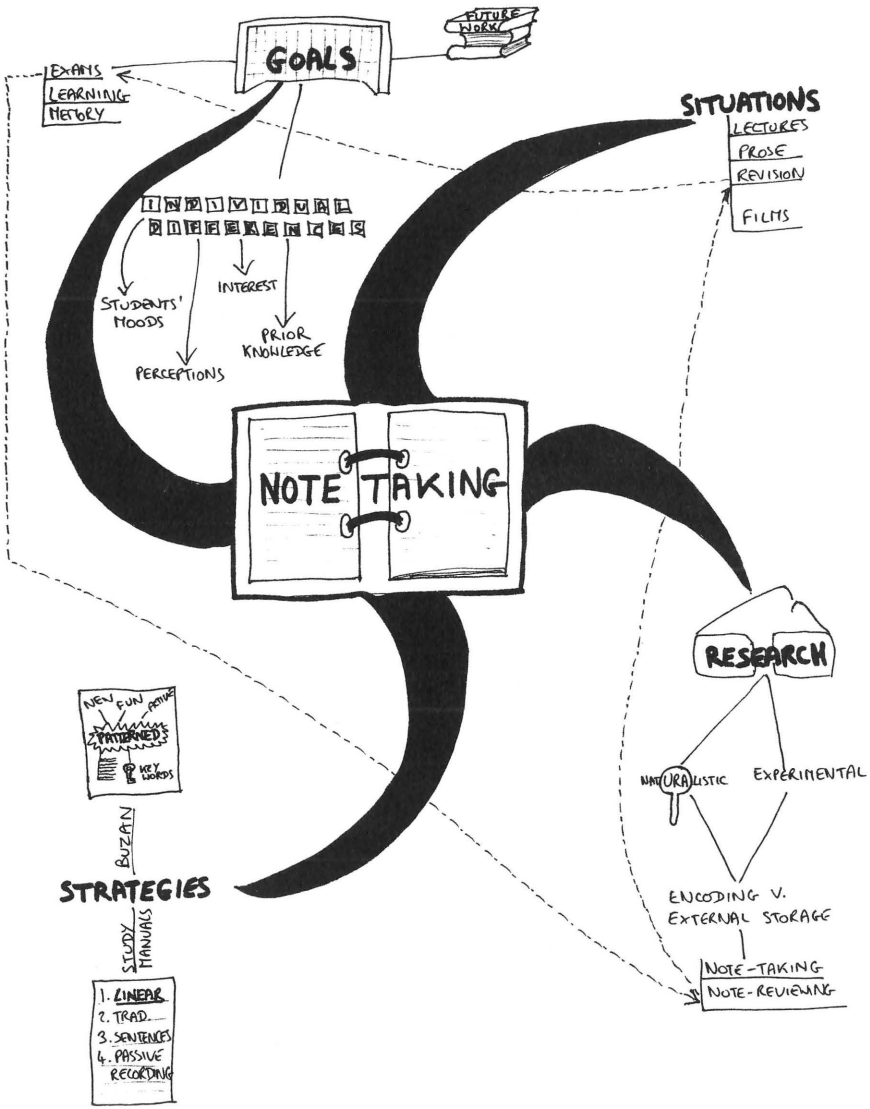


Figure 1. Patterned note-taking illustration.

connections and inter-relationships all the time. Buzan argues that if we record information in a linear way, then we are operating contrary to the way in which the brain itself works. Such an argument has important implications for the recall of information and for note-taking. Since it has been shown that the majority of students take notes in order to review for examinations (Hartley and Davies, 1978), the question of how to aid recall from notes is of paramount importance. The advantage of patterned over linear note-taking for recall appears to depend on two factors: 1) the use of what Buzan terms 'key' words or phrases, and, 2) the active involvement of the student in transforming incoming information when taking patterned notes. These two factors will now be discussed in turn.

Key words

Buzan devotes considerable space in his book to describe key words and to make a distinction between what he calls *key recall* and *key creative* words. A key recall word is described as 'one which funnels into itself a wide range of special images, and which when it is triggered, funnels back the same images' (p. 75). A key creative word, on the other hand, is far more general than the key recall word. Such words are 'especially evocative but do not bring back a specific image' (p. 76). In all further discussion in this paper, key words are taken to refer to Buzan's key recall words.

Since the role of key words is a vital component in patterned note-taking, actually being able to identify which words are key words and which are not becomes rather important. Buzan says they are usually nouns or verbs and that sometimes they are accompanied by adjectives or adverbs. As in most areas of educational research, however, there is no one definition, but broad general agreement with differing emphases. Russell (1979), for example, agrees that key words tend to be nouns or verbs but he goes further by saying that they are generally concrete rather than abstract. Russell sees key words as the most memorable and the words that carry the essential information of the sentence or paragraph.

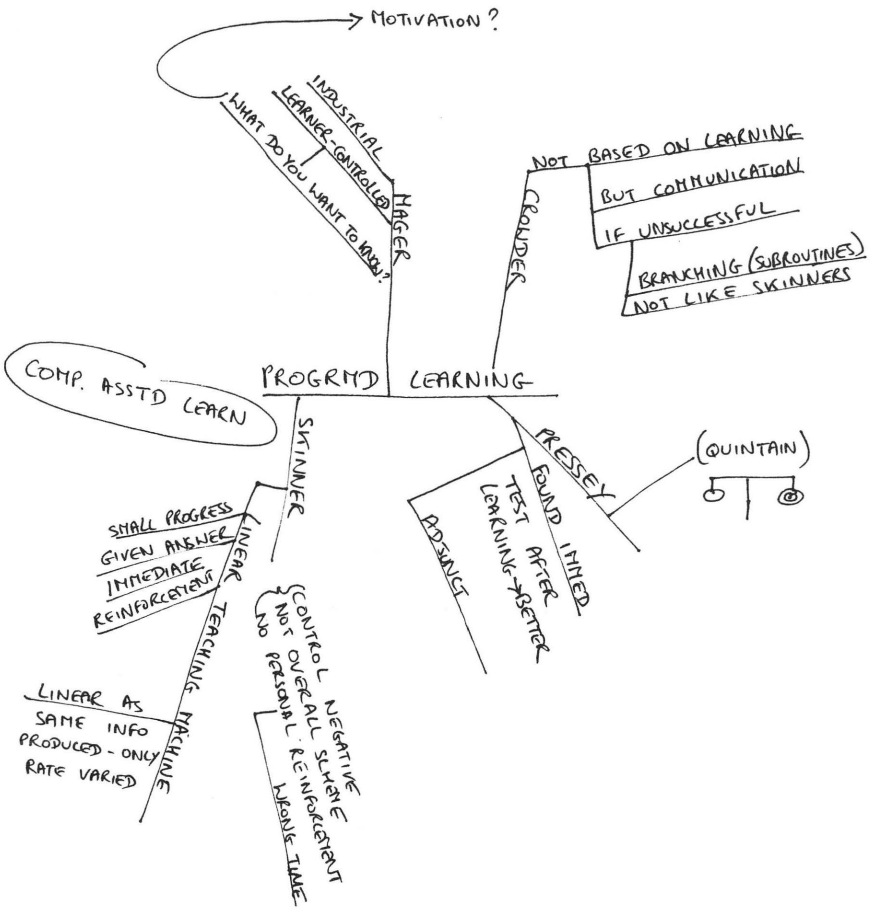
Percentage of key words written in notes

In an interesting comment on the percentage of key words written in notes, Russell says, 'When students are asked to take notes in whatever way they have found to be the most efficient and effective, it is usually found that only 5 to 10 percent of the words written are actually key words' (p. 174). As there is no evidence provided to support this observation, it must be assumed that this conclusion stems from Russell's own examination of students' notes.

In spite of the difficulty of identifying which are key words, this percentage would seem to be so low as to be doubtful. Figure 2 shows a comparison between the linear notes of one student and the patterned notes of another.

Both these students were undergraduate psychology students and they both attended the same lecture. There were 53 students at the lecture and of this number, only two took patterned notes, the rest took linear notes. The example of patterned notes shown in Figure 2 was chosen because it was a clearer example than the notes of the other patterned note-taker. The linear notes selected to make the comparison were chosen because they were closest to the patterned notes in terms of the total number of words written. Using these examples it was possible to look at the two types of note-taking and compare them on the number of key words that each contained. Figure 2 shows that although the percentage of key words was lower in the linear than in the patterned notes, it was still considerably higher than the figure quoted as usually occurring by Russell. Interestingly, though, the linear notes actually had a slightly higher *total* number of key words than the patterned notes. Thus it would seem that the more words a student writes, the more key words will be recorded, a finding contrary to the main idea of patterned note-taking where the aim is to record as much essential information in as few words as possible.

Hartley and Cameron's (1967) study bears some relation to the question of what percentage of key words are recorded in notes. In this study the percentage of 'information units' in the students' notes was compared with a lecturer's 'ideal' notes. The amount of agreement with the ideal notes ranged from 21 to 73 percent in different sections of the lecture. While accepting that 'information units' are not exactly the equivalent of key words or phrases, the fact that these units were similarly concerned with essential content would seem to lend support to the argument that Russell's estimates are



Total number of words:	68
Total number of key words	54
Percentage of key words to total words	79%

Figure 2. A comparison between linear and patterned notes taken in a lecture on computer assisted instruction.
2a. An example of patterned notes.

1. Pressey - 20's - machines. - people tested after learning → better retention.

2. Skinner - widespread, controversial views - can't give enough reinforcement Careful progression of info - sequences - to facilitate learning. Aimed at 95 on test.

3. Crowder - not based on learning. Questions → right → more info. Wrong - program failed. More flexibility than linear. Larger info — multi-choice. - Communication of learning Aimed at 85 on test.

4. Mager - learner shd decide control of instruction - student generated diff. controls / programs of learning. - concrete → theoretical rather than V. V.

Total number of words	86
Total number of key words	59
Percentage of key words to total words	69%

2b. An example of linear notes.

too low. Another study by Nye (1978) also compared the content of students' notes with the content of the lecturer's notes. Nye found an average of 32 main points in the student notes, as compared with 46 in the lecturer's notes.

Negatives as key words

It must be concluded that Russell's low estimate of the number of key words noted by students results from an over-rigid definition of what a key word actually is. Such an approach, where the emphasis is on concrete nouns and verbs, holds certain dangers. Words such as 'no', 'not' and 'never' may be easily missed and yet they are obviously crucial as they change the whole sense of what is being written. If the reader thinks that it may seem unnecessarily fanciful that students would miss out negatives, Howe and Godfrey (1977) have shown that this actually does occur, and that it is not rare. In a lecture on psychology, the notes that the students took were later examined and it was found that out of twenty students, sixteen had reproduced a piece of negative information either incorrectly or had made notes that were ambiguous. Howe and Godfrey quoted what the lecturer actually said: 'that the infant seems to be like some sort of ball of clay, infinitely malleable, and the parents can then mould the baby into whatever type of person they wish. Of course, it isn't like that . . .' (p. 79). They go on to reproduce the students' versions from which the following three excerpts are taken:

'The infant at birth is "malleable", the parents can mould the baby into shape that they wish.'

'The infant is like a ball of clay—hence parents can . . .'

'Mould like a ball of clay as parents discipline child' (pp. 79–81).

Making notes that are ambiguous has serious consequences for patterned note-takers as they are trying to record a lot of information in a few words. It would be of value, therefore, to carry out a naturalistic study comparing the notes of patterned with linear note-takers after a lecture in order to see whether or not either technique produced a greater proportion of incorrect or ambiguous information.

Do key words aid recall?

There has been some research on the effectiveness of using key words in aiding recall. Howe, Ormond and Singer (1974) carried out an experiment designed to determine the effects of different recording activities when listening to a

prose passage. Undergraduate students were allocated to one of four experimental conditions: 1) write down the entire passage as in dictation, 2) write only key words, 3) write only words containing the letter 's', and, 4) write nothing. Test scores obtained before and after the experimental treatments were compared and it was found that there was a statistically significant improvement in conditions 1 and 2 combined, compared with conditions 3 and 4, also combined. It is important to note, however, that there was no significant difference between recording key words (condition 2) and recording the whole of the passage (condition 1).

Howe and Godfrey (1977) designed an experiment to find out what the effect would be of asking students to write down the three words that they considered were important from each sentence of a prose passage, compared with writing down the whole of each sentence. In two separate experiments with 14 and 16 year old pupils, no significant differences were found between the pupils who wrote down three important words and pupils who wrote down everything. This result confirms the findings of Howe, Ormond and Singer. It was found, however, that pupils who scored the highest on the test recorded a significantly greater number of words considered pertinent to the test questions, than had the low test scorers. This finding suggests that it is the actual words selected which is the important factor in aiding recall, and not that the number of words to be noted should be limited.

Since the above investigation did not include a review period, Howe and Godfrey carried out a further experiment with undergraduates acting as subjects and incorporating a review period. This led to the finding that those students who noted three important words from each paragraph (as opposed to each sentence), had significantly higher test scores after review than the students who were instructed to read, copy or write down the first three words of each paragraph.

There does seem to be a limited amount of evidence then, that using key words may have a beneficial effect on recall, especially if the words chosen for recording are genuinely *key* words. Such a reservation presupposes a high level of ability in the students who are taking notes and may explain why in three of the four experiments described, writing

down all the information presented was as effective as selecting just three important words. This consideration leads to the wider question of whether patterned note-taking might only be suitable for those students who are capable of identifying which words are the important ones and for those who can do it at speed–a necessary requirement in a live lecture. There has not yet been sufficient research to indicate what particular abilities a patterned note-taker needs, but the evidence so far suggests that an ability to identify key words would be one of them.

Active note-taking

Considerably more attention has been paid to the importance of the active element in taking notes. The question of whether the process of taking notes is of itself actually of value for later recall has revolved around the central dilemma of whether students take notes to have a concrete record of the information presented to them or whether they believe that the actual act of taking notes somehow helps in the learning process. It is the latter position that Buzan stresses as important. He argues that by making patterned notes, the student is actively involved in imposing his own organisation on the incoming information. Buzan claims that the linear note-taker, on the other hand, is merely acting as a passive recorder of information.

This dichotomy has been given different names by different researchers, but perhaps the most widely used is Di Vesta and Gray's (1972) 'encoding' versus 'external storage' terminology. These investigators hypothesise that the encoding function is more important in aiding the learning process, for it involves the student in transforming and categorising the information being received. Not all researchers agree. Carter and Van Matre (1975), for example, argue that it is *having* the notes that is important rather than the taking of them. The implication here is that the external storage function is more important.

Does active note-taking aid recall?

Over twenty studies have investigated the encoding versus the external storage hypothesis. These studies have used a variety of strategies such as comparing conditions of note-taking versus no note-taking, review versus no review, and, studying one's own notes versus studying lecture handouts. Bearing in mind, therefore, that the aims and

methods of these experiments have sometimes been quite different, the experimental findings have been summarized in Table I.

This table lists those studies that have found that encoding leads to better recall, those that have found that external storage does so and those that have been unable to show any significant advantage for either note-taking function. From this summary it can be seen that there are slightly more studies suggesting that encoding may be the more important function. Nevertheless, quite a number of the studies have reached the opposite conclusion.

Table I

Summary of research on the encoding versus the external storage hypothesis in note-taking.
Studies indicating encoding as the more efficient function (Total, 12):
Howe, 1970b.
Di Vesta & Gray, 1972.
Di Vesta & Gray, 1973 (two studies).
Baker et al, 1974 (one study).
Howe, Ormond & Singer, 1974.
Annis & Davis, 1975.
Peper & Mayer, 1977 (three studies).
Powers & Powers, 1979.
Weiland & Kingsbury, 1979.

Studies indicating external storage as the more efficient function (Total, 7):
Fisher & Harris, 1973.
Baker et al, 1974 (one study).
Hartley & Marshall, 1974.
Carter & Van Matre, 1975.
Collingswood & Hughes, 1978.
Rickards & Friedman, 1978.
Howe, 1978a.

Studies indicating that neither function is the more efficient (Total, 3):
Fisher & Harris, 1974a.
Fisher & Harris, 1974b.
Thomas, 1978.

The evidence then suggests no clear advantage for either function of note-taking. Although it is true that more studies did find encoding to be advantageous, the fact that the evidence was not more clear cut, leads to the interesting question of whether note-taking does actually help the encoding process, or whether, as Baker *et al*. (1974) 'Actively taking notes may particularly interfere with effective cognitive encoding.' (p. 1).

The argument is not whether encoding information aids recall–a generally accepted hypothesis–but whether note-taking aids encoding. If it does not, then Buzan's claim that being actively involved in taking notes should help students achieve greater understanding and lead to better recall, may only be true in any situation where time is not at a premium. In a live lecture, however, students have no control over the rate at which the information is being presented and so taking notes may interfere with encoding that information.

Many of the researchers involved in these studies stressed that note-taking serves *both* an encoding and an external storage function and it can be very difficult to isolate the two as separate elements. Buzan himself implicitly acknowledges the external storage function when he advises the necessity of having up to four review sessions. Russell, on the other hand, claims that making patterned notes or 'mind maps', as he calls them, is so effective for recall that often it is not necessary to go back to the notes at all. This would seem to be dangerous advice. However, if the normal procedure is to review one's notes, be they patterned or linear, a disadvantage might arise with the patterned notes because of the scant amount of information actually on the page. Maddox and Hoole (1975) argue that as students do not generally bother to look at their notes again for some considerable time, there is a danger that: 'over-simplification is very likely to occur when notes are taken in too sketchy a fashion' (p. 28). It is presumably of little benefit being able to review one's notes if those notes do not contain enough information. Hartley and Marshall (1974) found that 'good' note-takers, in contrast to 'poor' note-takers, showed much greater improvement on a test following a review period. The 'quality' of the notes was measured by 1) the number of words written, and, 2) the amount of information recorded which was considered necessary to enable the students to answer test questions correctly.

Comparing patterned with linear notes

At the time of writing there is no research known to the author which compares the recall of patterned note-takers with that of linear note-takers. The closest that research has come to examining the effectiveness of patterned note-taking in recall has been a study by Dansereau *et al*. (1979). This experiment involved training students in one of three study strategies, as part of a larger study skills course and then finding out which of the three was most effective. The three strategies were paraphrase/imagery, 'networking' (i.e. producing two-dimensional maps) and analysis of key ideas. There was also one no-treatment condition. Comparisons were made on the basis of test scores obtained from textbook material. Tests were given before, during and after the training course, which was also concerned with building up the right mental attitude to study and which lasted for a period of fifteen weeks. Dansereau and his colleagues found that although there were no significant differences between the test scores for each strategy, all outscored the control group, with the 'networking' group showing the biggest improvement.

Dansereau and his colleagues then carried out a further experiment specifically to investigate networking. The new study involved training students in networking for approximately five and a half hours. Their performance on a test on a prose passage was then compared with that of a no-treatment control group. Both groups were allowed three minutes to review the notes they had made when studying the material. This experiment led to the interesting finding that the networking group performed significantly better on main ideas but *not on details*. This would seem to support the warning given by Maddox and Hoole about the danger of not taking sufficiently detailed notes.

Dansereau's study does provide some evidence of the effectiveness of networking which appears to be similar to patterned note-taking. It refers, however, to learning from prose material rather than from a live lecture and there is no direct comparison with students who take conventional linear notes. The no-treatment control group may well have taken linear notes, but this is not specified, so it may be that they took no notes at all. A further drawback to this study is that only a few hours training were given to the students. This may have meant that they did not feel entirely comfortable with, and accustomed to, their new study strategy. A comparison between students who habitually take notes in a

patterned or linear form would perhaps reveal greater differences, since both groups would be thoroughly familiar with their own particular technique.

Summary of the empirical research

To recapitulate briefly. Research on key words provides some evidence to support the notion that using key words in notes helps retention. Selecting the pertinent key words may, however, be a crucial factor in recall. Research has also provided some support for Buzan's claim that actively transforming incoming information is effective in helping the learning process. However, since several studies found that the major advantage in note-taking was in having a set of notes to review, there is some doubt about whether taking notes actually helps or hinders the encoding process. There has been no research directly comparing patterned with linear notes, but studies have shown that networking, a similar technique to patterning, appears to aid recall from a prose passage.

Criticisms of patterned note-taking

The critics of Buzan's approach include both students and lecturers as well as educational researchers. Student express considerable reluctance to try such a radically different method, particularly when they feel their main concern is to record as much information as possible. Such students feel worried that by creating patterns in a lecture they will not have time to record essentials, especially if they have to stop and think how to fit in each piece of information into their pattern. Lecturers express the view that not all lectures are structured to reveal the central concept at the beginning of the lecture (some, they say, are not structured at all!) In lectures where the structure is a step-by-step argument, for example, it is difficult to identify the central concept so that it can be placed in the middle of the page as a starting point. Gibbs (1980) says that in such a situation patterned notes are a 'chaotic mess'. He argues that Buzan's technique is best suited to making notes from textbooks or to being used as a recall device when revising from conventional notes.

Distorting the technique

It could be argued that these criticisms and doubts reflect a lack of familiarity with what Buzan actually recommends. It is a sad fact that many techniques which become popular suffer from being passed from person to person, without reference to the original source material. Inevitably, this

leads to at best a dilution and at worst a distortion of the actual method. In his book, Buzan makes it clear that the student should have two pages of notes in a lecture, so that the left hand side can be used for patterns and the right for information that has to be recorded linearly, such as quotes, formulae, references and so on. Most importantly, Buzan recommends that the final pattern should be made *after* each lecture. This, he claims, should only take about ten minutes and, in making such a final pattern, the student is also carrying out his first review. Following such a practice would reduce in force many of the objections to patterned note-taking and yet this advice is rarely passed from one student to another when describing the technique. With regards to the 'chaotic mess' criticism, Buzan argues that notes which look neat and ordered are messy in informational terms. It is the content and not the appearance of the notes which is important.

Learning patterned note-taking

When learning any new technique it would seem essential that the learner go to the original source. Merely hearing about it from other students or study advisors, or reading other peoples' interpretations of it, is not sufficient. Helweg-Larsen (1979) is a study advisor who stresses the importance of teaching students how to take patterned notes, otherwise, he argues, they tend not to bother or they produce hybrid versions. Helweg-Larsen describes a course of study skills which actually involves students first copying an example of patterned notes as an introductory exercise. This is followed by the students being asked to make their own patterned notes over the next few days, coupled with discussions of the technique. Since creating patterns involves active participation as well as creative thought, it is not surprising that acquiring the technique takes a considerable amount of time, effort and practice.

Even if a student is prepared to invest the necessary time and effort, there is still the possibility that patterned note-taking might not suit that individual student's needs and abilities. Dansereau *et al*. (1979) discuss the particular abilities required for networking. They conclude that in transforming prose into two dimensional maps, a general reading comprehension ability is needed, and also that there may be a type of comprehension skill required which is different from vocabulary level and prior knowledge. Hanf. (1971) says that making maps involves critical thinking and

'demands the student's insightful judgements and discriminate decisions about the material' (p. 225). Both these researchers are discussing abilities which are required when taking notes from written material. The problems which arise when taking notes in the 'here and now' situation of a lecture obviously require further exploration, but some of the abilities needed may be similar.

Because different techniques and different subject matters require different sets of skills, more and more study advisors are now recognizing that there is no single correct method for any studying activity. Some study manuals, too, are beginning to follow this line (e.g. Gibbs, 1977), but unfortunately, there are still too many of them taking a didactic approach and claiming that one particular study strategy will lead to greater academic success. Buzan himself makes such a claim even though, as has been the theme of this paper, there is no real evidence to suggest that his method is more effective than any other.

Conclusions

Finally it should be stressed that there is a need for more research concerning the beneficial effects, if any, of Buzan's patterned note-taking strategy. Experiments need to be carried out in lecture situations as well as in learning from textbooks. Naturalistic studies, where students are unaware that their notes will later be examined, need to be undertaken to compare the notes of patterned with those of linear note-takers. Such studies would be useful in determining what differences occur naturally in the notes and where the two methods have advantages and disadvantages.

Buzan published his study manual in 1974. Enough time has elapsed now to establish that the technique is not a 'flash in the pan', but is a radical attempt to change the way in which students take notes. Buzan is one of the few study advisors who presents a specific system designed for note-taking, and, as such, it deserves more attention from educational researchers. Students, however, should be cautious about following a single study strategy. This is particularly so in this case where there is so little scientific evidence to demonstrate that patterned note-taking is more effective in helping learning, than other more conventional methods of note-taking.

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The uses of space in music notation

John Sloboda

Abstract

Space is an essential notational dimension in music. The use of space in orthochronic notation (accepted today as the standard system) is described in some detail. The historical development of this use is outlined, with examples from earlier systems. The major uses of space are to provide means of notating pitch and duration, and to indicate the synchronisation of concurrent musical events. The question of how one might evaluate different ways of using space in music notation is then treated with reference to three levels of analysis: (1) the information about the music which needs to be represented, (2) the nature of the symbols (and their spatial characteristics) chosen to represent the information, and (3) the requirements of the reader.

1. Introduction

In this article I want to describe how space is used in music notation. Music notation is unfamiliar to many people and so I have attempted to make what I say intelligible to the non-musician by defining all the technical terms I use. Music notation (score) is very different from language notation (text) and so some prefatory comparative remarks may help to place this notation in a wider context.

Perhaps the most fundamental difference between score and text is that a score must be able to specify different events as occurring simultaneoulsy whereas text portrays a single sequence of events. The problem of how to link up parallel streams of information has thus been fundamental to the development of score. No analogous problem exists for text. A second difference concerns use. Score readers are mainly concerned with producing a musical performance. Text readers are more concerned with understanding and remembering what they read. This difference makes issues of layout of foremost importance in a score. The music reader cannot afford to lose his place or experience ambiguity even for a second if he is to maintain the flow of performance. This demand has expressed itself in intense and prolific experimentation with different ways of arranging score material over the centuries. In contrast, the solitary text reader is able to pace his own reading to accommodate deficiencies in layout. Thus there has

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Author's address: Department of Psychology, University of Keele, Keele ST5 5BG, England.
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not been the same historical incentive to experiment with layout. Unhelpful layout may be a nuisance: but it hardly ever leads to total breakdown. A third difference concerns the levels at which spacing and layout become important. Score material presents the reader with diverse spatial information at a microscopic level. Any two-centimeter square of a modern score will contain a rich array of symbols at varying distances and directions from one another. In contrast a similarly sized portion of text is most likely to contain evenly spaced letters in evenly spaced rows. Interesting spatial differentiations occur, if at all, at the macroscopic level, and concern such matters as how paragraphs are sited. Another way of putting this difference is to say that in a score there are complex spatial constraints which determine the positioning of each notational element with respect to its neighbors, whereas in text the determination of the position of one letter in relation to its neighbors is trivially simple. Thus, layout is an integral part of the music notation system. In language notation it is an optional extra.

There are, of course, many points one could make which would tend to blur the clear lines drawn up by these distinctions. There is not *one* use for scores any more than there is for texts. It would be fair, however, to claim that these differences do characterise broad and prevailing tendencies within the two systems.

What follows from these comparisons? Firstly, spatial considerations in music notation are more complex and multi-levelled (and arguably more interesting) than spatial considerations in text. Secondly, perhaps as a result of the complexity, there has been little, if any, controlled experimentation using different spatial arrangements of music. And so, thirdly, this article cannot draw on published psychological research. Rather its aim is to present an historical and conceptual perspective on some of the major motivations for, and problems with, using space as a notational tool. In this task I draw most heavily on the work of musicologists and music historians, in particular the monumental study of Apel (1953). Other useful source and background material has been provided by Abraham (1979), Cole (1974), Hyatt-King (1964), Karkoschka (1972) and Read (1974).

Western musical civilisation of the last 1500 years has produced a bewildering multiplicity of notational systems devised in different contexts and for different purposes. Nonetheless, today we would recognise one particular system as central. This is, to adopt Read's (1974) terminology, the *orthochronic* system. Figure 1 shows a typical portion of this notation. It has been the major western notational system for

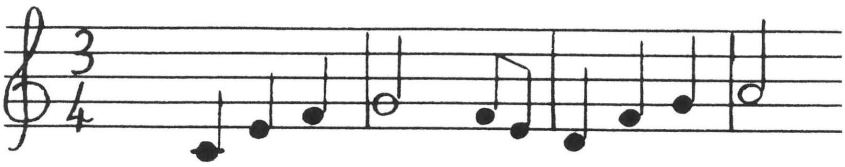

Figure 1 A section of orthochronic notation showing the principal notational features.

over 400 years, holding its place against all competitors even in this century which has seen a mushrooming growth of new notations. As the discussion proceeds I shall touch on various aspects of orthochronic notation, looking both at their development and at notational systems which have used space in different ways to achieve similar ends. Also, since any notational system can only meet limited needs, it is necessary to compare orthochronic notation with systems whose aims are different. Differing aims place differing demands on the available space.

2. Directions for action

A most important fact about orthochronic notation is, apparently, negative. It is impossible to tell, just by examining a typical extract, which instrument the extract is intended for. The central features of the notation are abstract. They specify pitch and rhythmic relationships between notes and groups of notes, *not* what keys are to be pressed on an instrument *nor* precisely how the notes are to sound. They are intended to convey something of the musical structure to a reader. Psychological implications of this fact have been discussed by Sloboda (1978a, in press). This characteristic probably explains why orthochronic notation has retained its central position. It is a *lingua franca* for all musicians, as understandable to a violinist as to a singer.

The corollary of this is that each instrumentalist must have additional practical knowledge before he can actually play the music. For instance, orthochronic notation may tell a flautist to play the note *D*, but it does not tell him which fingers to place over which holes to achieve the *D*. The wish to have a more direct notational aid to performance has sometimes led to the development of notations based upon a different principle – that of specifying actions on a particular instrument. Such notations achieve this end at the expense of universality. A notation devised for the violin would be meaningless to a trumpet player.

One large sub-group of such systems are the tablatures. Figure 2 is part of a French lute tablature of the sixteenth century. The horizontal lines represent the strings of the lute. The letters designate frets on the finger-board. In this example, the frets are marked by the letters B to H, with A denoting an open string. Tablatures use letters or numbers to specify at least part of the actions required. Some modern successors have eliminated alphabetic symbols completely in favour of graphic representation. A simple example of this is modern guitar notation (Figure 3) in which strings and frets are represented on a two-dimensional matrix, with dots to show the finger positions.

A more complex example is a modern system for the piano called Klavarscribo. In this system vertical lines represent the black keys on the piano, the spaces between representing white notes. The score is read from top to bottom, and the small circles represent the keys to be struck (unfilled circles are white notes). Figures 4 and 5 show the same extract from F. Chopin's Sonata op. 58 written in orthochronic notation and Klavarscribo. To the eye there is little to suggest that it is the same music in both cases.

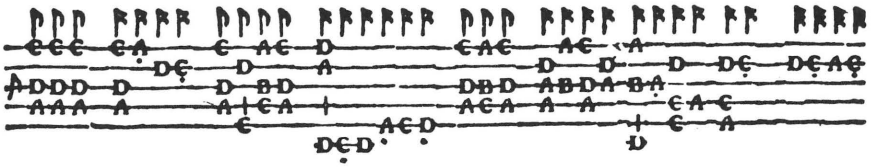

Figure 2 "Fortune a bien couru sur moi" from *Tres breve et familiere introduction pour entendre et apprendre par soy mesme a iouer toute chanson reduictes en la tabulature du Lutz*. Source: Apel (1953) p. 65.

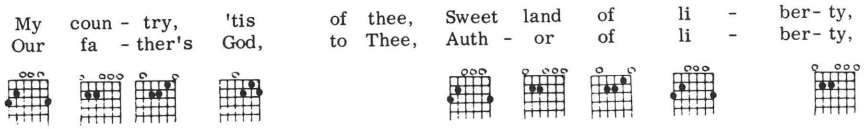

Figure 3 Chord sequence for "My Country, 'tis of thee" (first line) in modern guitar notation.

When we go on to consider the detailed requirements of a developed music notation system, I shall wish to return to these examples to argue that the price paid for instrumental specificity is, in general too high, since it restricts the number of dimensions remaining for representing other important aspects of the music. An alternative approach which has worked very well for many instruments is to incorporate additional symbols into the orthochronic system without altering its basic characteristics. Thus, for instance, many piano scores contain small numbers over some of the notes, which prescribe fingering. There are also many simple symbols which can be placed over or under notes to specify such things as the nature of attack, loudness, phrasing. The spatial constraints here are rather indefinite. If there are too many of these additional symbols the score takes on a cluttered appearance, and there is a danger of overloading the reader with detail. Compare Figures 6 and 7 which are different editions of the same music. Figure 6 is crowded with specific performance directions. Figure 7 uses such directions sparingly. In general, editors must take a middle line between giving the performer no help at all (trusting to his own musical competence) and giving him so much that some of it is bound to be ignored. The trend recently has been towards the former approach, at least in respect to classical music. It is not coincidental that Figure 6 predates Figure 7 (a contemporary edition) by some decades.

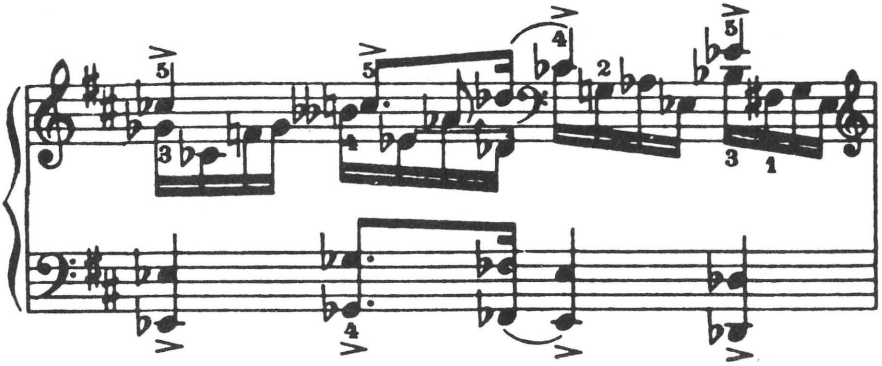

Figure 4 A bar from F. Chopin, Sonata Op. 58, in orthochronic notation. Source: Karkoschka (1972). p. 12.

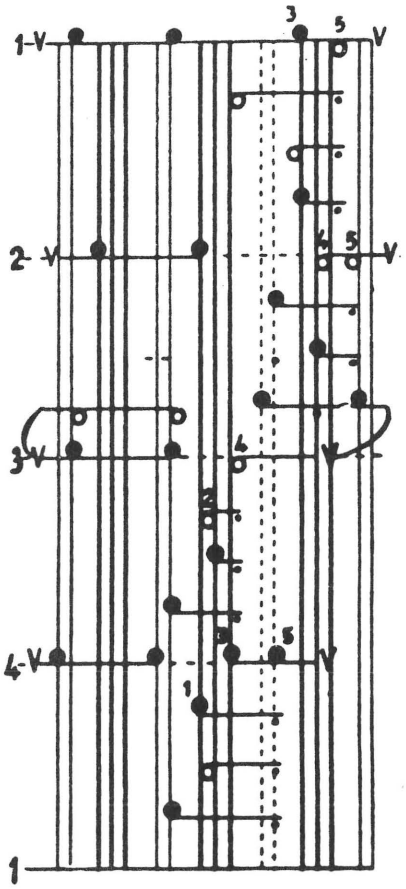

Figure 5 The same music as Figure 4 notated in Klavarscribo. Source: Karkoschka (1972). p. 12.

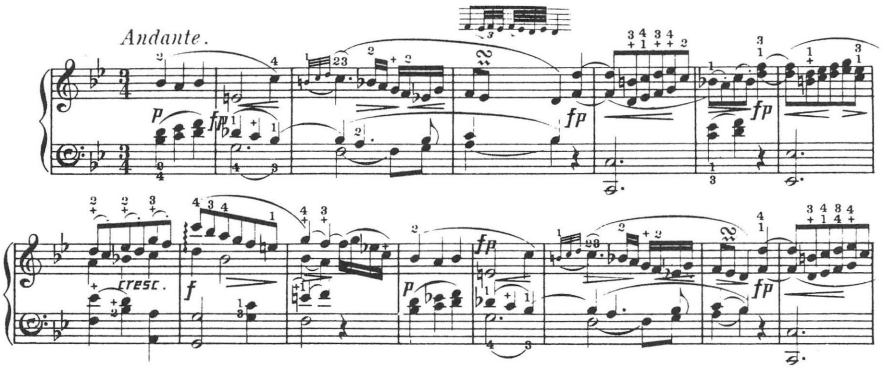

Figure 6 Opening bars of "Andante" from W. A. Mozart, Sonata in F, K. 533. (Ed. A. Zimmerman). London: Novello. Undated (c. 1900).

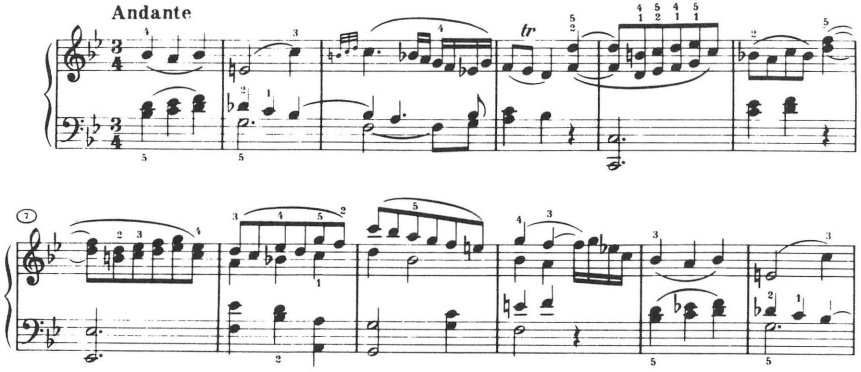

Figure 7 The same music as Figure 6. (Ed. W. Lampe). Munchen: Henle, 1955. Reproduced with the publisher's permission.

3. The staff

The most noticeable and characteristic feature of any segment of orthochronic notation is the grid of five horizontal lines on which the notes are placed. These lines are called staff-lines, with the five lines known, collectively, as a staff (plural staves). Unlike the tablatures, the function of the staff in orthochronic notation is to represent the pitch dimension. From earliest times pitch was seen as one of the most important aspects of music to notate. The earliest notations were alphabetic, dating at least as far back as pre-Christian Greece. In these systems each note of the scale was designated by a letter or other symbol. To notate a melody one simply wrote out the letters in the correct order. The first use of space to indicate pitch was the development of *neumes*

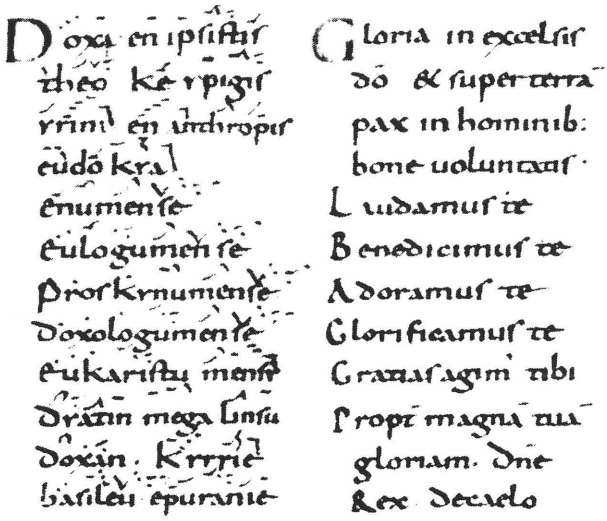

Figure 8 "Gloria" from a St. Amand manuscript c. 871. Paris: Bibliotheque Nationale, ms. lat. 2291. Reproduced with the Trustees' permission. Source: Abraham (1979), p. 62.

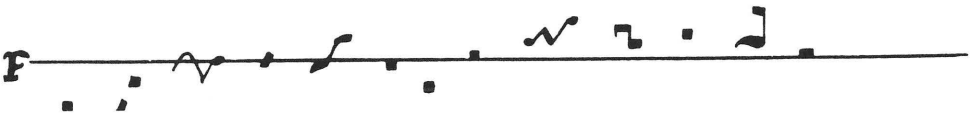

Figure 9 Tenth century neume notation (author unknown). Source: Read (1974), p. 10.

in around the eighth century AD. These were used almost exclusively in the liturgy of the Christian Church to notate the plainchant melodies to which prayers were sung in religious communities. Figure 8 shows one of the earliest examples of neumes from a French manuscript C 871. The neumes are written above the Greek text and indicate the directions of pitch change. Thus ⟋ denoted a rise, ⟍ a fall, and ⟋⟍ a fall followed by a rise.

This system had no power to specify the extent of a pitch change, only its direction. Read (1974) comments "Useful solely as a reminder to the singers, refreshing their memory of a general rise and fall originally learned by rote, the neumes provided only the over-all contour of the plainsong melodic line – not an exact map by which a novice might approach an unknown musical territory" (p.7). This comment introduces a very important consideration, that of the context in which a notational system is used. Neumes did not do badly what orthochronic notation does better. They probably served the cultural and psychological requirements of their users better than modern notation would have done. They had an economy of symbolism which exactly served its purpose within monastic choirs, where novices would learn most of what they

needed through repeated hearing of the same hymns. It was only, possibly, as chants elaborated and diversified that more precise mnemonic systems were necessary.

The next conceptual development was the use of vertical distance to indicate the extent of the pitch change. Figure 9 shows an early example from the tenth century which places neumes relative to a single horizontal line given a precise pitch (*F* below middle *C* in this example). The distance of a neume from this line gives an indication of its pitch distance from *F*. The difficulty with this, from a modern musician's point of view, is that the y-axis is not calibrated. A reader cannot easily tell what range of pitches is covered, nor the exact distance of any particular neume from the baseline. Both these problems were solved over the next two centuries by the addition of further horizontal lines denoting other precise pitches. By the 12th century the number of lines had reached 4. This number seems to have been supported by two principles. One was that lines were provided for alternate pitches in a scale. Thus, the bottom line might represent *A*, the space above it *B*, the next line *C*, the next space *D*, and on. This principle remains in operation today in orthochronic notation. It means that the pitch of a note need never be estimated by reference to its physical distance from another point on the paper. It can be identified precisely by counting up the staff lines. For experienced readers, even this is not necessary. The position of the note is directly known by a kind of spatial subitising. The look of each position on a staff becomes so distinctive that no conscious counting is required.

The second principle was that the number of staff lines was tailored to the pitch span of the melodies. Most melodies could be encompassed within nine successive pitches of a scale. This span (about an octave) would be the comfortable range of an average untrained male voice. Even in the 12th century most notated music was church music sung exclusively by monks. As time passed, however, it became more customary for instrumental music to be noted on a staff. Instruments have larger pitch spans than voices, and so more lines were needed to encompass the melodies that could be played on instruments. Six lines were fairly common and up to fifteen were known. Somehow things settled down and the five lines of modern orthochronic notation became the norm. Although it is impossible to know this with certainty, it seems probable that one of the reasons why the five-line staff survived is that it represents the best compromise between good span and readability. Figure 10 presents a ludicrously extreme example of the readability problem. This is part of a composition by E.Brown (1952). There are fifty staff lines, and it is practically impossible for a reader to keep any bearings at all. Luckily for the performer, Brown does not intend the lines to be taken seriously, but the moral is clear enough. There is a limit to the number of lines a staff can contain if a performer is to use it to rapidly identify the pitches of successive notes. This presents a problem within orthochronic notation when melodies span more than eleven notes of a scale, as frequently happens. The problem has been solved in three ways, all in common use today.

The first solution is to recalibrate the staff as the melody rises above or falls below the range of the staff. This is conventionally done by arbitrary symbols known as clef signs. The leftmost symbol in Figure 1 is the treble clef sign, and it indicates that the

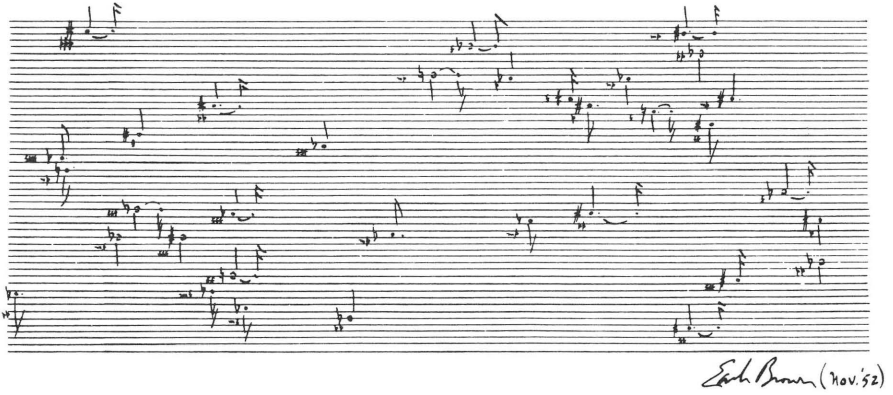

Figure 10 "November 1952" from *Folio* by E. Brown. New York: Associated Music Publishers Inc. Reproduced with the publisher's permission. Source: Karkoschka (1972) p. 90.

bottom line of the staff is to be read as the *E* above middle *C*. There are four or five such symbols in common use, and when one of them occurs in the course of a piece of music it instructs the reader to recalibrate everything from that point onwards until another clef sign is encountered.

For tunes which skip about a lot, clef signs are, however, rather unsatisfactory. If the clef must be changed every few notes the reader will spend as much time interpreting the clef symbols as the notes themselves. Another solution which is in common use is to temporarily extend the staff by ledger lines. The first note of Figure 1 is on a ledger line and the reader is asked to interpret it as if it were another staff line below the lowest one shown. In fact, the reader may imagine the staff is extending indefinitely both above and below its visible portion, but to avoid the problems associated with Figure 10 only that portion of it becomes visible which allows a single note to be identified. Thus, ledger lines extend only as far on either side of a note as to make them clearly visible. Most fluent readers become adept at rapidly interpreting up to five ledger lines. With more lines, problems of readability again develop. Figure 11 shows two extracts using ledger lines; (a) would be easily read by most competent readers today; (b) would not be fluently read.

At this juncture a comment about the vertical spacing of staff lines and ledger lines is pertinent. Although not logically necessary, it has always been standard practise to make the distances between adjacent staff-lines equal to one another. This has meant that the vertical distance between notes is an accurate measure of the pitch distance between them.

Although this information is technically redundant, it does provide readers with an additional analog cue to pitch which arguably supplements the ''digital'' information supplied by the lines themselves. There is, for instance, some evidence that music

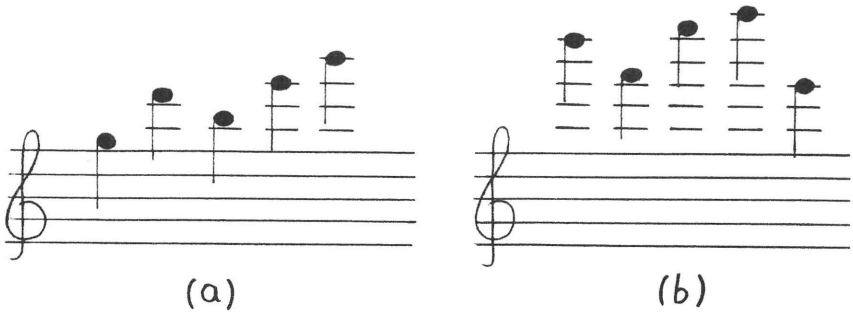

Figure 11 Two examples of the use of ledger lines: (b) is more difficult to read than (a).

readers can be aware of the contour of a notated melody before they can precisely identify the constituent notes (Sloboda, 1978b). It is unclear how much use competent musicians make of this information in performing situations, but one informal observation supports its importance. It sometimes happens that staves are printed so close together that there is a difficulty about placing a note on, say, the fifth ledger line. If the spacing of the ledger lines were to preserve the spacing of the staff lines, they would come too close to, or overlap, the adjacent staff. In such a situation the ledger lines are squashed closer together. This, of course, upsets the analog representation of pitch, and many musicians complain bitterly that such notes are very difficult to read, especially if the music is unfamiliar. In the best publishing houses this crowding of ledger lines never occurs. The solution is, of course, to move the staves further apart, but with fewer staves to the page, production expenses increase. This probably accounts for the persistence of this troublesome practice. An allied point concerns the size of a staff. This has both psychological and economic implications. If staff lines are too close together the reader has problems of discrimination, especially if he must be at some distance from the score when performing. Conversely, if the lines are too far apart then it may be impossible to see the stave clearly with a single fixation. Similarly, from the printer's point of view, closely spaced lines demand finer (and thus more expensive) printing. Widely spaced lines mean fewer staves per page and thus more pages. Engraving tradition seems to have settled on a between-staff-line distance of about 0.20 to 0.25 cm as suitable for most performing scores.

The third solution to the problem of increased melodic span we owe to the rise of polyphonic music in the middle ages. Polyphonic music is that where several streams of notes are performed simultaneously. This type of music can be vocal, where different singers take different melodies simultaneously. It can be for an instrumental

group, where, for instance, different pipe instruments play different notes. Or it can be for a keyboard instrument played by one performer producing simultaneous sounds with different hands and fingers.

In all these cases, the notational problem is to indicate which person or hand takes which stream of notes. To put all the notes on to a single staff would be to overcrowd it hopelessly if more than a couple of parts were involved. So the solution arrived at fairly early was to give each part a separate staff. These staves were vertically aligned and joined in some way to indicate simultaneity. A typical example of this is given in Figure 4. This is part of a piano piece – the curved bracket at the left indicates that the two staves are to be played simultaneously, the upper by the right hand, the lower by the left hand. This arrangement is necessary when a single performer must read both staves simultaneously: the relevant portions must clearly be as close to one another as possible. It also provides an ideal vehicle for extending the span of pitches which can be notated. This is because the two staves can be calibrated differently by clef signs, as in Figure 4. Suitably calibrated, the piano score has over twice the pitch span of a single staff. In the notation of symphonic music this system can be extended indefinitely, twenty staves being a not uncommonly large number for a conductor's score. Of course, in this case many of the staves overlap closely in pitch calibration, or, indeed, are identical. Each staff is identified with the name of the appropriate instrument at the left of the page.

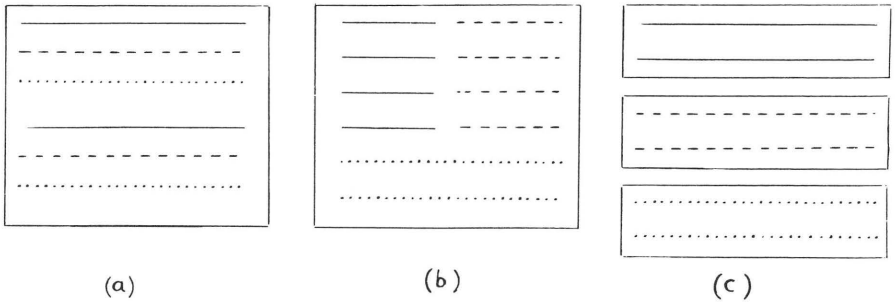

Figure 12 Three arrangements for polyphonic scores.

It remains to add that this score arrangement is not the only possible or desirable one for polyphonic music. When many performers are involved it often makes sense to arrange things so that each performer has primary access to his own part. Figure 12 shows in diagrammatic form the three major ways in which a polyphonic composition can be arranged in space. In this example three parts are shown, but the same principles can apply to any number. The full, dashed, and dotted lines represent the staves for the three separate parts or instruments; (a) is the score arrangement just described, and would be typified by any organ score (separate staves for right hand, left hand and feet); (b) is an arrangement whereby each part is confined to a circumscribed area on the page. Although the other parts would be visible to a

performer they would not get in his way. This arrangement is typical for one piano, three players music and for much medieval vocal music where each part was to be taken by one singer. In (c) each part is physically separate and can be distributed around the room among the various performers. This is the usual format for modern orchestral players where their own part may be one of as many as fifty different parts going on simultaneously. Of these systems, (a) is undoubtedly the oldest. It allows the reader to keep a direct check on the synchrony of the parts. Examples (b) and (c) make visual checks progressively more difficult. The survival of (c) depends upon the development of cues to synchrony. One, outside the scope of this article, is the conductor, who provides an external reference for a group of performers through his gestures. Probably more crucial was the development of methods for notating cues to synchrony and timing within individual parts. It is to this second major dimension that we now turn.

4. Bars, timing and rhythm

We have seen how orthochronic notation has commandeered the vertical dimension for notating pitch. It is only a first approximation to say that the horizontal dimension represents time. Temporal aspects are certainly represented, but not in any strict analog sense. Distance from left to right is not a direct measure of time elapsed. To understand how time notation works it is necessary to return to its beginnings in history.

As we have seen, most of the early notations were designed for singing liturgical chant. Thus there were two parallel notations – one giving the words in an orthography essentially that of today – the other, usually above the words, giving musical directions. In addition, the early music was all homophonic. No matter how many people sang, they all sang the same melody. It would not be unfair to say that up to about the thirteenth century the only timing information explicitly supplied by the musical notation was that of order; the order of the successive words and the pitches to which they were to be sung. If there were differences in the duration of the notes then these were possibly suggested by the flow of the words, or were part of an oral tradition of timing which had grown up in particular communities. Thus, while pitch notation continued to develop towards the modern staff system, the temporal aspect remained undeveloped until the thirteenth century. At that time notational distinctions between long and short notes began to be made.

For some reason, the strategy of using space to indicate time was not adopted. A compelling explanation for this is that scribes felt themselves constrained by the parallel vocal text. From the appearance of Figure 13 one could guess that the scribe had written out the words before embarking on the music. The spacing of the letters and the words is very regular; that of the notes is quite irregular. Clearly, the main consideration was to ensure that the right notes fell over the right syllables. This is what determined the spacing of notes, and so timing had to be indicated in some other way. In general, this was done by altering the shapes or appendages of the notes. In

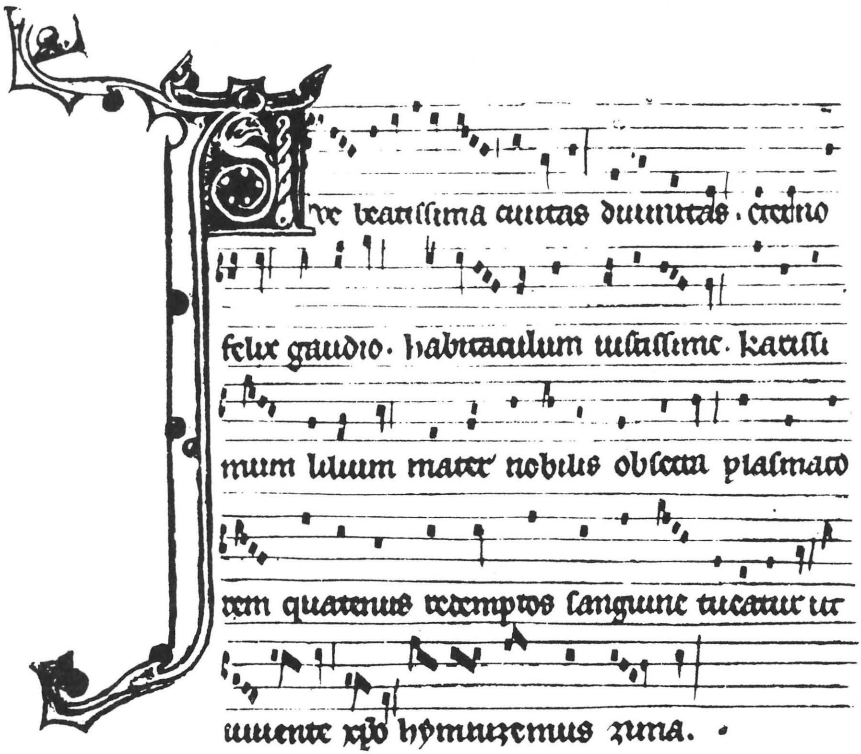

Figure 13 "Ave beatissima" from the *Codex Montpellier* (thirteenth century). Montpellier: Bibliotheque de l'Ecole de Medicine. Ms. H 196 p. 93'. Reproduced with the Trustees' permission. Source: Apel (1953) p. 291.

this example, from a thirteenth century French manuscript there are three types of note: squares with stems, squares, and diamonds, denoting long, short and shorter notes respectively. It is along this path that rhythmic notation continued to develop despite the fact that much notated music now came to be instrumental, and so without constraint of words.

The history of the subsequent development of rhythmic notation is of some complexity, but certain principles emerged which have remained with us to the present day. One was that note durations were conceived as simple multiples of each other. The other was that simple combinations of durations would often recur several times thus setting up a rhythmic grouping. A simple example of this, as apposite to the twentieth as to the thirteenth century, is given in orthochronic time notation in Figure 14 (a). In this example the white (unfilled) notes have twice the duration of the black (filled) notes. If the duration of the black note is taken as one unit, then we can see a repeating pattern every three units. This is expressed today by saying that a triple

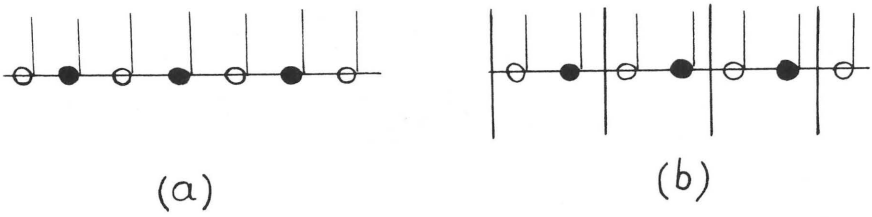

Figure 14 Rhythmic notation.

metre is being used. When the rhythm is more elaborate, it is not so easy to determine what the repeating grouping should be just by examination of the note values. Sometimes a sequence can be grouped in more than one way. In these cases, some notational means of specifying the grouping *directly* is required. It is required because rhythmic groupings have important performing implications. For instance, the first note in each rhythmic group is typically accented in some way (e.g. played louder). This is particularly important for communicating the rhythmic structure to a listener. A direct and visually compelling cue to rhythm is particularly useful when the musician is reading unfamiliar music "at sight". Under these conditions he will not have time to work out the rhythmic structure from the note sequence itself. In more leisured study circumstances, or where the music is already partly familiar, direct cues are not so crucial. In modern times sight-reading is required of musicians in many circumstances. The same was not true 700 years ago. The possibility of effective sight-reading has rested upon the emergence of two notational devices.

The first of these is an indication, at the beginning of a sequence, of the number and type of notes in each metrical grouping. This is achieved by two numbers (see Figure 1). The upper number tells the reader whether the recurring grouping is 2,3,4 or whatever number of units. The bottom number specifies the unit. These two numbers together comprise the time signature of a piece, and in Figure 1 this signature indicates a triple metre, with the filled note (known as a quarter-note in America) as the unit.

The time signature, however, leaves a very important question unanswered, for it does not tell the reader which note is the first, accented, note in each group. One cannot simply assume that the first note printed is given the accent. Many tunes begin on an unaccented note. Furthermore, it would be quite difficult for a reader to keep track of the metre through a long piece without dropping a note. A recurrent cue is required. This is supplied, in orthochronic notation, by bar lines. These are vertical lines, running the extent of a staff, which precede the first note in each metrical unit. A bar is the space between two adjacent bar lines, and so each bar contains a complete metrical unit with its first, accented, note at its leftmost edge. The correct barring for Figure 14 (a) is shown in Figure 14 (b).

Regular metrical barring did not become widespread until the sixteenth century, but when it did if offered a number of cues to synchronisation. The first is the use of bars

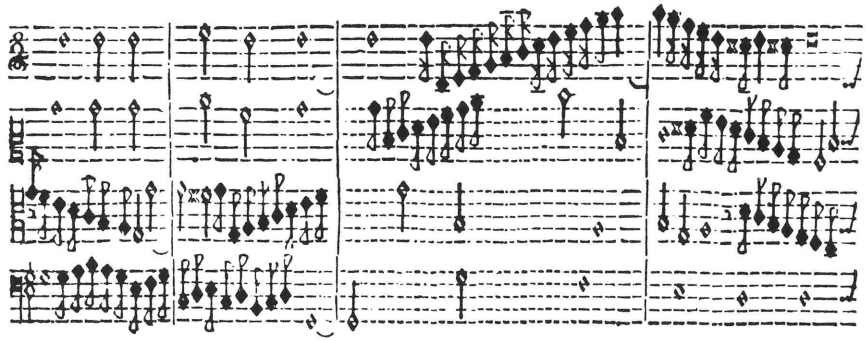

Figure 15 From A. Mayone *Primo libro di diversi capricci per* Naples, 1603, p. 70. Source: Apel (1953) p. 17.

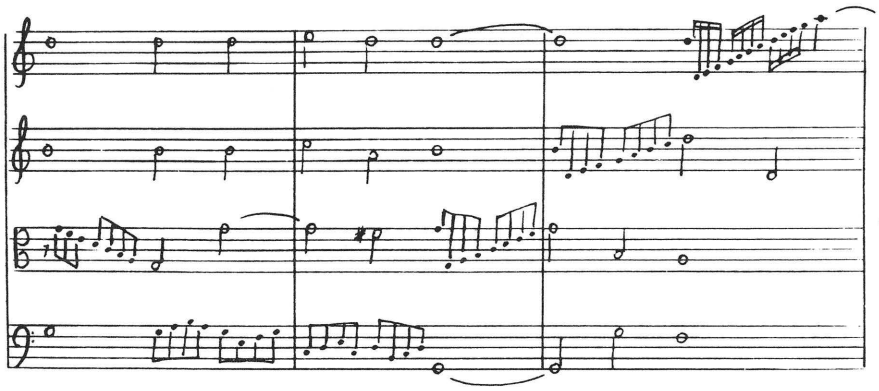

Figure 16 Transcription of first three bars of Figure 15 using the conventions of modern orthochronic notation.

as a tally in part performance (Figure 12 (c)). If a performer knows the metre and the speed he can keep track of the music by counting the bars. In symphony orchestras a primary responsibility of a conductor is to maintain the beat, moving his arms in such a way as to clearly indicate the timing of the first note in each bar (the down-beat) and the regular progression of metrical units during each bar. Performers may then tally each downbeat with a bar on their score. In addition, many parts actually number the bars so that in rehearsal performers can agree to 'start from bar 50'.

The second cue to synchronisation is available only in parallel score arrangements (Figure 4 and 12(a)). This is achieved by vertically aligning bar lines in the separate parts. In many instances the bar line will be ruled right down the whole system of parallel staves to make more salient the points of synchrony. Figure 15 shows an early example from Italy (Naples, 1603). Two features are of note. One is that when some

parts contain many short notes the bars must be widened to accommodate them legibly. Thus bars are not of regular size. The trend in modern orthochronic notation has been to attempt to minimise difference in size between successive bars, although it is not possible to eliminate them entirely. In some music, a bar may contain so many notes that it requires the whole width of a page. To maintain this width for bars containing only one or two notes has little psychological advantage, and severe economic disadvantage. The other feature is that the distance between adjacent notes in parallel parts cannot be kept constant if the bars are to be aligned. The clearest example of this in Figure 15 comes in the third bar, where the top two parts have many closely spaced notes, whilst the bottom two parts contain only few notes. In this example, and in general up to at least the eighteenth century, no consistent method for spacing out the notes within a bar was adopted. Thus, although bar-lines provided conceptual points of synchrony for a reader, one could not drop a plumb-line at any other point within a bar and expect any synchrony between the notes encountered in the various parts. The time dimension from left to right was stretched and contracted quite arbitrarily within each bar. It is worth noting that in some early scores the bar lines were not even straight. What appears to have happened is that bar-lines became so useful to musicians that scribes often went back over old un-barred scores to put the bar-lines in. In these older scores there was often no attempt whatsoever to maintain vertical alignment of parts, and scribes were apparently too hard-pressed to write out the music afresh. So one finds examples like the splendid British keyboard score (circa 1540) in Figure 17, where the clumsy barring indicates the extent of the visual splits which early keyboard players were required to perform. Notational clarity apart, a modern keyboard performer would find it impossible to sight-read such a score. I suspect that a sixteenth century player would have found it equally difficult, and it suggests that such a score would have had rather different purposes—perhaps archival, perhaps as an aid to a performer attempting to memorise a piece, or perhaps as a starting point for an improvisation.

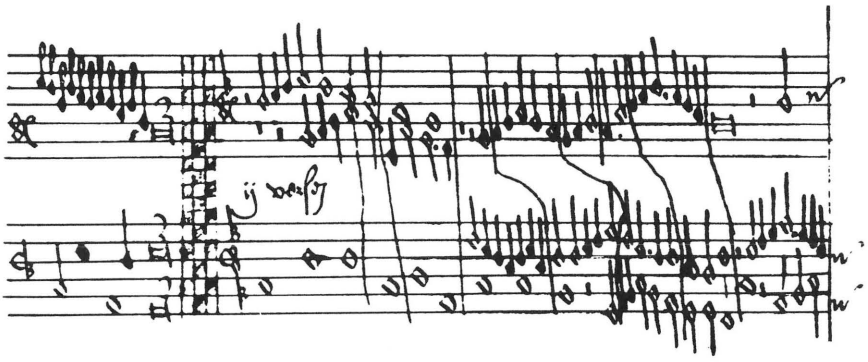

Figure 17 From a keyboard manuscript. London, 1540. British Museum, Ms. Add. 29996, p. 117'. Reproduced with the Trustees' permission. Source: Apel (1953) p. 11.

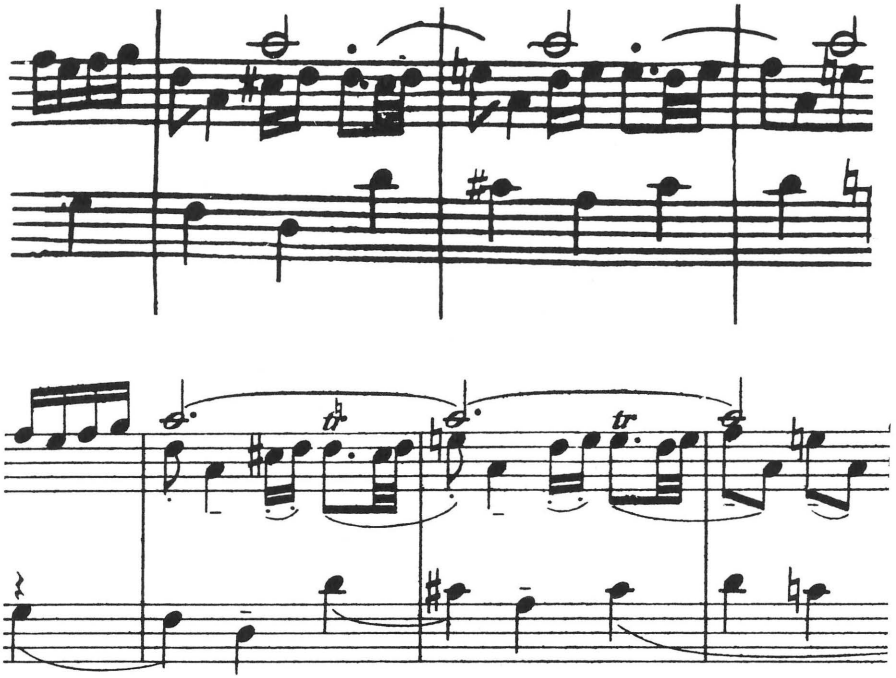

Figure 18

(a) From G. F. Handel, Organ concerto Op. 4 No. 3. Publisher unknown, c. 1800. Source: Cole (1974) p. 58. (b) The same music as (a). Ed. K. Matthaei. Kassel: Barenreiter, 1956, p. 59. Reproduced with the publisher's permission.

It was not really until the nineteenth century that what we now see as a logical corollary of bar-lines, namely proportional spacing of notes, came to be widely accepted. It is now standard notational practice to make systematic use of the space within the bar. Two main principles summarise this practice:

Firstly, notes which begin simultaneously must be vertically aligned. This has the useful consequence for, say, a pianist, that all the notes he must play simultaneously can be seen from a single vertical slice of score. This supercedes an earlier, intermediate, principle of spacing whereby a note occupied the centre of the time-space allotted to it, rather than the left-hand boundary of that space. This meant that a keyboard player had to scan horizontally as well as vertically to find the notes which had to be played together. Figure 18 shows a small extract from a score of a Handel organ concerto; (a) is an early printed score (c. 1800 ?); (b) is a modern reprinting. The clearest example of the change can be seen at the beginning of the

second bar. In (b) the three notes to be played simultaneously are precisely aligned; in (a) there is considerable divergence, particularly for the top note, which, because it lasts for the whole bar, is placed almost in the middle of the bar.

Secondly, the space between a note and the following note must be proportional to the time between their respective onsets. This has always been interpreted rather loosely. It is not necessary that the space following a particular note need be twice that of a note with half its duration, only that the space be discernibly larger to the reader. This principle, in fact, follows as a necessary consequence of the first principle applied to parallel staves. It is, however, used nowadays, even in cases where the constraints of alignment do not strictly require it. Thus, as in the pitch dimension, analog spatial information about timing is available to the reader as a formally redundant cue. Again, what psychological evidence exists is consistent with the idea that, at least in some circumstances, readers make use of proportional spacing of notes in organising their perception of the score (Sloboda, 1977). To illustrate the principles of proportional spacing in an extended orthochronic example, I offer as Figure 16 my own transcription of the example in Figure 15 (first three bars).

5. How well does music notation use space?

The preceding sections outlined the principal spatial characteristics of orthochronic notation and its forbears. In this final section I wish to turn to questions of greater generality: to look at music notation not from the point of view of musical history, but from that of the formal study of symbolic systems. This shift in perspective allows us to focus less on questions of development and more on questions of information content, symbolic structure and psychological effectiveness. Any musical notation system must code certain types of information about the music. It uses particular symbols in particular spatial arrangements to represent this information, and has a greater or lesser effectiveness in conveying this information to the reader in a manner consistent with his requirements. These issues can be examined without reference to the historical context of particular notational systems. What follows is an outline of the way in which these issues may be expanded and articulated to form a conceptual framework within which systematic scientific evaluation of alternative notations could be carried out. It is necessary, I believe, to say something about these three issues separately, although the overall goodness of a system will be the result of a combination of factors from the three levels.

(a) *Information content*. The information conveyed by different musical systems can vary in two major respects: how specific the information is, and what type of information is conveyed. The notion of specificity is best conveyed by two extreme examples. Figure 19 is the score of a contemporary composition in which the performer is asked to contemplate what he sees and play anything that the pattern suggests to him. No detailed rules are supplied for interpreting the various elements. Thus there is no sense in which particular elements of the display correspond to particular sounds or features of the music. At the other extreme are notations which

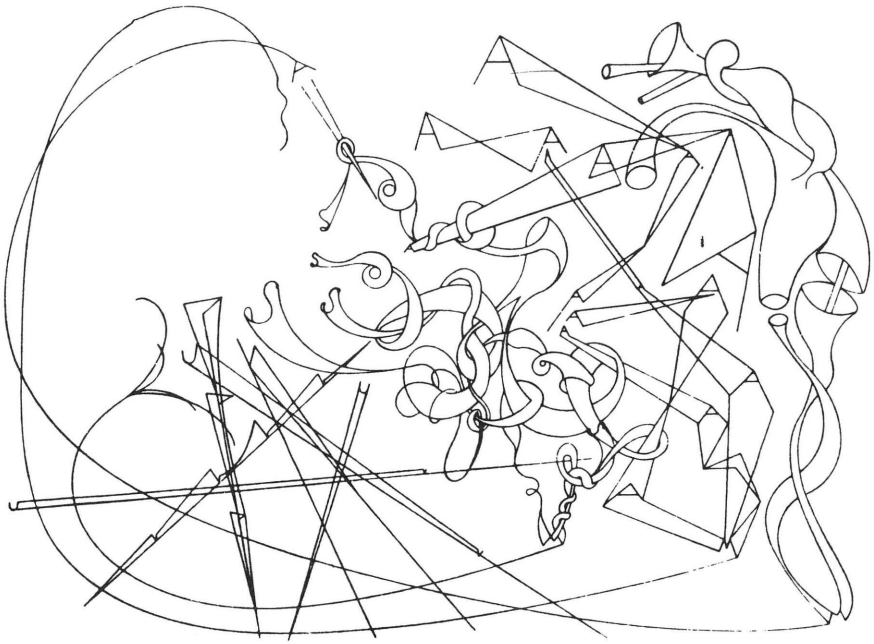

Figure 19 Sheet 3 of A. Logothetis, *Cycloide*. Munich; Edition Modern, MusikVerlag Hans Werwerka, 19. Reproduced with the publisher's permission. Source: Karkoschka (1972) p. 129.

almost totally specify each sound. Some modern electronic compositions achieve such specificity by giving the precise details of all the oscilators, filters, etc. Orthochronic notation is specific in that it provides information about each note in a piece of music. Of course, even in such a case, specificity can vary according to how *much* information about each note is provided. Sometimes only one or two dimensions of the sound (e.g., pitch and duration) are notated. Sometimes many more dimensions of the sound are specified. The need for specificity poses certain formal problems for a notation system. One is how to represent the order of events. Another is how to correlate the elements in the various dimensions which refer to the same note. How do we show, for instance, that a given note has a pitch x, a duration y, and an intensity z?

At a given level of specificity there can be further variation in the *type* of information represented. One distinction of type was mentioned in Section 2, that between systems which notate actions (e.g. the tablatures) and those which notate aspects of the sound. If any consideration were to limit the number of dimensions which could be notated, then the different types of information would have to be traded of against one another. Increased specificity in one area would imply decreased specificity in another.

(b) *Symbolic structure*. By structure is meant both the nature of the symbols chosen and their spatial arrangement. Design of the structure becomes a formal problem when some degree of specificity is required.

There are a whole set of solutions to this problem which we could characterise as essentially non-spatial. As an example, we could assign each event a number (1 being the first event, 2 being the second, and so on) and then make certain statements about the various characteristics of each event (e.g. '2 has a pitch of 565 Hz', '7 has an intensity of 65 dB', etc.) These statements could be arranged on the page in an arbitrary order. One's immediate feeling that such a system would be pointless (i.e. ineffective) does not invalidate it as a perfectly consistent and correct way of symbolising the specified dimensions of the music. Nonetheless, a notation system could utilise the space provided by the writing surface in a more systematic fashion. The most primitive use of space is to order the elements in some way. With music, the ordering is nearly always temporal. Information about the first note is spatially adjacent to information about the second note, and so on. This is, presumably, because temporal order is the dimension which *makes* music. In the example just given, one could achieve this characteristic by grouping all the statements about event 1 together at the top of a page, with all the statements about event 2 following immediately below, and so on. This could be structurally described as a list. The next advance on a list is a matrix. Here, the two spatial dimensions of a page are utilised systematically. Thus, for instance, the horizontal dimension might represent the temporal order of events, with the various characteristics of each event separated out vertically down the page. So, for example, reading across one row would give the pitches of successive notes, reading across another row would give their intensities, and reading down a column would give all the features of a single event. (I owe much of my conceptualisation of structure and some of the terminology to Twyman (1979)).

A different use of the two dimensions might be called 'co-ordinate'. Here, both horizontal and vertical dimensions represent ordinal axes on which some 2 dimensional function may be plotted. Orthochronic notation can be seen, in part, as a graph of the pitch (y)–time (x) function, each note plotted as a point on the graph. Matrix and co-ordinate notations can be made very powerful by the use of two other supplementary devices, partition and clustering. In partitioning, one divides the page up into discrete areas where space may serve a different function. Thus, for instance, in Figure 15 the pitch dimension is not represented continuously in the vertical dimension. It only operates within each staff, recalibrated for each. The space between the staves has no pitch implications at all, and so other, pitchless information may be placed here. In some modern scores, for instance, a rising and falling line between staves is given to indicate increases and decreases in speed. A most imaginative use of partitioning is shown in Figure 20. This is the second page of Busotti's *Siciliano*. Here, vertical space within staves is interpreted conventionally, but the slant of a staff indicates the degree of acceleration or deceleration of speed. Dotted vertical lines indicate points of synchrony.

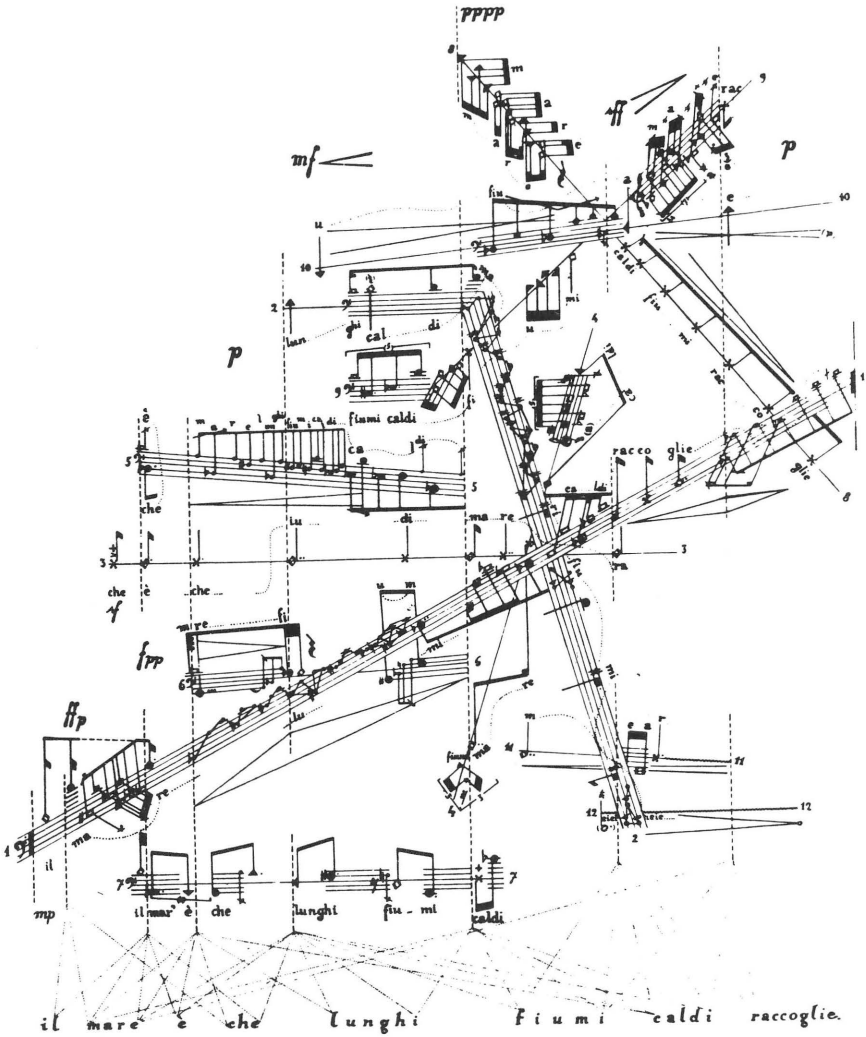

Figure 20 Page 2 of S. Bussotti, *Siciliano*. Florence: Aldo Bruzzichelli, 19 . Reproduced with the publisher's permission. Source: Karkoschka (1972) p. 94.

Clustering refers to the practice of representing several dimensions of an event, not by separate symbols, but by different aspects of a composite symbol. Thus, a note's position could indicate its pitch, whilst its shape indicated its duration, and its colour indicated its intensity. This is a useful economy of space, which allows one to compact several rows or columns of a matrix into one.

These strategies, in their detailed operation, would seem to account for most of what one could say about the possible structures of music notation systems. When a combination of all the strategies is available there would seem to be very few formal limits on the number of specific dimensions which could be represented by a symbolic system. If questions of how well space is used have significance at this level, it is with respect to the economy of space. A system which allows clear representation of twenty pieces of information has a claim to greater efficiency than one which allows representation of only ten pieces of information within the same area of space. But for a criterion of what constitutes a clear representation, we must turn to the final, psychological level of analysis.

(c) *Psychological effectiveness.* Music notations are for use by readers. Their effectiveness is the extent to which readers are able to retrieve the information about the music which they supply. Effectiveness is not simply a function of the symbolic structure of the score, nor of the information it contains, but of the conditions under which a reader is expected to retrieve the information. These conditions may include general factors of human psychological functioning; they certainly include factors specific to the particular reading situation. All I am able to do here is to enumerate a representative sample of issues pertaining to psychological effectiveness. Although these issues are all empirically determinable, almost none have received rigorous empirical treatment.

A fundamental issue I have already referred to is the extent to which a reader is expected to provide a coherent performance of the music at first sight. Clearly, the more the reader must do without prior knowledge, the more constraints are placed upon what is an acceptable notation. Some of these constraints are straightforward matters of legibility. Even within a single notational system clarity and consistency can vary greatly according to the care with which a score is laid out and the nature of the reproduction process. It is distressing to discover that many of the parts which players in major symphony orchestras must use (at least in Britain) are shockingly presented and reproduced. Figure 21 shows a not untypical example of the kind of thing an orchestral player must put up with. It has not been determined how much this upsets performance. Certainly the players themselves complain bitterly. A major difficulty is spatial uncertainty. This can occur when staff lines are badly printed, or too close together. In this case it is sometimes difficult to see which line a note is centred on. A similar problem occurs when noteheads are too large with respect to the staff lines. A different type of spatial uncertainty is caused when ancillary marks are not properly aligned with the notes, or when they are too far from the staff to allow easy estimation of their alignment.

These considerations lead to the wider issue of discriminability. When a notation system uses a large number of different symbols, two different symbols can often look very much alike. If a reader is expected to discriminate the symbols at speed, then he will arguably be helped by symbols which are as different as possible in appearance. On the other hand, if he is to perceive relations between different notes then he will also arguably be helped by symbols which preserve that relationship (e.g., symbols for notes close in pitch will be more like one another than symbols for notes not

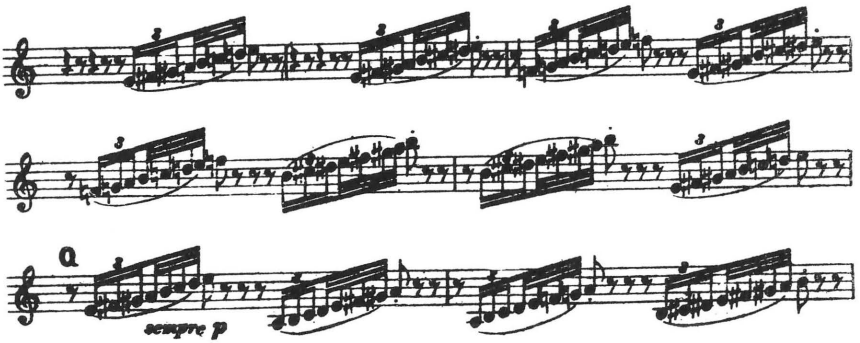

Figure 21 Extract from an orchestral part used by a British symphony orchestra, date and publisher unknown.

similar in pitch). The analog representations of pitch and time in orthochronic notation are based directly on this latter principle. Here, closeness in space maps directly on to closeness in pitch and time. When space is the notational dimension then it is possible to achieve increased discriminability simply by expanding the axes (i.e., make the staves larger and the notes farther apart). But to do this raises problems in a different area, that of the visual span and eye-movements.

If a reader is to use the score to organise immediate performance then he must take in all the information required for a particular action with as few fixations as possible. An average rate of performance for a moderately demanding piano piece might be ten notes per second (some of them executed simultaneously). It would be difficult to achieve more than four or five separate fixations in this time, and so the information required must necessarily be contained in a small area. Expanding the dimensions of the symbols would increase the number of fixations required to read the same number of symbols. Thus an effective notational system also has to be compact, and this poses problems when more than one dimension of the same event must be notated. The conventional matrix would be unhelpful because different aspects of one note could be spread right down a page. The device which arguably saves orthochronic notation is the clustering described in the previous sub-section. By using different visual aspects of the same symbol (position, shape) to indicate different sound aspects of the same note (pitch, duration) one can increase the visual density of the information at little expense to clarity. In general, a system such as the staff system would seem to be able to support about five different dimensions of sound without difficulty. For instance, the two spatial dimensions could represent pitch (vertical) and order (horizontal). Shape of note is a third dimension which could be used to represent duration. Ancillary symbols above and below the note could represent intensity and phrasing. There is, however, clearly some limit to the number of dimensions which could be usefully added in this way. This shows itself in lute notation (Figure 2) where note shape is used to designate which fret to touch, at the expense of a means of signifying duration. Klavarscribo fits in an extra dimension only because the arrangement of

keys on a piano is isomorphic with the pitch dimension. Thus, the same horizontal information specifies both pitch *and* which key should be pressed (Figure 5).

A final requirement of a system that is to be read at sight is universality. One can only become proficient at reading any system if one encounters a large body of music written in that notation. Many contemporary notation systems are ruled out on this count because they are designed by the composer with a particular composition in mind, and are used only for this composition. Thus, Brown's fifty-line staff (Figure 10) has never been used before or since his one composition. Many contemporary notations are designed with the expectation that a performer will devote considerable time to a study of the particular score and its notation before a performance is possible. It would be inconceivable to arrange a performance of Busotti's *Siciliano* (Figure 20) at sight. Neither he nor his performers would wish for that. Similarly no notational system devised prior to about 1500 would have been read at sight. Musical culture just did not require it.

Today, musicians accustomed to reading orthochronic notation at sight become very sensitive to slight changes in notational practice. One simple spatial example concerns the positioning of note-stems (the vertical lines attached to notes). The modern convention is that descending stems are attached to the left edge of a note-head, ascending stems to the right. Some earlier scores reversed this convention. Informationally and structurally this has absolutely no consequences at all, but it *is* psychologically disruptive. Such scores are more difficult to read at sight, and the subjective impression is of something quite wrong about them.

Even when reading at sight is not required, a score's primary function is to assist a musician in performance. In such cases the score may be used to elicit learned response patterns in the correct sequence. This means that the performer must be able to keep place in the score, even if he does not use all the information in it. When detailed prompting is required, he must be able to find the appropriate information rapidly and effectively. Thus, many of the psychological considerations pertinent to reading at sight remain important in less extreme reading situations. Compactness and discriminability are still necessary. Consistency in positioning of information is also important. A reader must be able to know exactly where to go for particular types of information, even if he does not always need them. For instance, in a conventional orthochronic score, information about intensity is always to be found below the staff.

Two concluding remarks are in order. First, I hope to have shown that spatial factors in music notation are of some complexity and importance, and that there are several frameworks within which empirically determinable questions about efficiency of alternative arrangements may be asked. Second, I need to emphasise that nearly all my remarks about the psychological aspects of music reading are based on personal experience and accounts of other musicians rather than on rigorous investigation. Although it is to be hoped that serious empirical work will be undertaken, I should perhaps finish by firing one warning shot across the bows. Efficiency can only be

meaningfully estimated where a reader is as familiar with the system in question as he is with the accustomed system with which the experimental system is being compared. Failure to find an immediate effect of some notational change does not imply that there will be no effect after the months or years of familiarisation that has been received by the accustomed system. Any evaluation of notational reform is going to be a long-term process, and one which will require a considerable commitment from musicians who are required to learn and operate with new systems. Any short-term experimentation is almost bound to lead to the erroneous conclusion that orthochronic notation as it now stands is the best of all possible systems.

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Résumés des Articles

Traduction: Fernand Baudin

La typographie sans paroles par Michael Twyman

L'article propose un moyen tout simple de noter certaines variables typographiques en n'utilisant que le "x", le "o" et le "i" du clavier dactylographique. Il peut servir à toute personne qui travaille en langage imprimé. Cette méthode a son intérêt pour l'enseignement car elle éveille l'attention sur l'existence même des problèmes typographiques. L'auteur énonce les règles et en fait les démonstrations à l'aide d'exemples pratiques concernant les titres et sous-titres, parce qu'ils ont trait au thème général de ce numéro spécial. Cette notation est utilisée depuis des années dans le Department of Typography & Graphic Communication of the University of Reading pour la formation des étudiants et du personnel. Indépendamment de son utilité dans l'enseignement, elle faciliterait assurément les communications entre chercheurs et imprimeurs.

Comment la mise en page et la rédaction affectent la présentation des manuels d'instructions *par J. Hartley et M. Trueman*

Un jury s'est prononcé sur la présentation d'un certain nombre de manuels, du point de vue de la mise en page aussi bien que de la rédaction. Il s'était donné trois critères de qualité et les résultats obtenus montrent qu'ils pourraient bien avoir quelque utilité purement quantitative mais qu'on ne pourrait pas trop s'y fier pour les nuances.

La théorie et la pratique de la composition à plusieurs niveaux par *D. L. Jewett*

Un style de composition à plusieurs niveaux laisse plus de latitude au lecteur que les méthodes traditionnelles. Il est d'ailleurs plus commode même pour le rédacteur. Plusieurs présentations pour différents objectifs sont utilisables en vue d'améliorer la communication imprimée si la formule est testée sur un échantillon de lecteurs; ces tests sont au moins aussi important sinon plus que telle ou telle présentation typographique. L'article expose (1) le contexte et la théorie, (2) les procédés typographiques et (3) la hiérarchie des niveaux selon ma perspective personnelle (compte tenu du fait que j'ignore ce que d'autres ont pu faire). L'article luimême sera rédigé à plusieurs niveaux d'écritures avec trois rentrées d'alinéas différentes pour exprimer les trois niveaux principaux: les idées principales, leur développement, les remarques éventuelles.

Les artifices typographiques et les mises en page des manuels au service des étudiants *par W. L. Shebilske et J. A. Rotondo*

96 étudiants en candidature à l'Université de Virginie ont étudié un passage comprenant 2 866 mots d'un manuel de chimie de 10e année. Les uns dans une présentation standard; les autres dans une version typographiquement plus élaborée. Les deux groupes disposaient de 19 minutes environ **(La memorisation des alineas, les préférences des étudiants, les réponses au questionnaire permettent de conclure que la typographie et la mise en page peuvent favoriser l'étude et la memorisation).** On a examiné les possibilités d'application. (La disposition utilisée ici est similaire mais non identique à celle que nous avons utilisée). Ici nous utilisons les grasses pour les mises en évidence; dans l'expérience en question nous avons utilisé des capitales parce que les textes étaient dactylographiés. Ici, ce sont les auteurs qui ont fait les alinéas; à l'université, ce sont des étudiants qui en ont décidé. Voici les instructions à donner: **(Le passage est à composer selon une disposition qui joue sur les interlignes et qui fait appel aux parenthèses et aux grasses. Chaque proposition est marquée par un interligne; les parenthèses en font ressortir l'essentiel, que la proposition soit importante ou non. Lorsqu'une proposition est importante, l'essentiel en est résume et composé en gras).**

Planimétrie de l'information: description, justification, et comparaison avec le codage de l'information *par D. Jonassen*

L'auteur explique d'abord ce qu'il entend par planimétrie de l'information; il donne un exemple et présente les résultats obtenus par une expérience où les mêmes informations sont présentées sous forme planimétrique et sous forme codée. En l'occurence, les deux types de présentations étaient également efficaces, mais il s'est avéré que l'information planimétrique était plus facile à récupérer que l'information programmée.

La notation spatialisée: que vaut-elle? *par L. Norton*

La notation spatialisée telle que la définissait Tony Buzan, en 1974, consiste à prendre ses notes selon un arrangement spatial qui contraste avec la disposition linéaire qui est la plus répandue. Il s'agit (1) de noter les mots-clés et (2) de se concentrer sur le groupement des notes. Aucune recherche n'a été faite pour comparer les résultats obtenus par le méthode linéaire habituelle avec ceux que l'on obtient par la méthode spatialisée. Toutefois il semble bien que l'inscription des mots-clés et la disposition concertée de l'information soient favorables à une bonne mémorisation. Ceux qui veulent savoir comment s'y prendre pour spatialiser les notes qu'ils prennent feront bien de peser le pour et le contre avant de se lancer dans une technique dont il n'est pas du tout prouvé qu'elle procure de meilleurs résultats que celle dont ils se servent couramment. Il leur est fortement recommandé de se référer au texte original de Tony Buzan, car sa méthode est souvent très mal présentée par certains enseignants.

L'utilisation de l'espace pour la notation musicale *par J. Sloboda*

L'espace est une dimension importante pour la notation musicale. L'auteur donne une description détaillée de la notation orthochronique (qui est à présent la méthode standard). Il en fait l'historique et la compare avec quelques systèmes antérieurs. L'espace est utilisé principalement pour indiquer la hauteur et la durée des sons ainsi que la synchronisation de plusieurs effets musicaux. Il examine ensuite comment on pourrait comparer et évaluer les différentes méthodes de spatialisation et il poursuit son examen à trois niveaux: (1) quant à la quantité d'informations musicales à présenter (2) quant à la nature des symboles (et leurs caractéristiques spatiales) qui ont été choisis pour représenter ces informations et (3) quant aux besoins du lecteur.

Kurzfassungen der Beiträge

Übersetzung: Dirk Wendt

Typographie ohne Worte *von M. Twyman*

In diesem Aufsatz wird eine einfache Notation zur Darstellung einiger der graphischen Variablen der Typographie eingeführt. Sie basiert auf dem Gebrauch der "x", "o" und "i" der Schreibmaschine und soll von jedem benutzt werden können, der sich mit graphischer Sprache beschäftigt. Es wird angenommen, daß die Notation auch von Wert in bezug auf den Unterricht ist, weil sie zu ernsthaftem Nachdenken über typographische Probleme in begrifflicher Nomenklatur führt. Die Regeln der Notation werden erklärt, und der allgemeine Ansatz wird durch die Behandlung eines einzelnen Themas "Überschriften im Text" demonstriert. Dieses Thema wurde gewählt, weil es sich auf das Thema dieser Ausgabe dieser Zeitschrift bezieht. Die Notation ist seit einer Reihe von Jahren im Department of Typography & Graphic Communication an der University of Reading in Gebrauch, im Zusammenhang mit dem Unterricht für Studienanfänger und Laien. Es wird angenommen, daß die Notation neben ihrem Nutzen für den Unterricht auch wertvoll zur Förderung des Gesprächs zwischen Forschern und Typographen sei.

Die Auswirkung von Änderungen des Layout und Änderungen in der Formulierung bei Lehrtexten *von J. Hartley und M. Trueman*

Beurteiler gaben ihre Präferenz für Lehrbuchseiten an, die in Layout, Textformulierung oder beiden diesen Variablen variierten. Es wurden drei verschiedene Methoden zur Erhebung der Bevorzugungen benutzt. Die Ergebnisse legen nahe, daß diese Maße nützliche quantitative Rohdaten darstellen können, aber daß man sich nicht allzusehr auf sie verlassen könne, wenn differenziertere Beurteilungen gefordert werden.

Schreiben in mehreren Ebenen in Theorie und Praxis *von D. L. Jewett*

Ein Schreibstil auf mehreren Ebenen ermöglicht dem Leser mehr Beweglichkeit als traditionelle Formen der Darstellung. Dabei wird im allgemeinen auch das Schreiben selbst leichter. Für verschiedene Zwecke können viele Formen benutzt werden, um die gedruckte Kommunikation zu verbessern, wenn die Form an einer Stichprobe aus der vorgesehenen Leserschaft erprobt worden ist; diese vorherige Erprobung ist ebenso wichtig oder noch wichtiger als irgend ein typographisches Schema. In diesem Aufsatz werden (1) Hintergrund und Theorie, (2) typographische Methoden und (3) hierarchische Ordnungen des Schreibens in mehreren Ebenen vom Gesichtspunkt des Verfassers behandelt (der nicht damit vertraut ist, was andere in dieser Hinsicht getan haben). Der Aufsatz selbst ist in mehreren Ebenen geschrieben, mit Einrückungen des Textes zum Ausdruck von drei allgemeinen Ebenen: Haupgedanken, Ausführung der Hauptpunkte, Randbemerkungen.

Typographische and räumliche Hinweise, die das Lernen aus Lehrbüchern erleichtern *von W. L. Shebilske und J. A. Rotondo*

Sechsundneunzig Studienanfänger an der University of Virginia lernten nach einem Auszug von 2866 Wörtern aus einem Biologie-Lehrbuch für das 10. Schuljahr, und zwar entweder im üblichen typographischen Layout, oder in einem speziellen mit typographischen und räumlichen Hinweisen. Beide Gruppen bearbeiteten den Text etwa 19 Minuten lang. (**Die Ergebnisse eines Wort-Erinnerungs-Tests, eines Mehrfach-Wahl-Tests und eines Fragebogens zeigten, daß die typographischen und räumlichen Hinweise das Lernen und Erinnern erleichterten.**) Es wurden mögliche Anwendungen in der Unterrichts-Praxis diskutiert. (Die hier benutzte Darstellungsform ist nicht identisch mit der im Experiment benutzten.) Hier benutzten wir halbfette Schrift zur Betonung; im Versuch verwendeten wir Großbuchstaben, weil das leichter ging mit der Schreibmaschine. Hier legten die Verfasser die Einheiten der Textsegmentierung fest; im Experiment taten das Gruppen von College-Studenten. Die Anweisungen zur Anwendung unserer Darstellungsform sind: **(Die Textstelle wird in bestimmter Weise gedruckt, unter Benutzung von Zeilenzwischenräumen, Klammern, und Halbfettdruck. Zeilenzwischenräume trennen Ideen, und Klammern kennzeichnen den Kernpunkt jeder Idee, ob sie bedeutend ist oder nicht. Wenn die Idee bedeutend ist, wird ihr Hauptpunkt halbfett gedruckt.)**

Informationsgruppierung: Beschreibung, Begründung und Vergleich mit programmierter Instruktion *von D. Jonassen*

In diesem Aufsatz wird Informationsgruppierung (information mapping) definiert, in der praktischen Anwendung gezeigt, und werden die Ergebnisse einer Untersuchung dargestellt, in der ein Lehrtext in gruppierter und in programmierter Form verglichen wurden. Die Ergebnisse zeigen, daß in diesem besonderen Falle beide Formen gleich wirksam beim Lernen waren, daß es aber signifikant leichter war, in der gruppierten Information einzelne Informationen wiederzufinden als in dem programmierten Text.

Mitschreiben in Mustern: eine Bewertung *von L. Norton*

Das Mitschreiben in Mustern, wie es von Tony Buzan (1974) beschrieben wurde, ist eine Technik zur Aufzeichnung von Informationen in räumlichen Anordnungen, die im Gegensatz zu dem üblicheren linearen Stil steht. Die Wirksamkeit des Mitschreibens in Mustern soll (1.) vom Niederschreiben von Schlüsselwörtern und (2.) von aktiver Beteiligung beim Mitschreiben abhängen. Es gibt noch keine Untersuchungen, in denen die Effektivität des Mitschreibens in Mustern mit der des linearen direkt verglichen wird. Es gibt jedoch einige Hinweise, daß das Niederschreiben von Schlüsselwörtern und aktive Umformen der Information beim Mitschreiben das Behalten fördert. Den Studenten, die lernen möchten, in Mustern mitzuschreiben, wird empfohlen, sich es sorgfältig zu überlegen, ehe sie ein Verfahren lernen, für das es keine überzeugende Evidenz gibt, daß es wirksamer ist als das konventionelle Mitschreiben. Es wird sehr empfohlen, daß Studenten, die mehr darüber erfahren wollen, Buzan's Originalschrift lesen, da die Technik häufig von Studienberatern erheblich verzerrt dargestellt wird.

Der Gebrauch des Raumes in der Musik-Notation *von J. Sloboda*

Raum ist eine wesentliche Dimension in der Musik-Notation. Der Gebrauch des Raumes in der Partitur-Notation (die heute als Standard-System akzeptiert ist) wird in einigen Einzelheiten beschrieben. Die geschichtliche Entwicklung dieses Gebrauchs wird umrissen, mit Beispielen aus früheren Systemen. Der Hauptgebrauch des Raumes besteht in der Festlegung von Tonhöhe und -dauer, und zur Andeutung der Gleichzeitigkeit parallel ablaufender musikalischer Ereignisse. Die Frage, wie verschieden Arten des Gebrauchs des Raumes in musikalischen Notationen zu bewerten seien, wird dann unter Bezugnahme auf drei Ebenen der Analyse behandelt: (1) die Information über die Musik, die dargestellt werden soll, (2) die Art der Symbole (und ihre räumlichen Eigenschaften), die gewählt werden, um die Information darzustellen, und (3) die Anforderungen des Lesers.

Resumenes de los Artículos

Traducción: Ana Fisch

Tipografía sin palabras *por M. Twyman*

Este artículo introduce una notación simple para presentar algunas de las variable gráficas de la tipografía. Ésta reside en el uso de la 'x', la 'o' y la 'i' de la máquina de escribir y está dirigida al uso de cualquier interesado del lenguaje gráfico. Se sugiere que la notación tiene valor con relación a la enseñanza porque estimula el pensar seriamente sobre problemas tipográficos en términos conceptuales. Se explican las reglas de notación y se muestra un punto de vista general por intermedio del tratamiento de un tópico simple, 'Títulos en el texto'. El tópico fue elegido porque se relaciona con el tema de este número de la revista. Se ha usado la notación en el departamento de tipografía y de comunicación gráfica de la universidad de Reading a través de un número de años en conección con la enseñanza de estudiantes universitarios y de legos. Aparte de su uso en relación con la enseñanza se sugiere que la notación tiene el valor de estimular un diálogo entre investigadores y tipógrafos.

Los efectos de los cambios de disposición y de los cambios de términos en las preferencias del texto de instrucción *por J. Hartley y M. Trueman.*

Los jueces han tasado sus preferencias de las páginas del texto de instrucción que variaban en términos de su disposición, de sus términos o de ambos. Se han utilizado tres métodos diferentes para evaluar preferencias. Los resultados sugirieron que estas medidas podrían proveer de datos cuantitativos aproximados de los que no se debería depender demasiado si se requiriese un criterio definido.

Sugestiones espaciales y tipográficas que facilitan el aprendizaje de libros de texto *por W.L. Shebilske y J.A. Rotondo*

Noventa y seis estudiantes universitarios de la universidad de Virginia estudiaron un extracto de 2866 palabras de un libro de biología del décimo grado ya sea en una disposición tipográfica corriente o una especial que contiene sugestiones espaciales y tipográficas. Ambos grupos estudiaron el texto durante 19 minutos. (**Resultados de una memorización parafrásica, un examen de 'multiple choice' y un cuestionario indicaban que las sugestiones tipográficas y espaciales facilitaban el aprendizaje y la memoria**). Fueron discutidas las aplicaciones potenciales en el aula. (El formato usado aquí es similar pero no idéntico al usado por nosotros). Aquí utilizamos letras del tipo prominente par lograr énfasis; en el experimento usamos letras mayúsculas pues resultaba más fácil en la mecanografía. Aquí los autores determinaron las unidades de segmentación; en los grupos de experimentación en el college los estudiantes las determinaron. Las instrucciones para el uso de nuestro formato son: (**El pasaje está impreso en un formato especial utilizando espacios entre renglones, corchetes y letras del tipo prominente. Los espacios entre renglones enfatizan cada idea y los corchetes enfatizan lo esencial de cada idea sea esta importante o no. Cuando la idea es importante la esencia está en letras prominentes**).

Descripción del trazado de la información en forma de mapa, razones fundamentales y comparación con la instrucción programada *por D. Jonassen*

Este artículo define el trazado de la información en forma de mapa, lo ilustra en la práctica y presenta los resultados por intermedio de un estudio que hace la comparación entre un trozo de texto de instrucción puesto en forma de mapa o programada. Los resultados sugieren que en este caso particular ambas formas de presentación enseñaban con la misma eficacia, pero que era significativamente más facil recobrar información del 'mapa de información' que del texto programado.

Una evaluación sobre el tomar notas en forma deseñada *por L. Norton*

El tomar notas en forma diseñada, descrito por Tony Buzan (1974), es una técnica para grabar información en una representación espacial que contrasta con el estilo lineal más común. Se dice que la eficacia del tomar notas en forma diseñada depende del: (1) escribir palabras claves y (2) estar activamente compenetrado en el proceso del tomar notas. No se ha llevado a cabo ninguna investigación que compare directamente la efectividad del tomar notas en forma diseñada con la lineal. Sin embargo, hay cierta evidencia que hace sugerir que el escibir palabras claves y el transformar información activament ayuda a la retención del tomar notas. Se aconseja a los estudiantes que deseen saber cómo tomar notas en forma diseñada de considerar cuidadosamente antes de comenzar a aprender una estrategia lo cual no tiene una evidencia real para sugerir que es más efectiva que los estilos más convencionales del tomar notas. Se aconseja a los estudiantes que deseen empezar que consulten el manual original de estudio de Buzan ya que la técnica es a menudo seriamente falseada por los ayudantes de estudios.

Los usos del espacio en la notación *por J. Sloboda*

El espacio es una dimensión notacional esencial en la música. Se describe con cierto detalle el uso del espacio en la notación ortocrónica (hoy aceptada como un sistema corriente). Se bosqueja el desarrollo histórico de este uso con ejemplos de sistemas previos. Los principales usos del espacio son de proveer de medios para la notación de tono y de duración e indicar la sincronización de sucesos musicales concurrentes. La cuestión de cómo uno puede evaluar maneras diferentes de usar el espacio en la notación musical es luego tratada con referencia a tres niveles de análisis: (1) la información sobre la música que necesita ser representada; (2) la naturaleza de los símbolos (y sus características espaciales) elegidos para representar la información y (3) los requerimientos del lector.