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A NOTE ON COLOUR AREA SYMBOLS FOR THEMATIC MAPS: NEGATIVE RESULTS FROM TWO EXPERIMENTS ON LEGEND DESIGN

Geology maps, soil maps and similar thematic maps often use colour codes to classify areas of land. The map reader freqently needs to match a colour on the map with the same colour in the map legend. Colours on the map are viewed against a multi-coloured background whereas colours in the legend usually appear against the white colour of the paper. It is possible that this difference in background might cause difficulties in matching and so a legend printed against a gray background or even a black background might be easier to match.

When legend colours appear against a gray rather than a white background, the colours appear to be brighter and more saturated. It is not obvious whether this would make colour matching easier or harder. However, it could be argued that gray is better because it comes closer to the average value of the colours which form the background on the map. A black background to the legend enhances the appearance of the legend colours even more, but again it is hard to say what practical effect this would have.

Two experiments have investigated the effect of the legend background colour on map readers' performance. The second experiment also investigates a related problem: the printing of black lines between areas of colour on the map. These black holding lines make the colours on the map appear brighter and more saturated in much the same way that a gray or black

background changes the legend. A white line between colours produces the reverse effect: the colours appear flatter. However, white holding lines cannot be produced using normal cartographic printing methods and so were not tested here.

In the first experiment 18 men and 18 women undergraduates acted as subjects. All had normal colour vision. Six men and six women were randomly assigned to each of three conditions: a white, gray or black legend background. The experiment used a 1:25,000 Soil Survey map of Faringdon which has 30 different colour codes. Normally a map reader can check he has matched a colour correctly from letter codes which are associated with each colour code and which are printed both on the map and on the legend. But in order to make the matching task more difficult, these were blacked out on the map. Twenty five colour codes were chosen as targets and the numbers 1 to 25 were stencilled on the map in bold black lettering. Straight black lines joined the numbers to make them easy to find. The map was mounted on a wall with the appropriate legend placed next to it. Subjects sat in front of the map. They were instructed to find the colour labelled '1' on the map, match it on the legend and write down the corresponding alphabetical code. They then carried on working through the numbered sequence as quickly as they could. They were told, 'Be as accurate as you can but do not spend more than about 10s on each colour. After 10s make a quick guess and go on.' After practicing the task on a different map, they began the test and were stopped after two minutes.

The mean number of correct responses was 13.6, 12.7 and 11.2 with the white, gray and black backgrounds respectively but the differences were not statistically significant on an analysis of variance ($F(2,30) = 1.8$). Women had a mean of 13.9 and men

a mean of 11.1 and this was significant ($F(1,30) = 7.2$, $p < .05$). The interaction was not significant.

The second experiment used a slightly different procedure which is arguably more typical of normal map reading behaviour. Subjects were asked to find examples of rock types on a 23 by 18cm area taken from a 1:63,560 geology map of the Rochester area. Twelve men and 12 women acted as subjects. All were university students with normal colour vision and none had taken part in the first experiment. The experiment had a 3 by 2 by 2 independent groups design with two subjects per cell. The independent variables were legend background as in the first experiment, sex of subject and the width of the black holding lines between colours on the map which were either thick or thin. Thin lines were about 0.1mm wide and some were broken into dashes as they appeared on the original map. Thick lines were about 0.5mm wide and were unbroken lines applied to the map with a drawing pen. Subjects were tested individually sitting at a table with the experimenter opposite. After practising the task on a different map, they had two series of search tasks. In the first series they were asked to find examples of eight types of solid geology. These were labelled A to H on the legend and subjects were told to tackle them in alphabetical order and to point to each example as it was found. The time taken to complete the series was recorded. The second series of searches was identical except that the targets were eight types of drift geology.

Unlike the first experiment, the alphanumeric or symbolic codes which accompanied each colour code were left on the map and subjects were taught how to use these to check their accuracy. As a consequence they were always able to correct their own errors. The search times for the solid and drift series were

analysed separately using analyses of variance. No main effects or interactions were statistically significant. For the solid series, the mean times for the white, gray and black backgrounds were 62s, 61s and 60s, and for the drift series, 99s, 106s and 77s, respectively. The means for thick lines and thin lines were 60s and 62s for the solid series and 101s and 87s for the drift series, respectively.

Clearly, neither the value of the legend background nor the thickness of holding lines has a strong effect on the time taken to find colour codes. Further experiments employing more subjects or different testing conditions might show an effect, but it is unlikely that any strong recommendations on map design can be made. It would appear that although the two experimental manipulations tested here change the appearance of colours, they have no strong effect on the ease of using colour codes.