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Introduction to Data Science

Eliminating Clutter

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Disclaimer and Acknowledgement

- The content for these slides has been obtained from books and various other source on the Internet
- I here by acknowledge all the contributors for their material and inputs.
- I have provided source information wherever necessary
- I have added and modified the content to suit the requirements of the course

Eliminating Clutter

- Cognitive Load
- Clutter
- Visual Ordering

Cognitive Load

Cognitive Load

What is cognitive load?

- We experience cognitive load anytime we take in information
- Cognitive load is the *mental effort* required to learn new information
- Cognitive load increases every time we add a new element onto the page or screen
- Humans' brains have a finite amount of this mental processing power
- As data scientists, we want to be smart about how we make our audience use their brain power
- We want to avoid extraneous cognitive load because
  - it is the processing that takes up mental resources but doesn't help the audience understand the information

Source: Storytelling with Data by knaflic

Cognitive Load

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The data-ink or signal-to-noise ratio

- Signal is the information we want to communicate to our audience
- Noise are those elements that either don't add to, or distract us from, the message we are trying to communicate
- Data-ink ratio
  - "The larger the share of a graphic's ink devoted to data, the better (other relevant matters being equal)."

    -- Edward Tufte
  - Also referred to as maximizing the signal-to-noise ratio

    -- Nancy Duarte

Source: Storytelling with Data by knaflic

Cognitive Load

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Perceived Cognitive Load

- It is the *degree* or the extent to which our audience *believe* that they have to work hard to get the information out of the visualization
  - This is what matters most when it comes to our visual communications
- If our audience believe that it is too much work:
  - They might move away
  - Message is not communicated well
- To the extent possible, try to minimize the perceived cognitive load for our audience

Source: Storytelling with Data by knaflic

Gestalt principles of visual perception

Gestalt principles of visual perception

Clutter

- Clutter is the presence of unnecessary elements on the screen/page that
- One thing that can contribute to excessive cognitive is *clutter*
- Clutter
  - Occupies space
  - Reduces understanding
  - Increases complexity

Source: Storytelling with Data by knaflic

Gestalt principles of visual perception

How to eliminate clutter?

- The Gestalt School of Psychology was established in the early 1900s to understand how individuals perceive order in the world around them
- They came up the *principles of visual perception* that define how people interact with and create order out of visual stimuli
- Gestalt principles of visual perception are based on
  - Identifying *signal* in our visuals (the information we want to communicate)
  - Identifying *noise* (what needs to be eliminated)

Source: Storytelling with Data by knaflic

Gestalt principles of visual perception

Six principles

- Proximity
- Similarity
- Enclosure
- Closure
- Continuity
- Connection.

Source: Storytelling with Data by knaflic

Gestalt principles of visual perception

Six principles

- Proximity
  - We tend to think of objects that are physically close together as belonging to part of a group

We naturally see the dots as three distinct groups because of their relative proximity to each other

We see columns and rows, simply due to dot spacing

Source: Storytelling with Data by knaflic

Gestalt principles of visual perception

Six principles

- Similarity
  - Objects that are of similar color, shape, size, or orientation are perceived as related or belonging to part of a group

We naturally associate the blue circles together or the grey squares together

- The similarity of color is a cue for our eyes to read across the rows (rather than down the columns)
- Eliminates the need for additional elements such as borders to help direct our attention

Source: Storytelling with Data by knaflic

Gestalt principles of visual perception

Six principles

- Enclosure
  - We think of objects that are physically enclosed together as belonging to part of a group

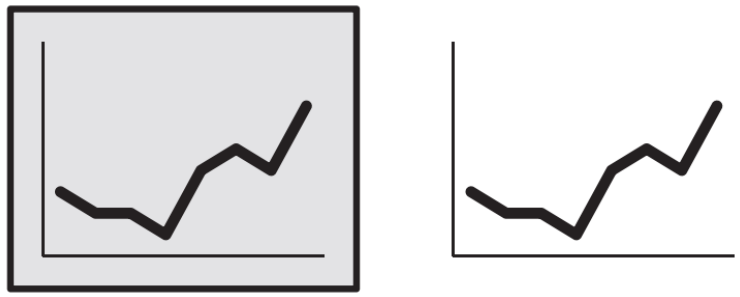
The shaded area separates the forecast from actual data

Source: Storytelling with Data by knaflic

Gestalt principles of visual perception

Six principles

- Closure
  - The closure concept says that people like things to be simple and to fit in the constructs that are already in our heads
  - People tend to perceive a set of individual elements as a single, recognizable shape when they can—when parts of a whole are missing, our eyes fill in the gap



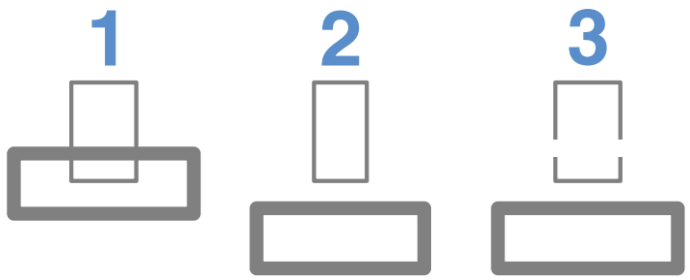
The graph still appears complete without the border and background shading

Source: Storytelling with Data by knaflic

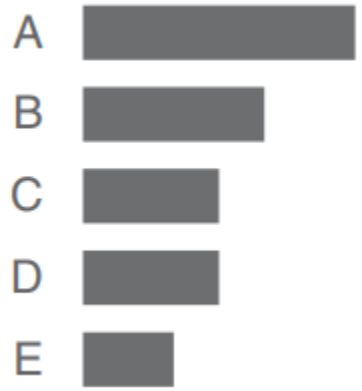
Gestalt principles of visual perception

Six principles

- Continuity
  - Similar to closure
  - Our eyes seek the smoothest path and naturally create continuity in what we see even where it may not explicitly exist



If we pull objects from (1) apart, most people will expect to see what is shown next (2). However, it could be easily shown what is in (3)



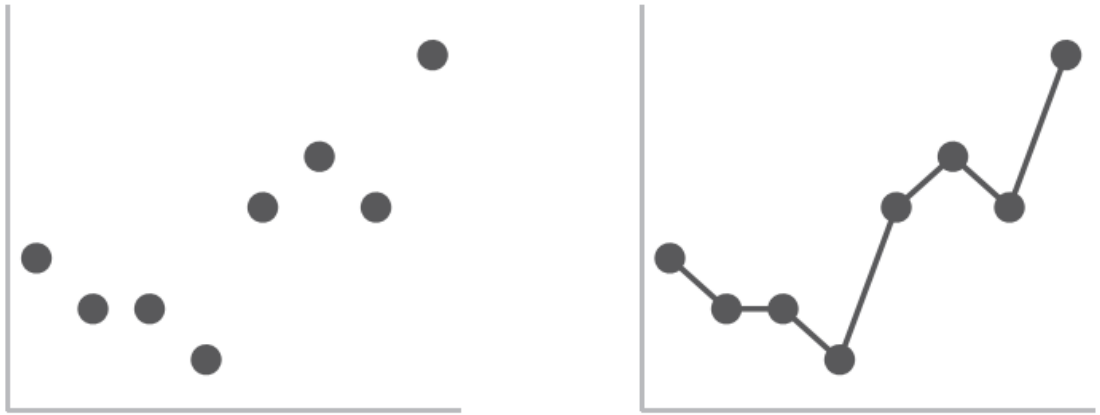
Even with removed vertical y-axis from the graph, our eyes still see that the bars are lined up at the same point because of the consistent white space between the labels and the data

Source: Storytelling with Data by knaflic

Gestalt principles of visual perception

Six principles

- Connection
  - We tend to think of objects that are physically connected as part of a group
  - The connective property typically has a stronger associative value than similar color, size, or shape
  - The connective property isn't typically stronger than enclosure



Source: Storytelling with Data by knaflic

Visual Ordering

Visual Ordering

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Lack of visual order

- Increases burden on the users
- More mental processing required to scan the information

Source: Storytelling with Data by knaflic

Visual Ordering

Lack of visual order (Example)

- Figure summarizes survey feedback about factors considered by nonprofits in vendor selection
- Positives from the figure
  - Takeaway is clearly outlined
  - Well labelled
  - Key points articulated
- Negative side
  - Haphazard ordering of components w.r.t. overall page

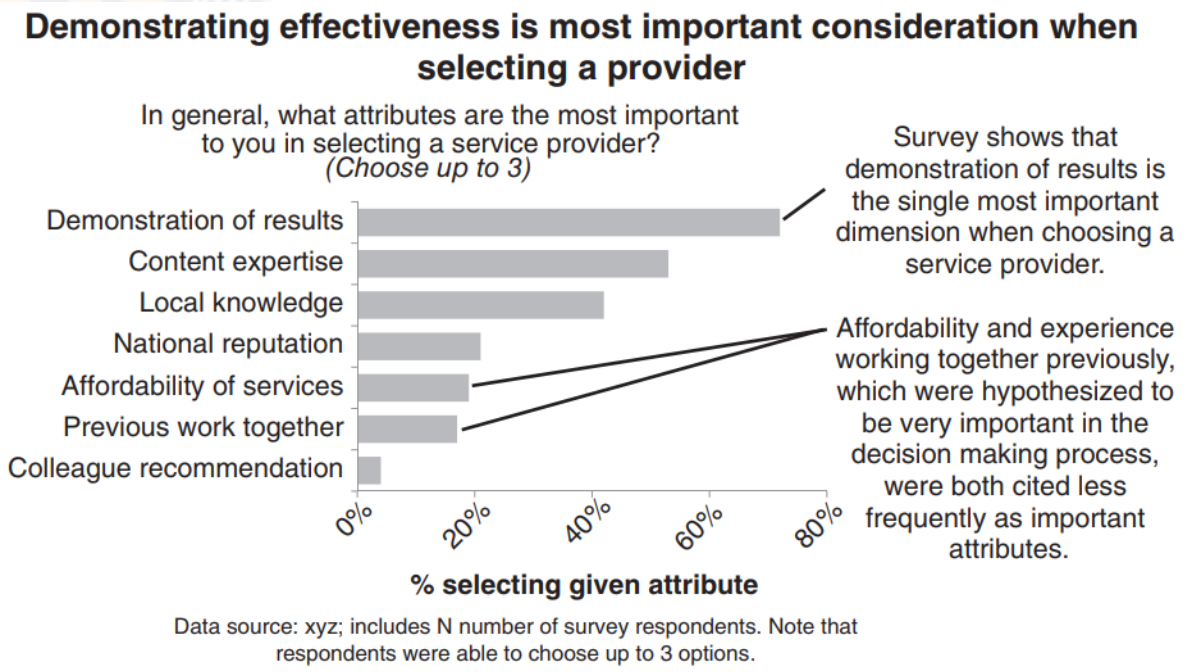

FIGURE 3.13 Summary of survey feedback

Source: Storytelling with Data by knaflic

Visual Ordering

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Lack of visual order (Example)

- Now, the same content is reorganized
- Placement and formatting of elements have been modified
- What's improved? : Alignment
  - Left alignment of text
  - Bold text in sentences
  - Diagonal elements removed
    - lines connecting takeaways to data
    - axis labels

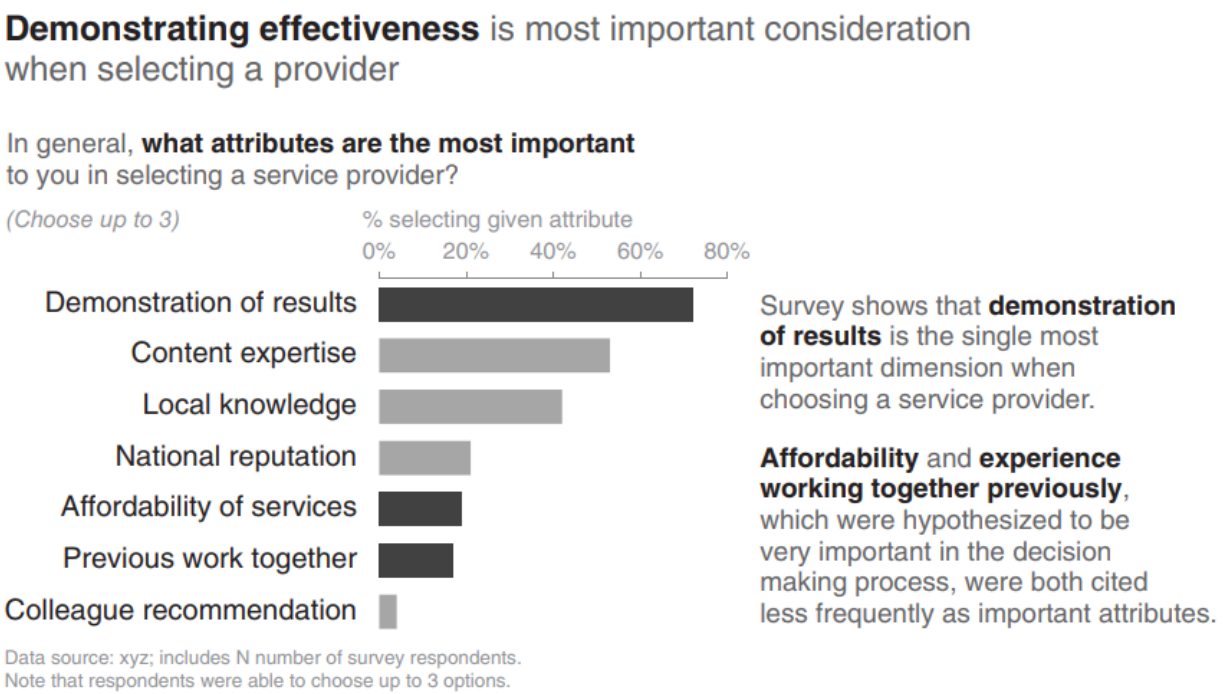

FIGURE 3.14 Revamped summary of survey feedback

Source: Storytelling with Data by knaflic

Visual Ordering

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Lack of visual order (Example)

- What's Improved? : White space
  - White (blank) space preserved
  - Serves like pauses in verbal communication
  - Margin without text / visual
  - No stretching of visual to fill empty space

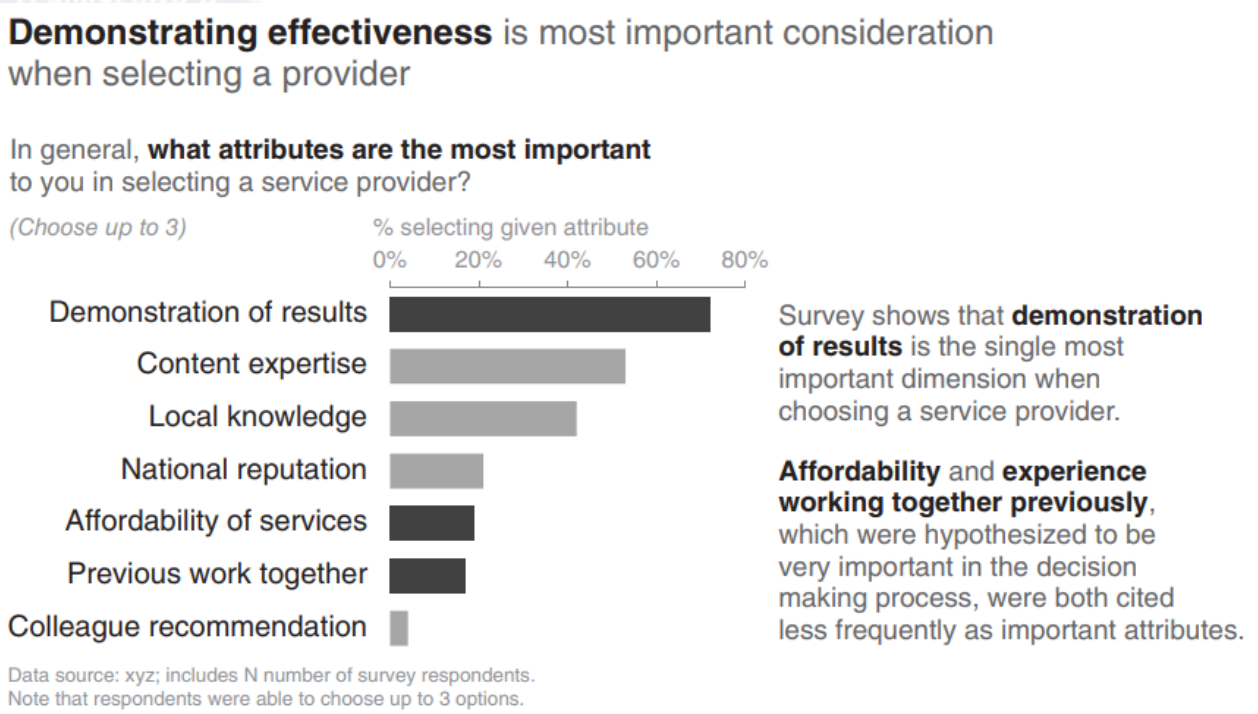

FIGURE 3.14 Revamped summary of survey feedback

Source: Storytelling with Data by knaflic

Visual Ordering

Lack of visual order

- Alignment
  - Avoid center-aligned text
  - Left- or right-justify your text based on the other elements on the page
  - Avoid diagonally oriented elements such as lines and text
- White space
  - White space is like a pause in a speech
  - Use white space strategically to draw attention to the non-white space parts
  - Margins should remain free of text and visuals
  - Do not stretch visuals to take up the available space
    - Instead, appropriately size your visuals to their content

Source: Storytelling with Data by knaflic

Visual Ordering

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Contrast

- “It’s easy to spot a hawk in a sky full of pigeons, but as the variety of birds increases, the hawk becomes harder and harder to pick out.”

  -- Colin Ware in Information Visualization : Perception for Design

- The more things we make different, the lesser the degree to which any of them stand out

Source: Storytelling with Data by knaflic

Visual Ordering

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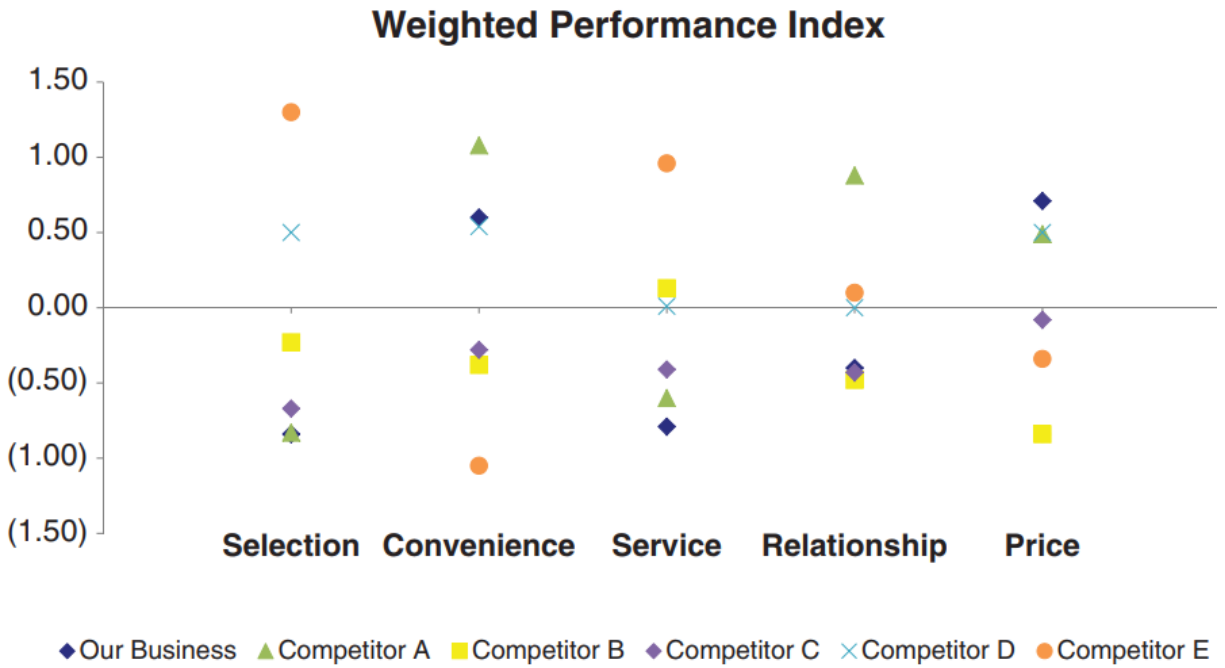
Lack of contrast (Example)

- Comparison of customer shopping experience between our business and other retailers

- What's going on?
  - Lot of elements
  - Each one trying to grab attention
  - Difficult to focus attention



Source: Storytelling with Data by knaflic

Visual Ordering

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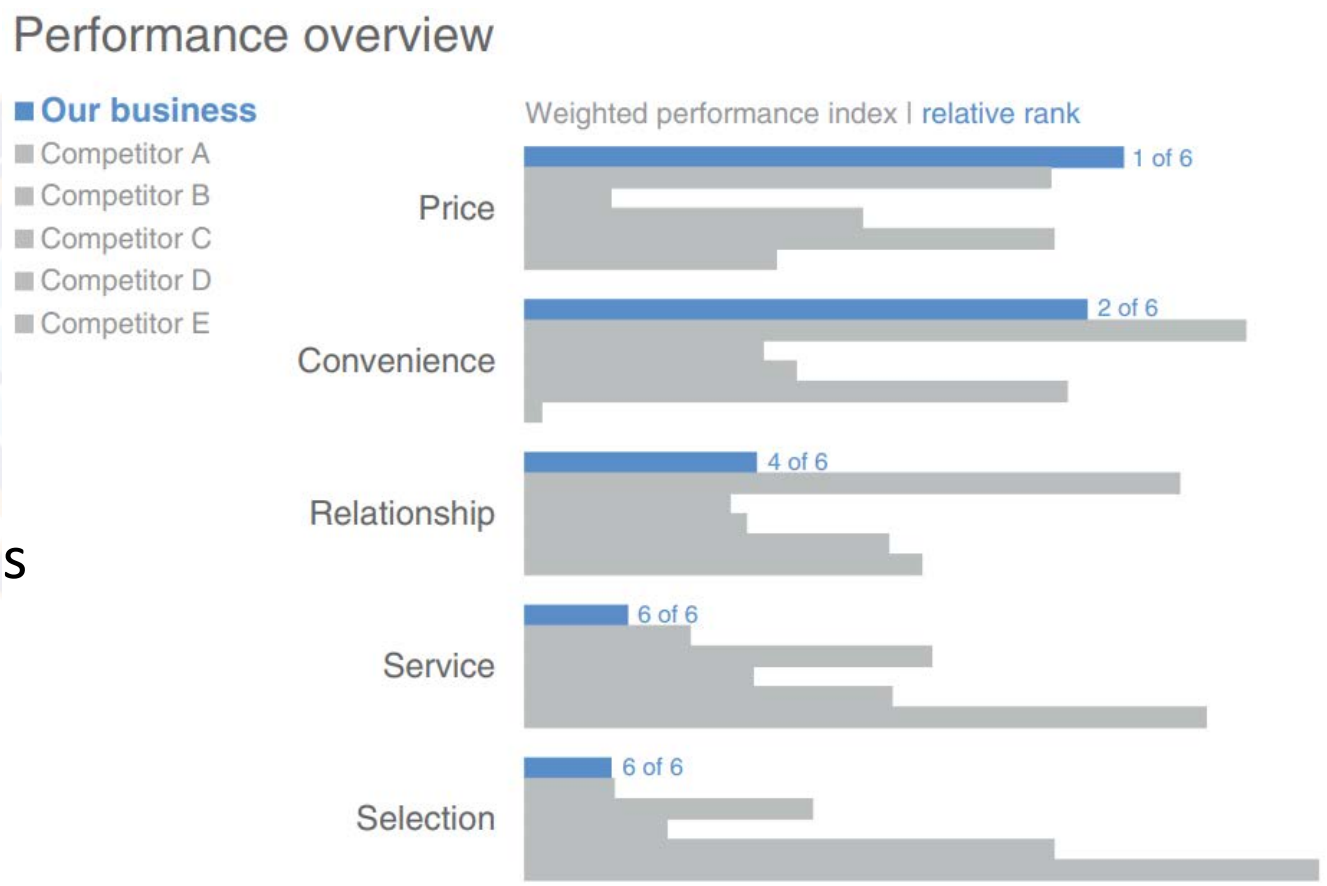
Lack of contrast (Improved Example)

- What's improved?
  - Contrast used more strategically
  - Horizontal bar
  - All numbers on +ve scale
  - Blue for "our business", grey for "others"
  - Same ordering among subcategories



Source: Storytelling with Data by knaflic

Thank You!