Rothesay
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Information Visualization

A fundamental challenge in information visualization is to convert raw data into a simple and informative visual format. Data analysts can make use of the inherent capacities of our visual system to make efficient graphics. This essay will discuss how perceptual mechanisms support information visualization.

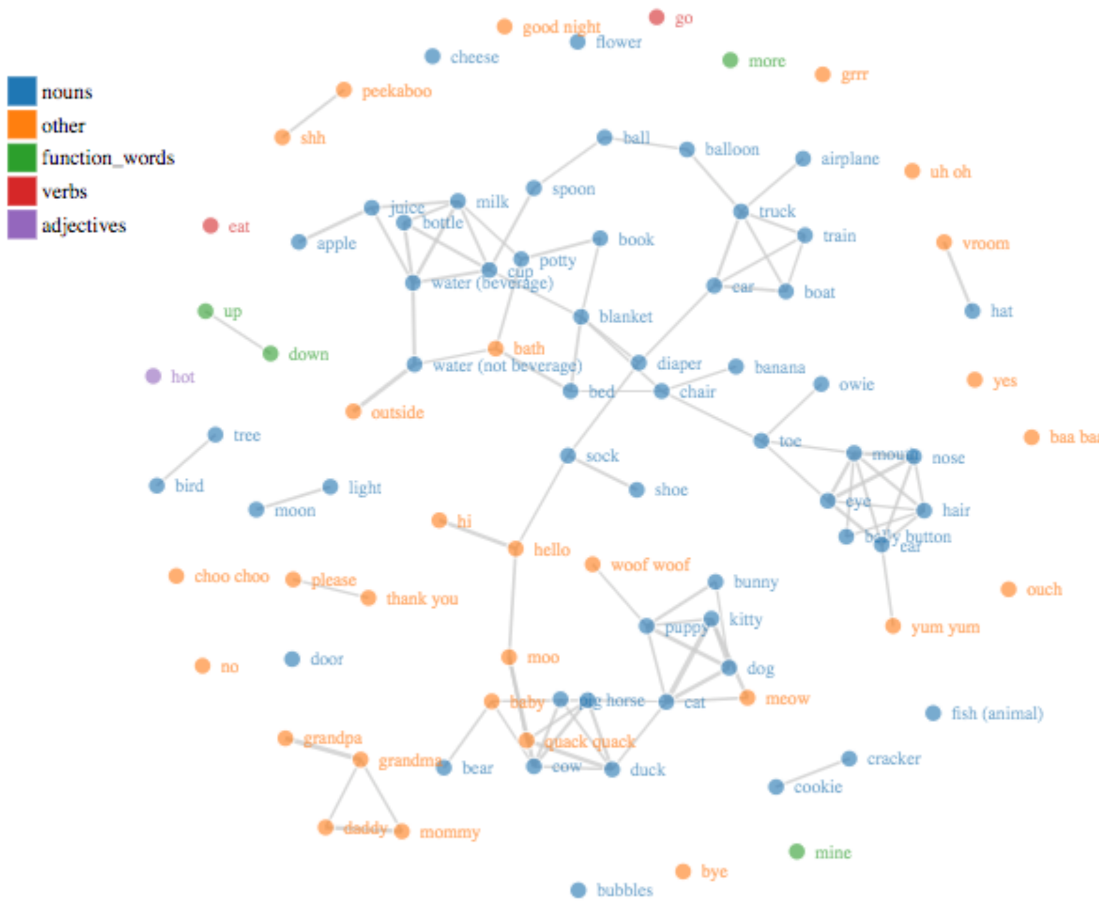
When we look at a static graphic, our visual attention selects a subset of information from our visual field for further processing. However, before attending to a specific location on the graphic, several features, such as size, can be processed preattentively (Wolfe & Horowitz, 2017). Based on visual search paradigm, a big item will pop-out among small items (Wolfe, 2000). As long as the size of targeting area is visibly distinct from the rest, our attention can be drawn to it. The designers can implant these findings to help the readers to prioritize important information. For example, when we move to a new city, we usually try to avoid the most dangerous area and find the safest area to live. On a crime map, the biggest circle can be used to represent the most dangerous area, and the smallest circle can be used to represent the safest area. In this case, the readers will easily identify their area of interest because the most dangerous and safest areas in the city will pop-out to them.

Color is commonly used for visualizing information, but it is important to consider how to appropriately use the three dimensions of color: hue, saturation, and lightness. For categorical data, hue can be a useful tool to differentiate categories. For instance, on a bar graph, blue hue can represent males, and red hue can represent females. However, for a large number of categories, hue might not be a useful tool because our visual system has a limit in distinguishing hues. Saturation or lightness can be used for ordered data because of its perceptual ordering, such as from zero saturation to full saturation and from white to black (Munzner, 2009). However, hue does not have this perceptual ordering. If we wanted to visualize the percentage of employees who are satisfied with their salary based on scores from a Likert scale (e.g., 1 being not satisfied at all and 5 being extremely satisfied) using a bar graph, the lightest bar can represent 1 and the darkest bar can represent 5. Using distinct hues in this example would be meaningless because people do not have a consistent ordering system for hues. Importantly, the designers are not limited to only one color dimension. A combination of two dimensions can also be powerful, for example, using hues and lightness in heat maps.

Another remarkable capacity of our visual system is to perceive patterns in the environment. There are multiple Gestalt laws to describe how we perceive patterns. Among the Gestalt laws, spatial proximity can be useful in graphic design. Spatial proximity refers to our tendency to perceptually group objects that are close together (Ware, 2012). For example, to build the semantic network of 20 months old toddler, the designers can place semantically associated objects closer together in the network (Figure 1). This will help readers to identify the semantic categories based on the clusters in the network. Although the connecting lines in Figure 1 also help to group semantic categories, they will become distracting when the number of categories increases. Using spatial proximity for many categories will be clearer.

Given the inherent capacities of our visual system, such as preattentive processing, color perception, and grouping, designers should take these abilities into account to present information in an efficient approach.

Figure 1: Semantic networks of 20 months old toddler. (http://wordbank.stanford.edu)



References

Munzner, T. (2009). Visualization. In P. Shirley & S. Marschner (3rd Ed.), *Fundamentals of computer graphics* (pp. 675-707). CRC Press.

Ware, C. (2012). *Information visualization: perception for design*. Elsevier.

Wolfe J. (2000) Visual attention. In K. K. De Valois (2nd Ed). *Seeing* (pp. 335-386). San Diego, CA: Academic Press.

Wolfe, J. M., & Horowitz, T. S. (2017). Five factors that guide attention in visual search. *Nature Human Behaviour*, *1*(3), 0058.