Hartland
Word Count: 564

Essay 2 – Use of Texture in Visualization Design

Ware (2012) and Szafir et al. (2016) note how elements of texture can be useful in visualization design, and how background texture can interfere with the perception of foreground information if due diligence is not paid. Use of texture in group codes can be useful when color coding is not an option, or when a second variable is displayed in addition to one coded via color. The utility of texture in visualization will be illustrated while walking through two visualization designs.

Consider designing a multiple-group scatterplot to accompany an article submitted to an academic journal. Academic journals typically only print in black and white, so distinguishing groups with color is not an option. Points on a scatterplot can be distinguished without color is using contrasting textures. Ware encourages using symbols made up of straight and curved lines in scatterplots, rather than filled shapes. Such symbols are easiest to discriminate when they show texture contrast, meaning they differ in spatial frequency and orientation of components. A pair of symbols effectively meeting this criteria is “o” and “w”. Because of texture contrast, it is much easier to detect that the o’s in figure 1(a) have a higher mean and lower standard deviation than do x’s on both dimensions, while this is much less obvious in figure 1(b), where N’s have a higher mean and lower standard deviation than M’s, but differentiating the ensembles is difficult due to similar spatial frequency and orientation components (Szafir et al., 2016).

Accounting for texture contrasts between symbols and backgrounds is also critical when texture is used in visualization. For example, which texture is best for identifying cities or other major landmarks on maps? In the case of topographic maps, which often have high spatial frequency and a variety of orientation components (Figure 2.), symbols which have high spatial frequency or distinct orientation components may be difficult to detect. Consider using filled circles or squares to identify landmarks on topographic maps instead of hollow o’s or x’s. This is illustrated in Figure 2. Note how easy it is to find the black circle at (1.2,1.7) relative to the x at (1.7,1.5).

In addition to encoding categorical information, texture can also be useful when visualizing quantitative data. Both Ware (2012) and Szafir et al. (2016) note that quantitative information can be encoded in texture via symbol size and density. Ware (2009), developed a 10-step texture gradient for encoding atmospheric pressure over a full-spectrum color gradient encoding temperature. This gradient transitions from large, filled, black circles, to small, hollow, black circles, to small, hollow, white circles, to large, filled, white circles. An example of such a visualization is presented on page 210 of Ware (2012). Because of the luminance contrast between background colors and foreground textures, it is reasonably easy to decode atmospheric pressure in each region in the map. It is worth noting that Ware’s gradient is easy to use despite no true perceptual ordering of texture elements. For example, there is no intuitive reason for the second step of the gradient, following large, filled, black circles to be large, hollow, black circles instead of medium, filled, black circles. Nevertheless, the transition from regions of low to high pressure using Ware’s texture gradient feels smooth.

While many of texture’s benefits to visualization design overlap with those associated with color, texture can be useful when color is not available, or when existing color-coded information makes the introduction of additional information via color difficult.

References

Szafir, D. A., Haroz, S., Gleicher, M., & Franconeri, S. (2016). Four types of ensemble encoding in data visualizations. *Journal of Vision*, *16*(5), 1-19.

Ware, C. (2012). Information visualization : perception for design. Retrieved from https://ebookcentral.proquest.com

Figure 1. Scatterplots

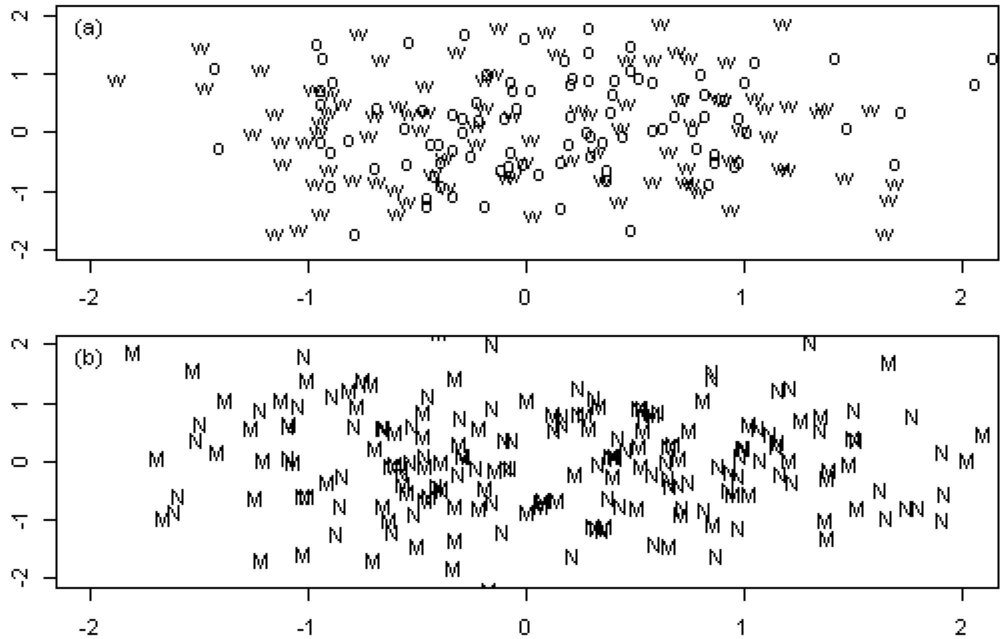

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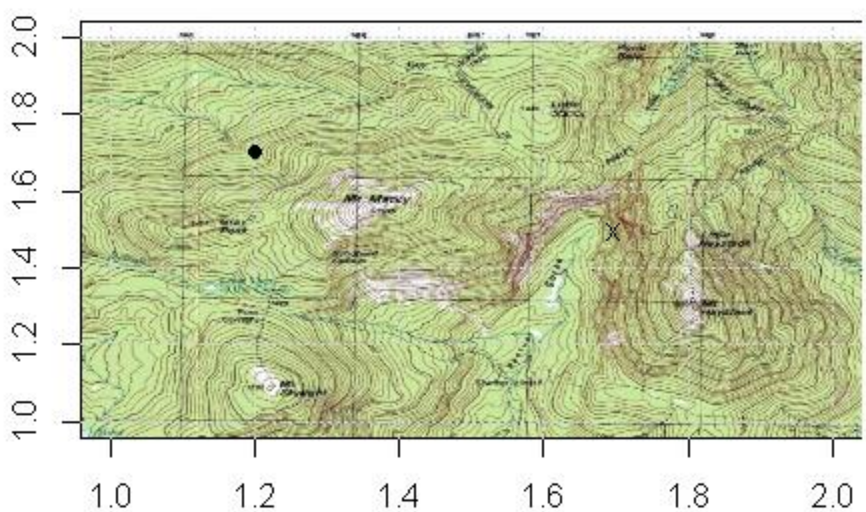
Figure 2. Topographic Map



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