

In this essay, I discuss perceptual processes and their implications for the design of statistical graphics. I explain how texture perception can interact with graphical perception. I examine orientation biases when performing estimations involving lines. I conclude with a consideration of Tufte's quartile plot in terms of perceptual organization.

Whether to use texture to encode data in a statistical graphic deserves careful consideration. Tufte assumes the stance that use of synthetic textures results in chartjunk, causing strain on the eye and upsetting the data-ink ratio¹. Nevertheless if we do employ texture encoding, we must avoid straining optical effects and acknowledge the limitations and irregularities associated with texture perception. Natural textures are often less straining and more aesthetically pleasing than synthetic textures. However, such textures are difficult to classify, subject to large individual differences²; this can be problematic when encoding ordinal or interval values. Use of natural textures in a statistical graphic can also interact with other visual processes. For one, our visual system also uses texture cues to make judgments of object shape, orientation, and distance³. As a result, some textures may elicit pop-out effects or illusions of 3D shape. These cues should be considered whether or not these effects are desired. In brief, awareness of how the visual system interacts with texture can be used to the advantage of the designer, while an unguided use of texture can result in unwanted visual artifacts.

In our class on drawings and diagrams it was established that there exists a perceptual bias in favour of vertical and horizontal line orientations⁴; we have a poor memory for oblique lines, which tend to be remembered as either more horizontal or more vertical. This helps explain the inaccuracies of pattern perception involving lines⁵. Assessing the rate of change from the slope of a line is a complex visual task; it is necessary to visualize and manipulate the vertical and horizontal projections of the line. As a result, it is difficult to compare multiple slopes because we cannot easily compare oblique lines directly to one another. If these comparisons are necessary, it is best to use gridlines or map rate of change directly on a new display, so comparisons can be made more easily. Simplifying the task can prevent this perceptual bias from factoring into our visual calculations.

In an attempt to maximize the data-ink ratio, Tufte suggests the quartile plot in favour of the box plot⁶. In a variant of this design, he suggests shifting the interquartile

¹E.R. Tufte. *The Visual Display of Quantitative Information*. ch. 5, pp. 107-112.

²V. Interrante. "Harnessing Natural Textures for Multivariate Visualization."

³S. Kim et al. "Conveying Shape With Texture."

⁴B. Tversky, "Spatial Schemas in Depiction."

⁵W.S. Cleveland. *The Elements of Graphing Data*. sections 4.2, 4.7.

⁶E.R. Tufte. *The Visual Display of Quantitative Information*. ch. 6, pp. 124.

line segment by a small offset in parallel to the remainder of the range. This design
35 contains the same information as the old design, is easy to draw, and requires little
ink. However, this variant is interpreted differently. The original box plot design
capitalizes on the Gestalt principle of good continuation: the range line passes behind
the interquartile range. The interquartile range is easily distinguished and emphasized
as a foreground object. In the offset design there is no longer a foreground-background
40 separation; the interquartile range is no longer a significant focus of attention. The line
segments are parallel and proximal, viewed as similar and having equal importance.
The designer must decide whether or not this is desired.

Perceptual processes can have interactions with the design of in statistical graphics,
from simple quartile distribution plots to complex texture-encoding schemes. In some
45 circumstances these interactions serve to emphasize elements in a display or facilitate
a particular task, while in other circumstances these interactions can have undesirable
effects.