Thirsty Crow

What did you learn?

Key Points

Audience [handwritten]

1. Understand the context

2. Choose an appropriate visual display

3. Eliminate clutter

4. Focus attention where you want it

5. Think like a designer

6. Tell a story

Cognitive Load

- Whenever we see anything new even if it is a blank screen, it takes brainpower to process the information, which is termed as cognitive load.

- Humans' brains have a finite amount of this mental processing power. Therefore, anything which is irrelevant or not adding any value in visuals it is better to get rid of that.

- Identifying and eliminating such irrelevant things or clutters

Cognitive Load

- Cognitive load has its origins in the psychology of instructional design: think teachers designing lesson plans for students.
- The concept comprises three different types: intrinsic, germane, and extraneous loads.
- When we ask a computer to do work, we are relying on the computer's processing power. When we ask our audience to do work, we are leveraging their mental processing power.
- This is cognitive load. Humans' brains have a finite amount of this

mental processing power

application of cognitive load

- Schemas are also important in reducing cognitive load in our working memory. For instance, if asked for the colors of the rainbow, many would recall the mnemonic, ROY G. BIV, from their elementary science classes. Remembering this acronym allows our working memory to remember and retrieve a reduced load of information. The alternative would ask your working memory to either store or retrieve red, orange, yellow, green, blue, indigo, and violet separately. Loading your working memory with seven unrelated bits of information is very likely to cause overload. However, remembering ROY G. BIV only represents a single schema and drastically cuts down on the cognitive load of information on our working memory.

clutter

- Clutter is the state in which excess items, or their representation or organization, lead to a degradation of performance at some task.
- These are visual elements that take up extra space but don't increase understanding and contribute to excessive or extraneous cognitive load.
- There is a simple reason we should aim to reduce clutter: because it makes our visuals appear more complicated than necessary.

- Visual clutter denotes a disordered collection of graphical entities in information visualization. Clutter can obscure the structure present in the data. Even in a small dataset, clutter can make it hard for the viewer to find patterns, relationships and structure

clutter

- As designers of information, we want to be smart about how we use our audience's brain power.

- The preceding examples point to extraneous cognitive load: processing that takes up mental resources but doesn't help the audience understand the information. This is something we want to avoid.

example

- Working memory should be seen as short term and finite, whereas long-term memory can be seen as infinite. The aim should be to move knowledge to long-term memory because when a student is exposed to new material, they can draw on this previous knowledge and the cognitive load is reduced. However, if subject knowledge is incomplete, the student is unable to fall back on the long-term memory and the working memory becomes overloaded, leading to working memory failures. According to Gathercole and Alloway (Gathercole and Alloway, 2007), indications of working memory failures include:

- incomplete recall
- failing to follow instructions
- place-keeping errors
- task abandonment.
- Of course, there are many other reasons for these that are not related to CLT; however, if teachers understand how this theory applies to their classroom, they can plan their lessons in a way that takes into account cognitive load.

Intrinsic Load | The Data
Intrinsic

- intrinsic cognitive load is associated with the nature and subject matter of the task or problem itself that the learner finds challenging. Intrinsic load is governed by the number of elements that interact with each other, which all have to be processed simultaneously, making the task more complicated. If there are a large number of elements that the person needs to attend to at once, the intrinsic load will be higher than in the case of low element interactivity. This can be illustrated in the case of interpreting graphs, where a simple bar graph is easier to understand than a complex histogram with too many parameters.

- The inherent difficulty of the content cannot be changed, but it can be managed according to the learner's prior knowledge regarding the material, aptitude, as well as capacity for learning. According to John Sweller, who developed the Cognitive Load Theory, the intrinsic cognitive load can "only be altered by changing the nature of what is learned or by the act of learning itself." For instance, instead of using a cursive, scribbly font, one can use a more plain and legible one to reduce the load on the reader..

Reducing cognitive load

- Intrinsic cognitive load can be reduced by breaking down the subject content, sequencing the delivery so that sub-tasks are taught individually before being explained together as a whole. The idea is to not overwhelm a student too early on in the introduction of new work.

Germane Load | The Audience

Germane load involves developing patterns of thoughts or behavior to organize categories of information. The more practiced the use of these behavioral schemas becomes, the more effortless the behavior becomes. This is displayed when envisioning different kinds of scenarios, for instance, when there are earthquake or fire drills conducted in schools. In such cases, people have to go over multiple solutions and ultimately construct an effective one and carry it out systematically. The repetition of such training promotes learning how to react and behave in an actual emergency. This type of cognitive load is encouraged.

Germane cognitive load can be promoted through the use of mnemonics, including acrostics, rhyme schemes, etc., all of which can make learning easier. For example, the acronym BODMAS is used to remember the order of operations in mathematics, which follows the sequence: brackets, orders (powers, square and cube roots), division, multiplication, addition, and subtraction.

Extraneous Load | The Visualization

- Extraneous cognitive load: Effort imposed by the environment. E.g., background noise that distracts one from reading smoothly.Extraneous cognitive load is the type of load created by the way information is presented to the person. The cognitive load is the result of irrelevant or unimportant pieces of information that are given to the person. For example, in online articles, you find multiple advertisements and pictures that serve no actual purpose and are included merely to make the item more attractive. These are the inessential pieces of information that interfere with the learning process and cause an extraneous load.

- This load can be the result of unproductive methods of teaching that throw off the learner and makes learning unnecessarily confusing and complicated. For example, if a graph and its corresponding text are not combined efficiently, then the person will need to use extra cognitive effort going back and forth between the graph and text, which will hinder learning.

- Extraneous load is the outcome that comes with background noise. Think of when you're trying to study and are disturbed by the dogs barking, cars honking, loud music, or talking. These various noises act as obstacles to the completion of the task and are deemed as extraneous load. It is not entirely necessary to reduce the extraneous cognitive load to help learning. There is evidence that moderate extraneous load in some cases can benefit the learner. The interaction of noise and focused attention on learning is complex and has circumstantial pros and cons.

Reducing cognitive load

- Extraneous cognitive load can be reduced by the way in which instructions are presented. We make sense of new material by referencing schema or mental models of pre-existing knowledge. Lack of clarity in instruction puts too high a load on the working memory, and so too much time is spent problem-solving the instructions as opposed to new schema formation. For example, lessons that use PowerPoint with excessive writing and the teacher talking at the same time, can inadvertently generate excessive cognitive load and lead to working memory failures. Chandler and Sweller (Chandler and Sweller, 1991) write that 'Cognitive Load Theory suggests that effective instructional material facilitates learning by directing cognitive resources towards activities that are relevant to learning.'

clutter

- These are visual elements that take up space but don't increase understanding.
- There is a simple reason we should aim to reduce clutter: because it makes our visuals appear more complicated than necessary
- clutter in our visual communications can cause a less-than-ideal—or worse—uncomfortable user experience for our audience (this is that "ugh" moment I referred to at the beginning of this chapter).
- Clutter can make something feel more complicated than it actually is. When our visuals feel complicated, we run the risk of our audience deciding they don't want to take the time to understand what we're showing,at which point we've lost our ability to communicate with them. This is not a good thing

Gestalt principles of visual perception

- When it comes to identifying which elements in our visuals are signal (the information we want to communicate) and which might be noise (clutter), consider the Gestalt Principles of Visual Perception.

- The Gestalt School of Psychology set out in the early 1900s to understand how individuals perceive order in the world around them. What they came away with are the principles of visual perception still accepted today that define how people interact with and create order out of visual stimuli.

- n the images above, the top chart comes from the USDA Economic Research Service. The bottom chart contains the same data but has less chart clutter, making it easier to read. Here are the things that were changed:

- Remove 3-D effect: A 3-D chart showing 2-D data doesn't add value to your charts but does add noise and makes the chart harder to read.

- Use softer color tones except where you want to draw attention. Bright colors can be tiring to look at. Be mindful of your color-blind audience and use tools like the Coblis Color Blindness Simulator to determine whether your visual is color-blind friendly.

- Pivot the chart: Use the horizontal bar chart when you have category labels that are many characters long so that users don't have to tilt their heads to read the chart.

- Choose an appropriate bar width: Make bars skinnier to use just enough white space so that the bars are slightly thicker than the white space between them. When the bars are too close together, your brain will naturally try to evaluate the area vs. length.

- Remove the x-axis header and add data labels. By adding data labels, you can easily see that the national average is 2.4%. Since we added data labels, the x-axis would be redundant and thus may be removed.

- A final change made to the bottom chart improves readability; sort the bars in descending order. By sorting, readers of the bottom chart can easily see that food price inflation is highest in St. Louis, Seattle and Atlanta and lowest in New York, Anchorage and Pittsburgh. Try for yourself to see which chart is easier to read.

- A good practice after creating a chart is to take a step back, identify unnecessary elements (chart clutter), and remove them. Repeat this process until nothing else can be removed because every element of the visualization has a purpose and supports the objective of the visualization.

- For other data visualization tips and tricks, be sure to check out BlueGranite's recorded webinar Effective Communication through Data Visualization.

- Proximity
- We tend to think of objects that are physically close together as
- belonging to part of a group. The proximity principle is demon_x0002_strated in Figure 3.1: you naturally see the dots as three distinct
- groups because of their relative proximity to each other.

- Proximity is a very important part of making a text easy to read. For example, a headline must have more space before it than after. By being closer to the section it belongs to, it feels more connected to it. Line height is another example. Space between lines must be bigger than between words, but small enough so they form a paragraph. The same is true for letter spacing. The spacing must be wide enough so letters are distinguishable but small enough to form words from the individual letters.

- Those rules apply in digital and print design alike.

- The fundamental law that governs a Gestalt principle is that we tend to order our experience in a manner that's regular, orderly, and recognizable. This is what allows us to create meaning in a complex and chaotic world. And having a solid understanding of how these principles work will help you in three ways.

- They'll help you determine which design elements are most effective in a given situation. For example, when to use visual hierarchy, background shading, gradients, and how to group similar items and distinguish different ones.

- These psychological principles hold power to influence our visual perception, which allows designers to direct our attention to specific points of focus, get us to take specific actions, and create behavioral change.

- And finally, at the highest level, the Gestalt principles help you design products that solve the customer's problem or meet the user's need in a way that's beautiful, pleasing, and intuitive to use.

similarity

- The principle of similarity states that when things appear to be similar to each other, we group them together. And we also tend to think they have the same function.

- For instance, in this image, there appear to be two separate and distinct groups based on shape: the circles and the squares.
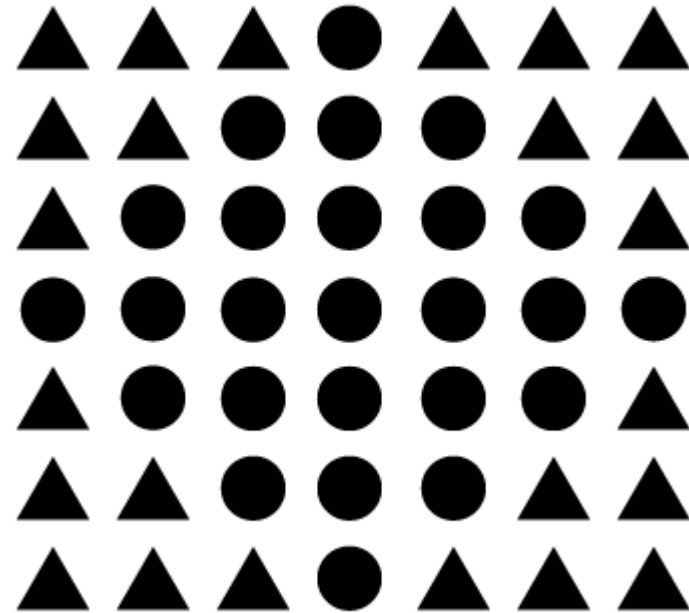
- **A variety of design elements, like color and organization, can be used to establish similar groups. In the image below, for example, even though all of the shapes are the same, it's clear that each column represents a distinct group:**

Examples of the similarity principle

- GitHub uses the similarity principle in two ways on the page below. First, they use it to distinguish different sections. You can immediately tell that the grey section at the top serves a different purpose than the black section, which is also separate from and different than the blue section.

- Second, they also use the color blue to distinguish links from regular text and to communicate that all blue text shares a common function.

proximity

- The principle of proximity states that things that are close together appear to be more related than things that are spaced farther apart.

- Proximity is so powerful that it overrides similarity of color, shape, and other factors that might differentiate a group of objects.

This is perceived to be one group and the components somehow related to each other.
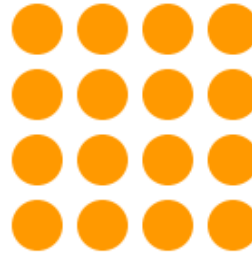
We perceive two groups here, and understand that there are differences between them.
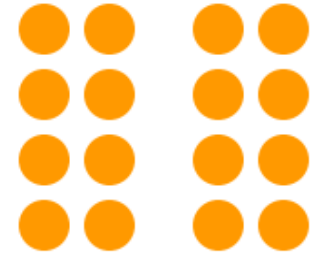
- Examples of the proximity principle
- The nearness of each image and its corresponding text communicates that they're related to one another.

- And Vice uses this principle to distinguish between the images, headlines, descriptions, and other information for each of its stories.
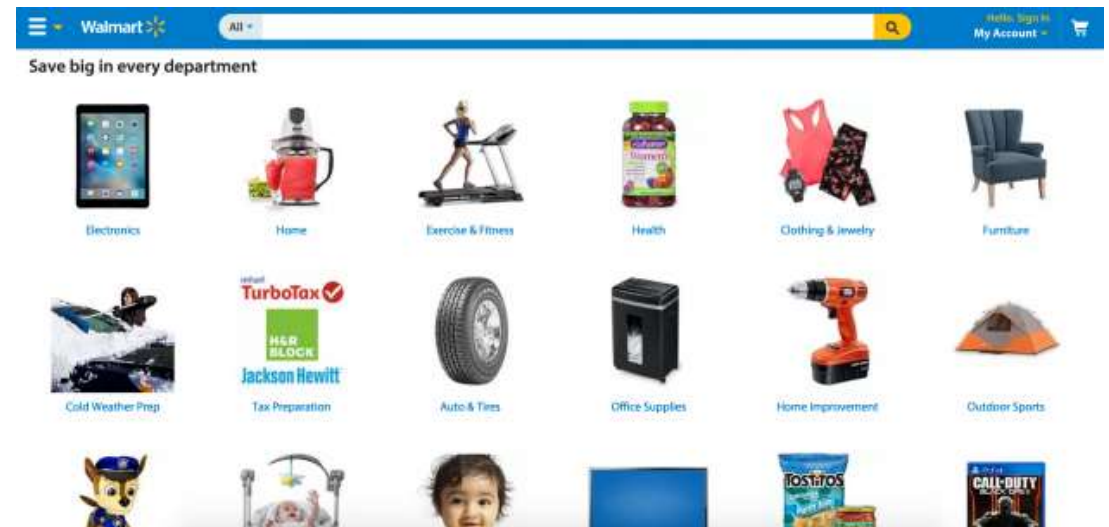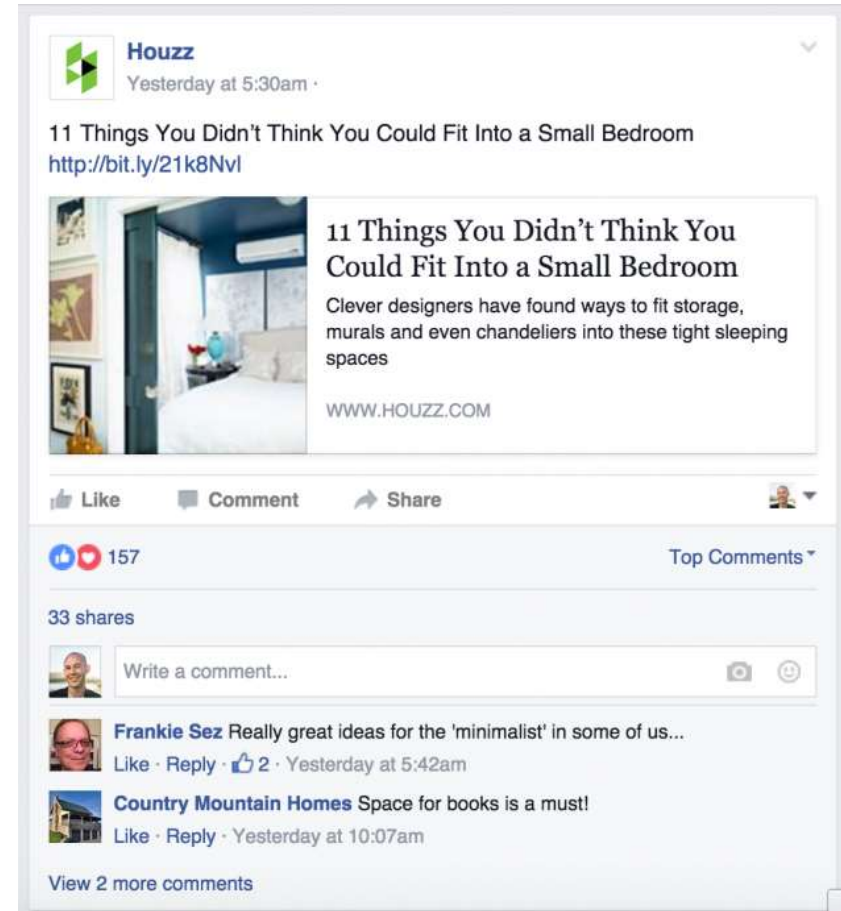
- common region
- The principle of common region is highly related to proximity. It states that when objects are located within the same closed region, we perceive them as being grouped together.

- dding borders or other visible barriers is a great way to create a perceived separation between groups of objects—even if they have the same proximity, shape, size, color, etc.
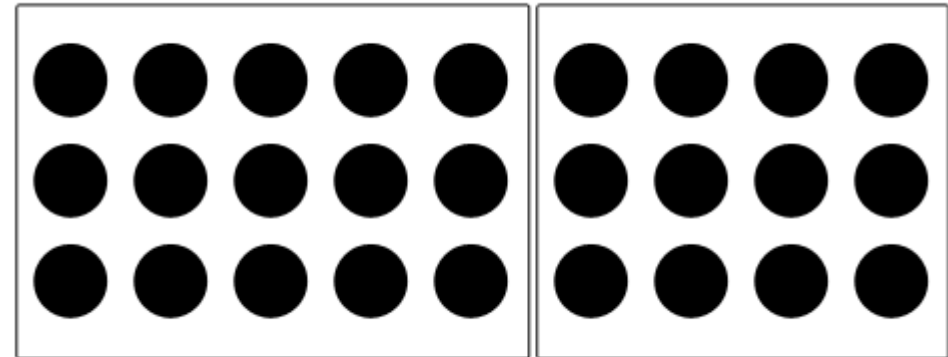
- Examples of the common region principle

- In the example from Pinterest below, the common region principle is used to separate each pin—including its photo, title, description, contributor, and other details—from all the other pins around it.
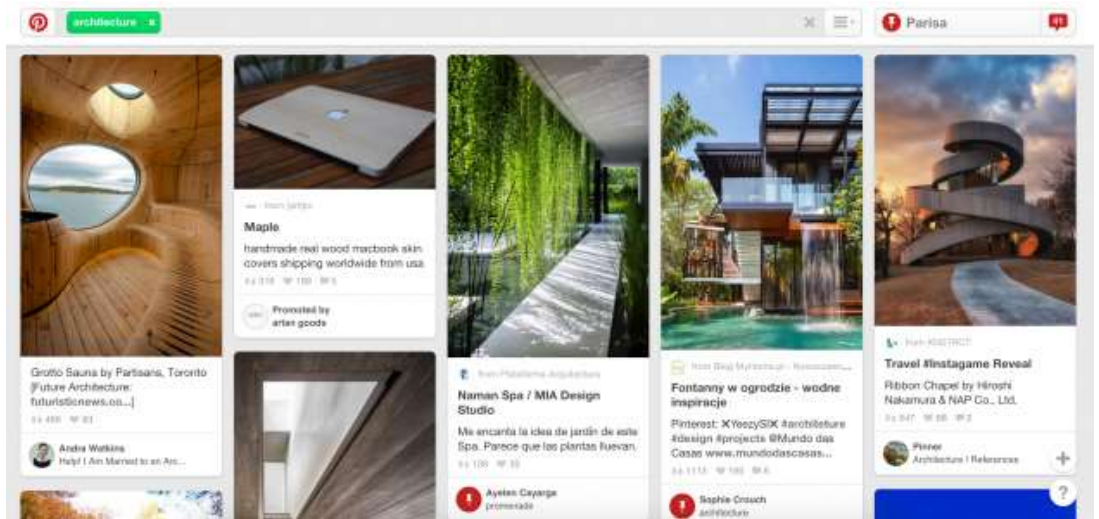
- And it's used in the Facebook example below to communicate that the comments, likes, and interactions are associated with this specific post—and not the other posts surrounding it.

- continuity

- The principle of continuity states that elements that are arranged on a line or curve are perceived to be more related than elements not on the line or curve.

- In the image above, for example, the red dots in the curved line seem to be more related to the black dots on the curved line than to the red dots on the straight horizontal line. That's because your eye naturally follows a line or a curve, making continuation a stronger signal of relatedness than the similarity of color.

- Examples of the continuity principle

- Amazon uses continuity to communicate that each of the products below is similar and related to each other (books of similar topics that are available for purchase).