Information overload alert: Reduce where possible and avoid clutter

Hello again. In this week we will give some thought of how we perceive the world around us, making sense of objects we see and what they might tell us. You will leverage some of the principles you learned in your previous class and see how they apply to the field of data visualization. This will provide us with a nice framework as we move on in future weeks and compare good and bad examples of conveying information. Rather than just learning this is a good example and emulating it, having some background in perception will help you grasp the why and allow you to interpolate the tips and tricks to a variety of examples you may encounter in your work life.

We are consuming more information these days than ever in history and it continues to grow exponentially. Just like computers, our brains have a fixed amount of processing. If the information that comes in exceeds our ability to handle it, we will not perform as well. This translates in us taking longer to understand the information, miss important details, or even get frustrated and overwhelmed by the task at hand and abandon it.

Cognitive Load

Psychologists coined the amount of required mental effort to learn new information as cognitive load.

For our purposes as user experience professionals, we modify the term slightly to mean the amount of brain resources that is required to use a program or a website or a system.

We as designers need to understand and design for our human cognitive limitations. The intricacies of this is beyond the scope of this course but it is important to leverage what we learned about cognitive science in previous courses and apply it in the context of developing data visualizations.

User's Intrinsic cognitive load is the effort of absorbing new information and of keeping track of their own goal or path for example through a website. There will inherently always be some cognitive load. What we as designers should strive to do is minimize the extraneous cognitive load. This load is the one that takes up mental resources, but doesn't actually aid users to understand the system, program, or content.

This second one is more in our control as designers. An example of this may be using color in places that doesn't convey meaning in your chart. We must make efforts to minimize and remove extraneous cognitive load. The biggest hit to extraneous cognitive load for data visualization is often visual clutter. It's critical to reduce and reduce to only those elements that really matter to convey the story the data is telling and what exactly you want your audience to focus on. Remove extraneous information; don't use ornate images or varied font for aesthetic reasons. We are machines that detect differences so make sure anything that is different in fidelity or design or font choice or line style etc. is done only intentionally to convey meaning. This will allow your use to process the information more effectively and efficiently.

Working Memory

It is important for us in designing interfaces in general to stay aware that memory is limited. Also you may recall that there are different types.

Iconic memory (roughly 200ms)

Working memory (slotted, think 5 items plus or minus 2)

Finally there is long-term memory, which varies quite a bit person-to-person.

I just point this out so as a designer creating visualization you consider how much information or types of data you are trying to display at once with this in mind. On top of considering these memory limits, users are often multi tasking when viewing interfaces, so we also have to consider attention.

Visual/Selective Attention

Human visual perception is much more incomplete and inaccurate than most people realize. More focus in one area means less attention elsewhere. Users' expectations manipulate their perceptions. Motivations manipulate our perceptions. This can impact how users interpret data and see what they want to see in it. This is another reason why well-designed visualizations are important and must tell the story accurately without ambiguity that could be subject to users interpretation.

The notion of looking at something but not really seeing it is something we have all experience in our day-to-day lives. It might be when you are looking for a lost object and you look and its not there where you expected it and then you look all around only to find it was actually where you thought it would be to begin with but you just didn't notice it. In psychology, this is call inattentional blindness or selective attention.

For more on this read the full article http://uxmag.com/articles/selective-attention-and-user-experience and if especially passionate about this area check out the interesting books mention at the end called

Social Psychology of Visual Perception, Emily Balcetis and G. Daniel Lassiter

The Invisible Gorilla: How Our Intuitions Deceive Us, Christopher Chabris and Daniel Simons

Another important thing we should remind ourselves of when designing is the theory of Gestalt psychology which you learned about in your prerequisite class.

As you may recall, Gestalt psychology is a set of laws that accounts for how we perceive or intuit patterns and conclusions from the things we see. By leveraging these laws in our design of data visualization, we can help our end users quickly and efficiently discern the patterns that matter in the data and the story we are trying to convey with it.

Besides removing clutter, prioritizing information will help make your data visualizations more readable and require less attention. As Amanda Cox, Head of The New York Times Graphic Department once noted, "Data isn't like your kids. You don't have to pretend to love them equally." Know where to focus your user's attention.

Gestalt Laws Apply to Data Visualization too

Law of Pragnanz

In the article "How to Make Data Visualization Better with Gestalt Laws, Padmanabhan and Choudhury do a great job identifying how to apply Gestalt Laws in the context of designing data visualization. I have summarized some of their takeaways below but I encourage you to read the full article here. Visualizing these principles in action through the examples in the article really help the information sink in and its relevance to data visualization.

http://sixrevisions.com/usability/data-visualization-gestalt-laws/

Gestalt Law of Continuity

"The law of continuity states that our eyes instinctively group things that are aligned with each other. As mentioned in the last example about order in bar charts from highest to least allows for a continuous downward direction for the viewer and thus easier for us to see grouping. Thus one key takeaway when

designing charts is to align elements linearly to facilitate comparison of different items that are in a related grouping.

Gestalt Law of Similarity

This Gestalt law theorizes that objects with similar characteristics — similar colors, similar shapes, similar sizes, similar orientation, etc. — are perceived as a group. For example if you ordered a bar chart from high to low but each bar used a different color this would increase the cognitive load since the color is not meaningful but a distraction. If you make them all the same color it makes it much easer for the user to compare and find points of interest. This may be counter-intuitive at first as we are used to thinking that distinguishing each data set from each other is helpful but, as we will learn, color plays differently when it comes to data visualization and should be used very sparingly and only to convey meaning. For example grouping related items is an effective use of color and allows us to perceive them as belonging and being similar.

Law of Focal Point

This law is basically the opposite of the law of similarity. A great example of this is to draw attention in a particular bar graph to say an individual's performance versus others. You may choose to color that particular bar to highlight it and draw the user's eye.

Gestalt Law of Proximity

This law states that objects placed close to one another are perceived as a group. We easily tend to make comparisons and look for similarities in such groups. Objects that are further apart are seen as unrelated or less related. As an example, ensure that there is more space between groups/clusters than there is between each member of the groups when organizing data.

Gestalt Law of Isomorphic Correspondence

This law states that people interpret and respond to images based on their past experiences. This law, for instance, explains why sticking to well-established user interface conventions, like blue-and-underlined hyperlinks in web pages, is effective. Other examples when doing charts is using green for positive and red for negative. In data visualization one application of this law involves leveraging and understanding connotations when selecting colors to use in your charts.

Gestalt Law of Figure/Ground

This law states that objects of a graphic either are perceived as figures (distinct elements of focus) or as ground (the background on which the figures rest). Foreground objects are important. Background objects are less important. Web designers should already be familiar with the concept of the Figure/Ground law. The more the contrast between the figure and the ground, the easier it will be to distinguish between the two types of objects.

This law comes to mind when I see examples of charts where the designer has increased the cognitive load for the user because they have used a colorful chart background or watermark image which competes for attention with the data on top of it. In general it is best practice to increase the contrast between the foreground (the data) and the background by using a white background so it does not compete for mental resources and attention and does not distract from the story the data is telling.

Gestalt Law of Common Fate

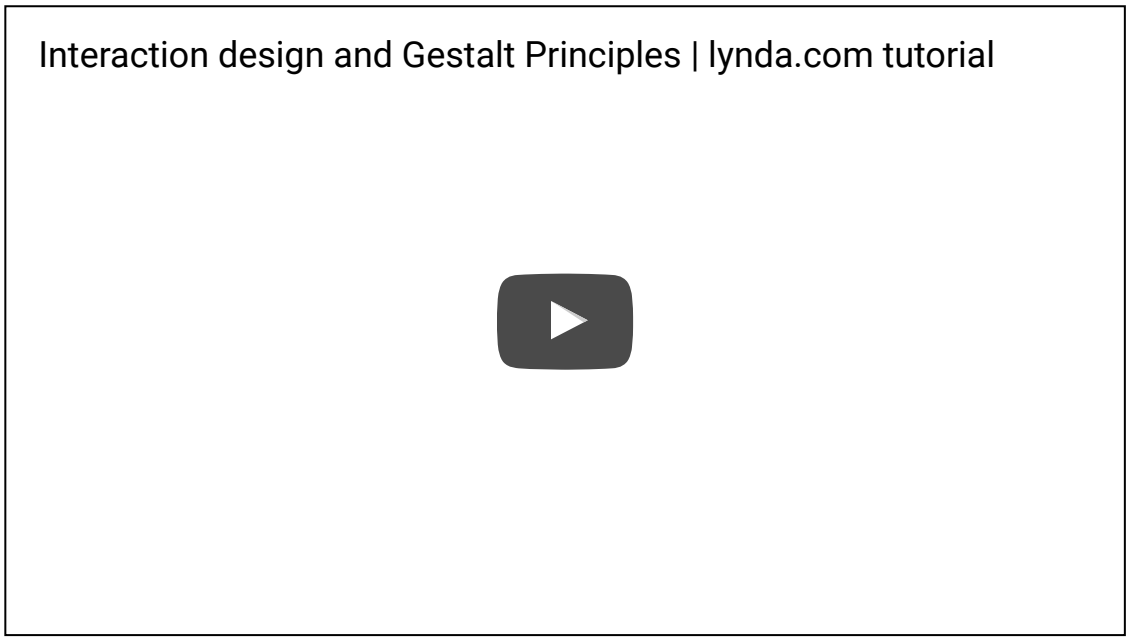
This law states that when lines or shapes move together in the same direction, they create a sense of unity and indicate a relationship. They share a common fate. On the other hand, when lines or shapes move in different directions, they are perceived as unrelated or less related.

For fuller review of these gestalt laws and their applications to data visualization, be sure to review one of your readings, How to Make Data Visualization Better with Gestalt Laws, from which many of the points above were excerpted. Visualizing these principles in action through the examples in the article will help you understand its relevance to data visualization. As we learn about data visualization it helps to have the tips, tactics, and principles visualized and in action for our own learning as well. "

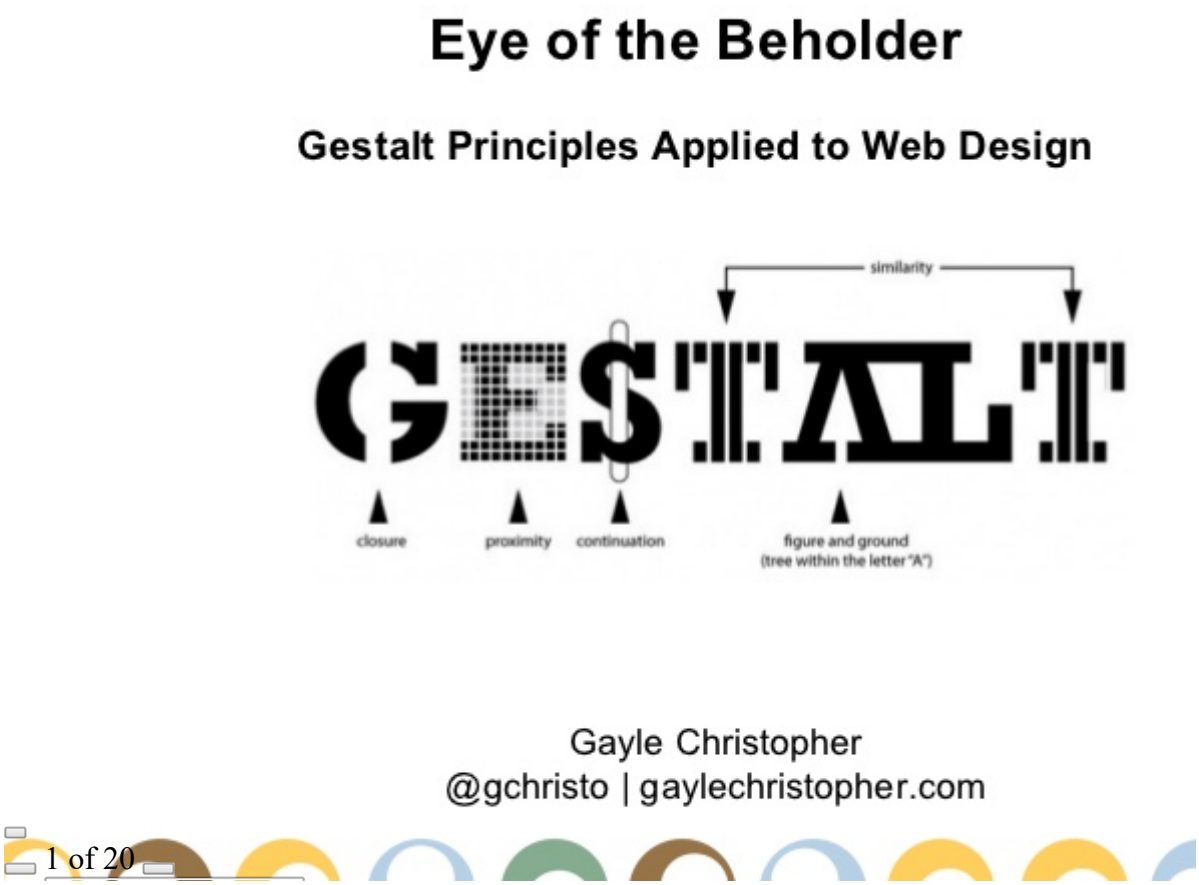
As we learn about data visualization it helps to have the tips, tactics, and principles visualized and in action for our own learning as well.

Learn More about Applying Gestalt to Design

Gestalt principles of form perception (interaction-design.org)
"Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules" (amazon.com)



Interaction design and Gestalt Principles (youtube.com)



Gestalt Principles of Design from **Gayle Christopher**

References

Brady, T. F., Konkle, T., & Alvarez, G. A. (2011). A review of visual memory capacity: Beyond individual items and towards structured representations. *Journal of Vision*, *11*(5), 4. http://doi.org/10.1167/11.5.4

McLeod, S. (2009) Short term memory. *Simple Psychology. http://www.simplypsychology.org/short-term-memory.html*

https://uxmag.com/articles/four-cognitive-design-guidelines-for-effective-information-dashboards
http://sixrevisions.com/web_design/gestalt-principles-applied-in-design/
https://www.nngroup.com/articles/minimize-cognitive-load/
http://jov.arvojournals.org/article.aspx?articleid=2191865
http://uxmag.com/articles/selective-attention-and-user-experience

https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/data-visualization-for-human-perception

http://sixrevisions.com/usability/data-visualization-gestalt-laws/

http://uxmag.com/articles/the-psychology-behind-information-dashboards