La Guardia Community College

DATA 203 DATA VISUALIZATION USING TABLEAU

Class 9

VISUAL PERCEPTION

Great designers understand the powerful role that psychology plays in visual perception. What happens when someone's eye meets your design creations? How does their mind react to the message your piece is sharing?
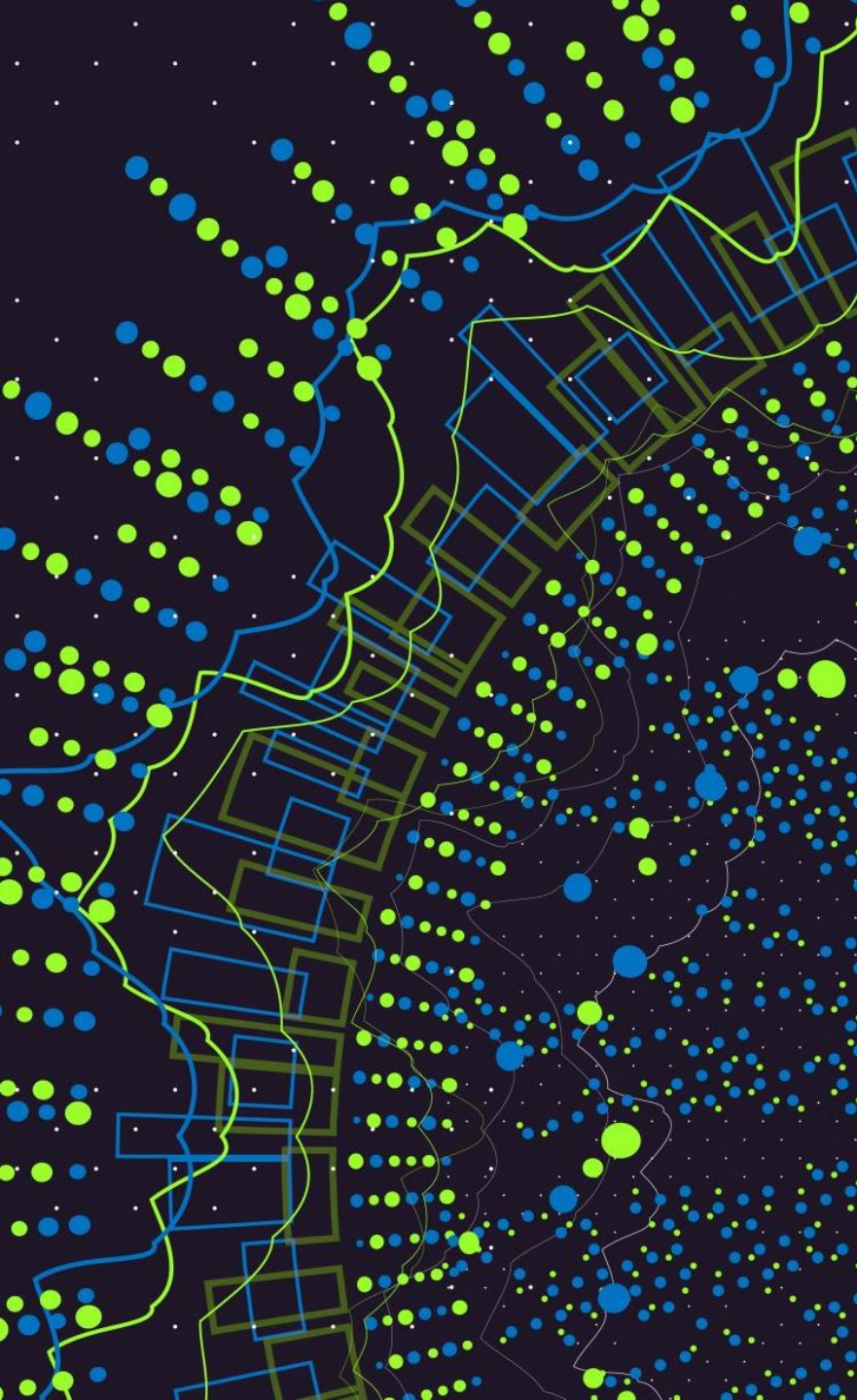
—Laura Busche, Brand Content Strategist at Autodesk

VISUAL PERCEPTION

According to Wikipedia …..

Visual perception is the ability to interpret the surrounding environment by processing information that is contained in visible light. The resulting perception is also known as eyesight, sight, or vision.
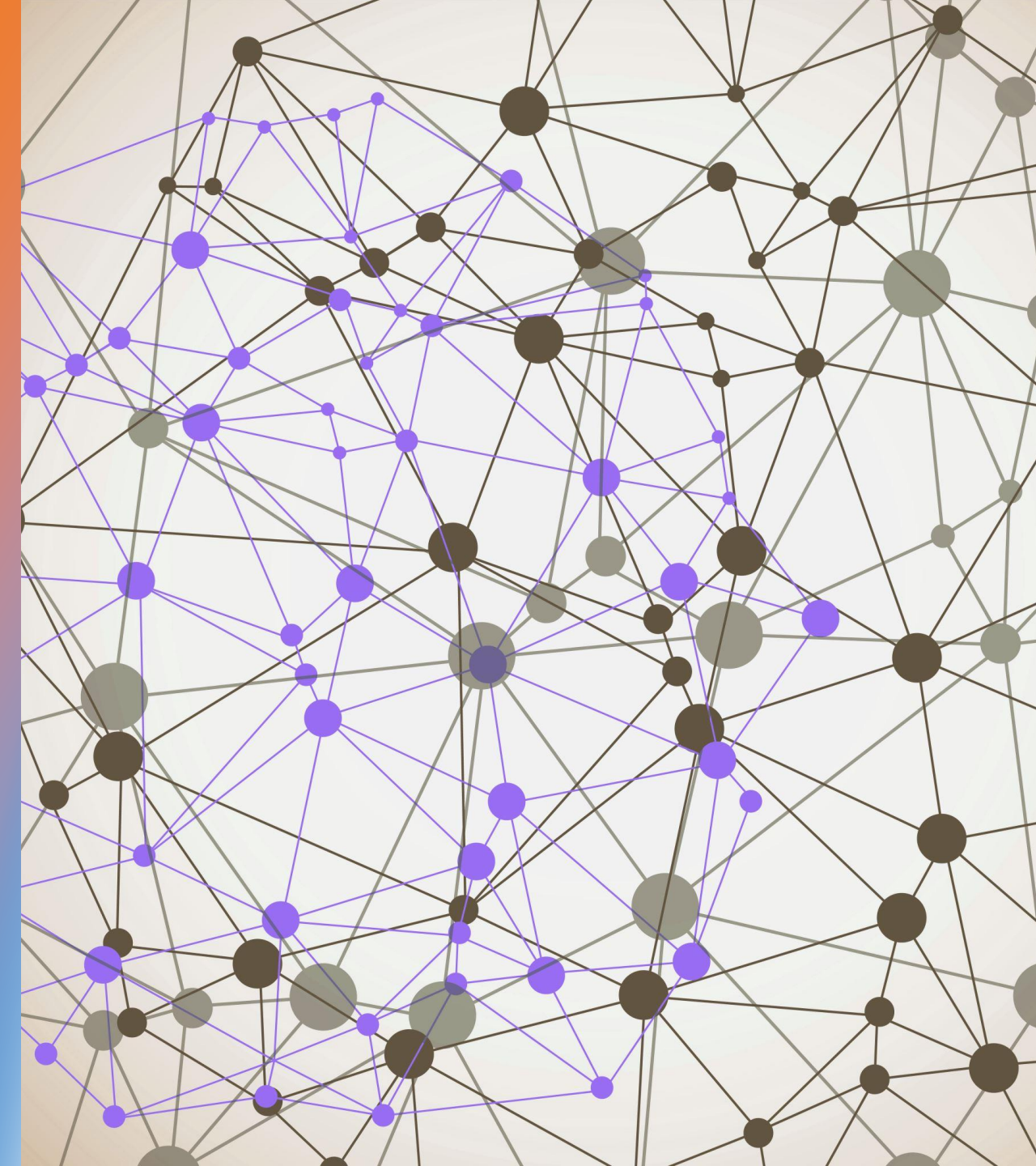
VISUAL PERCEPTION

In Data Visualization we want to understand trends, patterns, and relationships from a visual in order to make better decisions

This is nothing but deriving insights from data.

We don't see images with our eyes; but we see them with our brains.

This is Visual Perception

VISUAL PERCEPTION

**Three points to remember**

1. **Visual perception is selective**
   - If we looked at everything in our surroundings, we would be overwhelmed.
   - We selectively pay attention to things that draw our attention

2. **Our eyes are drawn to familiar patterns**
   - We see what we expect to see
   - Your visuals need to consider what your audience knows and expects

3. **Our working memory is limited**
   - Our memory can hold only a limited amount of information when looking at a visual

VISUAL PERCEPTION

Data visualization shifts the balance between perception and cognition to use our brain's capabilities to its advantage.

Perception - is the sensory experience of the world

Cognition - is the process of acquiring knowledge and understanding through thought, experience and sense to aid in decision making.
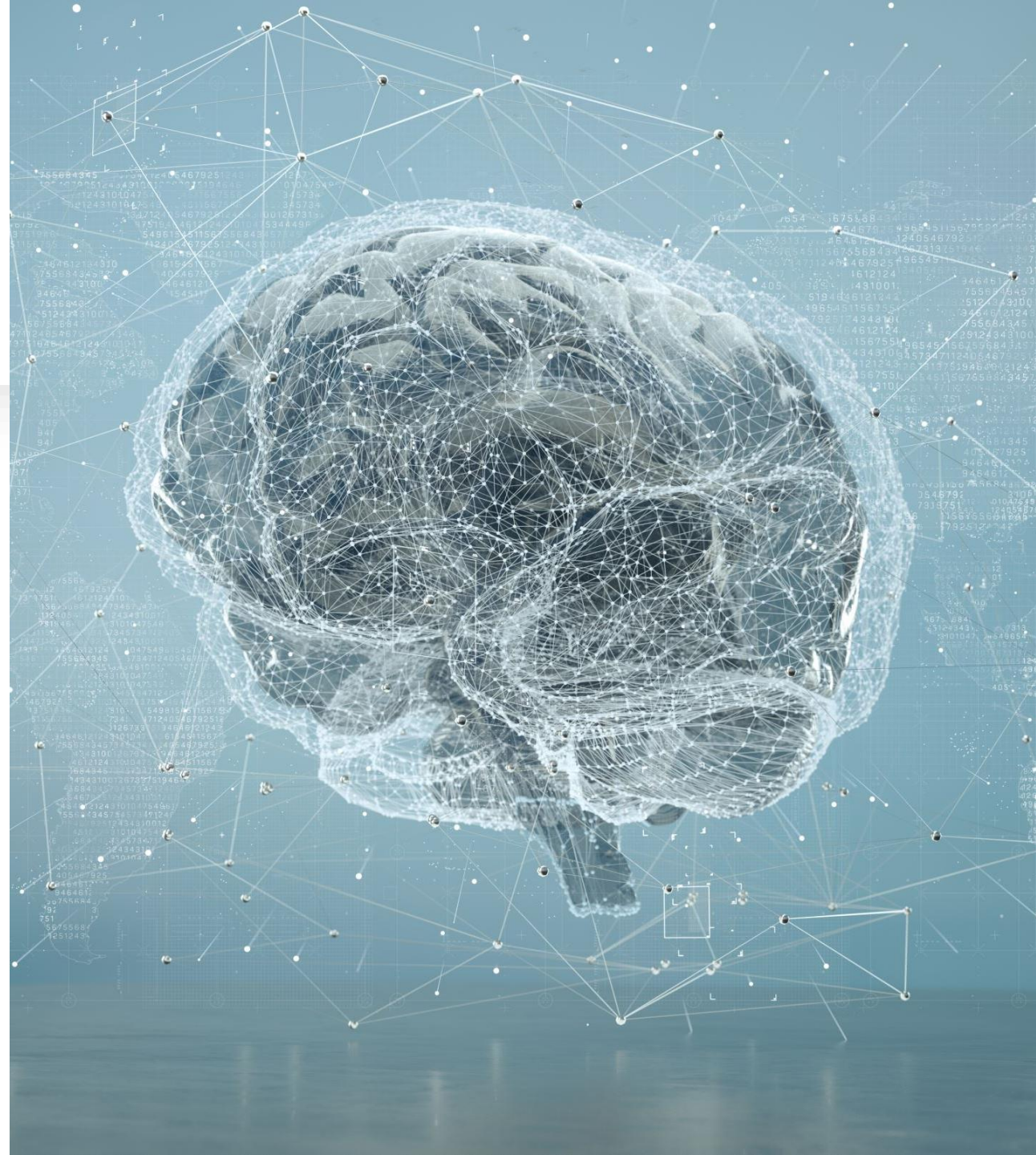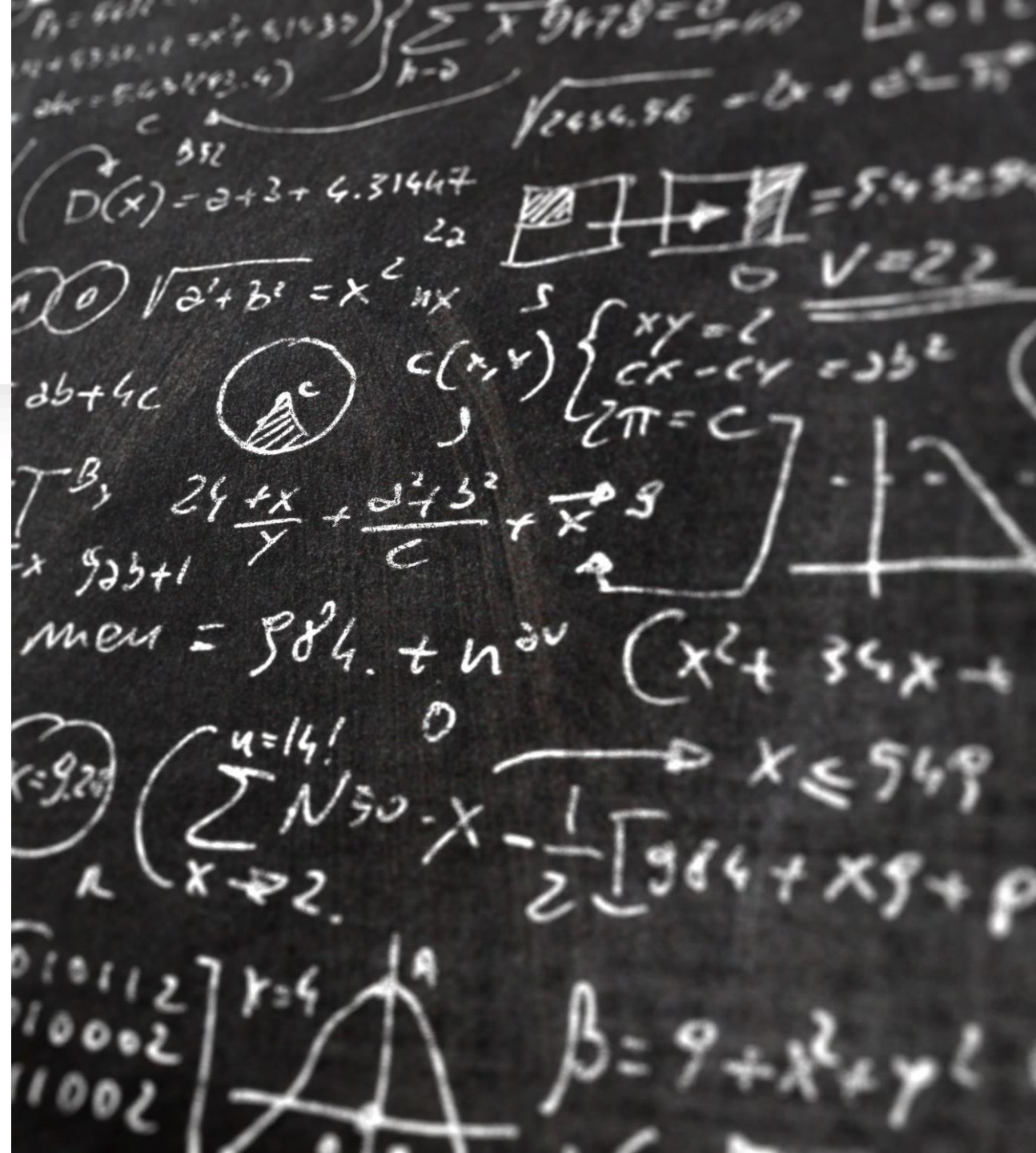
VISUAL PERCEPTION

Example

3 + 4 =

Perception

- You see 3, 4, +, =

Cognition

- Your mind remembers the meaning of the "+" and "=" signs
- Checks it against formerly learned training and understanding from long term memory
- Gives you an output of 7

VISUAL PERCEPTION TYPES OF MEMORY

| TYPE OF MEMORY

DURATION

HOW PROCESSING HAPPENS | Iconic Memory

About a second

Pre-attentive processing even before we pay attention | Working Memory

About a minute

Can hold and process between 5-9 chunks of information | Long Term Memory

A second to a lifetime

Information is stored by repeated application or through rehearsal |

COUNT THE 3s

VISUAL
PERCEPTION

75639506 8473
65866303 7576
86037265 8602
84658910 7830

Count the 3s example without preattentive attributes.
Source: https://kathep.com/tools/readings/focus-your-audiences-attention/

VISUAL PERCEPTION

- You will use the logical side of the brain to find out how many 3s there are.
- You are going to go down the table row by row to count 3s.
- This is a time-consuming process.

- This is called **ATTENTIVE PROCESSING**

COUNT THE 3s

75639506 8473

65866303 7576

86037265 8602

84658910 7830

Count the 3s example without preattentive attributes.
Source: https://kathep.com/tools/readings/focus-your-audiences-attention/

VISUAL
PERCEPTION

COUNT THE 3s

756**3**9506847**3**
658663**03**7576
860**3**72658602
84658910783**0**

Count the 3s example without preattentive attributes.
Source: https://kathep.com/tools/readings/focus-your-audiences-attention/

VISUAL PERCEPTION

- **By highlighting the 3s in black**

- Within seconds you can count that there are six 3s.
- Using this technique, you were able to see the 3s even before you knew what you were seeing.

COUNT THE 3s

7563950684**73**

65866**303**7576

860**3**72658602

84658910783**0**

Count the 3s example without preattentive attributes.

Source: https://kathep.com/tools/readings/focus-your-audiences-attention/

VISUAL PERCEPTION

- **Pre-attentive Properties**

  - **Visual properties that we notice without using conscious effort to do so.**

  - It takes less than half a second for the eye and the brain to process a Pre-Attentive property of any image.

  - These attributes can be harnessed to make it easier for users to understand what is presented through your data visualization.

  - Preattentive properties are a **very powerful** tool. They determine what your audience notices first when they look at your data visualization.
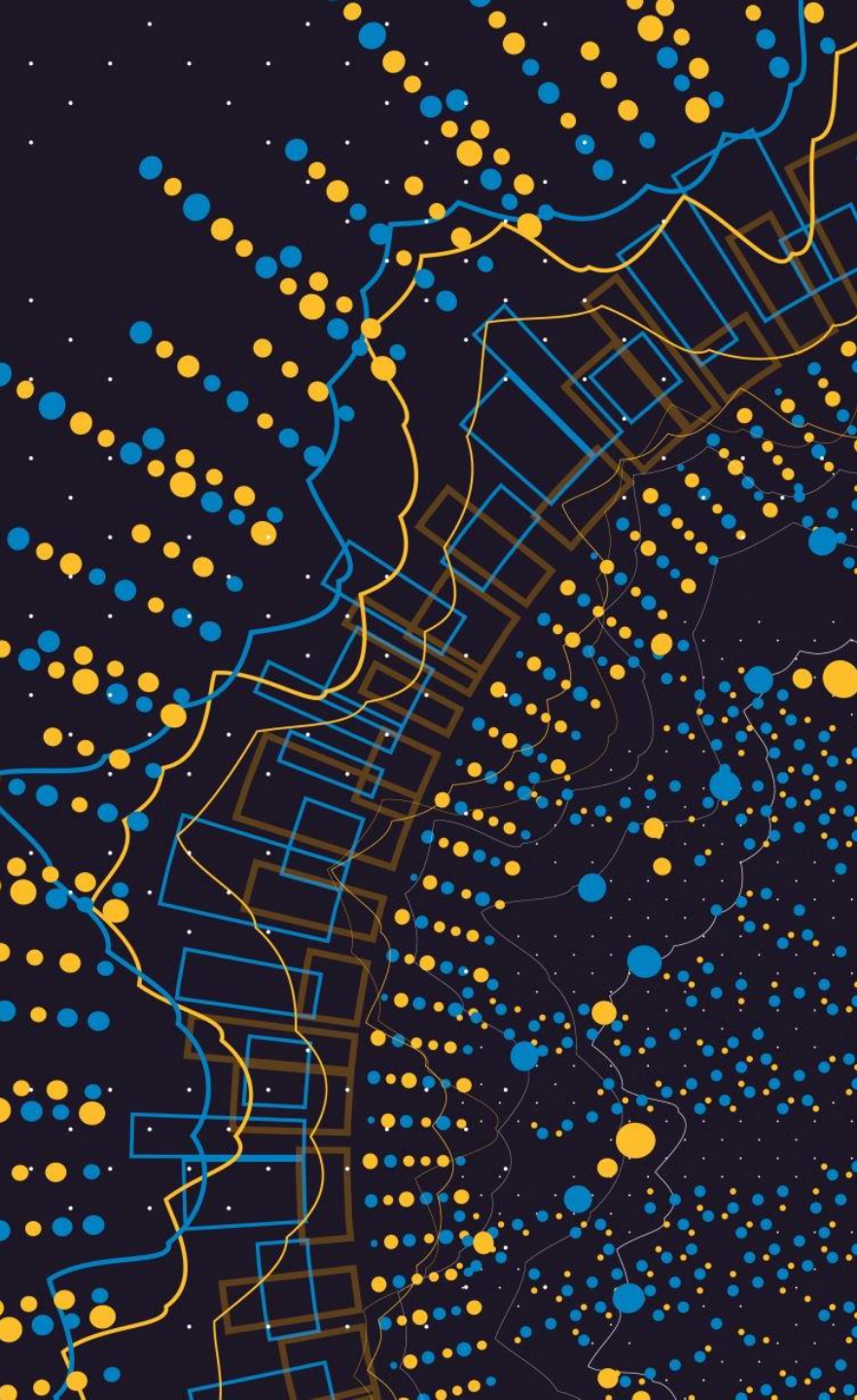
VISUAL PERCEPTION

- **Preattentive Processing** is an important aspect of the human visual system and a **powerful component** of data visualization.

- When used correctly, you can create visualizations that
  - gets the attention of the user
  - transmits information in the fastest, most effective and efficient way.

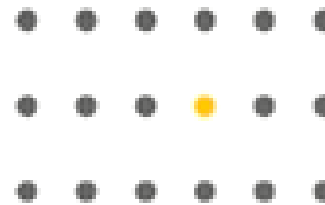# VISUAL PERCEPTION

PRE ATTENTIVE ATTRIBUTES

Form

- Applies to attributes listed in the figure

- Calls attention to a member of a data set

- In the figure you see how each FORM property is used to call our attention to a part of the visualization

- You see these differences even without realizing or thinking about them.

- It's all done in your sensory memory without conscious effort.
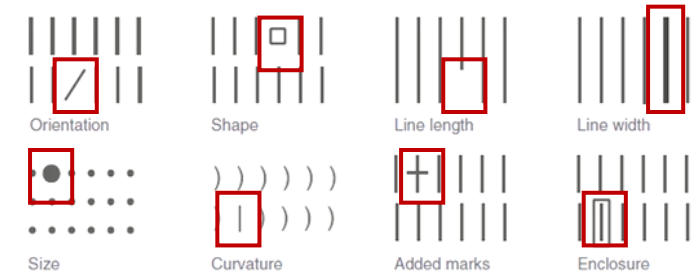
VISUAL PERCEPTION PRE ATTENTIVE ATTRIBUTES

- **COLOR**
- Hues and intensities are pre-attentively processed and can be used to separate visual elements from their surroundings.

- This saves the user from having to perform a visual search through data.

Hue
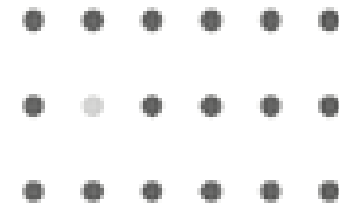
Intensity

VISUAL PERCEPTION - PRE-ATTENTIVE ATTRIBUTES

- **SPATIAL PROCESSING**
  - The ability to discern the position of two or more objects in space relative to each other.

  - 2D Positioning is often the best way to deliver data that can be easily recognized and processed visually.

  - It is particularly effective for quantitative data representations.
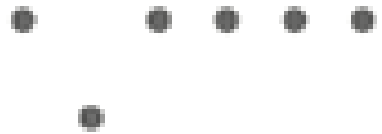
Spatial position

VISUAL PERCEPTION - PRE - ATTENTIVE ATTRIBUTES

Motion
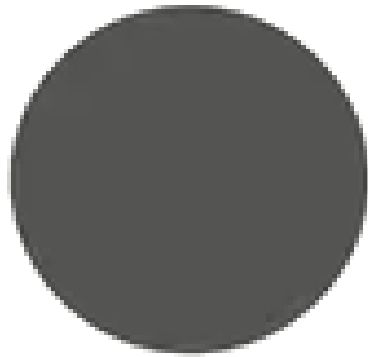
Flicker

- **MOVEMENT**
- Movement has two sub-attributes: motion and flicker.
- They can be used effectively to call someone's attention.
- Make sure that it does not become annoying or distracting to the audience..

VISUAL PERCEPTION

PRE ATTENTIVE ATTRIBUTES

You must make a conscious choice of using Preattentive Attributes with purpose.
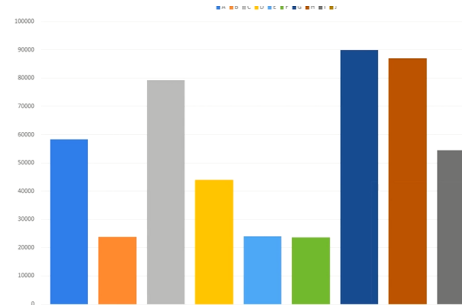

Chart 1:

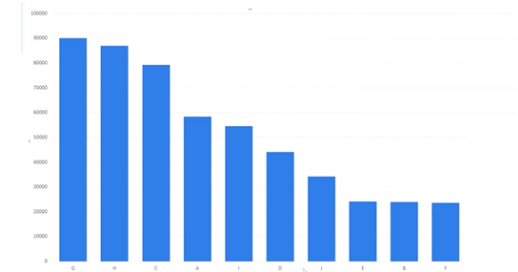- Too colorful and sorted by category name.
- Your eyes jump all over the graph lacking focus.

Chart 2:

- One color and sorted by sales amount.
- Your eyes move more easily across the categories from the largest to the smallest.

VISUAL PERCEPTION

- **GESTALT PRINCIPLE**

- In 1920 a group of German psychologists developed theories around how the human brain perceives structure around itself called **GESTALT PRINCIPLE**

- **GESTALT** is a psychology term - It hypothesizes that people tend to organize visual elements **into groups or "Unified Wholes"** when certain principles are applied.

VISUAL PERCEPTION

- *Any image is more than just the sum of its parts*

VISUAL PERCEPTION

GESTALT PRINCIPLES

- **Why are Gestalt Principles important in Data Storytelling?**

  - Your audience needs to understand what they see in your Data Visualization.

  - Understand and follow the Data Story you are telling them.

VISUAL PERCEPTION

GESTALT PRINCIPLES

- **SIX PRINCIPLES THAT APPLY TO DATA VISUALIZATION**

  - Proximity
  - Similarity
  - Enclosure
  - Closure
  - Continuity
  - Connection
  - Figure & Ground (also, known as Focus)

Proximity

- Things that are close together appear to be more related than things that are spaced farther apart.
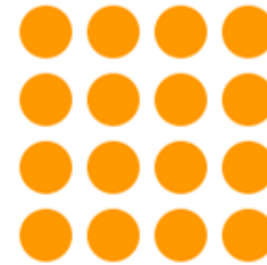
This is perceived to be one group and the components related to each other.
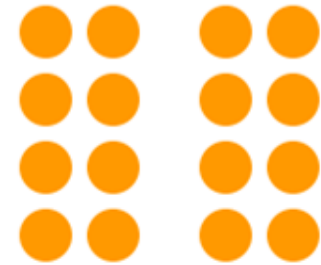
We perceive two groups here and understand that there are differences between them.

VISUAL PERCEPTION

GESTALT PRINCIPLES

Proximity

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

In the three groups of black and red dots above - the relative nearness of the objects has an even stronger influence on grouping than color does.

VISUAL PERCEPTION

GESTALT PRINCIPLES

VISUAL PERCEPTION
GESTALT PRINCIPLES

Proximity

- How would you use Proximity in visualization?
  - Keeping text close to a particular chart helps users to know that the text and the visual needs to be read and interpreted together.
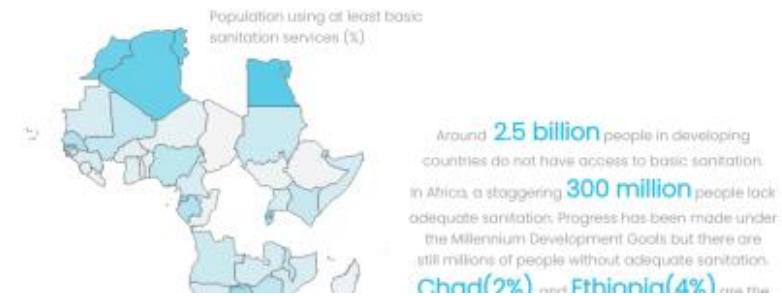
-

VISUAL PERCEPTION GESTALT PRINCIPLES

- **Proximity**

- How would you use Proximity in visualization?
  - Small multiple charts placed together in a visualization indicate that they are part of a group.
  - If you spread these charts out randomly around the visualization, then grouping will not be evident.

-

Similarity

- When things appear to be similar to each other, we group them together.

- By assigning different colors and shapes, your audience can now distinguish between the different groups and their relationships right away.
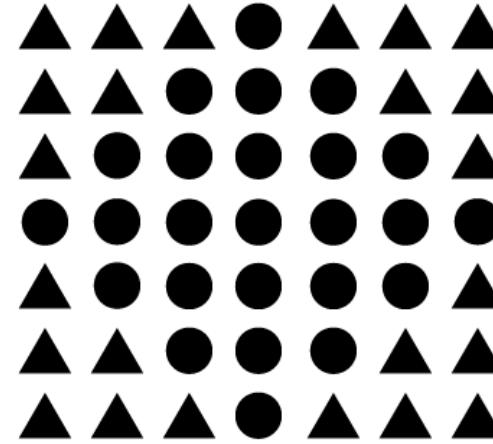
In the above image, there are two distinct groups based on shape : the triangles and the circles.
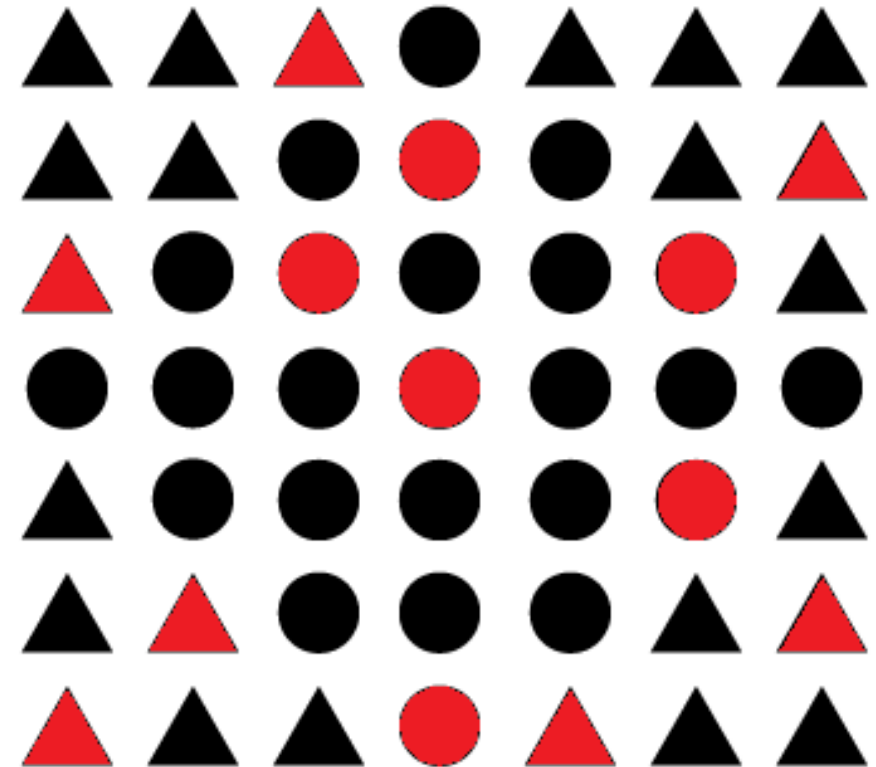
VISUAL PERCEPTION

GESTALT PRINCIPLES

VISUAL PERCEPTION
GESTALT PRINCIPLES

Similarity

- How many groups do you think your audience would see in this image?
- Two main groups
  - Shape: Circle, Triangle
  - Color: Black , Red

- Your audience sees 4 groups:
- Black Circles, Black Triangles, Red Circles and Red Triangles.
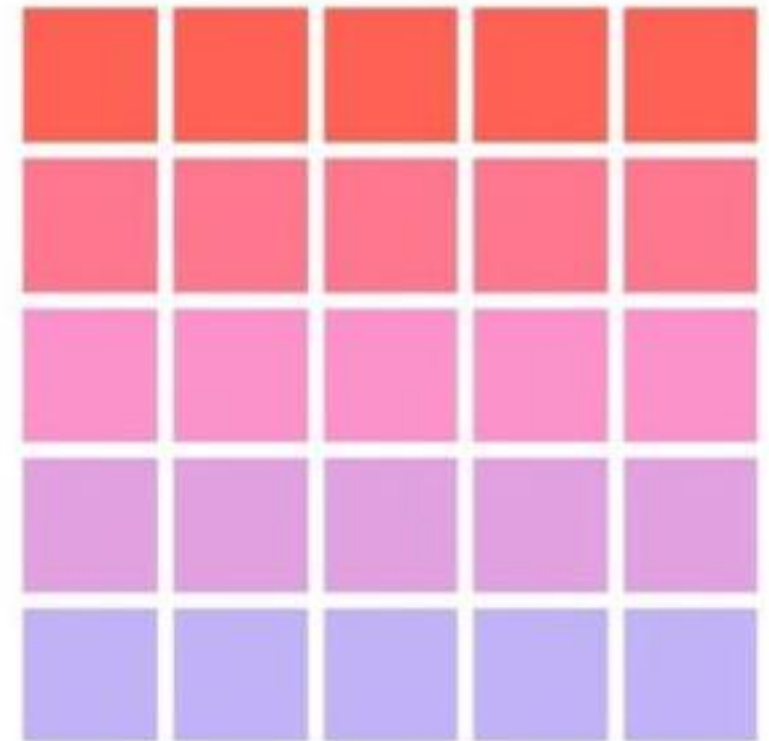
VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Example of Proximity and Similarity**

  - **Proximity**: The relative farness of the four gray columns is perceived as four groups regardless of the color.

  - **Similarity:** regardless of the shape being the same, each column represents one group based on color.

VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Example of Similarity & Movement**

  - In a tabular format, you can draw your audience attention in the direction you want them to focus.

  - Similarity of colors is a cue for your audience to read across the rows.

- Design Principle – Movement
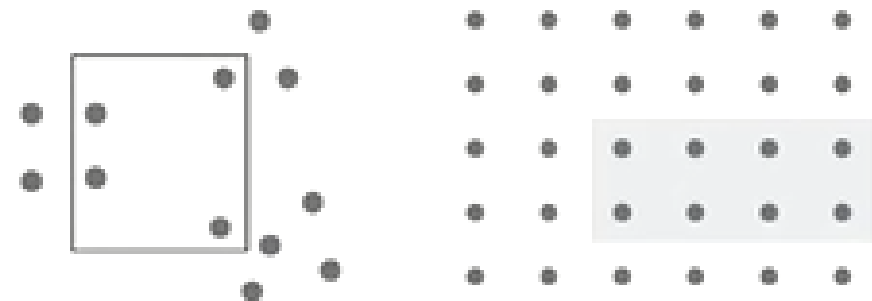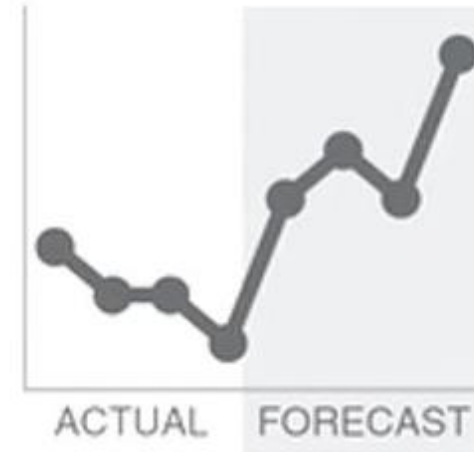- Gestalt Principle – Similarity

break your goals into steps

VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Enclosure**

- Objects collected within a boundary-like structure are perceived as a group.

- By placing a line or shading around visual elements on a dashboard, signals that objects within the boundary form one, or belong together.

ACTUAL   FORECAST

VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Examples of Enclosure**

  - In this bar graph the orange shading draws our attention to SBC, Indian Oil and HDFC Bank.

 - We perceive SBC, Indian Oil and HDFC Bank to be part of one group.

  -

Source: http://daydreamingnumbers.com/
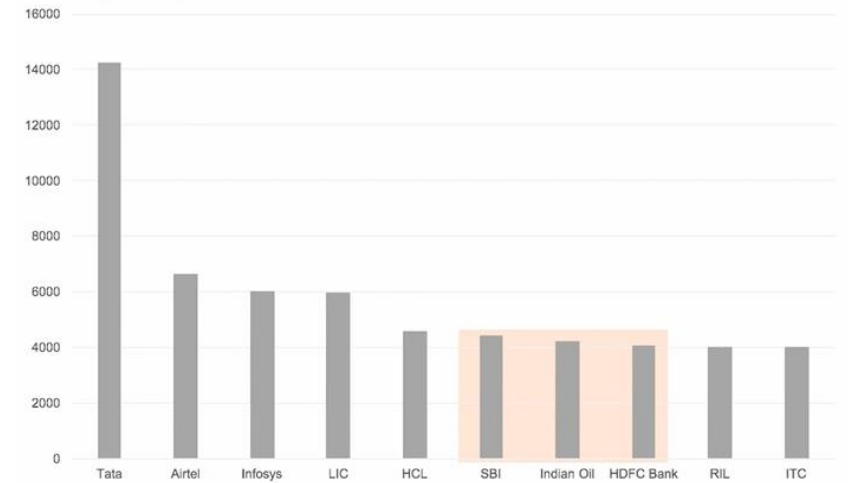
Example of Enclosure & Emphasis

- All objects of each multiple chart is placed in a container.
  - Title, Chart, Explanation

- These objects are not grouped together but also interpreted together.

- Each enclosed chart also grabs the attention of the audience.

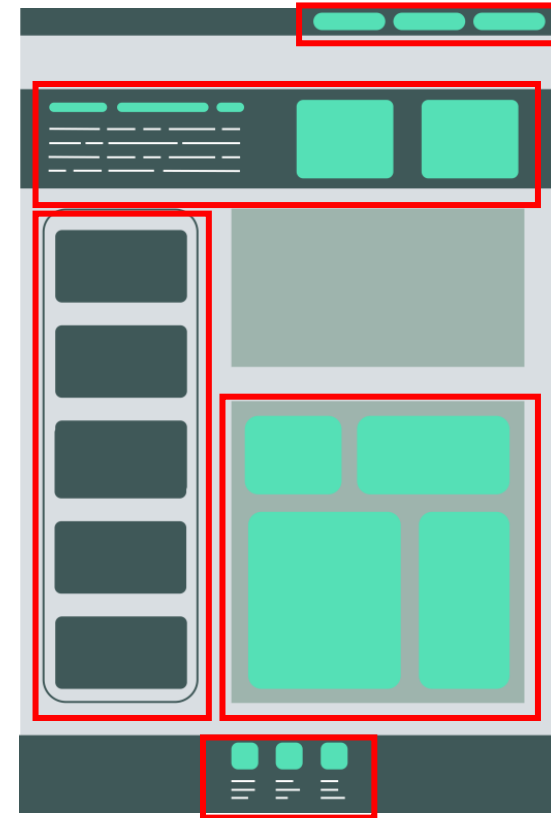Design Principle: Emphasis

Gestalt Principle: Enclosure
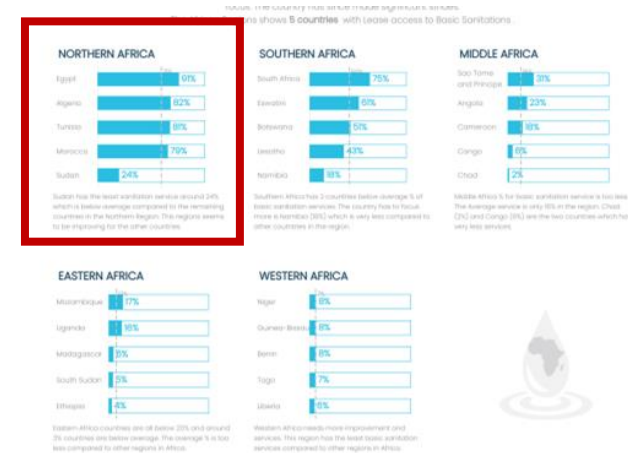
VISUAL PERCEPTION

GESTALT PRINCIPLES

Examples of Enclosure

- Template of a visualization with several enclosures
  - Side panel with five objects grouped together with a border
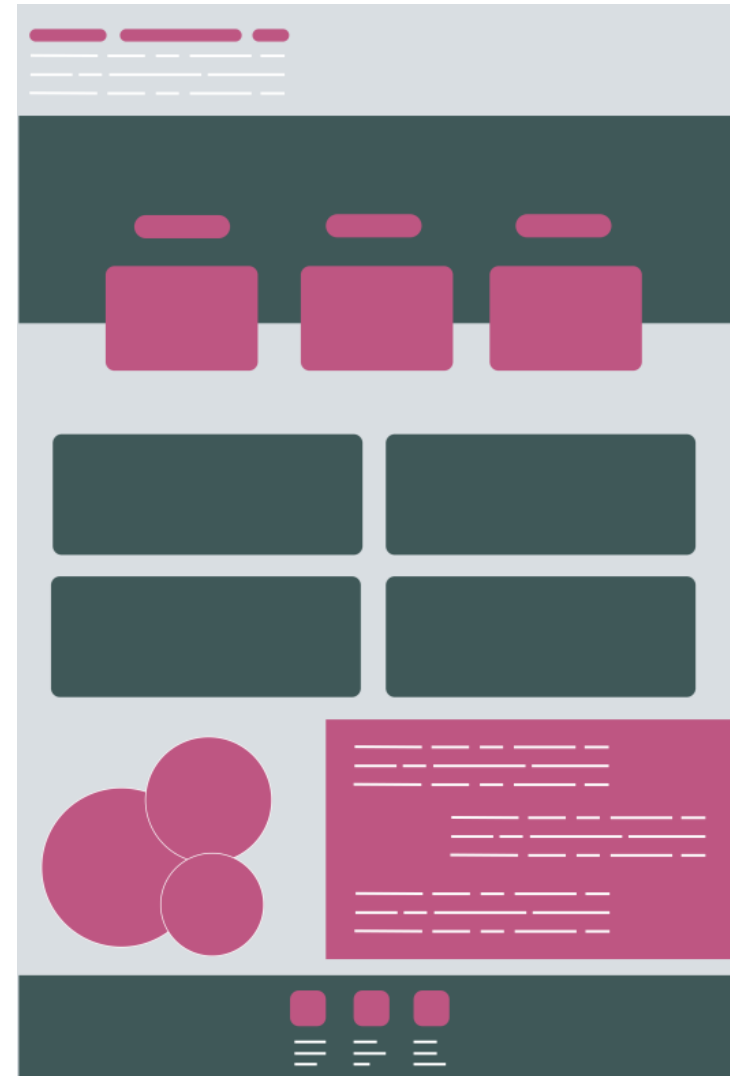 - Green charts grouped together with a gray background
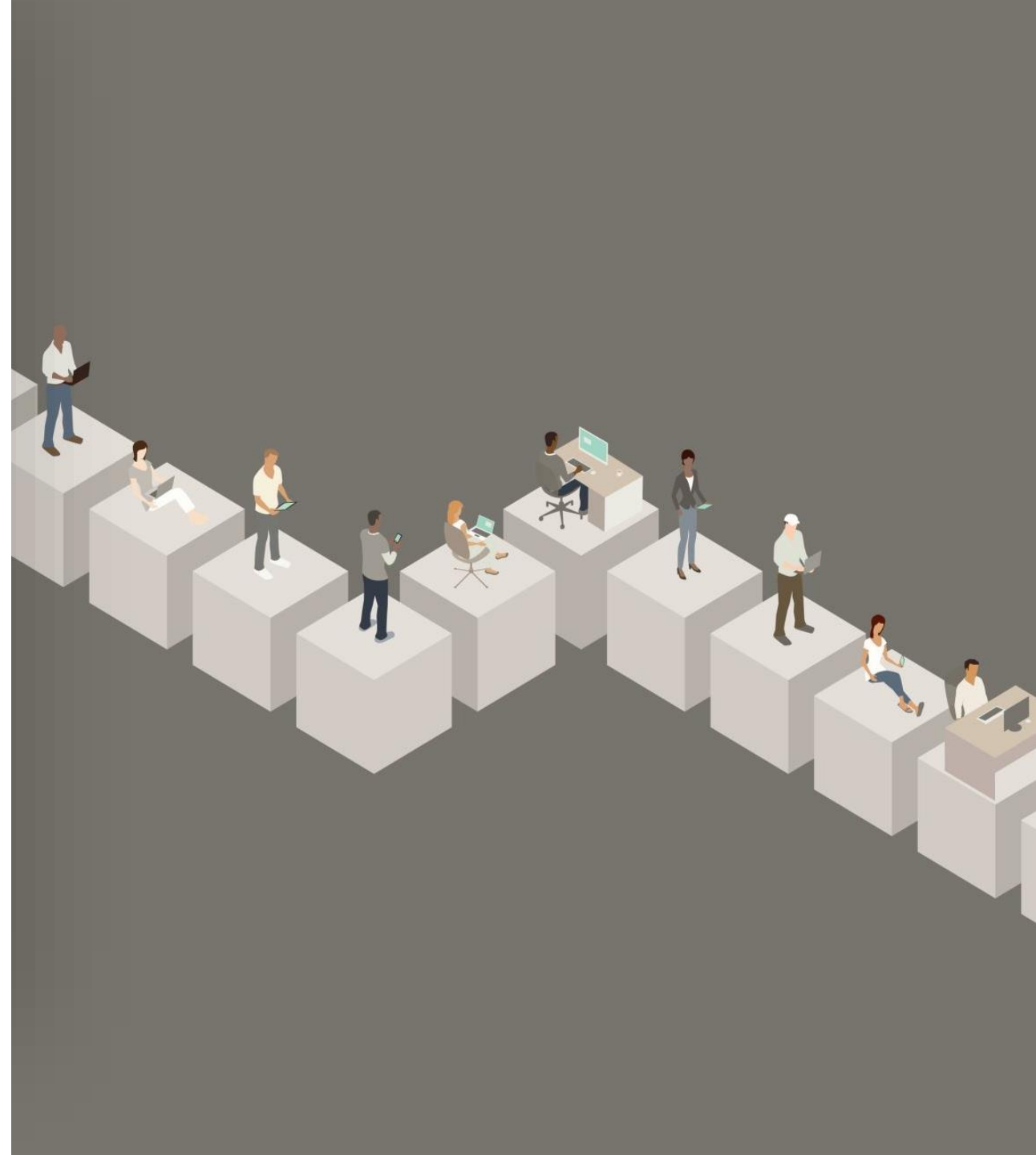
VISUAL PERCEPTION

GESTALT PRINCIPLES

VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Examples of Enclosure**
  - How is the principle of Enclosure used in this template?

VISUAL PERCEPTION GESTALT PRINCIPLES

- **Why Use Enclosure?**

  - Enclosure helps your audience know where to look and what to look at together.

  - Helps keep a flow to your story and analysis and direct your user to more likely view grouped elements at the same time vs. randomly looking all over the page to what catches their eye.

VISUAL PERCEPTION

GESTALT PRINCIPLES

- **Visualizations for Enclosure**

  - [Sanitation in China](#)
  - [Sanitation in Australia](#)
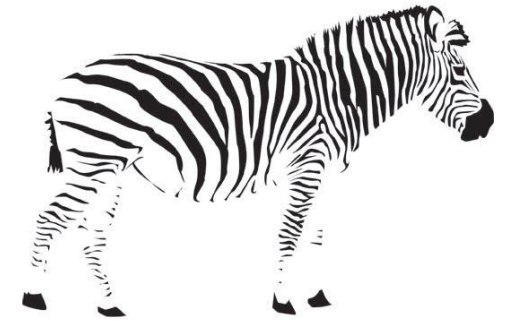 - [Sanitation in Poland](#)

VISUAL PERCEPTION

GESTALT PRINCIPLES

Closure

- Our tendency to complete an incomplete shape in order to rationalize the whole.

- When you see an image that has missing parts, your brain will fill in the blanks and make a complete image so you can still recognize the pattern.


When you look at the image above you most likely see a zebra even though the image is just a collection of black shapes. Your mind fills in the missing information to create a recognizable pattern based on your experience.
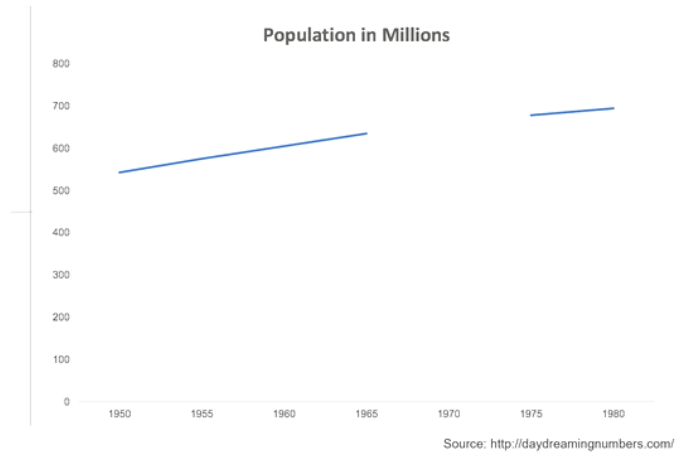
VISUAL PERCEPTION

GESTALT PRINCIPLES

- **Example of Closure**
  - In this chart we only see two axes, rather than full enclosure, are required on a graph to define the space in which the data appears, like in a bar chart with x and y-axis values visible
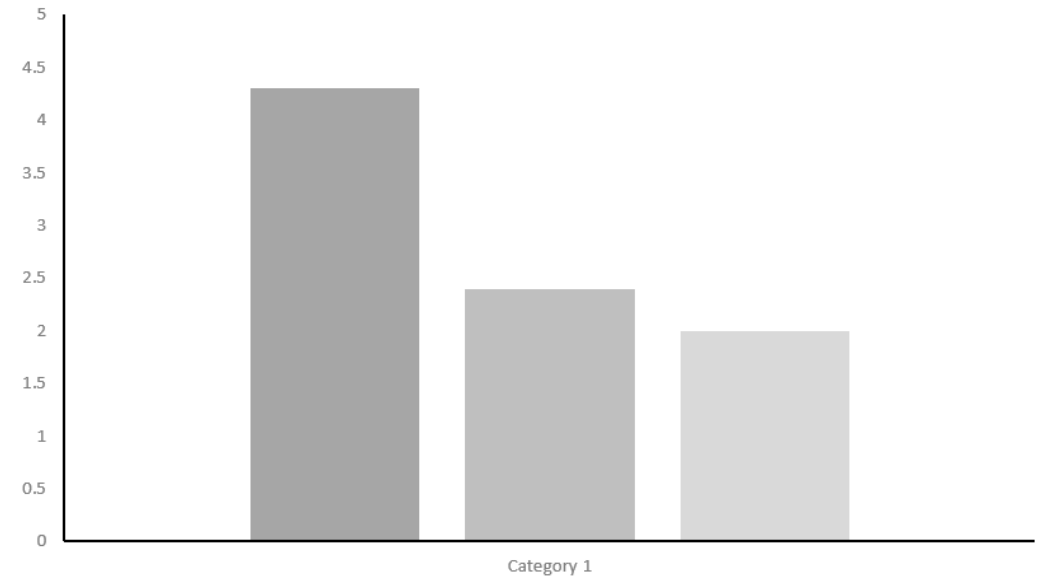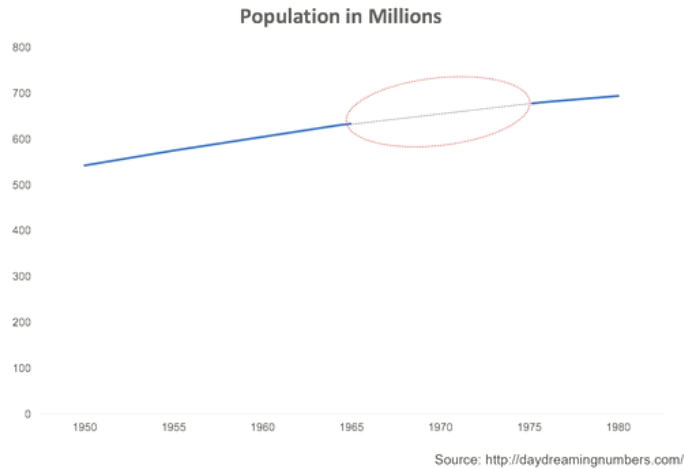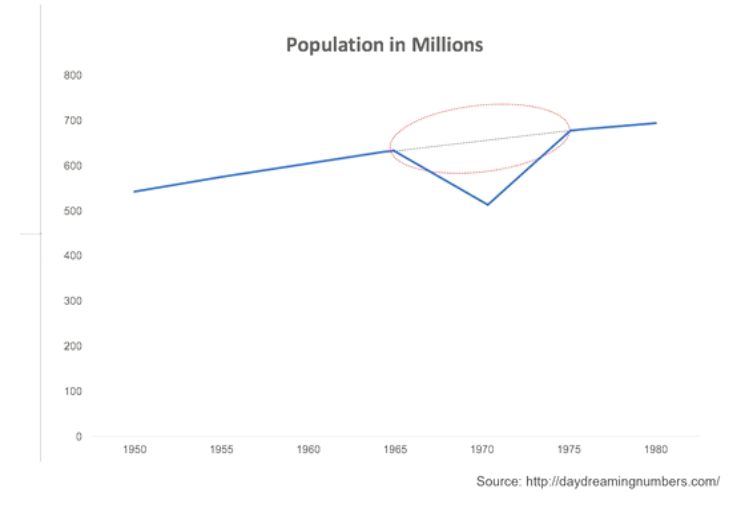
Example of Closure

Chart with missing data for 1970   What we imagine   What reality could be
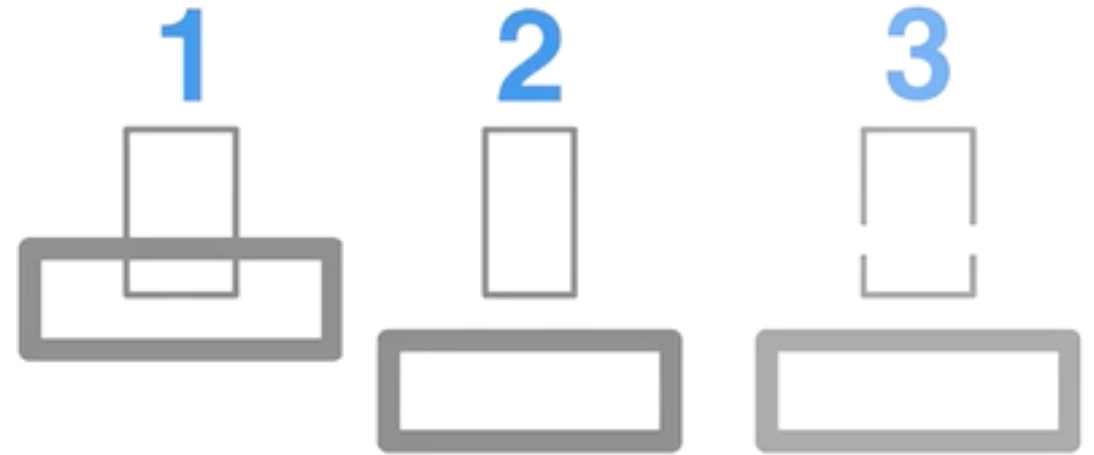

VISUAL PERCEPTION

GESTALT PRINCIPLES

VISUAL PERCEPTION GESTALT PRINCIPLES

- **Continuity**

  - Human eye follows lines, curves, or a sequence of shapes in order to determine a relationship between design elements.

  - When we see overlapping rectangles (1) we think that they are two complete rectangles (2), when in fact, it might be three different rectangles (3)

  -

VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Example of Continuity**

  - The five Olympic Rings could in fact be
    - Five partial circles
    - Four connectors that connect the five circles to form the Olympic Rings structure

  -
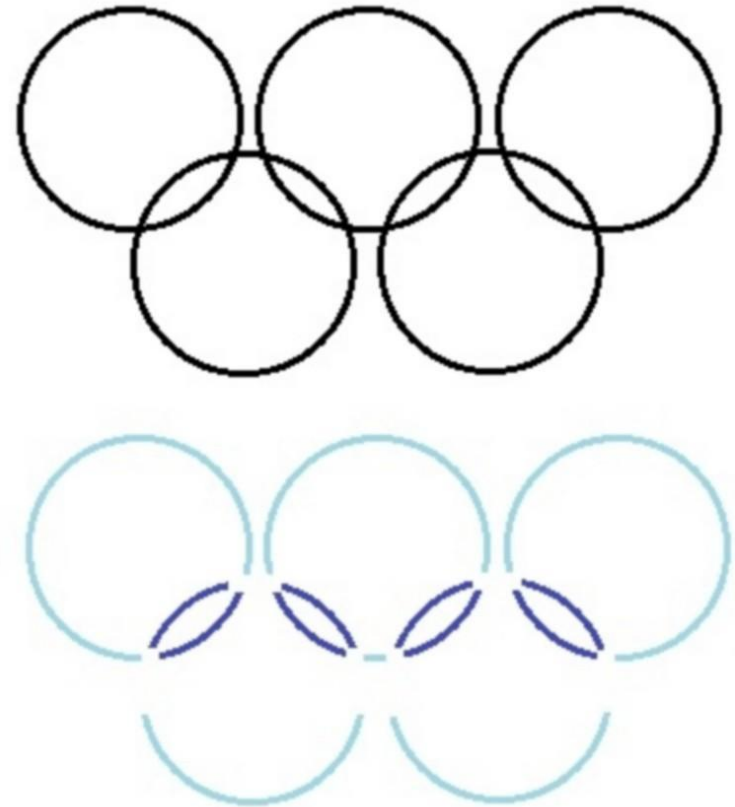
VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Example of Continuity**

  - If you look closely, the chart does not have an X-Axis line.

  - But we see these bars as sharing a common baseline due to the law of continuity.

  -

Most valuable brands in India (2018)

Brand Value (Millions USD)
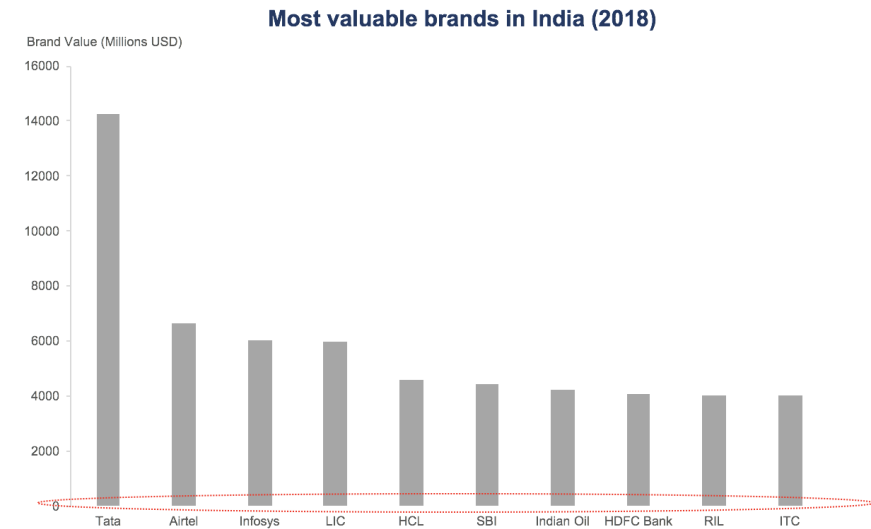
VISUAL PERCEPTION
GESTALT PRINCIPLES

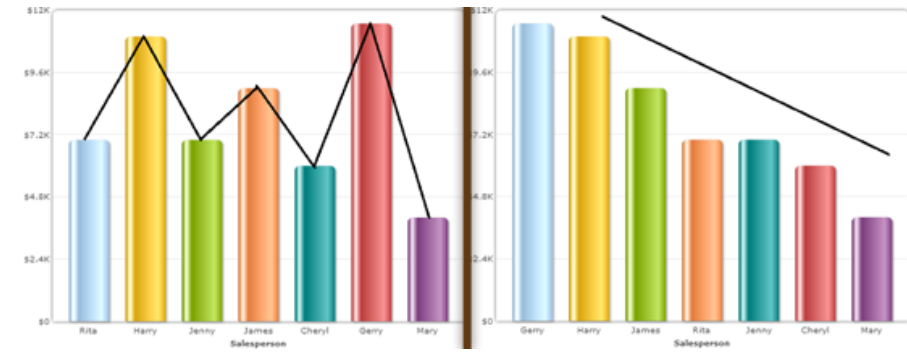- **Example of Continuity**

  - Principle states that our eyes group things that are **aligned with each other.**
  - In the left chart, there are abrupt directional changes.
  - In the right chart, the eye follows a continuous path.
    - makes the whole chart more readable because of the continuous downward direction.

  -

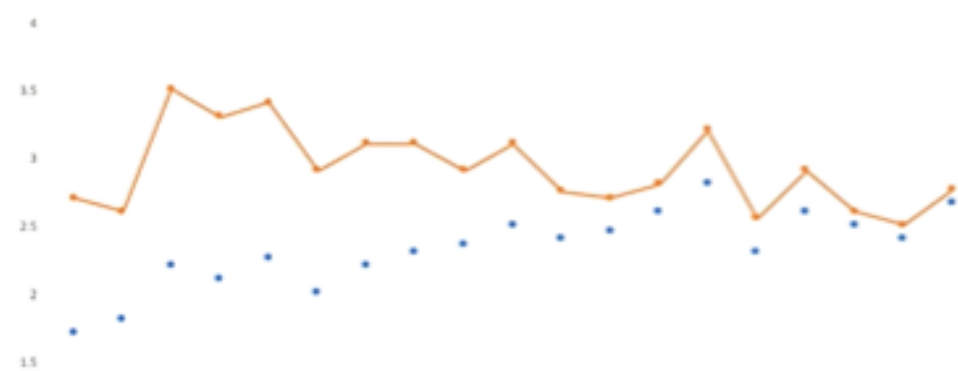# VISUAL PERCEPTION   GESTALT PRINCIPLES

- **Connection**

  - We perceive elements connected to each other as a single group as opposed to objects that are not linked in the same manner.
  - Elements that are connected to each other using colors, lines, frames, or other shapes are perceived as a single unit.

  - Connected property has a stronger associative value than similar color, size or shape.
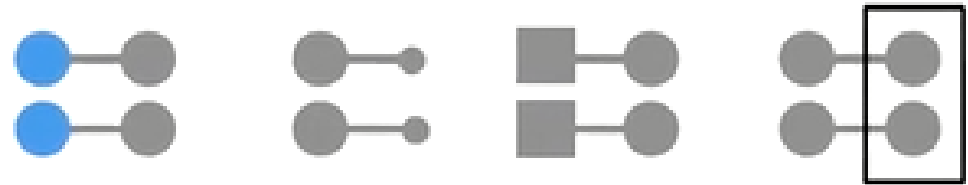
Example of Connection

- Blue dots appear to be connected, since they are connected to each other by a line.
- Orange dots appear scattered

- Blue dots appear scattered
- Orange dots appear connected, since they are connected to each other by a line.

VISUAL PERCEPTION

GESTALT PRINCIPLES

VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Figure & Ground (also known as Focus)**

- One of the most important principles.

- We instinctively perceive objects as either being in the foreground or the background. They either stand out prominently in the front (the figure) or recede into the back (the ground).

- It allows us to determine what we're supposed to look at and what we might safely ignore.

- Figure and Ground are sometimes interchangeable depending on the contrast between the two.

VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Example of Figure & Ground**

  - Chart on the Left-   the gray object (figure) resting on a white field (ground).

  - Chart on the Right – gray object (figure) with a hole in it (placed on a white field (ground))
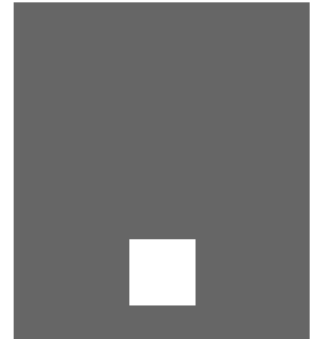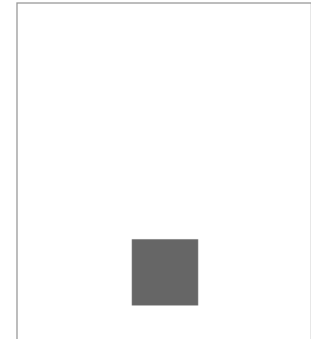
VISUAL PERCEPTION
GESTALT PRINCIPLES

- **Example of Figure & Ground**

  - The blue bubbles form the figure in the chart, they are in the forefront and capture our attention. The map in the background comes into focus next.

International Migrants Day: Mediterranean Death Trap
Migrant deaths worldwide by region in 2016

- 53 Europe
- 3 East Asia
- 4,812 Mediterranean
- 96 Middle East
- 409 U.S./Mexico Border
- 1,089 Sahara & North Africa
- 208 South-East Asia
- 52 Caribbean
- 159 Central America & Mexico
- 195 Horn of Africa
- 27 South America
- 77 Sub-Saharan Africa

International Migrants Day on Dec 18, 2016
@StatistaCharts Source: IOM

statista