A Picture is Worth a Thousand Words

A picture is worth a thousand words when the story is best told graphically rather than verbally. Data visualization is the graphical display of abstract information for two purposes: sense making and communication. Important stories live in our data and data visualization is a powerful way to discover and understand these stories, and then present them to others. (Few) To understand visual design principles, the session will briefly examine the science of human perception and cognition. We will spend most of our time exploring dataviz principles and common sense in graphics.

During the session, participants will be able to:

- Gain insights on how presenting information visually is much easier for the audience to understand and use
- Learn how to construct compelling and effective graphics using three basic principles: show the data, reduce the clutter, and integrate the text and the graphs

Pictures for Eyes and Mind

To translate abstract information into visual representations that can be easily, efficiently, accurately, and meaningfully decoded.

The display should:

- Clearly indicate how values relate to one another, example part-to-whole, relationship
- Represents the quantities accurately
- Makes it easy to compare quantities
- Makes it easy to see the ranked order of values
- Makes obvious how people should use the information

Using the Gestalt Principles to Bring Out Patterns in Visualizations

Gestalt principles describe how our mind organizes individual visual elements into groups, to make sense of the entire visual. When designing a visual, these principles can be used to highlight patterns that are important to us, and downplay other patterns. The image below illustrates the principles of Gestalt, which are relevant to visualization. (Taylor, How to Use the Gestalt Principles for Visual Storytelling #PoDV)

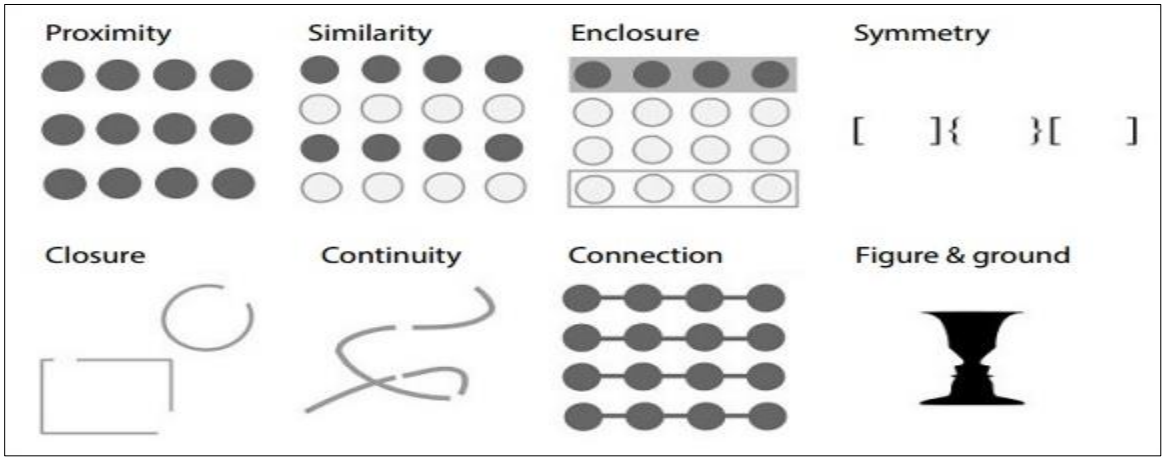


Image Credit: Taylor, Twain. How to Use the Gestalt Principles for Visual Storytelling #PoDV. 28 March 2014. Website. 25 September 2018.

Here is what we notice from each of the illustrations:

- **Proximity**: We see three rows of dots instead of four columns of dots because they are closer horizontally than vertically.
- **Similarity**: We see similar looking objects as part of the same group.
- **Enclosure:** We group the first four and last four dots as two rows instead of eight dots.
- **Symmetry**: We see three pairs of symmetrical brackets rather than six individual brackets.
- **Closure**: We automatically close the square and circle instead of seeing three disconnected paths.
- **Continuity**: We see one continuous path instead of three arbitrary ones.
- **Connection**: We group the connected dots as belonging to the same group.
- **Figure & ground**: We notice either the two faces, or the vase. Whichever we notice becomes the figure, and the other the ground

These principles allow us to perform many tasks such as reduce the noise from charts, choose the ideal aspect ratio, and show relationships between elements more clearly.

Preattentive Attributes Used by Our Working Memory

Colin Ware, a data visualization expert, wrote a book 'Information Visualization' in which he terms the basic building blocks of the visualization process as 'Preattentive' attributes. These attributes are what immediately catch our eye when we look at a visualization. They can be perceived in less than 10 milliseconds, even before we make a conscious effort to notice them. Here is a list of the preattentive attributes:

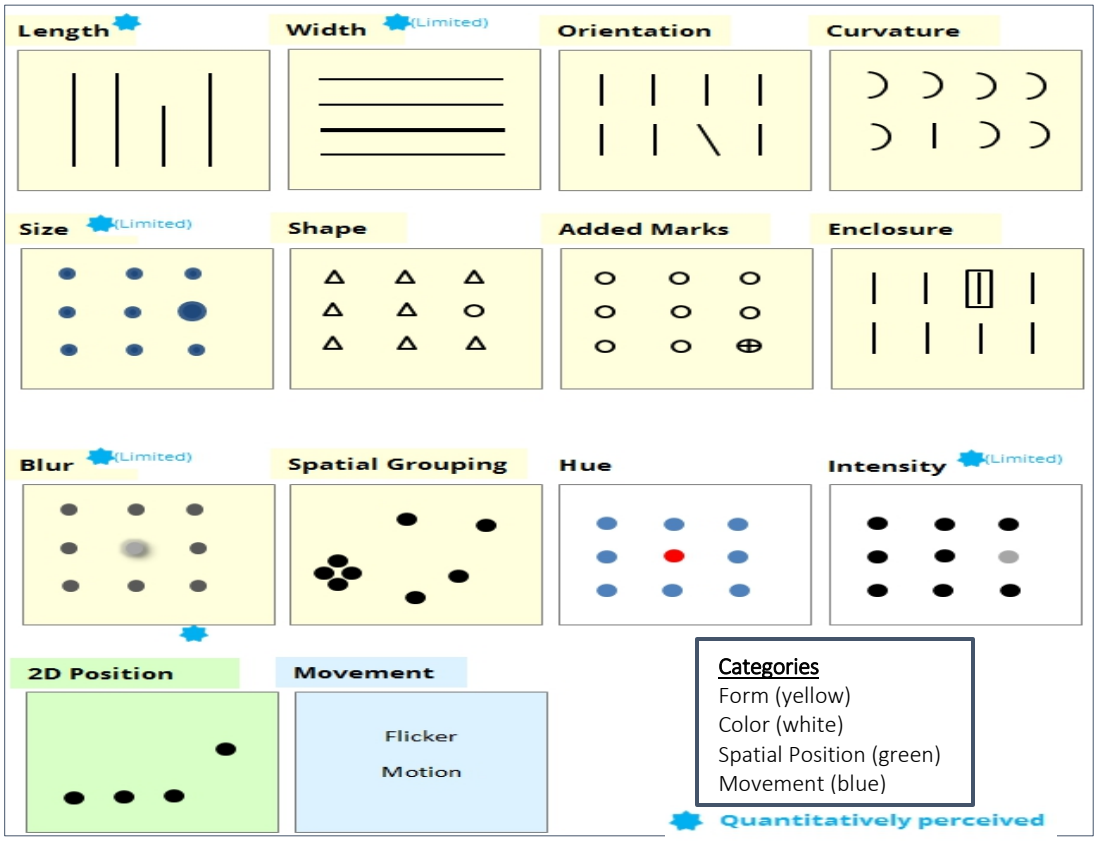


Image credit: Colin Ware, Information Visualization: Perception for Design
http://daydreamingnumbers.com/blog/preattentive-attributes-example/

These attributes come into play when we analyze any visual. Of this list, only 2-D Position, and Line Length can be used to perceive quantitative data with precision. The other attributes are useful for perceiving other types of data such as categorical, or relational data.

Forming Analytical Patterns Out of Preattentive Attributes

If preattentive attributes are the alphabets of visual language, analytical patterns are the words we form using them. We immediately identify the preattentive attributes in a visualization. We then combine the preattentive attributes to seek out analytical patterns in the visual. Here are the basic analytical patterns that we identify when looking at a visual (Taylor, How We Decode Visual Information – #PoDV, FusionBrew):

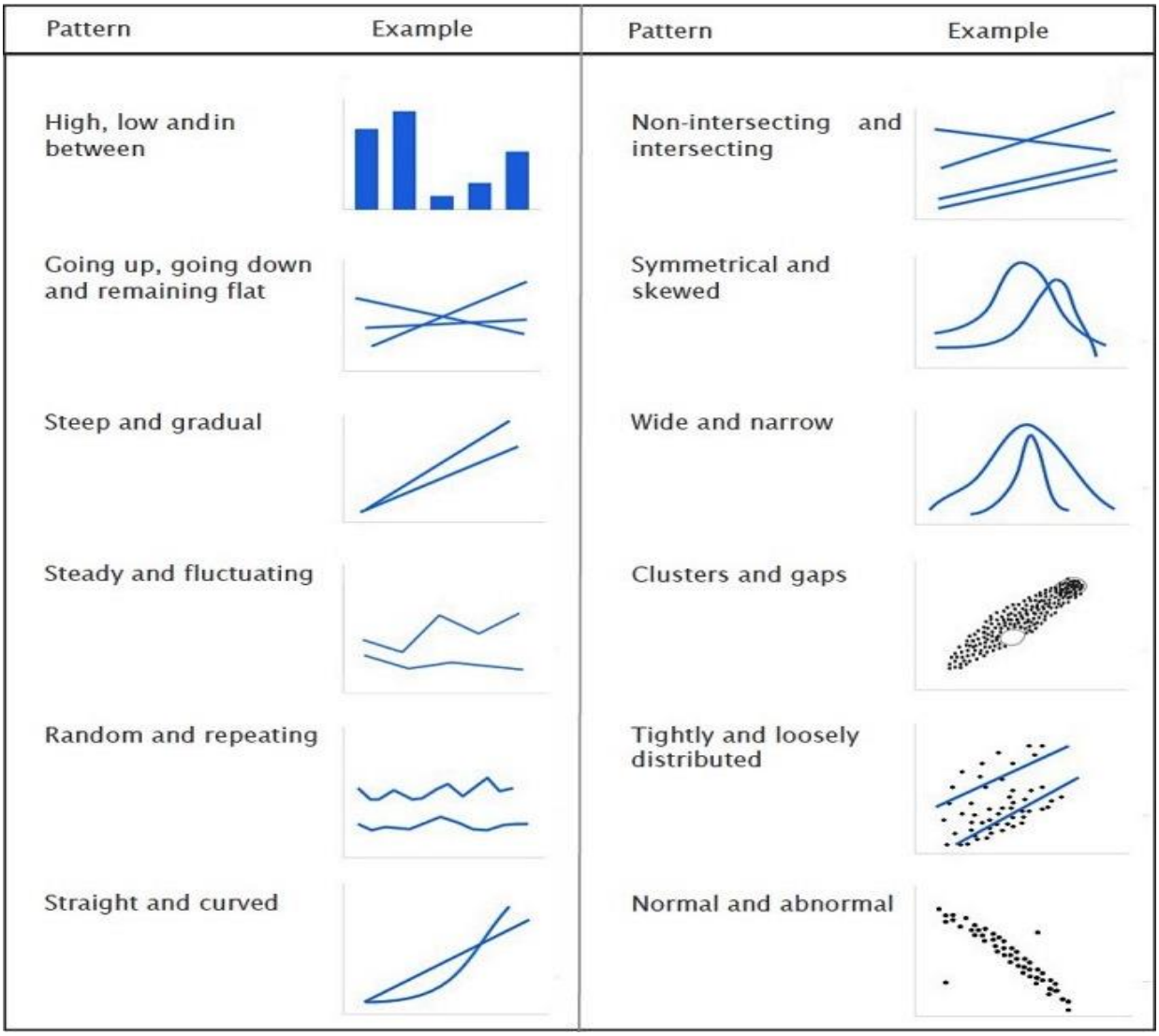
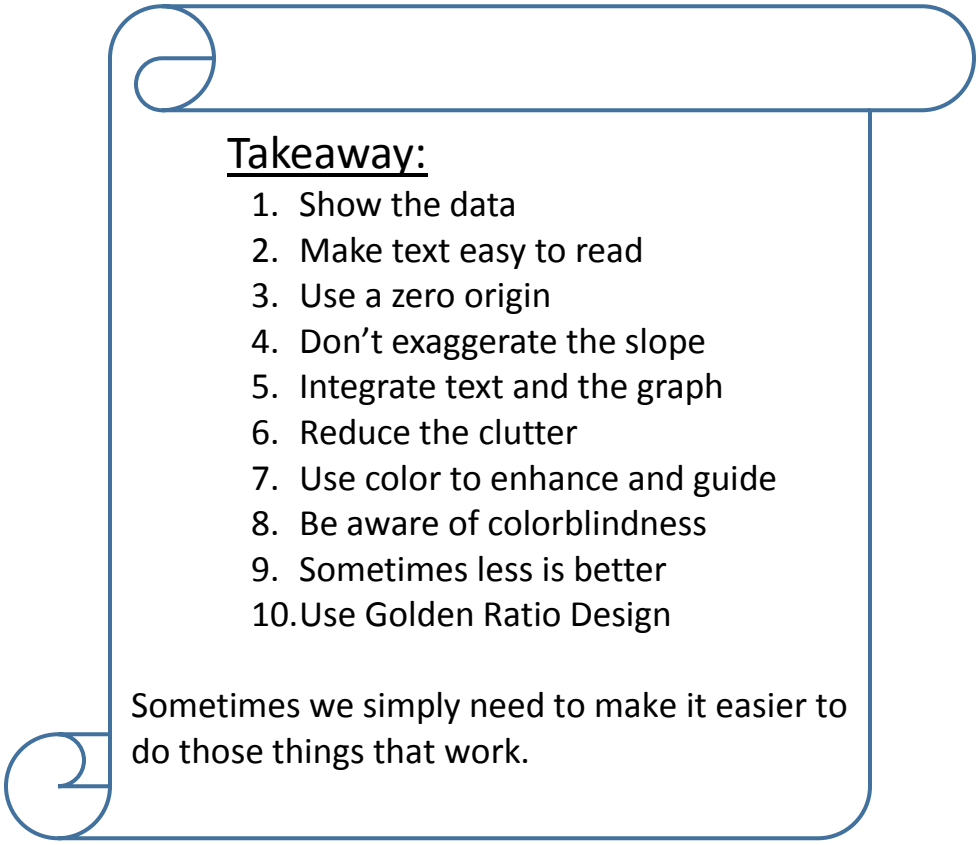


Image credit: Stephen Few, Now You See It: Simple Visualization Techniques for Quantitative Analysis

These patterns are an intrinsic part of our vision, and are frequently used when we analyze and describe a chart. However, as a word of caution, we are hard-wired to look for patterns in any visual information we notice. Sometimes we do this even when there is not an apparent connection or pattern in the visual. To avoid this, it helps to know the various patterns and have a wide vocabulary to work with

visuals. This will allow us to consider multiple options before concluding on the most prominent pattern in a visual.

Effective visualizations show the data to tell the story, reduce clutter to keep the focus on the important points, and integrate the text with the graphs to transfer information efficiently. (Schwabish)



Note: Red-black-green are problematic for most degrees of colorblindness, use orange-white-blue.

References

Few, Stephen. "Data Visualization for Human Perception, The Encyclopedia of Human-Computer Interaction, 2nd Ed." n.d. *Interaction Design Foundation.* Website. 21 September 2018.

Schwabish, Jonathan A. "An Economist's Guide to Visualizing Data." *Journal of Economic Perspectives* (Winter 2014): 209-234. Document.

Taylor, Twain. "How to Use the Gestalt Principles for Visual Storytelling #PoDV." 28 March 2014. *FusionBrew: The FusionCharts Blog.* Website. 25 September 2018.

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