Data Visualization

Agenda

1. Color Vision Deficiency (CVD)
2. CVD-friendly Designing Tips
    - Accessibility & CVD
3. Visualization Example
4. Questions

Color Vision Deficiency (CVD)

Color Vision Deficiency (CVD)

- Persons with **CVD**:
  - colors most people see as different will look the same for them

- **Colorblindness** is not the most accurate term
  - instead, use **CVD**

CVD Studies

- **Red-green CVD**
  - About **8% of men**
    - 6% of men have green weak (deuteranomaly) & green blind (deuteranopia)
    - 2% of men have red weak (protanomaly) & red-blind (protanopia)
  - About **0.5% of women**

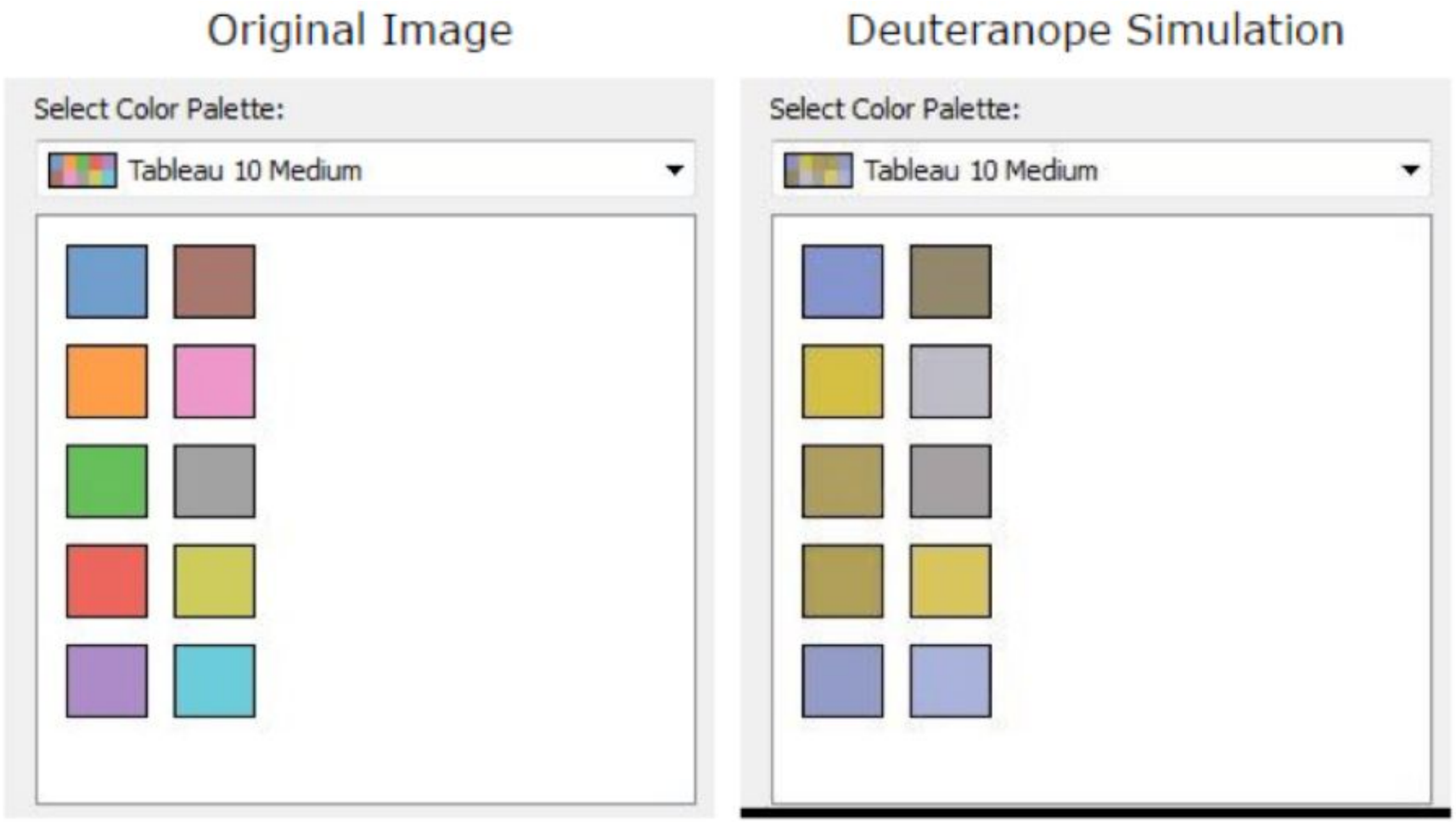
- **Blue-yellow CVD**
  - About **5% of all CVD cases**

- **CVD** doesn't mean: person can't see color
  - unless in very rare cases (1 in 33,000)

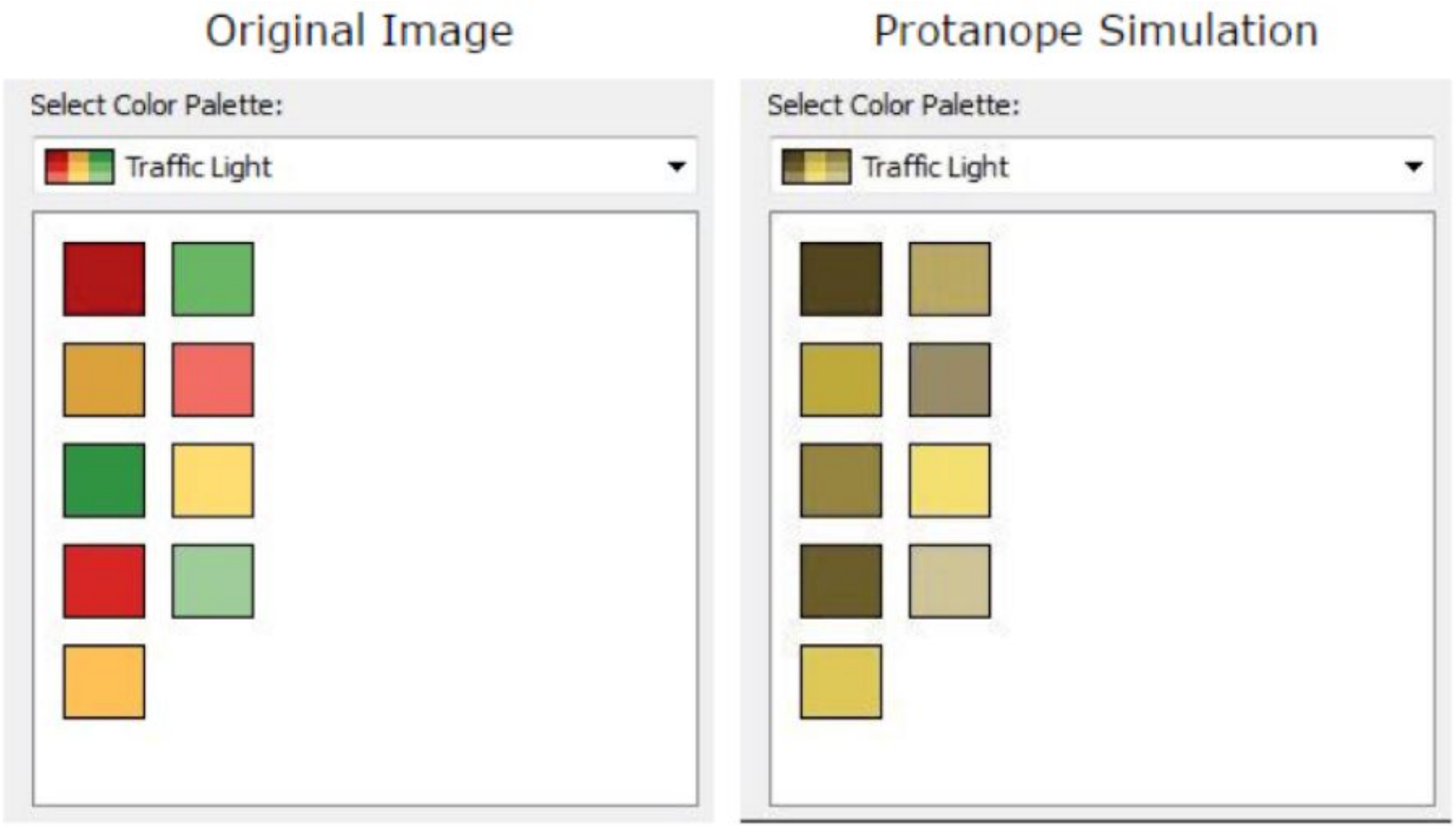
CVD Commonly Referred to as

- **green weak** (deuteranomaly)
- **red weak** (protanomaly)
- **red-green colorblindness**
  - green blind (deuteranopia)
  - red-blind (protanopia)

Deuteranope Simulation



Protanope Simulation



Data-viz Rule

Don’t use red & green together

CVD-friendly Designing Tips

CVD-friendly Designing Tips

1. Red and green together can be problematic, but

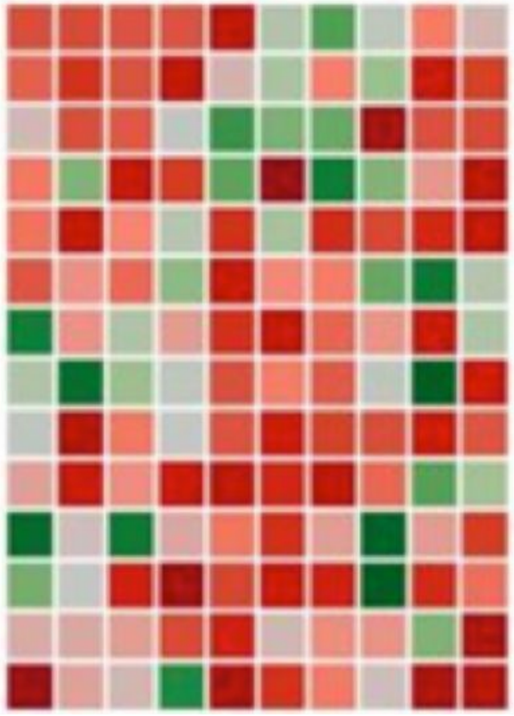
2. Be aware that it’s not just red and green.

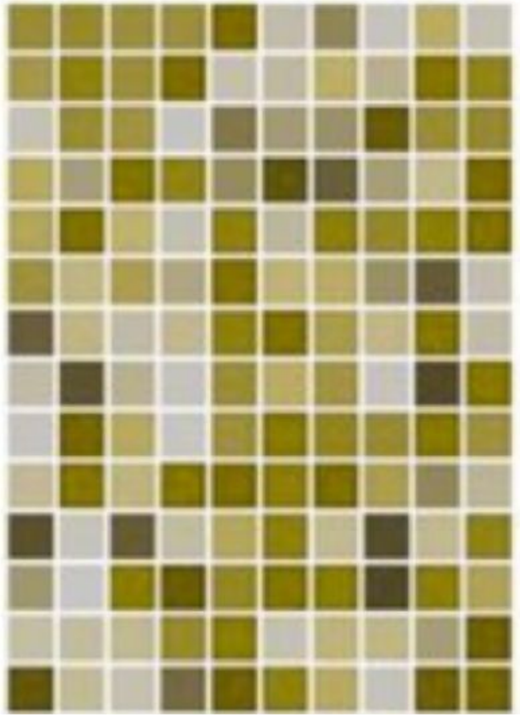
3. Use a CVD-friendly palette when appropriate.

4. If you must use red and green together, you can:
    a. leverage light vs. dark
    b. stand each color (red and green) alone
    c. offer alternate methods of distinguishing data
    d. use a checkbox (or similar GUI) to switch the color palette to a CVD-friendly palette

Tip 1) Red and green can be problematic but

- Although Data-viz Rule, red and green may be needed to tell
  - a good number vs. a bad number in a table
  - one line vs. another line in the same line chart
  - a good square from a bad square
- We can see how difficult this would be for one with CVD





Tip 2) More Complex Than Red vs. Green

- For someone with **strong CVD**
  - **red** & **green** & **orange** all can appear **brown**
  - Maybe more accurate to say: Don't use **red** & **green** & **brown** & **orange** together
    - In the RGB model: orange is RGB(255,165,0) & brown is RGB(150, 75, 0)

- Also, when mixing colors, they can be problematic.
  - **Example**: using **blue** & **purple** together
    - In the RGB model, **purple** is RGB(160,32,240)
    - If someone has issues with **red**, they may have issues with **purple** (appear **blue**)

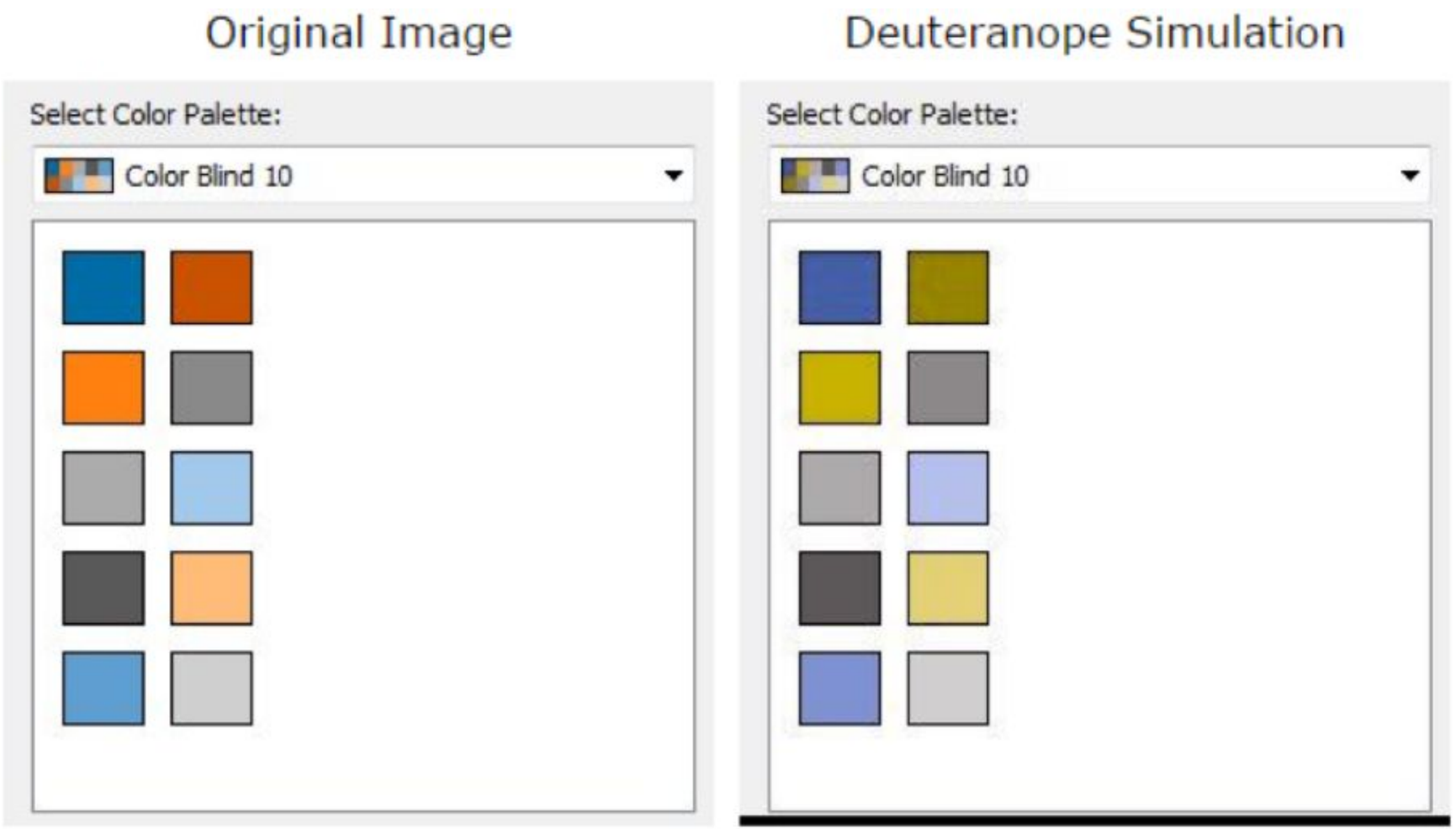
- Also, **gray** & **pink** or **gray** & **brown** can be problematic.

Tip 3) CVD-friendly Palette

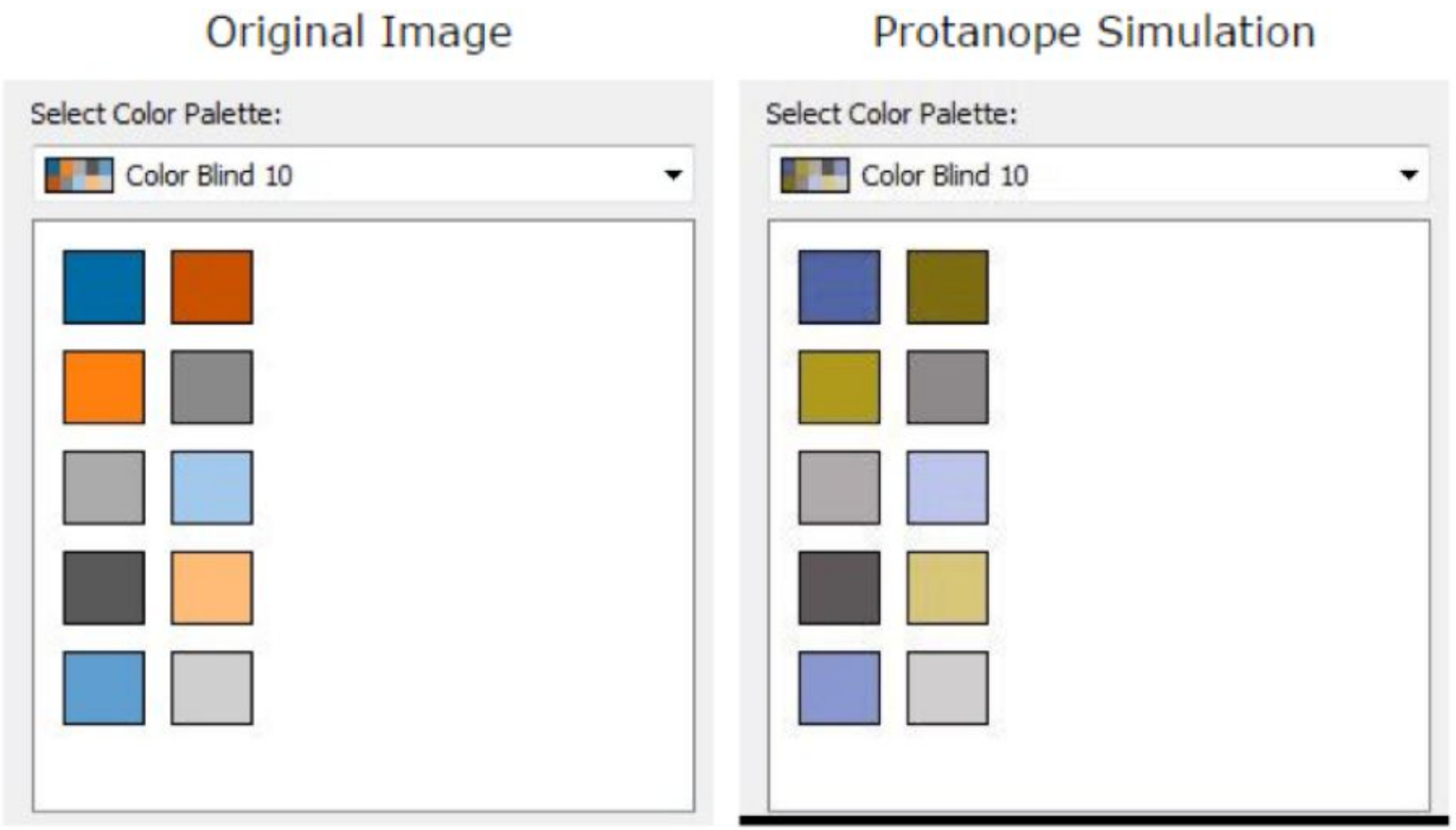
- One color combined with another color is generally fine
  - when one of them is not usually associated with CVD

- For the most common conditions of CVD
  - **blue** would generally look **blue**
  - **Examples:**
    - **blue/orange** is a common CVD-friendly palette
    - **blue/red** or **blue/brown** would also work

Tip 3) Deuteranope-friendly Palette



Tip 3) Protanope-friendly Palette



Tip 4-a) Leverage Light vs. Dark

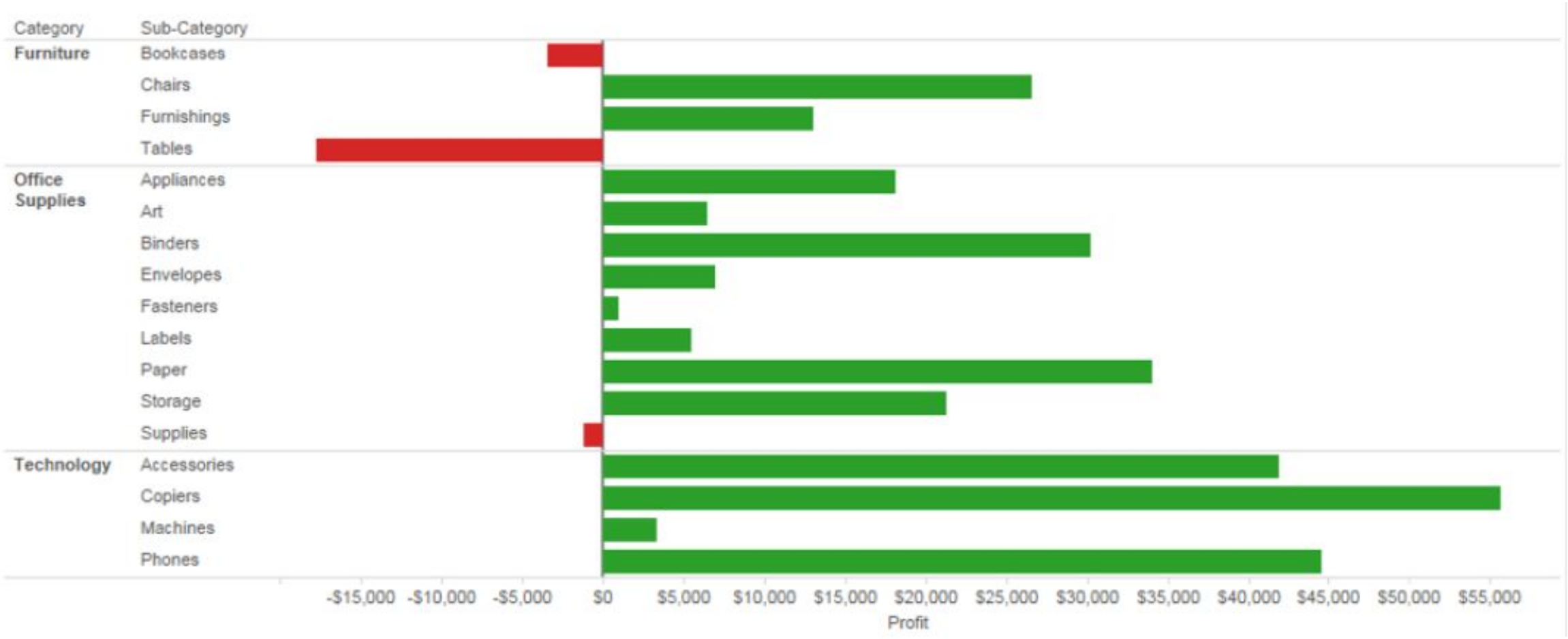
- The problem with **CVD** is **red vs. green** and not **light vs. dark**.

- Almost anyone can tell the difference between:
  - **very light color** and **very dark color**

- To use red and green together, we can use:
  - **light green**
  - **medium yellow**
  - **very dark red**

- Someone who has strong **CVD:**
  - would see as a **sequential color scheme**
  - would at least be able to distinguish based on **light vs. dark**

Tip 4-b) Stand Each Color Alone

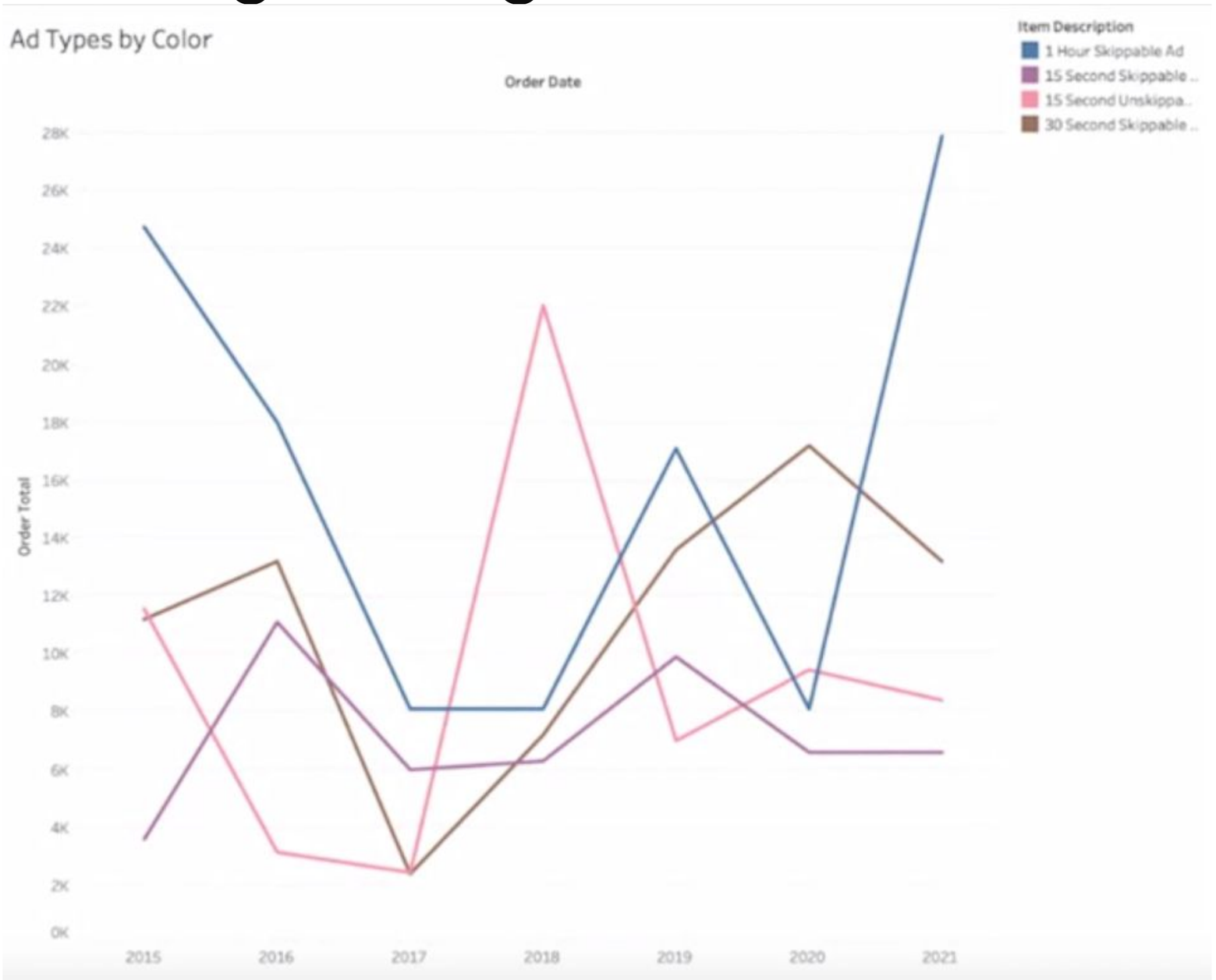


Tip 4-c) Alternate Distinguishing Methods

- Add indicators to allow to see that something is bad (red) vs. good (green), such as:
  - labels
  - icons
  - directional arrows
  - annotations
  - other indicators

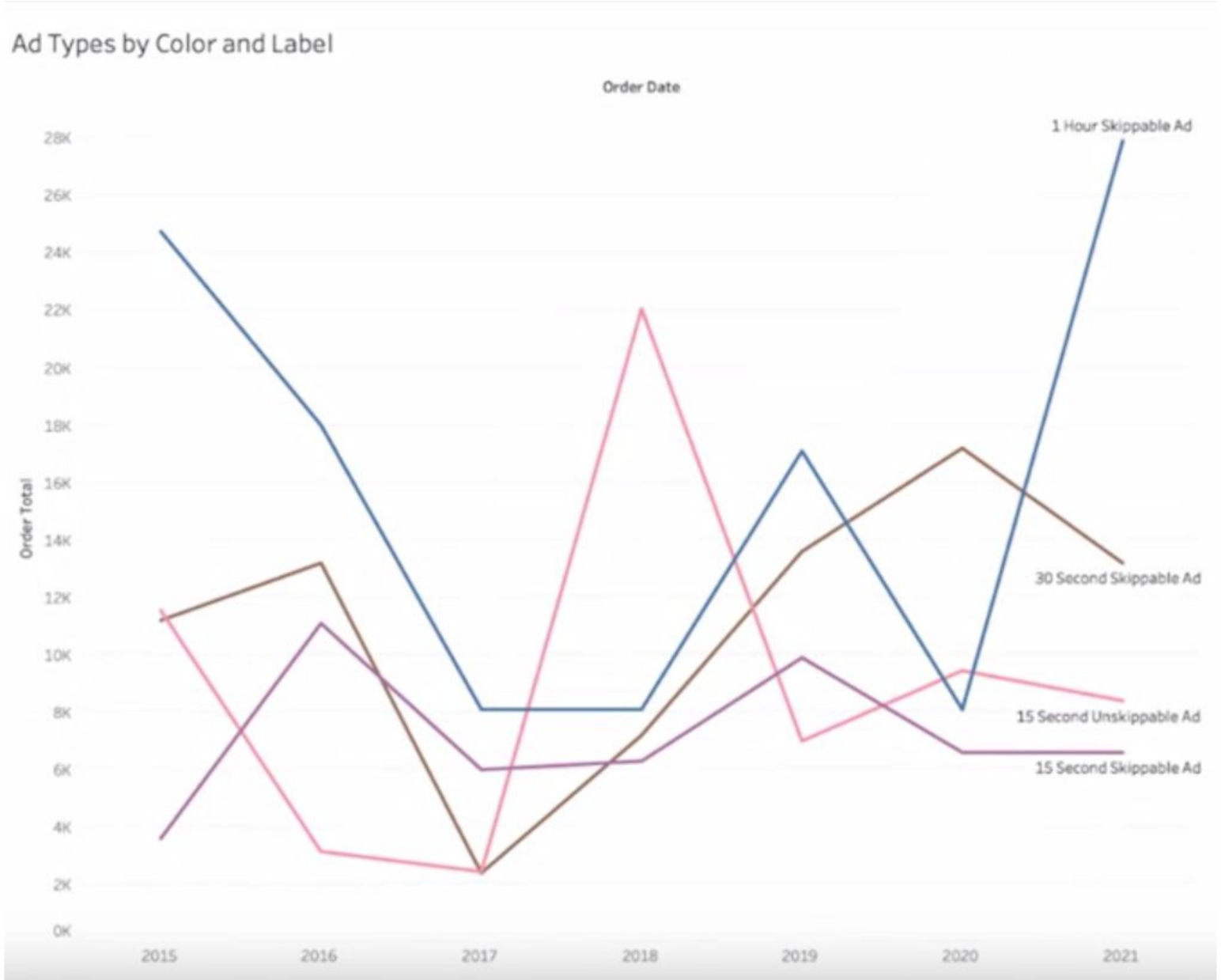
Tip 4-c) Alternate Distinguishing Methods

- The issue



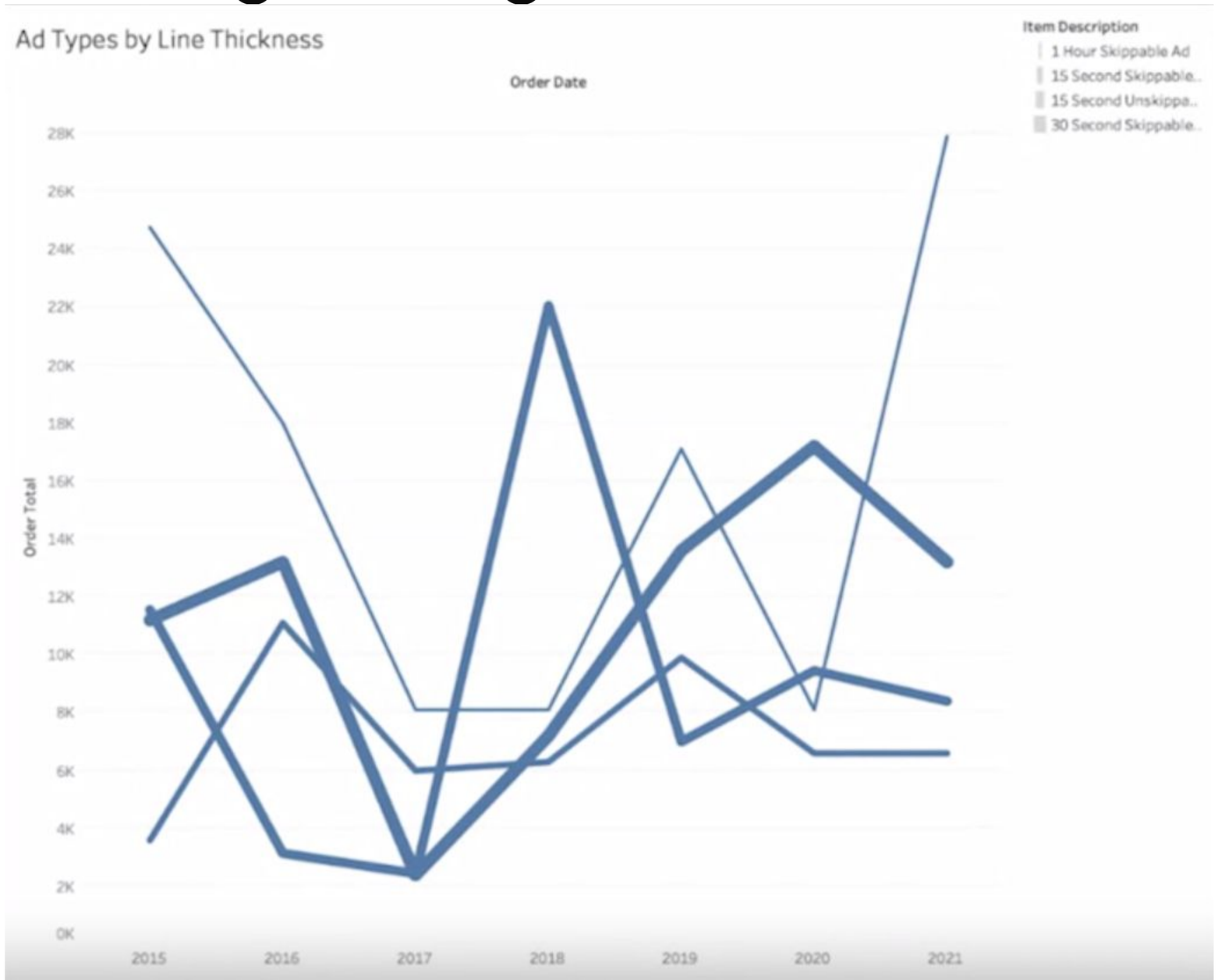
Tip 4-c) Alternate Distinguishing Methods

- Solution 1:
  - using labels
  - to provide **Accessibility**



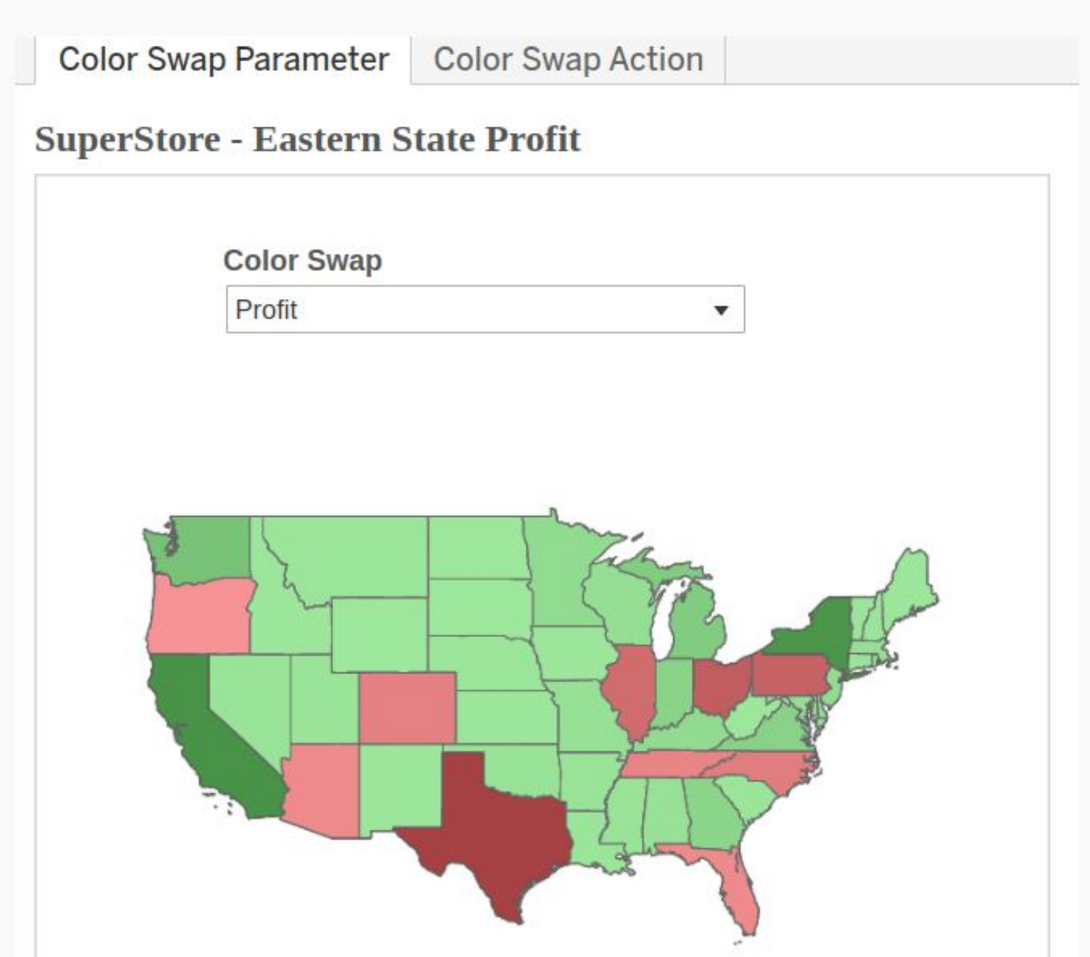
Tip 4-c) Alternate Distinguishing Methods

- Solution 2:
  - using Lines Thickness
  - to provide **Accessibility**



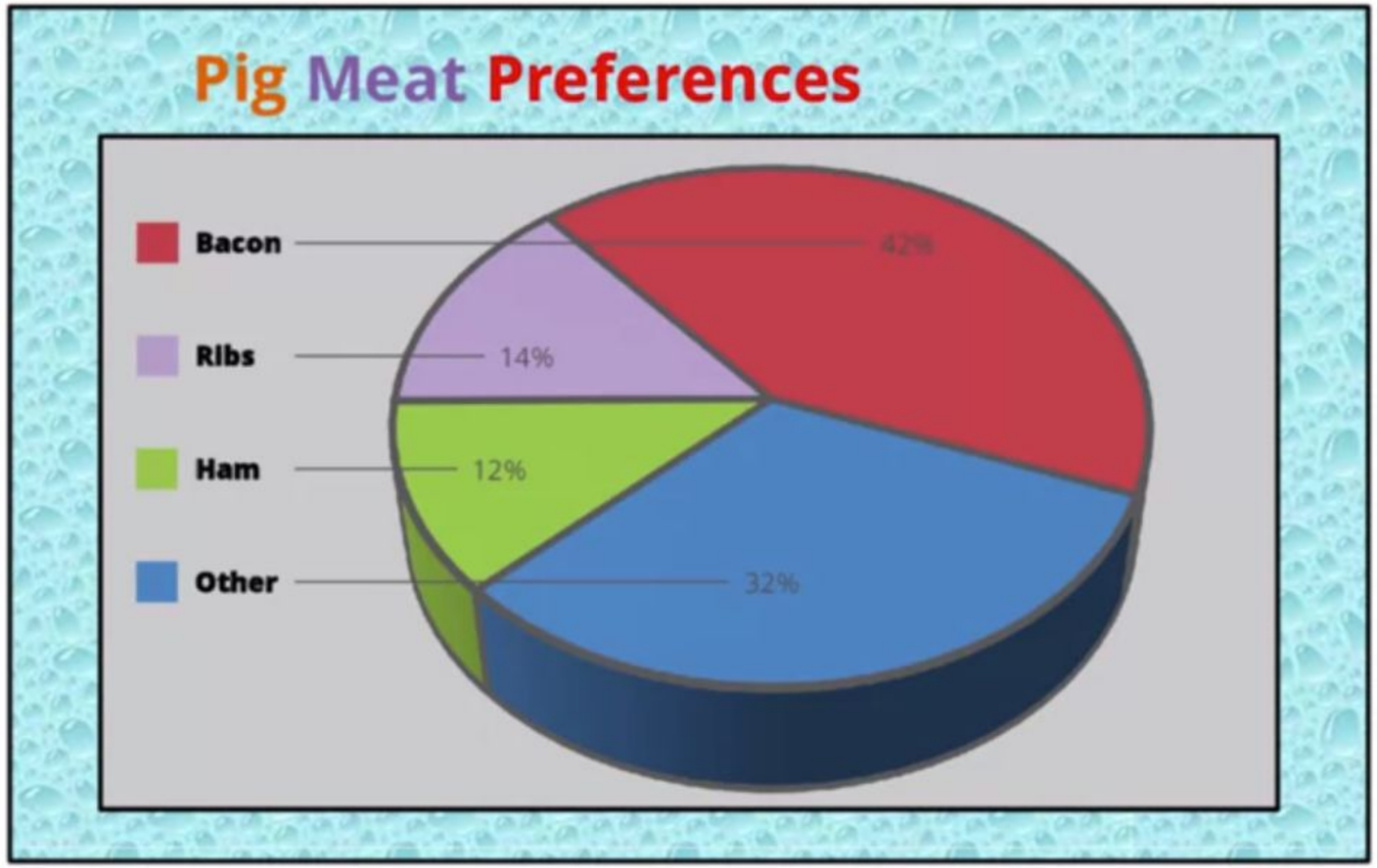
Tip 4-d) Use a UI element to Switch Color Palette

- Use a checkbox (or similar GUI) to switch the color palette to **CVD-friendly Palette**

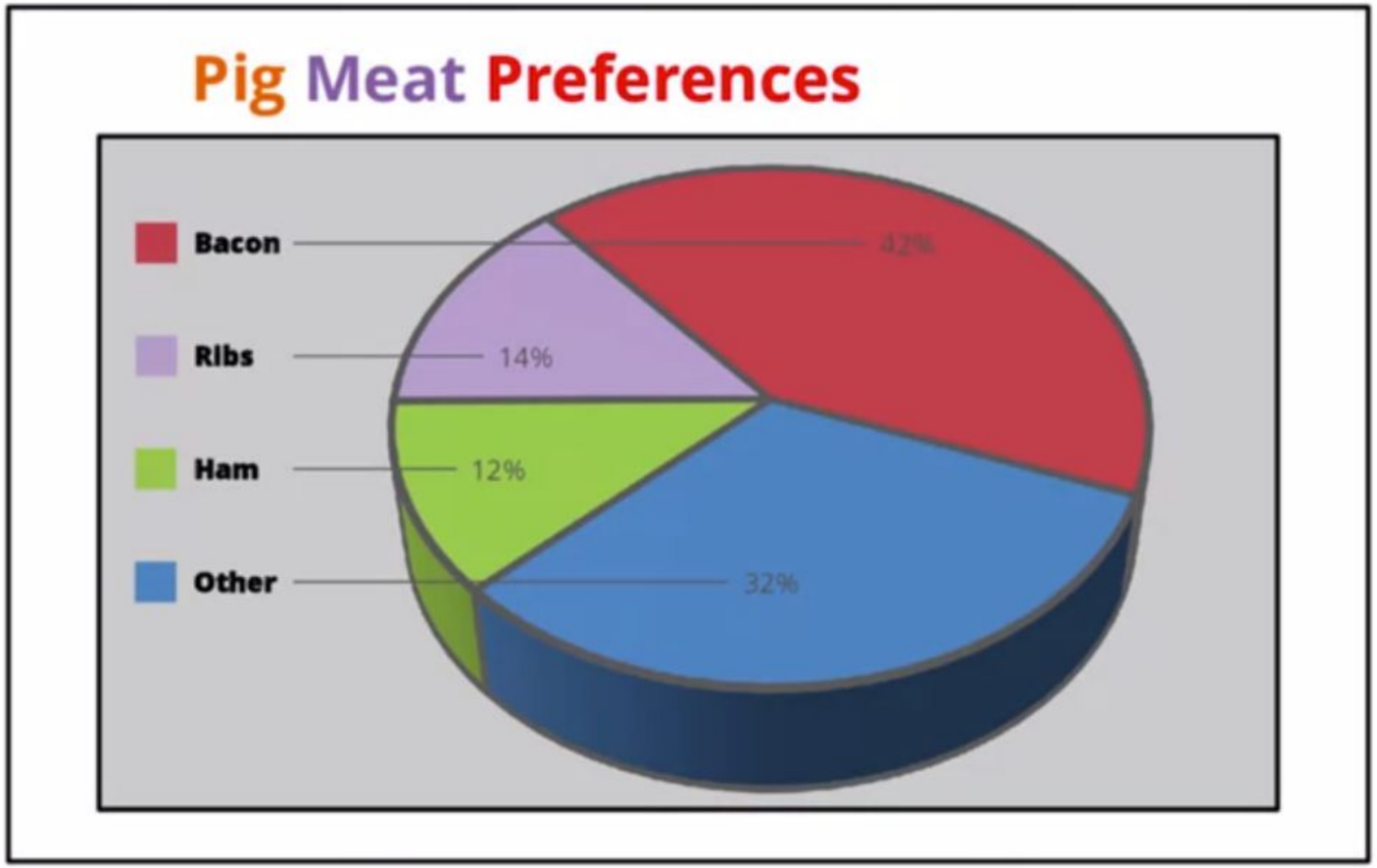


Visualization Example

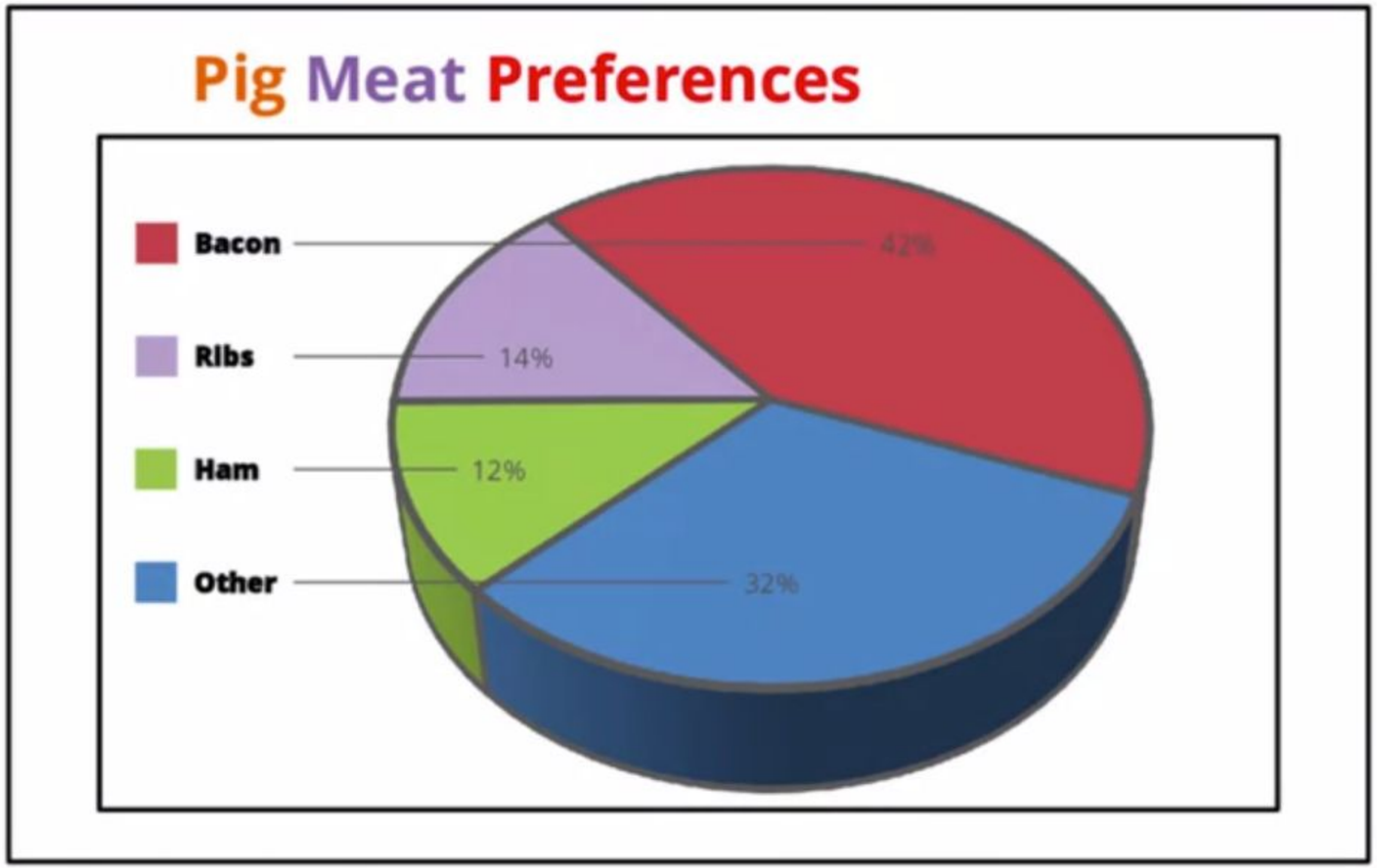
Visualization Example (1/12)



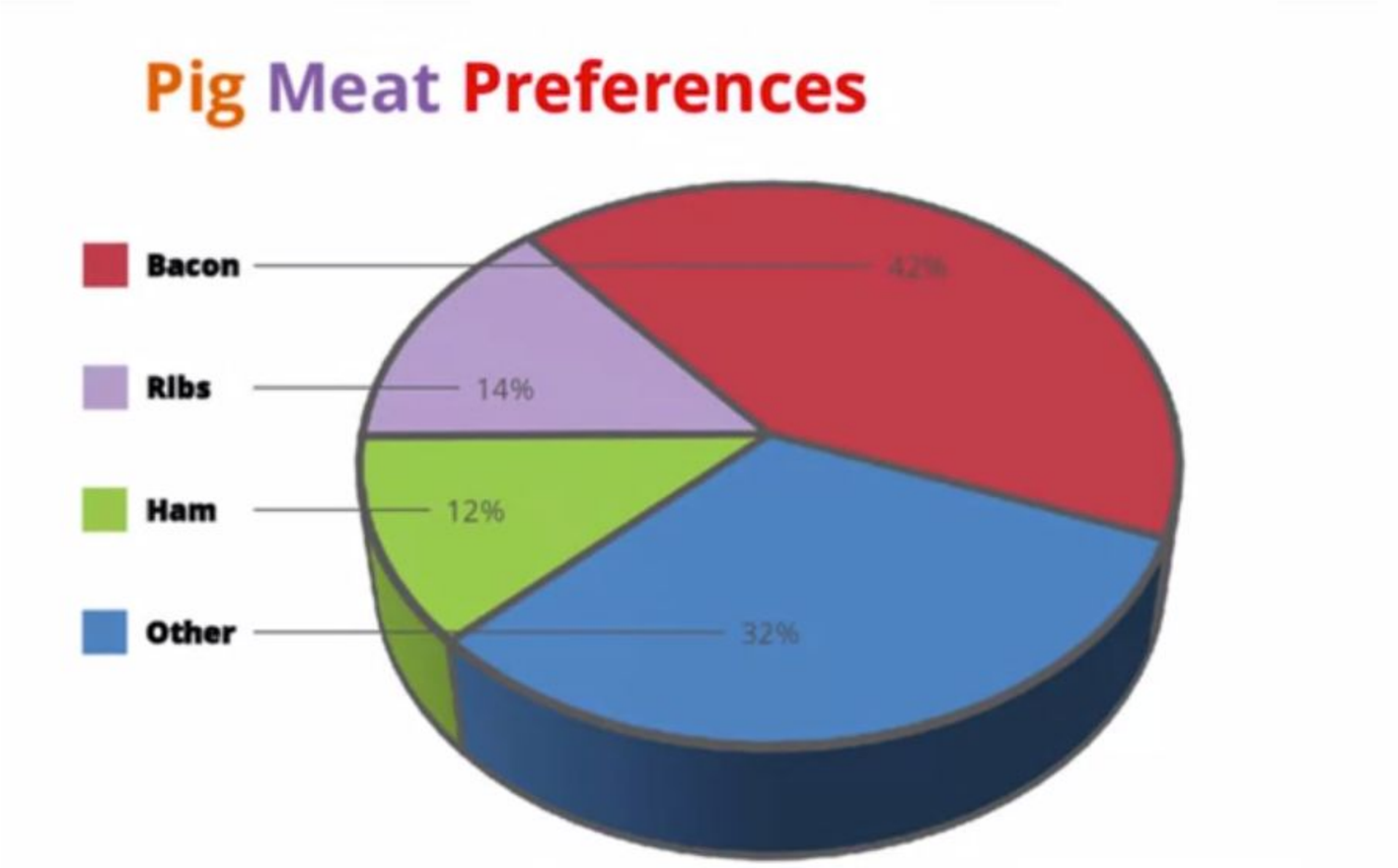
Visualization Example (2/12)



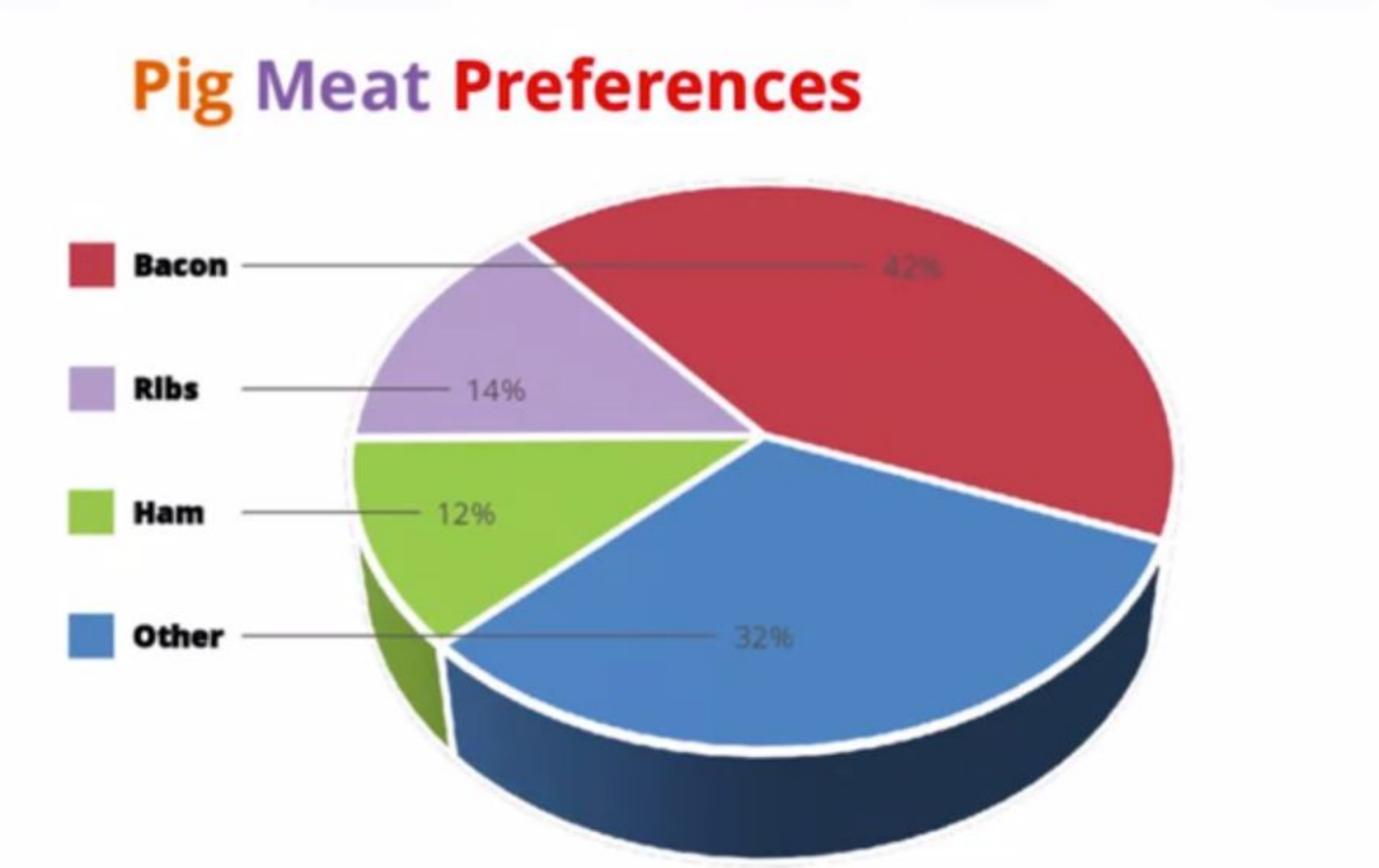
Visualization Example (3/12)



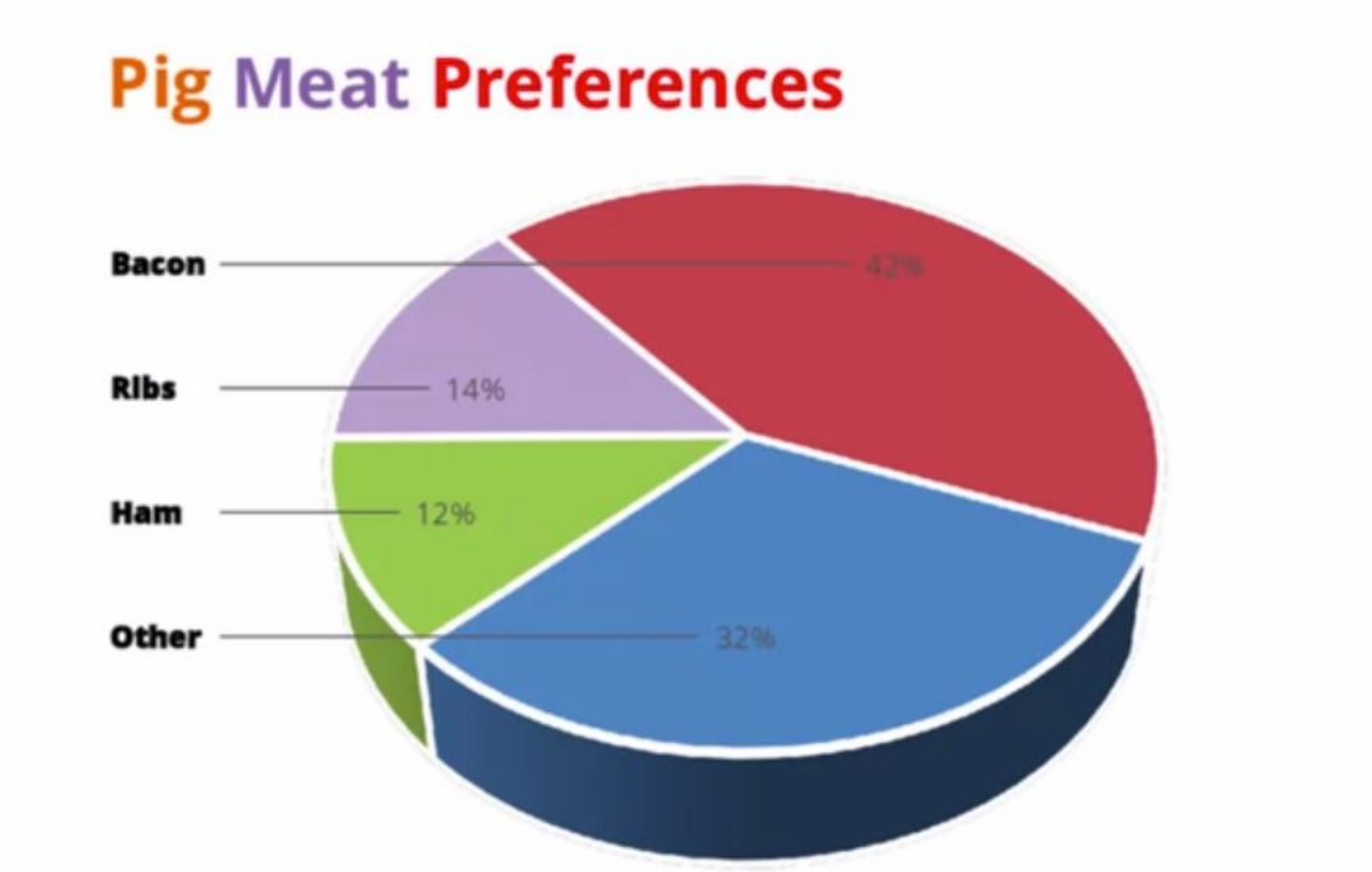
Visualization Example (4/12)



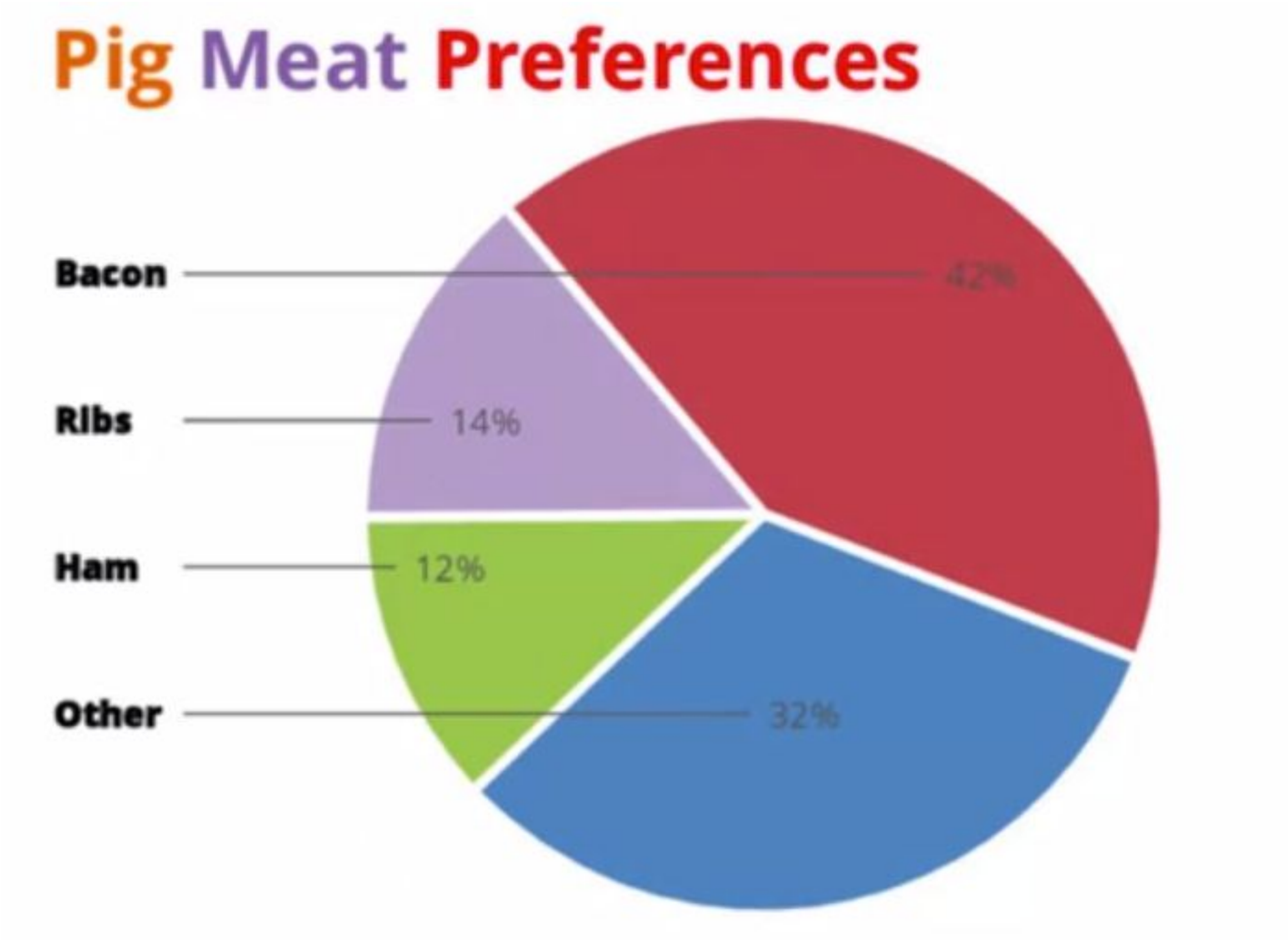
Visualization Example (5/12)



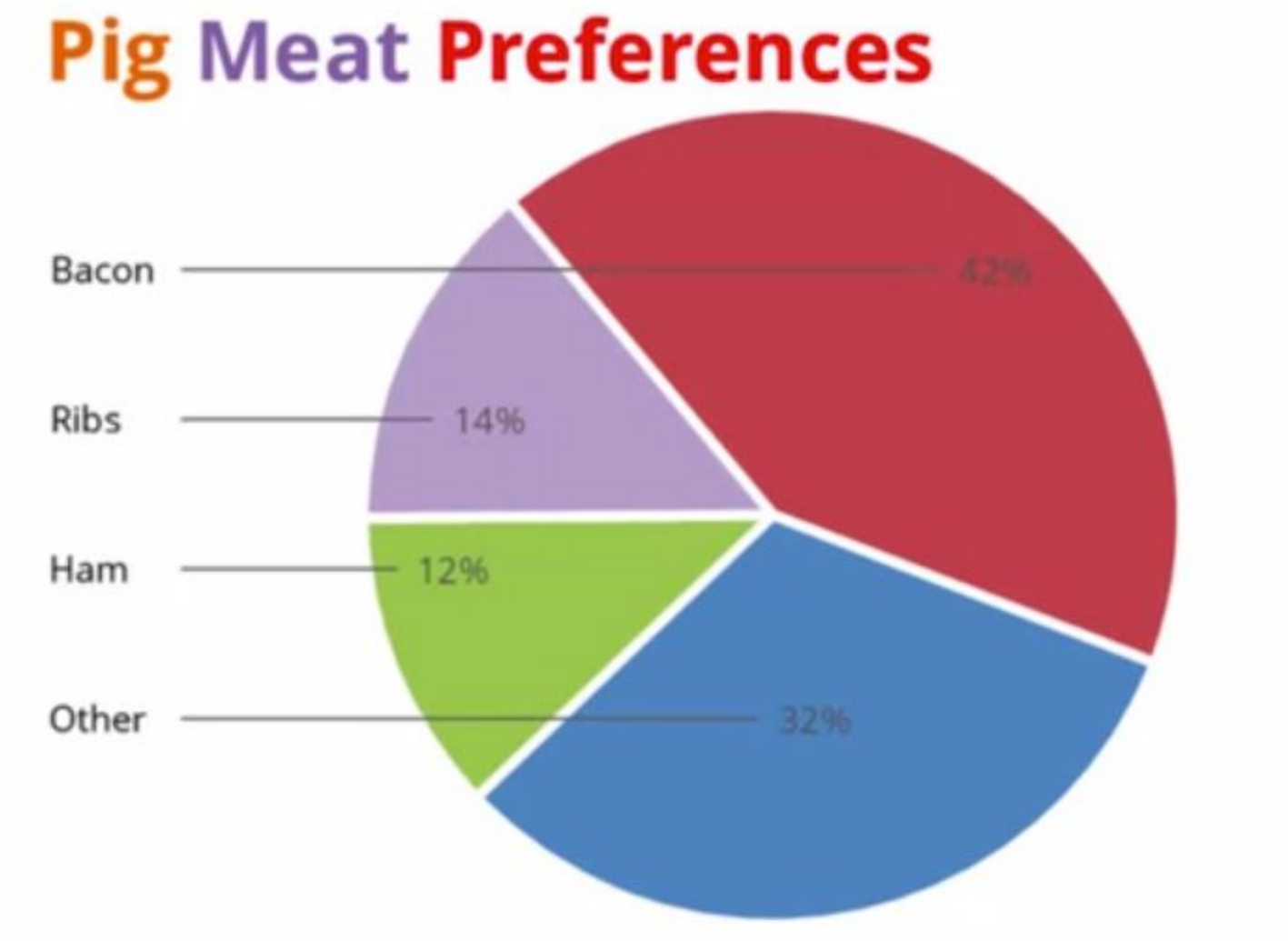
Visualization Example (6/12)



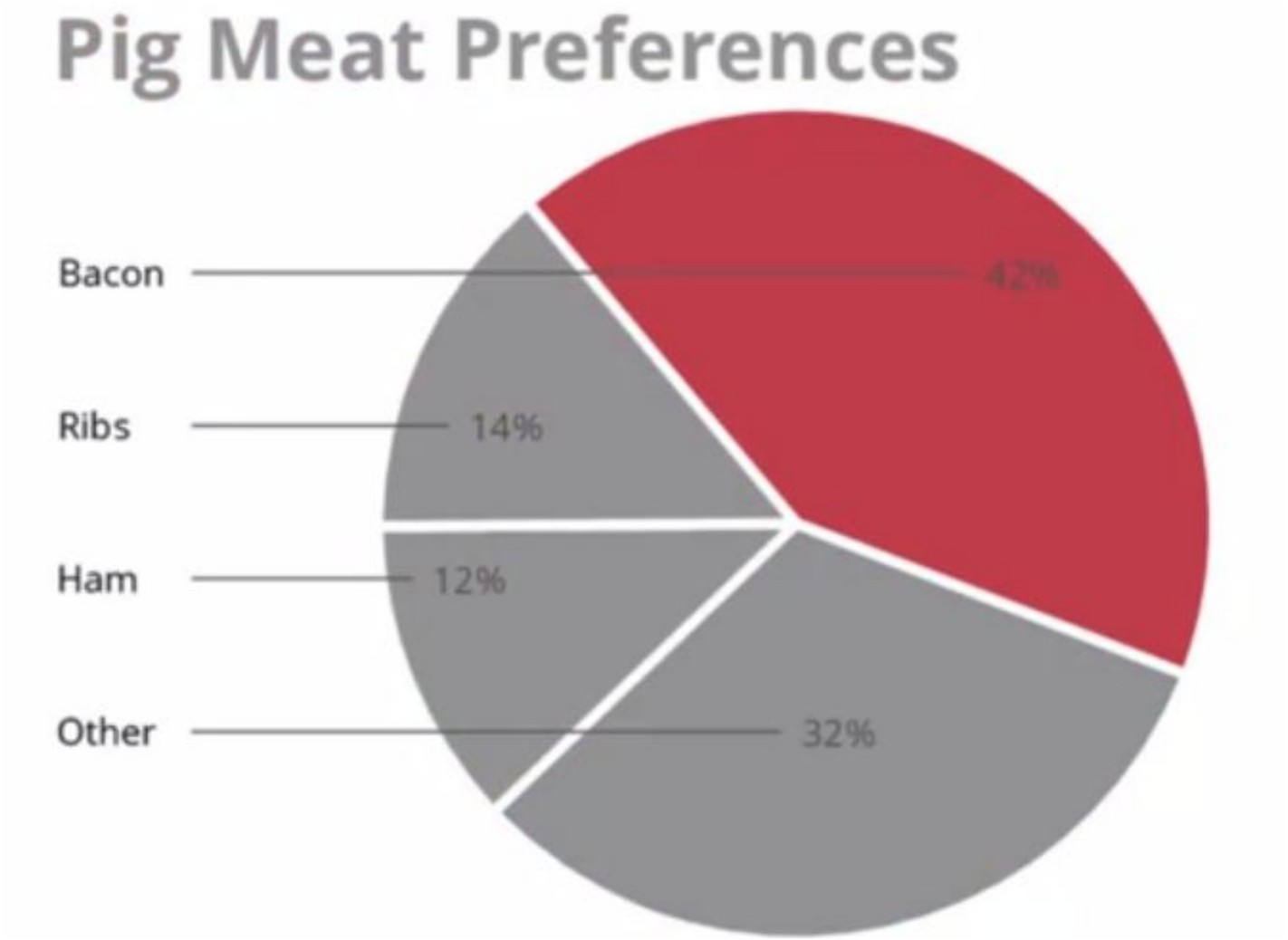
Visualization Example (7/12)



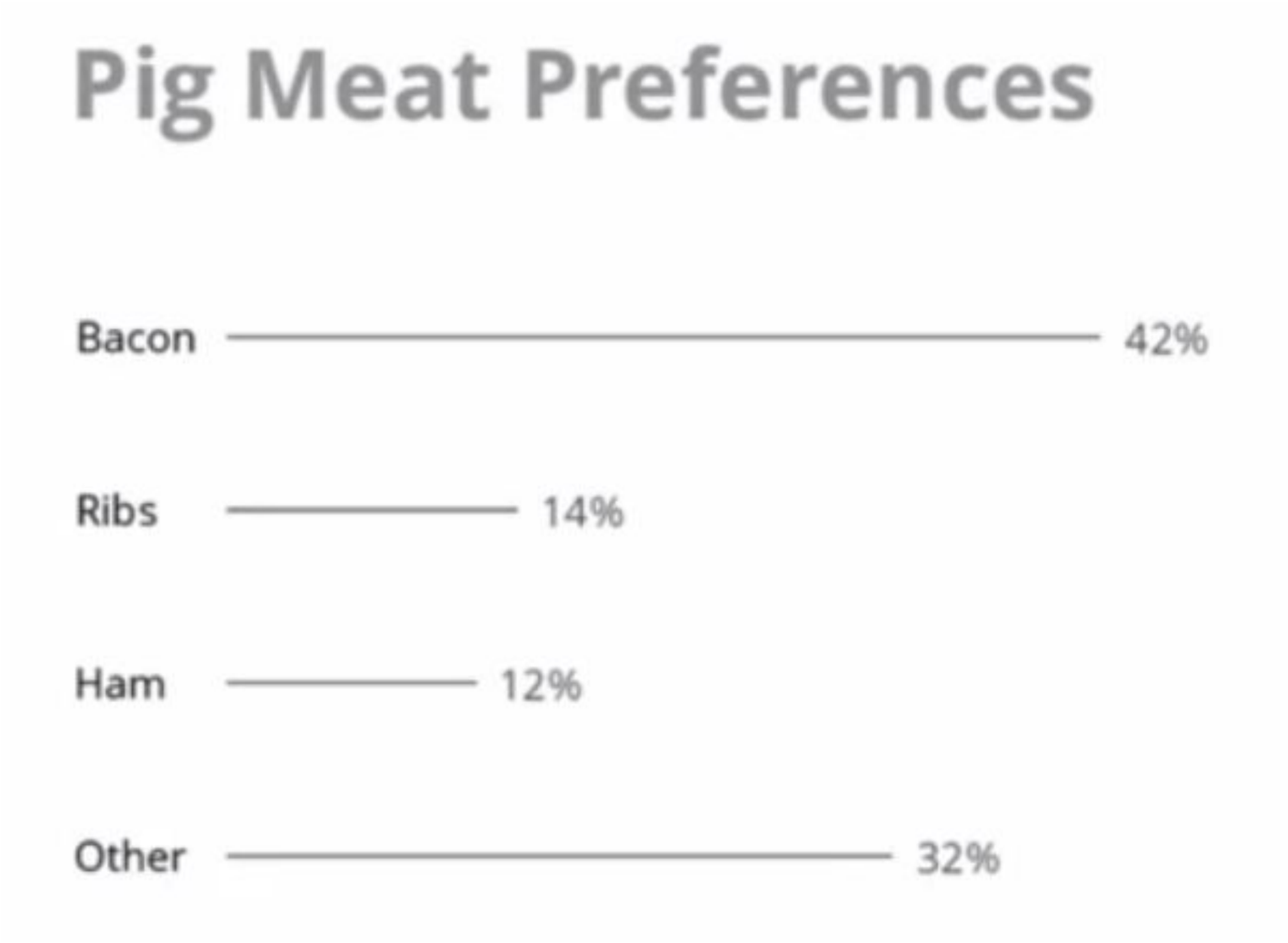
Visualization Example (8/12)



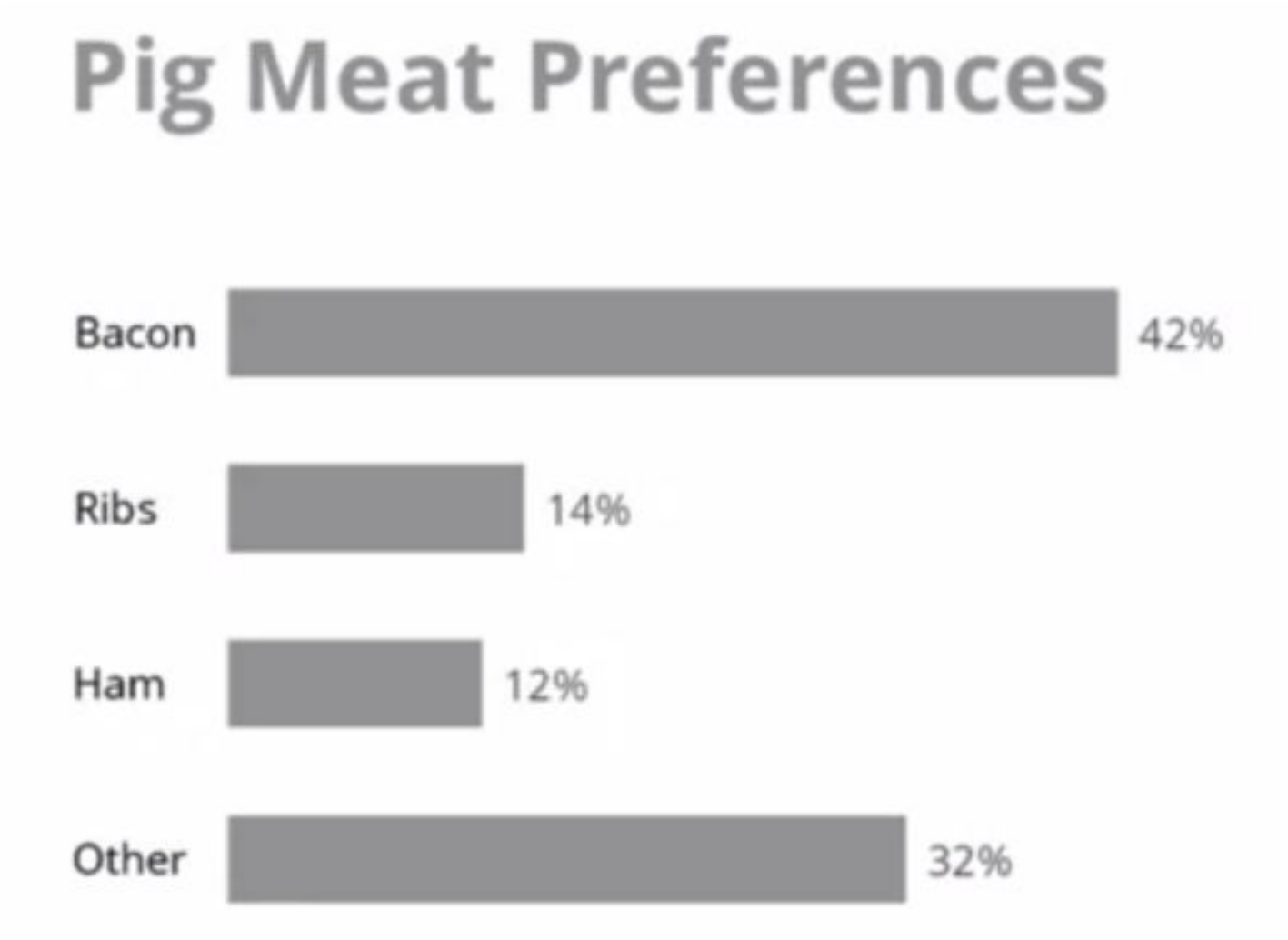
Visualization Example (9/12)



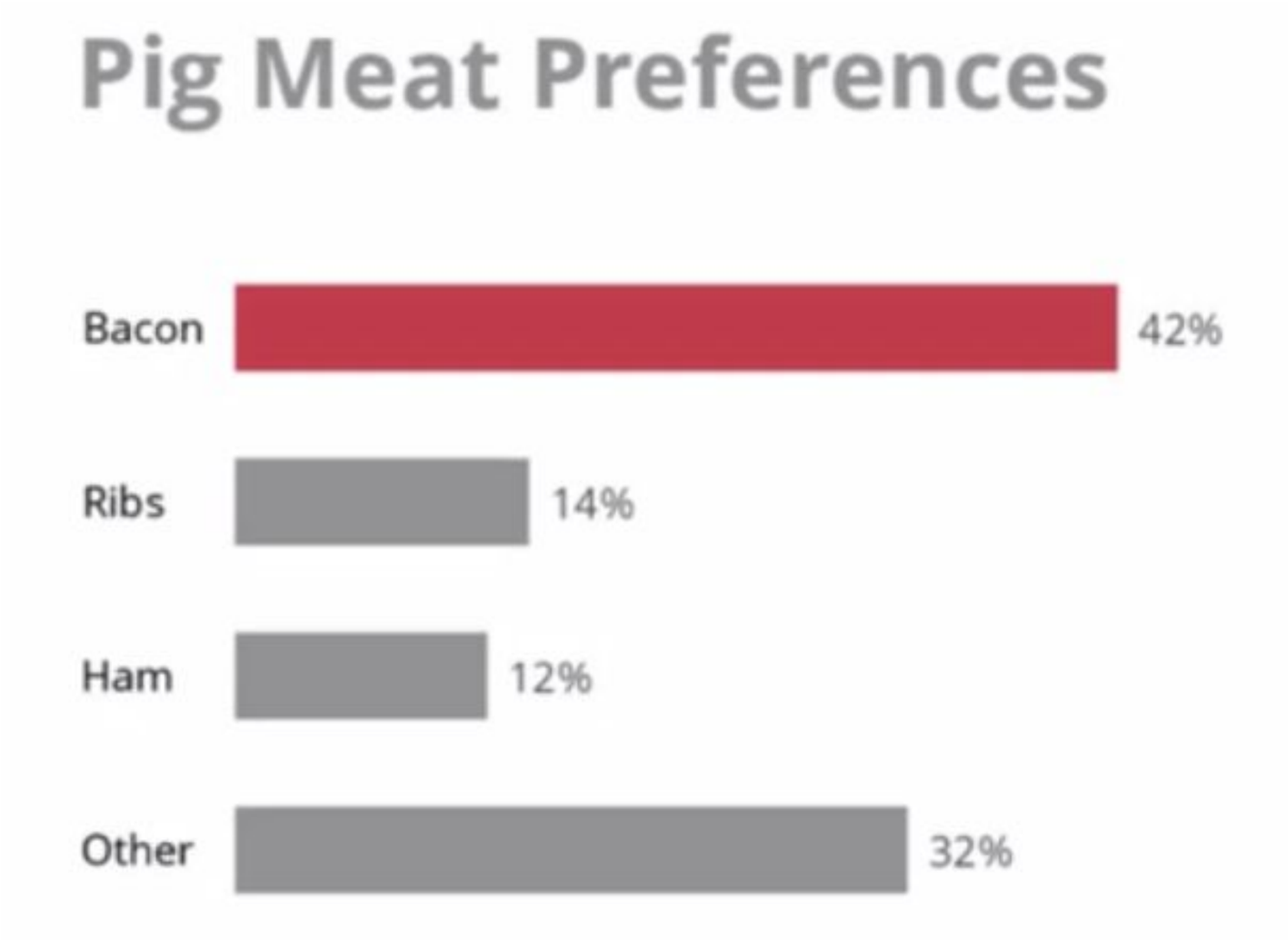
Visualization Example (10/12)



Visualization Example (11/12)

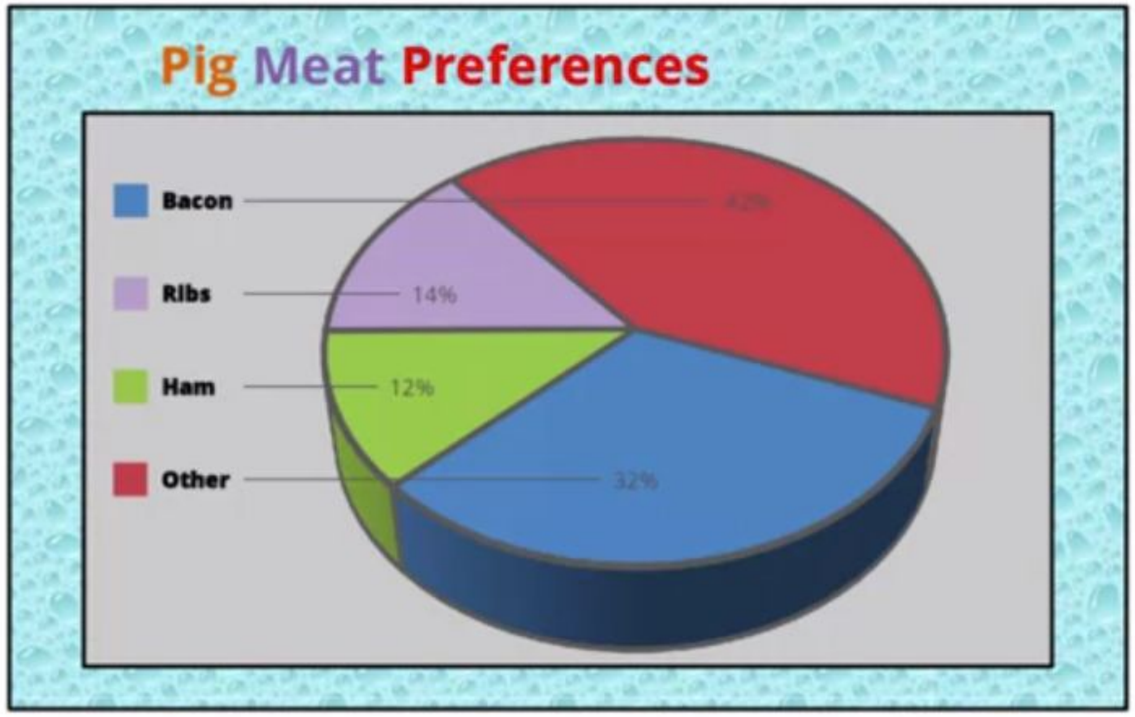


Visualization Example (12/12)

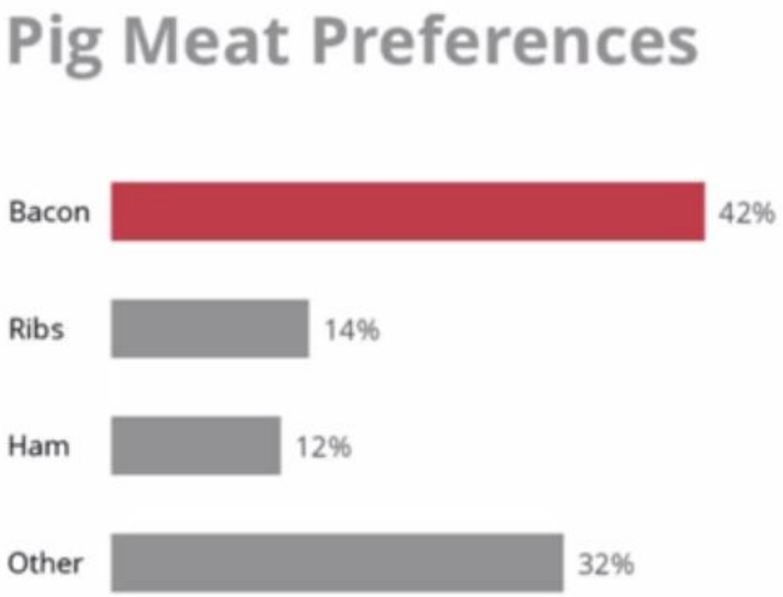


Visualization Example: Can it be enhanced more?

Before



After



Can we enhance it more?

Another Visualization Enhancement Example

Questions

Links

https://github.com/fcai-b/dv

References

1. https://www.tableau.com/about/blog/examining-data-viz-rules-dont-use-red-green-together
2. https://www.coursera.org/learn/foundations-data
3. https://www.coursera.org/learn/what-is-datascience