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The Legibility of Type on Maps

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In order to make practical recommendations to the map designer on type legibility, an experimental study was carried out using four map reading tasks to assess the effect of typographical variables on the map reader's performance. These included typeface, weight, size and case. Two hundred and fifty six undergraduates acted as subjects and many statistically significant differences were found. The principal recommendation is that names should be set in a typeface of normal weight in lower case with an initial capital. However, when names are very difficult to pronounce and need to be copied accurately, capitals are recommended.

1. Introduction

Hand drawn lettering on maps has largely been superseded by mechanical or photographic methods of typesetting, and the map designer has not been short of advice on the best type style to use, or the best way to place it (*e.g.* Keates 1956, Imhof 1962, Anon 1964, Crocker 1964, Gardiner 1964, Bartz 1969 a, Robinson and Sale 1969, Copland 1974). However, none of these studies attempts any objective measurement of the efficiency of type for the map reader, and while there are many experimental studies of the use of type in books, newspapers, posters and tables (see Cornog and Rose 1964, Spencer 1969), there are few investigating the use of type on maps. Bartz (1969 b, 1970 a) and Taylor and Hopkin (1975) have argued that typographical guidelines established from experimental work in other areas cannot safely be applied to maps: maps are exceptionally complex visual displays where type is distributed irregularly, often using a large number of type styles, and where the demands on the reader are very different from other types of display. Probably the first experimental investigation of type on maps was by Mackworth (1944) who compared the legibility of two alphabets for use on World War Two air raid maps, although this study can be criticised for not testing the letters in the context of the map.

Bartz (1970 b) carried out a series of experiments in which adolescent subjects searched for names on a map. In a first experiment, five versions of the same map were used to compare five type styles, but this failed to show any statistically significant differences. (Reasons for this are discussed later.) A second experiment used three more versions of the map in which type styles were mixed; in two out of three versions the only difference being in type size. When subjects knew in which type style a name appeared, they were consistently faster in finding names than in the first experiment, but when they did not know the style they were consistently slower. This suggests that using a mixture of sizes is an advantage if the map reader has a fair idea of the type size used for the target name: adults generally know whether they are looking for a town or a village. However when the map reader does not know what size to expect, as may be the case with children, a mixture of sizes is a disadvantage for searching.

A similar result has been found by Foster and Kirkland (1971) using a map where land names were in black, and water names in blue. When subjects knew the colour of the name, search times were faster than in a map where all the names were printed in

black, but when they did not know the colour, the single colour map was faster. These experiments are in agreement with work by Williams (1967) who demonstrated that the colour and size of geometric targets are discriminated well in peripheral vision, while shape is discriminated poorly.

Cartographers frequently arrange the letters of a name along a curve, for example, when naming a bay or a river. Another experiment by Foster and Kirkland has compared the use of curved and straight print on two versions of a monochrome map. Searching for straight names was significantly faster, although it is possible that the difference is due to the slant rather than the curvature of the names: straightening the names had also made many of them horizontal.

The experiments by Bartz, and by Foster and Kirkland convincingly demonstrate the value of using typographic differences to distinguish categories of names but neither study helps the designer decide which type styles to choose. Bartz's first experiment was directed at this question but it failed to show any significant statistical differences between the type styles tested, even though a large number of subjects were employed. This could be explained either if the differences between type styles are very small, or if the variance in search times is very large. The second possibility seems more likely: even if subjects were to search at the same speed they are unlikely all to start searching at the same point on the map, and so they will reach the target after different times, and, in practice, subjects' skill and motivation will lead to widely varying search speeds, together resulting in a large variance in search times.

In the experiment to be described, a number of steps were taken to reduce the variance in search times. Subjects had to find up to 40 names, one at a time, in four one-minute searches. They were instructed where to start searching on the map, and were required to search in the same direction. To make this possible, the names on the map were arranged along a path in the shape of a reversed *S*, beginning at the top left hand corner and ending in the bottom right hand corner, creating an effect similar to towns clustered along the sides of a meandering river. For each name, subjects were told to search by starting at the top of the search path, and working down. The problem arose: what should subjects do if they missed their target and reached the bottom of the search path? As they had already searched through more names than was necessary, it might be best to instruct them to miss that name out and go on to the next one. However, a pilot experiment suggested that this encouraged careless searching, and a lower variance was produced by instructing the subject to return to the top of the search path and try again.

There were two considerations in choosing questions to compare type styles. Firstly, they should be based on real map reading tasks (a point emphasised by Board 1975) and secondly, they should be questions which are likely to lead to statistically significant differences. These two aims are not always compatible, particularly in questions requiring complex map interpretation where variance is likely to be high. Bartz (1969 b) argues that a search task is the most appropriate for evaluating type on maps, and this is convincing as, on some maps, finding a feature can be more time consuming than interpreting it. Copying names from the map is another activity which the map reader must be able to carry out easily and with a minimum of error. Questions were based on these two tasks and on two others which are less realistic for the map reader, but nevertheless are of some theoretical interest.

Bartz's experiment can be criticised because she confounded her variables. If she had found a significant difference, say, between 12 point Venus Bold Condensed lower case and 8 point Monsen Light capitals, it would have been impossible to say

whether the difference was due to the change in size, the change in case, the change in weight, or the change in face. In the present experiment a factorial design was employed so that the effect of different typographical variables could be clearly assessed. Seven questions were used to investigate the effect of four typographical variables, and three other independent variables, on the map reader's performance, with the aim of making practical recommendations to the designer on type legibility.

2. Method

2.1. *Material*

Sixty-four different versions of the same map were printed on A4 size pages with a map area of 158 mm by 197 mm. Names were printed in black, and on all maps there was a grid also printed in black and layer tints printed in orange. On half the maps there was an additional printing in red depicting rivers, fault lines and other features which greatly increased the ' visual noise ' of the map. These two types of base map are called *easy* and *difficult*. The 60 names appearing on the maps were also either *easy or difficult*. Easy names were selected at random from the gazeteer of a world atlas *e.g.* Revelstoke, Valday, Alamosa. All were six to ten letters long and names which were exceptionally hard to pronounce were not included. Difficult names were anagrams of the easy ones, selected to have less frequently occurring letter transitions than the corresponding easy name, and they were therefore difficult to pronounce, *e.g.* Tlerseeokv, Vylaad, Lmoaaas. Every easy name or its corresponding difficult name occupied the same position on every version of the map.

Names appeared in one of 16 type styles, but type styles were not mixed on any of the maps. The four typographical variables were: size, approximately six point or eight point; case, all capitals or lower case with an initial capital (referred to as lower case); weight, normal or bold; and face, Times New Roman or Univers. Point sizes are a misleading guide to size and Table 1 shows the measured size of the type. These variables were chosen to be typical of modern cartographic practice.

Table 1. Measured dimensions of type used in the experiment (mm).

	6 point Times	6 point Univers	8 point Times	8 point Univers
Height of lower case '*w*'	1·0	1·0	1·4	1·3
Height of capital '*H*'	1·5	1·4	1·9	1·9
Length of '*Tarchan*' in lower case	7·2	7·1	9·7	9·5
Length of '*Tarchan*' in capitals	10·4	10·2	13·7	13·8

In addition to maps, sets of small booklets measuring 75 mm by 105 mm were prepared with lists of names to search for. A single name appeared on each of the ten numbered pages. Care was taken in designing these small booklets to ensure that no time was wasted in turning over the pages. The names were in typewriter script, and for half the subjects they were in capitals, and for the other half in lower case.

2.2. *Design*

The experiment had seven independent variables: (1) map base, (2) names, (3) type size, (4) case, (5) weight, (6) typeface and (7) booklet case. A 2^7 complete factorial design was used with two subjects per cell and subjects were assigned randomly to the conditions.

2.3. *Subjects*

The subjects were first year university undergraduates studying geography, and they were tested in six different groups. Three hundred were tested but data were rejected from 34 of these because they had failed to follow the instructions on one or more questions. From the remainder, the data from the first 256 were analysed. These were 127 men, 124 women and five people who would not specify their sex. Ninety-three per cent were aged between 18 and 20 years.

2.4. *General Procedure and Questions*

Subjects received a booklet containing seven identical maps interleaved with blank sheets of paper, and four small booklets with names to search for. They were informed of the general purpose of the research and were told that it was important that they did their best on the questions, even if they thought that the particular map they had been allocated was poorly designed. The seven questions each had a time limit and, when time was up, a loud buzzer signalled the subject to turn over the page, exposing a blank page in the booklet. Great care was taken to explain the questions clearly, and subjects were invited to ask questions.

Subjects were assigned to a particular type of map which they used for all the questions. If they had each worked on several different maps there was the possibility of range effects: these distort the results of an experiment so that performance is best, not on the optimum type style, but on the type style which falls in the middle of the range of those tested (see Poulton 1973).

It was likely that subjects' performance would improve as they became more familiar with their map and more skilled at doing the questions. With practice their strategies could change and fatigue might impair performance. The order they tackled the questions was clearly important. Searching for names is the most useful question and therefore it was put first. It was repeated four times to study changes in performance with practice. This was followed by two questions of relatively minor importance and, as these also involved searching, it is probable that their scores are affected by previous questions. The final question involved copying names and as this was a very different kind of task, it is unlikely that its results are much affected by previous questions.

2.5. *Questions 1 to 4 (Search)*

There was a small booklet for each question with ten names to search for, the order of the names being the same for all subjects. They searched for one name at a time, always starting at the top of the search path, and crossing out the name on the map. The time limit was one minute and the score was the number of names correctly crossed out. Questions 1 to 4 were identical except that each had a different set of target names.

2.6. *Question 5 (Letter S)*

The procedure was similar except that subjects crossed out names containing a letter *S* and the time limit was 30 s.

2.7. *Question 6 (Alphabet)*

Subjects were instructed to start by finding all the names which began with *A*, and to cross out whichever of these came first in alphabetical order: for example, if there were three names beginning with *A*: Avonmouth, Aberdeen and Axminster, they

should cross out Aberdeen as this comes first in alphabetical order. They were told to continue, treating names beginning with *B, C, D etc.* in the same way. If they could find no name beginning with a particular letter they were told to write ' No *X* ' underneath the map, although this was never necessary in practice. The time limit was 1·5 min. One point was scored for each name correctly crossed out, and half a point for an incorrect name.

2.8. *Question 7 (Copying)*

Subjects were asked to copy names accurately from the map onto a grid printed underneath the map, writing in capital letters. They were told to start copying at the top of the search path, but the exact order of names was left to them. The time limit was 45 s. One point was scored for each name written and a point deducted for each omission, instrusion or reversal of letters. As several mistakes could occur in one name, negative scores were possible although this happened only once in practice.

3. Results

An examination of the distributions of scores for skew and kurtosis suggested that the untransformed data were satisfactory for analysis of variance, and a separate *analysis of variance* was carried out for each question. No high order interactions were predicted and on all questions, the number of statistically significant three way and higher order interactions was no greater than would be expected by chance, and so the corresponding sums of squares were pooled with the error terms.

Table 2 shows the means for the main effects together with significance levels—the booklet case variable was not significant as a main effect and so is omitted. For reasons of space, the seven large analysis of variance summary tables are not included here. The authors would be happy to provide copies to any interested reader.

Table 2. The means for the seven questions and significance levels from the analyses of variance.

		1. (Search)	2. (Search)	3. (Search)	4. (Search)	5. (Letter S)	6. (Alphabet)	7. (Copying)
Maximum possible		10	10	10	10	18	26	60
Range of scores		1 to 10	1 to 10	0 to 10	0 to 10	10 to 18	1·5 to 9	−1 to 14
Grand mean		5·78	5·86	4·54	5·05	14·99	3·96	6·73
Size	6 point	5·41**	5·55**	4·66	4·84*	14·78	3·91	6·38**
	8 point	6·15	6·16	4·43	5·26	15·20	4·01	7·07
Case	Capitals	5·78	5·59**	4·45	4·84*	14·93	3·76**	7·05**
	Lower case	5·78	6·13	4·64	5·26	15·05	4·16	6·40
Weight	Normal	5·74	5·68	4·63	4·85*	14·74*	3·93	6·64
	Bold	5·82	6·04	4·46	5·24	15·23	4·00	6·81
Face	Times	5·80	5·95	4·67	5·22	15·22	4·08*	6·73
	Univers	5·76	5·77	4·41	4·88	14·76	3·84	6·73
Map base	Easy	6·23***	6·04	4·63	5·23	14·98	4·08*	6·95*
	Difficult	5·33	5·68	4·45	4·87	14·99	3·84	6·50
Names	Easy	6·38***	6·38***	4·88**	5·26*	15·30**	4·26***	8·03***
	Difficult	5·18	5·34	4·20	4·84	14·67	3·66	5·42
Two way interactions		Size x Map base*	Booklet case x Case* Booklet case x Size*	Booklet case x Case**	Booklet case x Case** Booklet case x Names** Size x Weight*			Case x Names***

(*** = $p < 0{\cdot}001$, ** = $p < 0{\cdot}01$, * = $p < 0{\cdot}05$, unmarked = $p > 0{\cdot}05$)

On questions 1 to 5, error rates were low, with errors occurring on less than 1% of questions. On question 6 there was a mean of 0·55 errors, and on question 7 a mean of 0·74 errors.

Although not part of the experimental design, the scores were examined for age and sex effects. No age effects were evident, but women scored higher than men on all questions and this difference was statistically significant ($t = 5{\cdot}60$, $d.f. = 249$, $p < 0{\cdot}001$). This is unlikely to bias the results because the distribution of booklets was carefully randomised, although it may be worthwhile to include sex of subject as an independent variable in future experiments of this kind.

4. Discussion

4.1. *Questions 1 to 4 (Search)*

Subjects carried out the same search task on the same map four times over, and it is likely that they were helped in the later questions by remembering some of the names, as well as by becoming more proficient at searching the map. On question 1 the difference between easy and difficult names was about 23%, but it dropped steadily to 9% on question 4. Similarly, the difference between map bases dropped from 17% to 7%, and for type size from 14% to 9%. These results suggest that subjects quickly learned to adjust for the difficulties of small type, a complex base map and unpronounceable names. With weight, face and case, the opposite effect may be present, for example, the difference between Times and Univers increases from 1% on question 1 to 7% on question 4, but as few differences in face, weight and case were statistically significant, these effects are less reliable.

In making practical recommendations for the designer, these differences are of little importance. What is needed is an average measure of search speed, and so for further analysis the four scores were added together.

On three out of four questions there is a significant interaction between the case (*i.e.* capitals or lower case) used on the map and the case in which names appeared in the small booklets. In addition, the case used on the map is a significant main effect for two questions, and there is a significant interaction between the booklet case and the type of name on one question. Figure 1 shows some means for the total number of names found on the first four questions. When easy names were sought, the most important factor was the case used on the map—lower case was easier than capitals. When difficult names were sought, what mattered was that the case used in the small booklets should have been the same as the case used on the map.

To explain this result it is useful to consider what the subject had to do. On each search, one name was read from the booklet, then an average of about 30 names were examined on the map, compared with the name in memory and rejected. Finally, a match was found and the response was made. The differences in Figure 1 almost certainly result from the time consuming part of the search: the repeated examination of names on the map.

When difficult names were printed in the same case on the map and in the booklet, the subject was almost certainly comparing visual codes of the name. Even if the unpronounceable names could be coded as phonemes, it is difficult to explain why the case used in the booklets should affect performance if phonemic coding was in operation. Visual coding could take several forms. The subject could be storing a crude, photograph-like image of the word, but this would be inefficient as the typeface in the booklets was different from the faces used on the map. Some form of graphemic storage is more likely where letters, or groups of letters, are coded for matching.

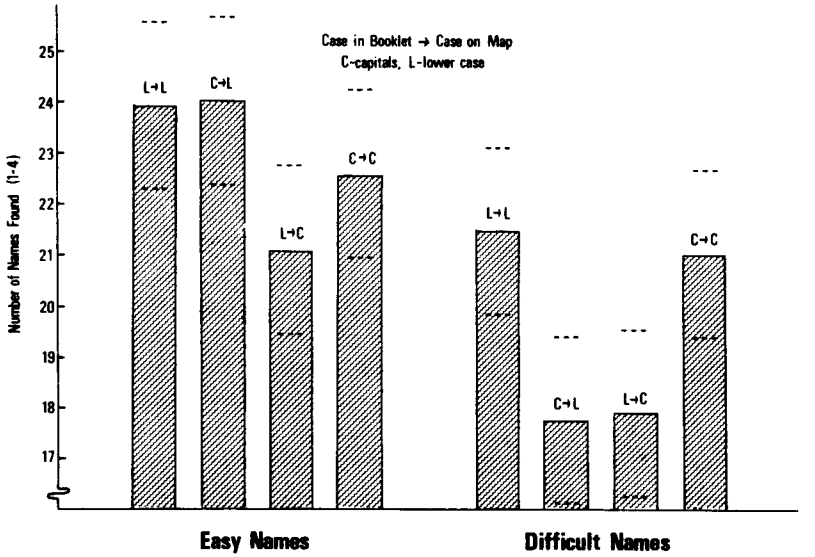

Figure 1. The mean number of names found in questions 1 to 4 is shown as a function of the case used on the map, the case used in the small booklets, and the difficulty of the names. The dotted lines show ± 2 standard errors of the mean, estimated from the error mean sum of squares.

Other forms of coding are possible, for example, a match with a lexical store, or a semantic association, although these are unlikely to be common over such short periods of time and, besides, they cannot explain why case needs to be unchanged. Therefore, it seems likely that with difficult names in a compatible case, the subject is matching visual or graphemic codes of the name, and these must retain some of the features of lower case and capital letters. When the case changes from the booklet to the map, performance drops substantially, suggesting this type of graphemic matching is no longer possible. In this situation subjects may be matching only part of the word, for example, the initial letter, and this wastes time as checking is necessary.

Performance was best in the situation which was closest to normal reading, when easy names were read from the map in lower case. It is tempting to suggest that while difficult names relied on matching graphemic codes, easy names were stored as phonemes. But in discussing phonemic and graphemic coding in word recognition, Meyer, Schvaneveldt and Ruddy (1974) have drawn attention to the difficulty of distinguishing the two experimentally. For example, in this experiment, the change from easy to difficult words not only makes words less pronounceable, but also introduces unfamiliar letter transitions which would affect any form of graphemic coding which works with groups of letters. Therefore, the change from easy to difficult words is not necessarily related to a change from phonemic to graphemic coding, and it is possible that easy names in lower case are matched as graphemic codes, although these must differ considerably from the graphemic codes of difficult names.

When easy names appeared in capitals on the map, performance lay somewhere in between the level for easy names in lower case, and the level for difficult names in a compatible case. It is possible that subjects were mixing the two coding strategies and the weak effect of case compatibility offers some support for this.

The problem is complicated by the fact that searching is probably a two stage process. Peripheral vision may be used to select names which resemble the target name, and these are then fixated for a more careful examination. It is hard to say, for example, whether easy words in lower case are easier to select in peripheral vision, or whether the advantage occurs when words are fixated directly. Some experiments we are conducting, recording eye movements, may elucidate this problem.

4.2. *Question 5 (Letter S)*

This question was included as a possible quick method for evaluating type on maps. The task has many similarities with searching for a name, but has the advantage that no special booklets need preparing. The presence or absence of the letter *S* can be determined acoustically, and so the subjects may not have found it necessary to search through individual letters, although this would have been necessary had the target letter been an *E* or an *H*.

Question 5 was statistically significant on only two main effects: the difficulty of the names and the type weight. Questions 1 to 4 demonstrated that type size and type case have an important effect on the speed of search, but neither of these were significant in question 5. It seems that question 5 is a poor predictor of those factors which affect searching for a name, although carry over effects from previous questions and a possible ceiling effect may have reduced its efficiency.

4.3. *Question 6 (Alphabet)*

This was a complicated task involving visual search, as did questions 1 to 5, but in addition putting a greater burden on the subject's memory, as well as putting special emphasis on identifying the first letter of a name. Performance was significantly better with the use of lower case, probably because this emphasises the initial capital letter. Typeface was also significant, with superior performance using Times.

4.4. *Question 7 (Copying)*

Unlike questions 5 and 6, copying a name from a map is a task frequently carried out by map readers. Type size and type case were both significant main effects and there was a significant interaction between case and word type. It should be noted that with this task capitals were superior to lower case.

4.5. *Recommendations for the Designer*

The tasks used in questions 5 and 6 are not typical of map reading and so recommendations should be based on the total score from questions 1 to 4, and on the score for question 7. The easy names are typical of those found in international mapping, while the difficult names tend to be unnaturally hard to pronounce, and so it is desirable to base recommendations largely on the scores from the easy names. In Figures 2 and 3, data from easy and difficult names are plotted separately.

Figure 2 shows that when easy names were searched for, or copied, performance was about 7% better when using eight point type than six point type. In addition, searching was about 10% faster using lower case type rather than capitals, but the copying task was unaffected by case. Type weight had little effect on either task, and while Times appears to be superior to Univers for searching, this effect was not statistically significant.

Figure 3 shows the corresponding data for difficult names, and the most striking

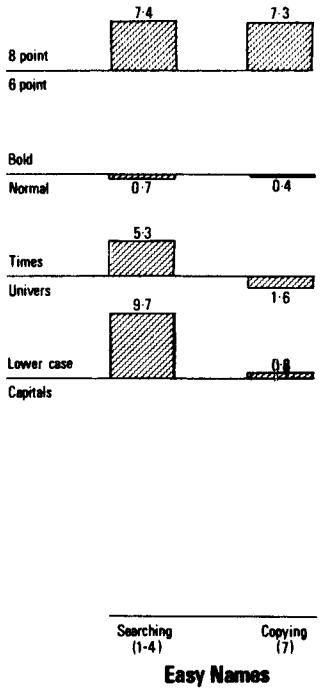

Figure 2. Taking the easy names only, the histograms show the percentage difference between means for the four typographical variables.

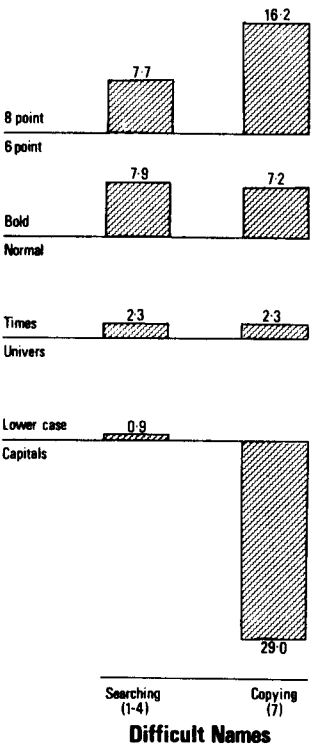

Figure 3. Taking the difficult names only, the histograms show the percentage difference between means for the four typographical variables.

difference is that capitals are much better than lower case for the copying task. This result suggests that, although lower case is generally preferred, capitals should be used when the map reader is likely to find a name very difficult to pronounce, and when it is important that it is copied accurately. It is possible that the large advantage of capitals is partly due to the fact that subjects wrote the names in capital letters. With difficult names there may be a similar effect to that found on questions 1 to 4: performance is best when case remains the same. Question 7 was given to a further 16 geography students who had not taken part in the main experiment and they were told to copy the names in their normal handwriting. With lower case maps the mean was 9·38 and with capitals it was 10·43, with a 1·0 min time limit. Although this is not statistically significant, the 11 % difference suggests that the advantage of capitals still remains when copying in handwriting.

Type legibility must be considered in the context of the map as a whole: 12 point type is likely to be very legible but it would clutter a map unacceptably. The crucial question for the designer is: How important is type on this particular map? In a city street map, type is the most important feature, but in a geological map it is of relatively minor importance. Where type is important, large point sizes are justified, even though they may slightly reduce the legibility of other features on the map. Another important consideration in choosing type size is the complexity of the map. In this experiment, mean scores for six point type on the easy base were about the same as for eight point type on the difficult base.

Type size is frequently used to communicate the size or importance of a place and Bartz (1970 b) has shown this leads to faster searching when the subject knows which type size to expect. Williams (1967) argues that this increase in speed occurs because a subject can structure his percept of a display so that only targets of a particular size are processed, as though the perceptual system can filter out targets of an inappropriate size. If this is the case, the perceptual system can effectively reduce a map with names in a mixture of sizes to a map with names in one size only. This suggests that the results of this experiment should apply equally well to maps employing one size only or to maps with a mixture of sizes.

Mean scores were higher for Times than for Univers on all questions involving search but the absence of statistically significant differences (except on question 6) suggests the difference could be due to sampling. One disadvantage of Univers is that the capital '*I*' and the lower case '*l*' are almost identical: Ordnance Survey have solved this problem by introducing a curved '*l*'. It is possible that an experiment using typefaces other than Times and Univers would show statistically significant differences, although research on typefaces for reading has rarely found them. A notable exception is work by Poulton (1965) where comprehension scores were significantly higher for Gill Medium than for Univers or Grotesque, but even if this result was found on maps, designers are unlikely to adopt Gill, as its width appears to make it unsuitable for map work.

There is no gain in using bold type: this clutters the map without increasing legibility.

The results suggest that it is faster to search for a name set in lower case with an initial capital than for a name set entirely in capitals, even though the latter is physically larger. This difference may be due to the greater number of distinctive features in lower case letters, for example, the ascenders and descenders. But another explanation is possible: the initial letter is a capital and so it is emphasised. This would help the reader if he eliminates names on the basis of their first letter. If this is true, there

should also be an advantage when a name is set in small capitals with an initial large capital, but this prediction has not been tested.

This was a study of adult map readers and a different pattern may result from testing young children. The results largely confirm existing cartographic practice: most modern maps employ lower case type in a normal weight. This study has not compared italic and roman type styles, nor has it compared faces other than Times and Univers, and these subjects deserve some further investigation.

To summarise, the following recommendations are made to the map designer.

(1) Legibility of type must be considered in relation to the legibility of the map as a whole. The designer should ask himself: Are the names among the most important features on the map, or are they of relatively minor importance?

(2) The size of type should be determined by the importance of individual names, and the importance of names in general for the map in question. Eight point is easier to search for and is more accurately copied than six point type. Bartz has demonstrated that it is an advantage to use a mixture of sizes on a map when the reader is able to guess the size used for particular names.

(3) Names set in lower case with an initial capital are easier to search for than names set entirely in capitals. As lower case names also occupy less space on a map, they are strongly recommended.

(4) Bold type is no more legible than normal weight type and should be avoided as it has a cluttering effect on maps.

(5) The choice of typeface appears to have little effect on legibility. Names set in Times New Roman may be slightly easier to find than those set in Univers.

(6) Names which the map reader may find very difficult to pronounce (*e.g.* LLANUWCHLLYN or SZLICHTYNGOWA) should be set entirely in capitals if it is important that names are copied correctly.

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Afin de pouvoir proposer des recommandations pratiques aux éditeurs de cartes géographiques en ce qui concerne la lisibilité des caractères, on a effectué une expérience comprenant quatre épreuves de lecture de cartes afin d'étudier les effets des variables typographiques sur la performance de l'utilisateur. Ces épreuves portaient sur le type, le poids, la dimension et la catégorie majuscule-minuscule. Deux cent-cinquante-six étudiants servaient comme sujets. De nombreuses différences statistiquement significatives ont été trouvées. La recommandation principale est que les noms devraient être imprimés avec un type de poids normal, en minuscules avec une majuscule initiale. Cependant lorsque les noms sont très difficiles à prononcer et qu'ils doivent être copiés correctement, les lettres capitales sont conseillées.

Um praktische Empfehlungen für Karten-Entwürfe zur Verbessrung der Leserlichkeit zu machen, wurde eine experimentelle Studie an 256 Studenten durchgeführt. Es wurden vier Leseaufgaben von Karten gestellt, um den Effekt der typographischen Variablen auf die Leistung des Lesers der Karte zu bestimmen (Typen, Gewicht, Größe, Schriftsatz). Es wurden viele statistisch signifikanten Unterschiede gefunden und diese werden zusammen gestellt. Die hauptsächliche Empfehlung wäre, daß Namen in Typen von normalem Gewicht in kräftigem Schriftsatz mit Großbuchstaben am Anfang gesetzt werden sollten. Wenn jedoch die Namen sehr schwer auszusprechen sind und genau abgeschrieben werden sollen, sind Großbuchstaben vorzuziehen.

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