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LABEL SIZE DESIGN: AESTHETICS AND EFFECIENCY

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Abstract
Determining the 'best' legible label size is a critical concern that involves testing different design aspects besides the needs of the actual map user. These aesthetic criteria and users' efficiency can contribute to a better perception and legibility of maps. A number of screen maps were presented to the participants and they were asked to indicate their preference regarding the different label sizes. In a second user study, the participants' reaction times, during which they had to locate a target label with a certain size, were registered. Both areal and point data were integrated in the user study to determine their influence on the rules for label sizes. Based on the findings of both user studies, the correlation between the preferred and most efficient sizes was identified. These results allow defining rules that contribute to more efficient maps with a higher aesthetic level.

INTRODUCTION:

Bertin (1970) defined six visual variables (size, shape, orientation, colour, value and texture) that contribute to the overall design of the map. These six visual variables, and their associated perceived properties, are considered the basics rules for symbolizing data. Fairbairn (1993) also considered map labels as the fourth data type in addition to points, lines, and areas. The properties of size as visual variable make it a dominant variable in the visual attention. Size can provide selective, quantitative, and order perception. Size is the only visual variable that works for all quantitative attributes. Selective size allows map readers to distinguish between large sized symbols and symbols with a small size. When size indicates a numerical value, the interpretation of the size symbol is linked to the changes of the represented value. Size is limited by the ability of the map reader to estimate the difference between sizes. The perception of order is closely related to the hierarchical structure of the visualization. Applying these rules on the map labels results in several functions of map typography (Fairbairn, 1993).

The typographic design follows similar rules as for the other data types; however there are slight variations in this. Changing the size of a label can be done in a number of ways. First, the size of the labels can be adapted by changing the font size which is often expressed in points. Another option to increase the size of the labels (and thus their importance) is to depict them in bold. Finally, variation in the case styling (lower case versus upper case) also influences the actual size of the map labels (Deeb *et al*., 2012). Although the change in the dimensions of labels is typically measured in dots, it can only be compared quantitatively for similar fonts (shapes). Slocum *et al*. (2005) distinguished two levels of size variation: size changes of the entire symbol and size changes of the individual mark of the symbol. The first case is applicable when symbolizing labels with a constant size, depicted in the same font and with the same case style that use similar x-heights. Using uppercase for the first letter of the label and lowercase for the rest of letters creates mixed sizes due to the differences in x-height and cap height. A familiar example of size properties is the labeling of communities; the larger the community, the larger the label. This allows distinguishing between cities, towns, and villages. Representing the population in ranked sizes gives direct information about the community's importance. The distinction between cities, towns and villages represents the selective property of label size. When applying visual variables on thematical data, Garlandini and Fabrikant (2009) found out that the variable size is the most efficient variable under users' interaction display. Thus, it is important to link the influence of size on the users' performance regarding typographic design.

Bratz (1970) investigated the typographic variables shape and size on paper maps to evaluate their influence on the users' search time (efficiency), both for individual labels and the complete searching task. Bratz aimed to answer two essential questions. Firstly, how does the size of map typography's influences the users' search time? Secondly, what dimensions should the type have for certain map scale? Her study described users' performance on paper maps and described rules regarding the labels' size and the map's scale. Kraak and Ormeling (2010) described the difference between texts in a book and on a map. Furthermore, they defined rules for texts design on maps to improve their readability. They presented size as one of the leading variation to show hierarchy. van den Worm (2001) clarified that the legibility of web maps is primarily determined by text size and suggested that the minimum size of textual elements on these screen maps is 8 points. Furthermore, he indicated that bold sizes provide better legibility. Deeb *et al*., 2011 also compared the preference of two user groups (experts and non-experts) regarding the use of bold labels and found out that both groups have an incompatible viewpoint on the normal and bold size design. Labels are flexible symbols that need special care in their design in order to acquire the higher level of quality, particularly when considering digital maps.

This paper presents a user study attributing the label size characteristics. The study was made in two steps. Firstly, users determined the aesthetics of label size measured by their preference of map design. Secondly, users determined the efficiency of label size measured by millisecond. Combining the results from the two steps led to setting the suitable criteria for different design purposes.

METHOD

In order to visualize thematic maps, areal data was employed. The names of the areas were the same on all maps while the label design changed in size for each designed map. The designs used Arial font and labels sizes of 8, 10, 12, and 14 points. Both normal and bold sizes were applied. Labels were all depicted in lowercase. The maps used in this user study had a simple design without background colours. This ensures the limitation of the influencing factors on the users' cognitive processes and on map perception (Board and Taylor, 1979). Maps were designed at the scale of 1:100,000.Two groups of 50 map users each followed the test. To control the learning process, each group followed a part of the test. 16 map displays were presented to 50 participants. Of each 50 participant 25 were female and 25 were male. The average age is 24 years.

An online test was constructed to test users' reactions to label size design. Two different displays were presented to participantsas each group followed one stimuli. At first participants had to choose one of two maps which are presented simultaneously on the screen. An example of such two maps are illustrated in Figure 1. Their preference is registered in a database as an evaluation of the size aesthetics.
In a second user study, the participants had to locate a target label (see Figure 2) on these maps. The time needed to complete this task is registered as a measurement of efficiency. The target labels had the same length (seven letters) and were distributed in the four corners of the map. The users' search strategies can be either random (they don't follow a special method of scanning the map), or systematic (they scan the map in geometrical manners) (Lleras and Von Mühlenen, 2003). By clicking on the target, the time between the map appearance and the clicking is register in the database. Combining the results of the two experiments, two kinds of data thus are registered: the users' aesthetical evaluation of different label sizes and the users' efficiency regarding the use of different label sizes.

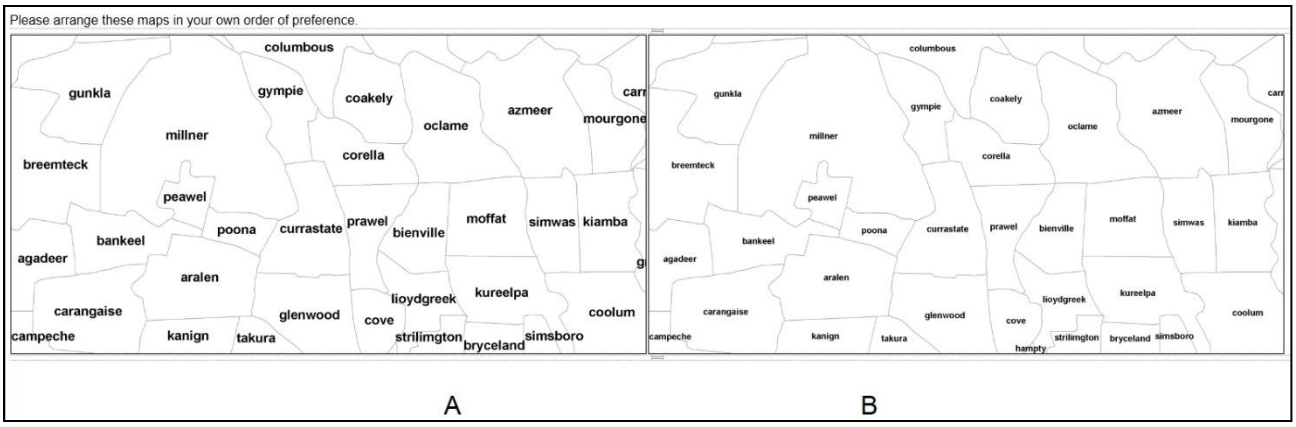

Figure 1. Example of two maps used in the first experiment: size 12 versus 8 points

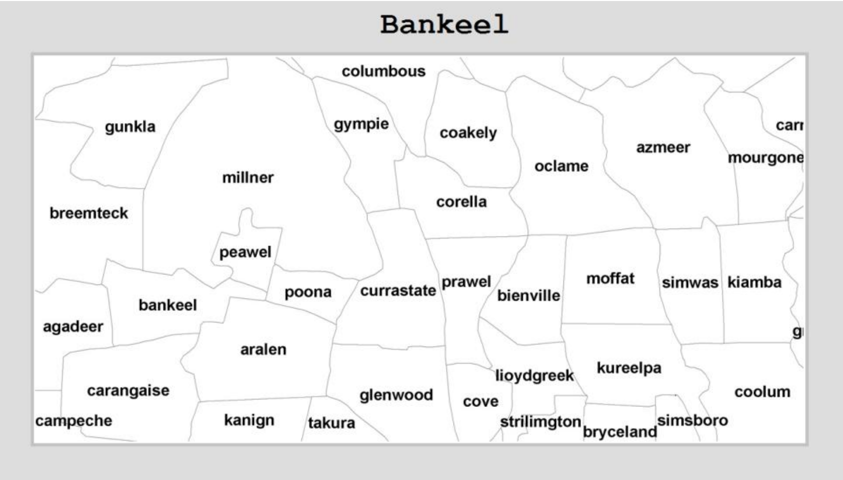

Figure 2. Example of a map and its target label used during the second experiment

RESULTS AND DISCUSION

The data from both experiments were collected and compared systematically. Studying the aesthetics of label size design, the four tested size (8, 10, 12, and 14 points) of Arial font were compared pair wise between normal and with bold size. The users' preference of regarding these sizes is depicted in Figure 3. Comparing normal and bold size preference of 8 point, map users slightly preferred bold over normal: 52% against 48%. The difference in the users' preferences varies more for the larger labels sizes (10, 12, and 14 points). When the size enlarges, the preference of normal increases as follows:

For size 10 points 62% of the map users preferred normal size 10 point over 38% of bold size.

For size 12 points 70% of the map users preferred normal size 12 point over 30% of bold size.

For size 14 points 74% of the map users preferred normal size 14 point over 26% of bold size.

The illustration clearly shows that the users' preference of size 8 almost equal between normal and bold, whereas the variation of preference enlarges steadily as the label size increases from 10 to 14 points. For a small label size, such as 8 points, the difference between a normal and bold font is less clear, especially when these labels are depicted on a screen with a limited resolution. The increase preference of normal label size could be linked to the map scale in which labels were presented. The ratio between bold preference and normal preference for size 10 is 2/3, the same ratio for size 12 is 3/7, and for size 14 is 3/8.

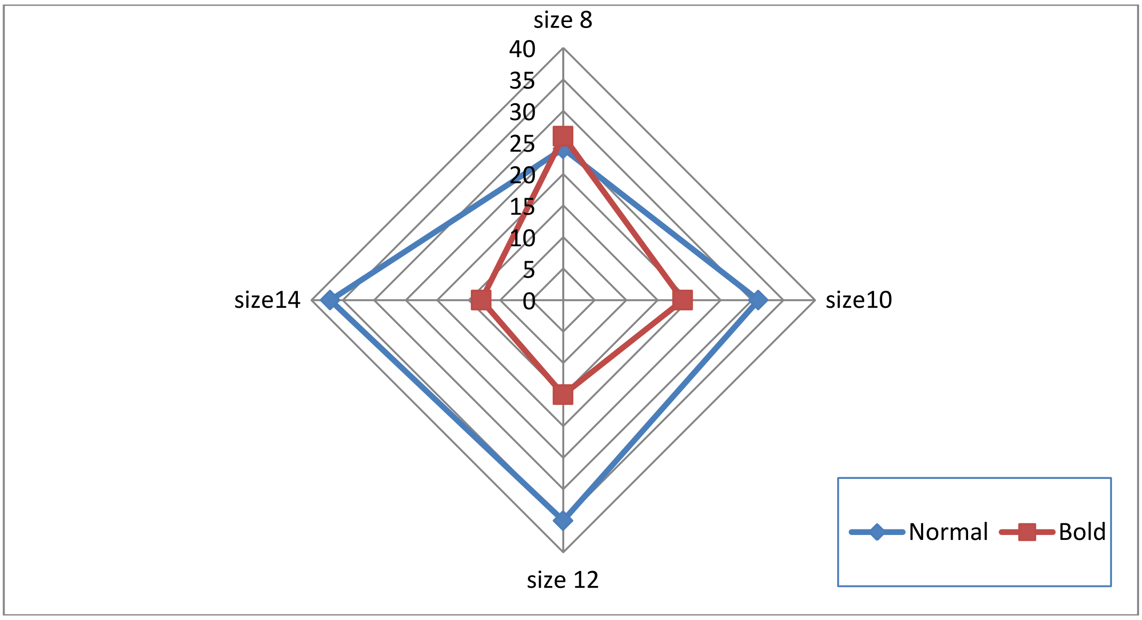

Figure 3. Frequency of the users' preference (%) of label size (normal versus bold)

The users' performance was studied by measuring reaction time related to the four tested sizes and the use of a bold font. A different trend than with the preferences values is noticed (see Figure 4). The bold sizes result in a higher level of efficiency indicated by shorter reaction times to locate the target label. There was not striking trend for users' performance regarding normal sizes registered. The largest reaction time was recorded for size 10 normal followed by size 8 normal then size 14. Thus, the most efficient normal size is 12 points. For the bold sizes it was most difficult to locate the labels depicted in the smallest size (8 points). Similar, but smaller, reaction times were recorded for bold size of 10, 12, 14 points. The variation in the registered performance measures for the same size is different for each size. The variation between normal and bold for 8 points size is about 4 seconds, for 10 points this is about 6 second), for 12 points it is about 2 seconds, and finally for 14 points this is about 5 seconds. These variations indicate the needs to consider thoroughly whether using bold or normal size for the design.

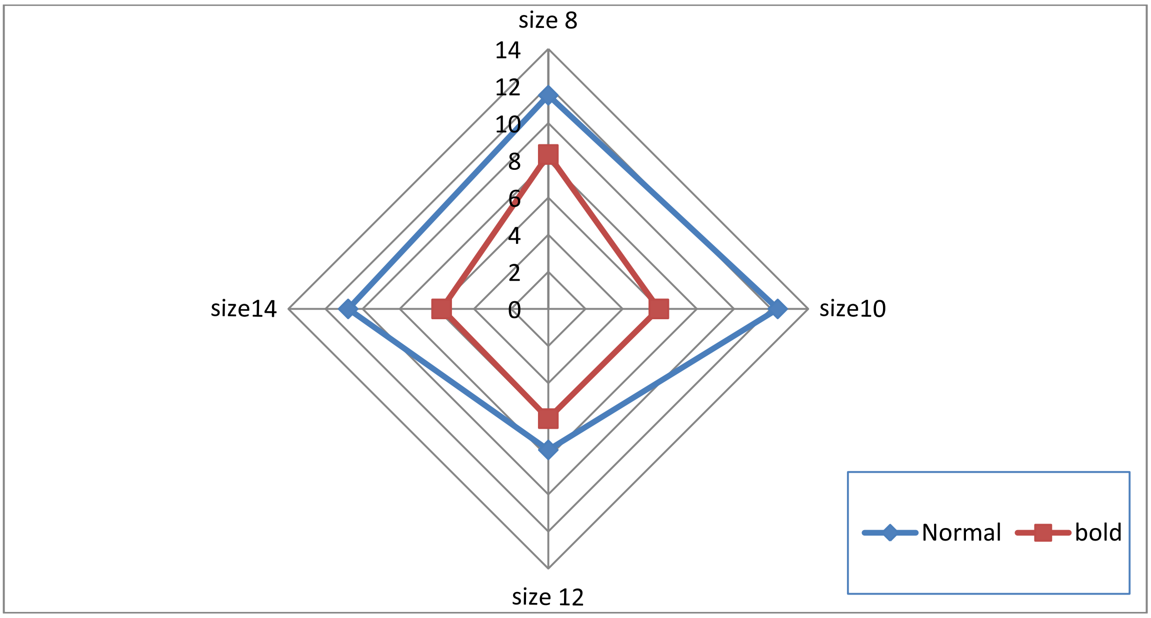

Figure 4. Average of users' performance of label size (Normal versus bold typography) measured in seconds.

Comparison of the preference and performance results is presented in Figure 5 and the related responses are demonstrated in Table 1. Matching users' preference with their performance can be done using the comprehensive results. A systematic trend was found for users' preference on the one hand, but on the other hand a random trend was registered for the users' performance. The shortest reaction time was registered for size 12 point (both normal and bold) and the longest reaction time was for size 8 point (both normal and bold). So it can be considered that 12 point is the most efficient label size and 8 point is the least efficient size over the four tested sizes. When analysing reaction time measurements and preference values related to labels depicted in a normal fond, size 12 can be identified as the most efficient and has the higher aesthetic evaluation. When analysing reaction time measurements and preference values related to the bold fonts, the results show a linear trend for both an efficient and aesthetic size design. As the efficiency increases, the preference values decrease. Therefore it can be considered that both bold sizes of 10, 12 a consensual sizes combine both efficiency and aesthetics of bold label design.

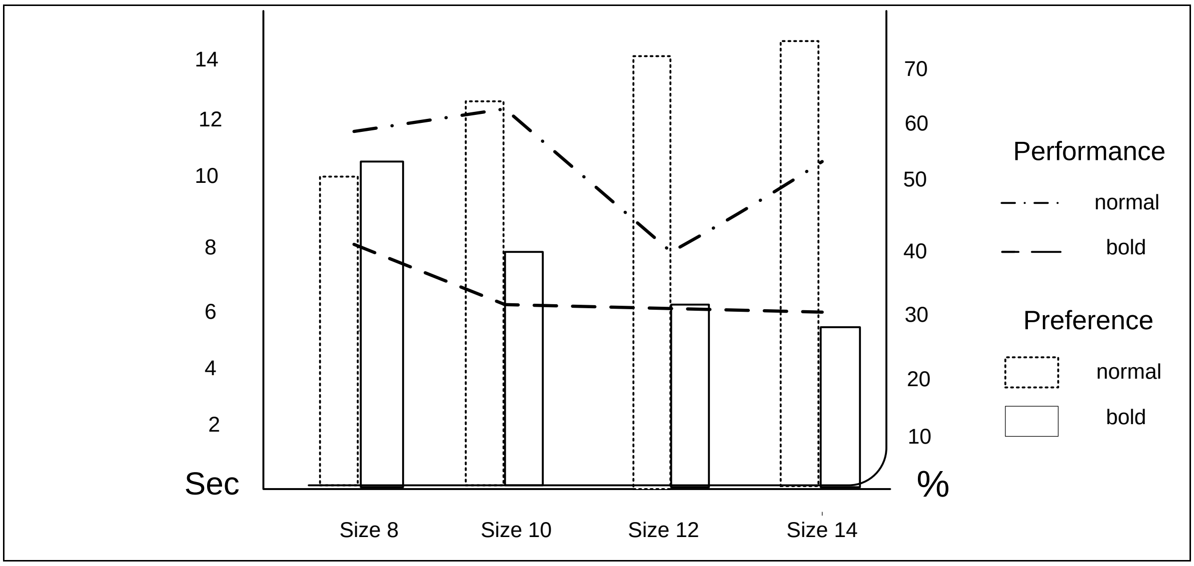

Figure 5. Comparison between users' preference (percentage of frequency) and performance (seconds) for both normal versus bold typography.

Table 1. Test measurements for both aesthetics (frequency of choices) and efficiency (seconds).

Size	Preference		Performance	
	normal	bold	normal	bold
size 8	24	26	11.515	8.324
size10	31	19	12.351	5.952
size12	35	15	7.597	5.914
size14	37	13	10.778	5.746

CONCLUSIONS

Cartographers always aim to present the most qualitative product. All of these products contain textual element to convey most of the involved data. The map users try to retrieve information from the map image in an efficient way.. Both the aesthetics and effectiveness are important to consider in order to create these high qualitative cartographic products. Label aesthetics is the most important when the map design is oriented towards attracting users. Besides that, label efficiency is required to create more effective maps, which is almost all cases applicable. Therefore, it is crucial to consider both elements in the map design. Setting the label size criteria involves thorough studies for both the map use and map users. The study does not directly address the best label size for both aesthetics and efficiency. Our result cannot be generalized for all fonts, because different font implies different measurements of the same point size, the study results are only valid when using Arial font. The results from two subsequent experiments indicate the following regarding the application of label sizes:

- The normal size design has more attraction than the bold size design and acquired higher assessment.
- For a size of 8 points, the users' preferences are almost equal for the bold and normal sizes.
- The preference of bold size decreases as the size increases for the sequential sizes of 8, 10, 12, and 14 points.
- On the contrary of bold size, the preference of the normal size increases as the point size increases.
- The bold sizes are considerably more efficient than the normal sizes, which corresponds to what van den Worm (2001) suggested for web mapping design.
- The time measurement registrations indicate that the most efficient size is 14 bold (in Arial). In addition to that, there is a trend that attributes the influence of bold design onto the users' efficiency towards the label perception.
- The efficiency of normal size does not have a significant trend over the four sizes (8, 10, 12, and 14 points), but it is worth mentioning that the most efficient normal size is 12 points.
- A comprehensive comparison for the four sizes showed that the most efficient and aesthetic size is 12 normal size. Both 10 and 12 bold sizes are considered as the most efficient and aesthetic bold size.
- The least variance between the efficiency of normal size versus the bold size was registered for the size 12 point in the group of the four tested sizes (8, 10, 12, and 14 points).

Further tests shall be conducted to describe different typographic size design for different fonts and different types of maps (thematic versus. topographic maps). Studying label size is a sensitive issue which is influenced by the scale of the map.

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