

Visualization (Vis)

**Storytelling with
Interactive Data Visualizations**



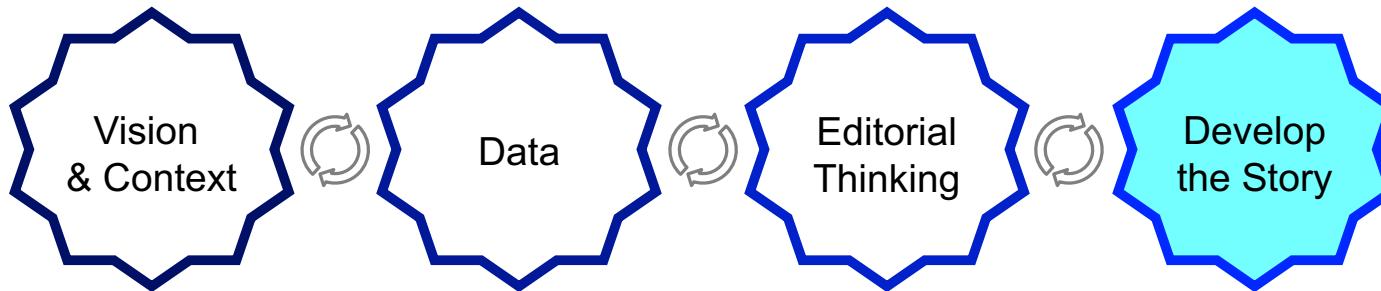
Lecture 8
—
**Annotation
Colour
Composition**



Image by Joakant from Pixabay



Develop the Story: Visual Encoding – Rules of Thumb



- ◆ Visual Encoding and Charts
- ◆ Rules of Thumb
- ◆ Interactivity and Storytelling
- ◆ Annotation, Colour and Composition



Visualization

Annotation / Colour / Composition

1. Annotation
2. Colour
3. Composition

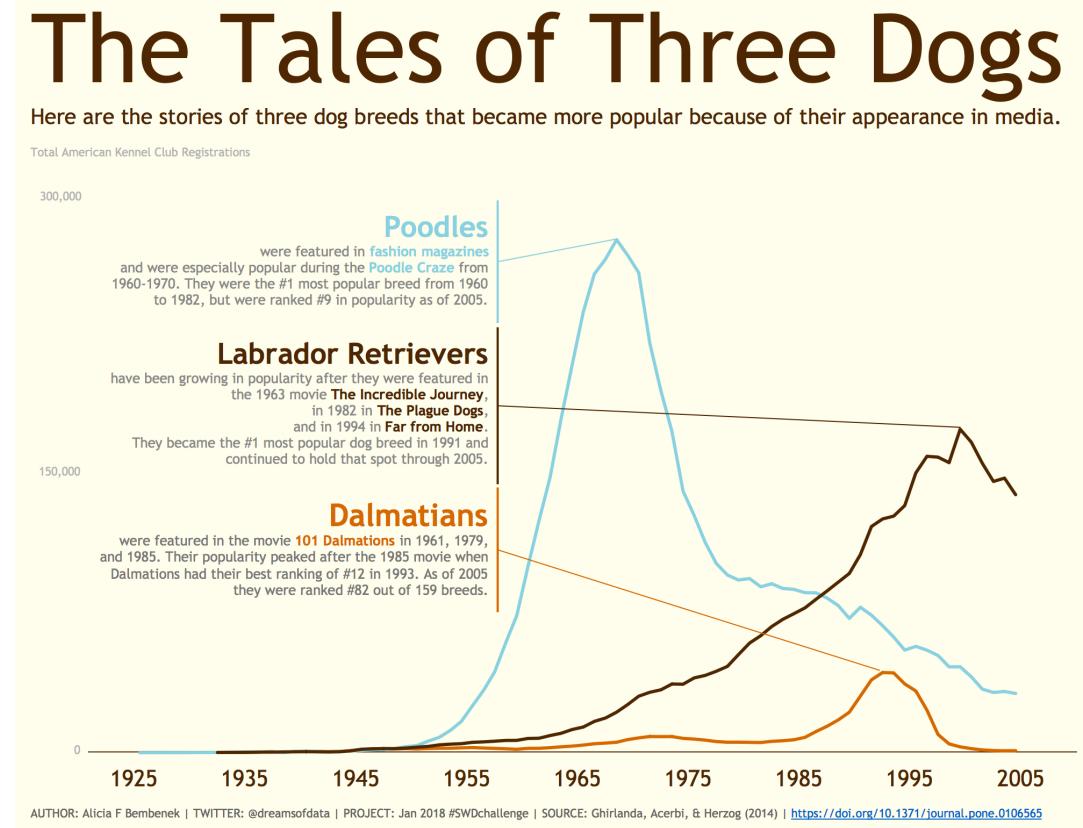


What is Annotation in Data Visualization?

- ◆ **Annotations:** textual or graphical elements that provide additional context or clarification

- ➔ Help guide the audience's attention
- ➔ Explain key insights
- ➔ Transform raw data into a clear and compelling narrative

A basic chart with key points annotated





Why Are Annotations Important?



ANALYSIS FINDINGS: Total unit decline in 12-month (-26%) and 48-month (-36%) from April to July, while cash grew (10%).

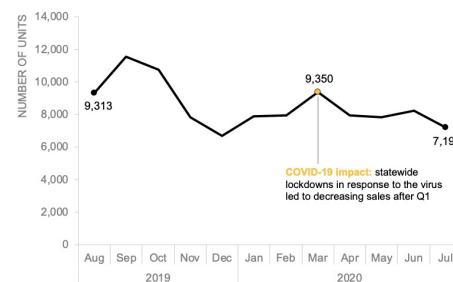
Before

Consumer behavior has shifted

Total units sold is **down 22.7% YoY** and down 23% since the **impact of COVID lockdowns** in the US.

The COVID impact caused a sharp decrease in the number of units sold as of July. We expect this decline to level out by each year-end due to discussions with key customers about resuming their purchasing cycles.

Total sales over time



Purchase type composition has evolved over time. **How might this impact our go-forward strategy?**

As a result of the market and access to financing, the 12 and 48 month leases are decreasing in utilization. **Cash purchases have increased 10% in the last 12 months.** We expect this to continue.

Sales by purchase type



Last year (Aug-19) This year (Jul-20)

After

- Provide clarity and context
- Explain trends, outliers, and key insights
- Guide the narrative in a data story
- Improve accessibility for different audiences

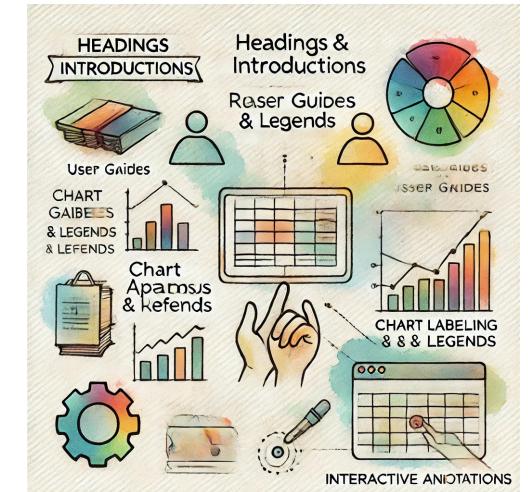
Source: <https://www.storytellingwithdata.com/blog/2021/1/10/lets-improve-this-graph-yt9xj>



Types of Annotations

- ◆ **Headings & Introductions:** Information about the upcoming content
- ◆ **User Guides:** Instructions for interactive features
- ◆ **Reader Guides & Legends:** Information on how to read a chart
- ◆ **Chart Apparatus & References:** Structural components of a chart
- ◆ **Chart Labelling & Captions:** Axis labels, axis scales and value labels
- ◆ **Footnotes:** Extra information, data source references, etc.

- ◆ Some of these may be **Interactive Annotations**
 - Change or Appear when the user interacts with the data (e.g., hovering over a point or clicking)





Headings & Introductions: Information about the upcoming content

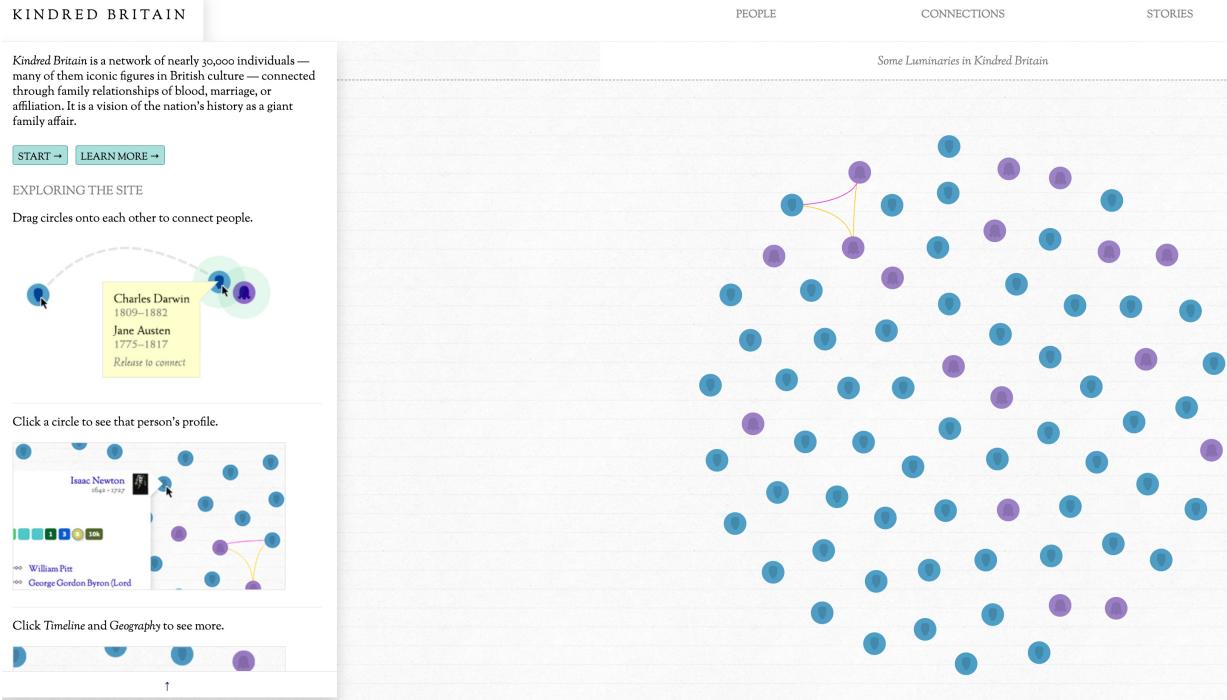
- ◆ **Headings:** Inform Viewers about upcoming content and orientate them in the content hierarchy
 - Statement Headings: Short titles with key observations, often in explanatory vis
 - Example: “[Why Peyton Manning’s Record Will Be Hard To Beat](#)”
 - Question Headings: align audience with motivating curiosity
 - Example: “[What’s Really Warming the World?](#)”
 - Descriptive Headings: Articulate what is on a chart. More functional, often for lower level headings
 - Example: “[Avenger’s characters’ appearance over time](#)”
 - Artistic Headings: short, enigmatic, pique the curiosity of the audience
 - Example: “[Bryce Harper: A swing of beauty](#)”
- ◆ **Introductions:** concisely explain what the project is about, often right after heading
Typical content:
 - Reasons for the project
 - Description of the analysis
 - Explanation of relevance of the analysis
 - Main message and findings about to be revealed



User Guides: Instructions for interactive features

- ◆ User Guides: Instructions, esp. for interactive visualizations

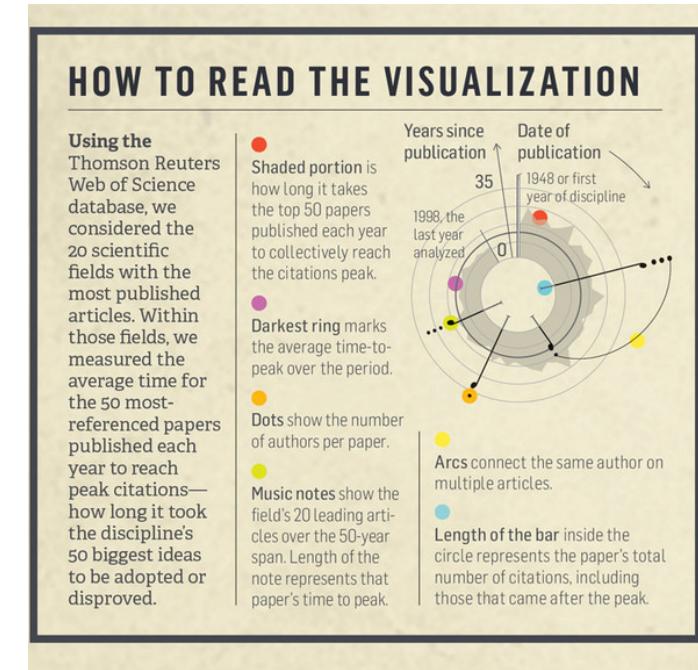
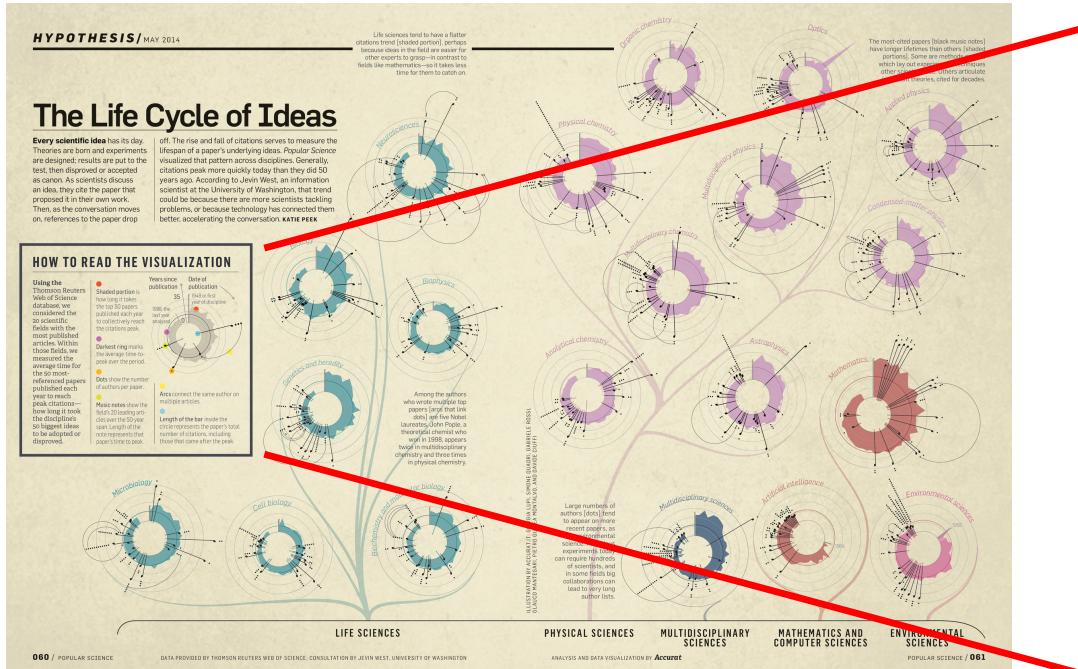
- ◆ Example:
Kindred Britain





Reader Guides & Legends: Information on how to read a chart

- ◆ **Reader Guides:** help viewer understand (unfamiliar/complicated) charts



- ◆ **Legends:** similar, but shorter

- Examples: color keys for categorical attributes



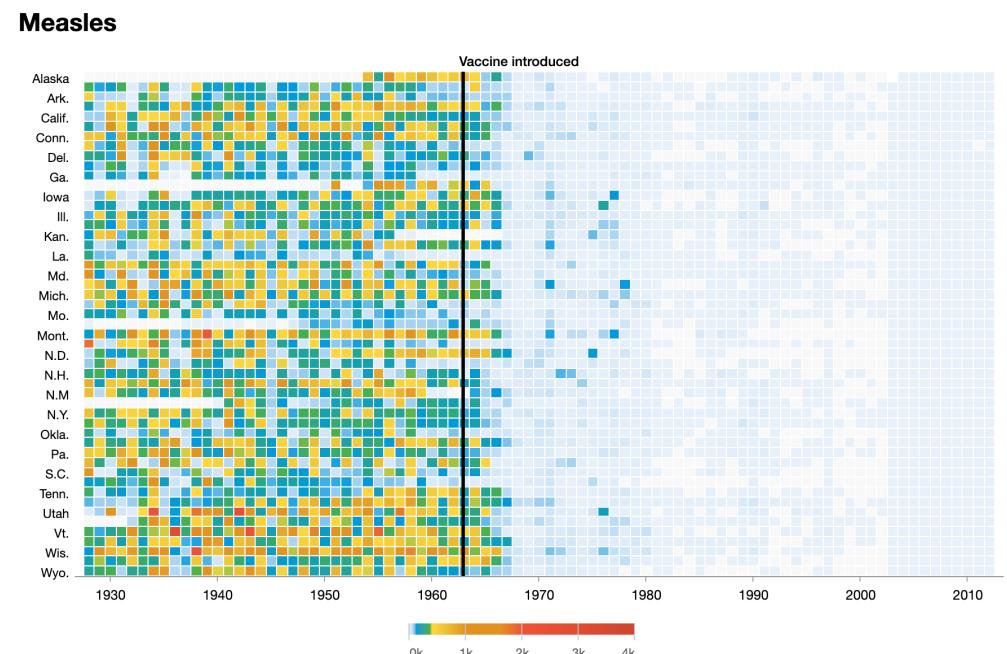
Chart Apparatus & References: Structural components of a chart

- ◆ **Chart Apparatus:** structural components in a chart

- Examples: Axis lines, gridlines, tick marks, ...
- Decide on what to include/exclude – do not just accept the defaults
- Remove clutter!

- ◆ **References**

- **Bandings:** Shaded areas to provide context
- **Markers:** additional points or symbols, e.g. a target value
- **Reference Lines:** position/size on axis for quantitative values

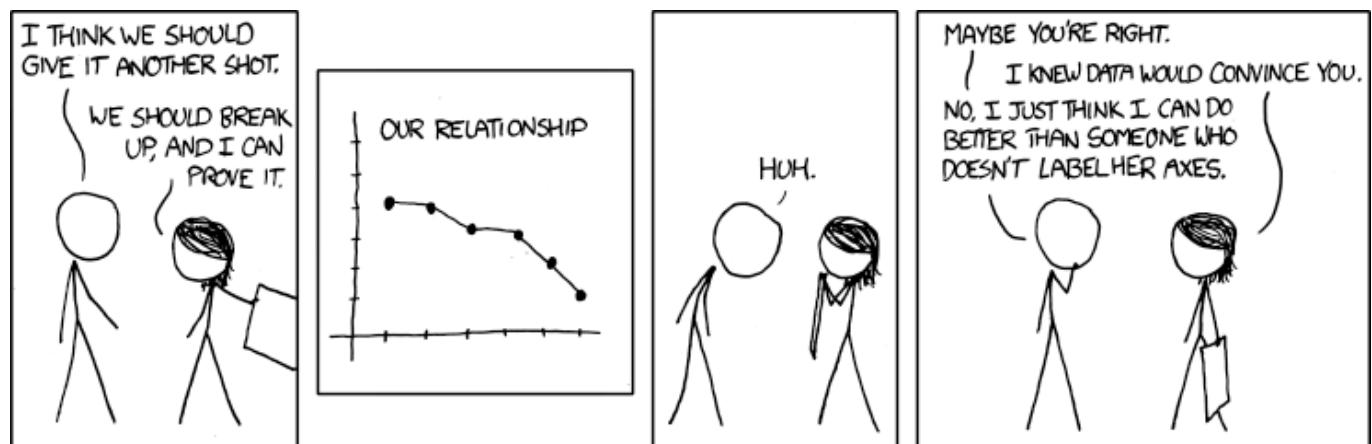


Note: CDC data from 2003-2012 comes from its Summary of Notifiable Diseases, which publishes yearly rather than weekly and counts confirmed cases as opposed to provisional ones.



Chart Labelling & Captions: Axis labels, axis scales and value labels

- ◆ **Chart Labelling & Captions:** added to chart
 - **Axis titles:** describe what values are plotted along each axis
 - **Axis scales:** references along each axis
 - **Value labels:** in proximity of specific marks inside a chart



Source: <https://xkcd.com/833/>



Footnotes: Extra information, data source references, etc.

- ◆ **Footnotes**: convenient place to share useful further information

- Data sources
- Credits
- Attribution
- Usage information
- Time/data stamps

About this project

«The Stories Behind a Line» is a project that wants to tell the stories of six asylum seekers who arrived in Italy in 2016: M.B., S.S., M.D., A.L., S.W.G. and T.K., who have been hosted at Vercelli CAS Migrantes, Anteo Social Cooperative Onlus.

I'm extremely thankful to them, because they shared with me their painful memories. I decided to tell their stories through data and numbers – traveled kilometers, hours spent, transportations – because I think that this information in its simplicity can really depict the exhausting and dangerous experiences lived by persons who are looking for a better life.

During our interviews I asked them to help me in filling up these lines with data and information and to tell me what they wanted to, without too many questions. This is why in some parts of the lines there are some quotes or notes: these are the moments in which they shared with me a more detailed fragment of their story.

There are some missing data and there are two main reasons for that: either they weren't able to recall the information or I was so moved that I simply forgot to ask it. I think that imperfections in this projects are inevitable and I think that's right.

I want to thank Alfonsina Zanatta, referent of "Vercelli Festa dei Popoli", who helped me to get in contact with CAS Migrantes.

I also want to thank Alberto Frapapane, who helped me in the communication with the French speaking persons.

Thank you to Alex Piacentini, who worked with me at the website and helped me to build up this project.

And thank you so much M.B., S.S., M.D., A.L., S.W.G. and T.K. for sharing with me your precious memories.

Federica Fragapane

is an award-winning Visual and Information Designer freelance.
«The Stories Behind a Line» is a personal project she started working on in 2016, interviewing a group of asylum seekers arrived in her hometown. She strongly believes in the communicative potential of data visualization and she's constantly testing it.

[Twitter](#) / [Portfolio](#)

Alex Piacentini

is an Italian UI and information designer working with graphics and code. His work consists in creating novel digital and cross-media user experiences for international clients on projects that have strong innovative, research or experimental connotation for the publishing, cultural and educational fields.

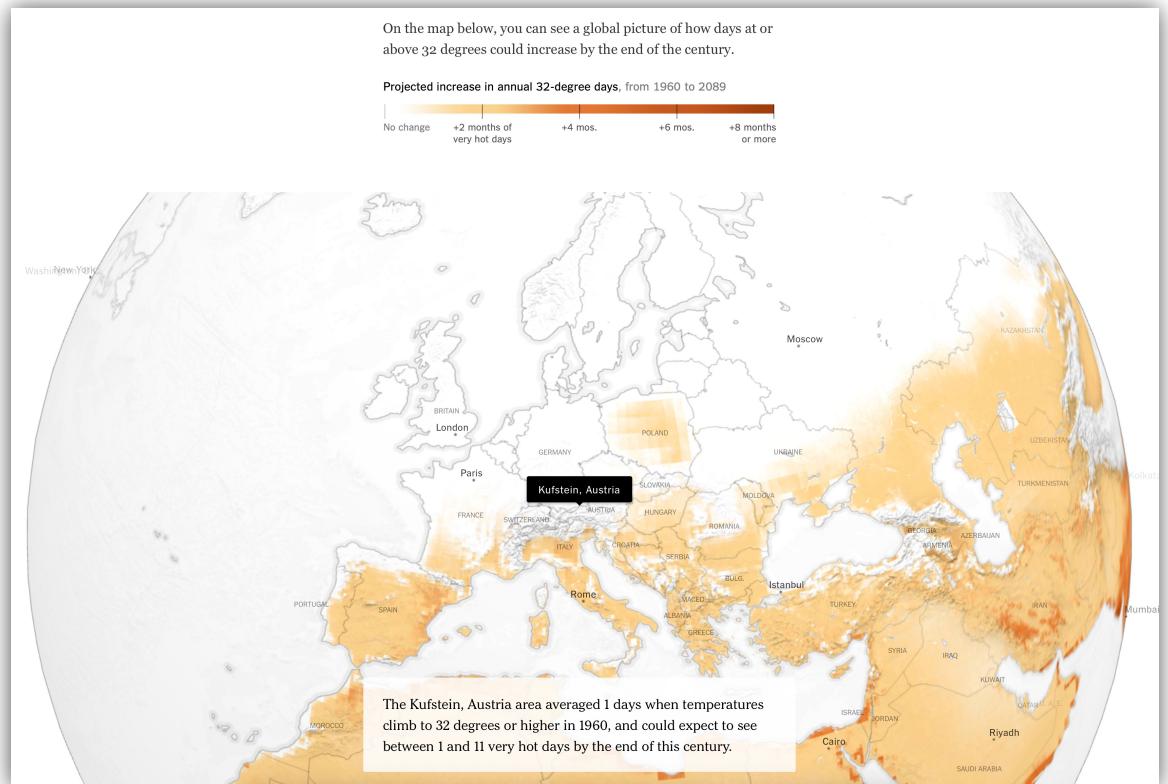
[Website](#)

Source: <http://www.storiesbehindaline.com>



Example: Interactive Annotation in Action

- ◆ Example: New York Times: [How Much Hotter Is Your Hometown Than When You Were Born?](#)
- ◆ Effective Annotations
 - Interactive annotations appear when scrolling
 - Annotations personalize the data by highlighting key information relevant to the user
 - Simple, effective captions summarize broader trends





Best Practices and Common Pitfalls

Best Practices for Effective Annotation

- Take your audience's needs into account
- Keep annotations concise and clear (don't clutter the visualization)
- Highlight only the most important points: don't over-explain
- Make sure annotations are visually distinct but not distracting
- Use interactive annotations to avoid overcrowding

Common Pitfalls in Annotation

- Over-annotating: Too much information can overwhelm
- Vague annotations: Be specific about what the data is showing
- Misleading annotations: Make sure annotations are accurate and don't oversimplify
- Lack of hierarchy: Annotations should guide, not compete for attention



Visualization

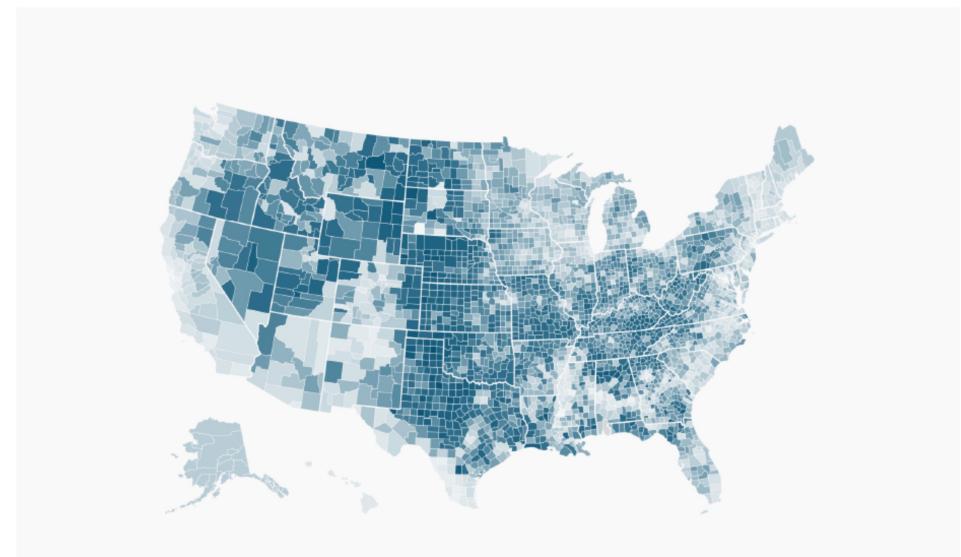
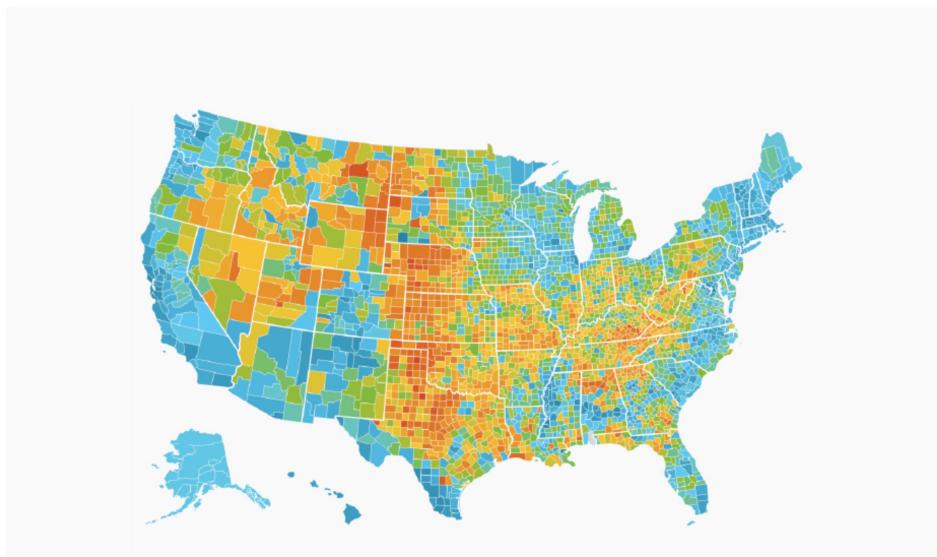
Annotation / Colour / Composition

1. Annotation
2. Colour
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The Role of Colour in Data Visualization

- Colour is a powerful tool for encoding, emphasizing, and enhancing data
- Colour choices affect the legibility, perception, and emotional impact of visualizations
- Effective use of colour can clarify, while poor use of colour can confuse or mislead

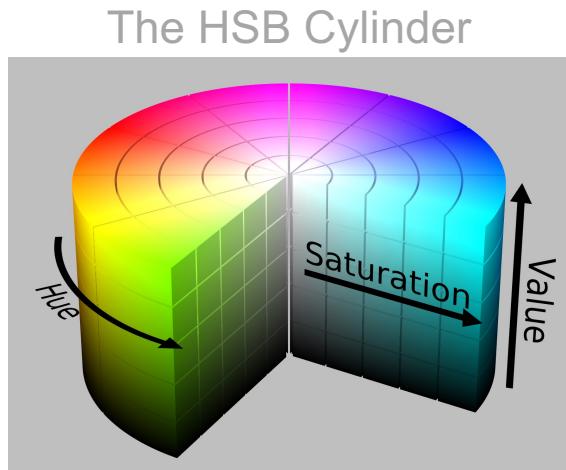


Source: <https://academy.datawrapper.de/article/140-what-to-consider-when-choosing-colors-for-data-visualization>



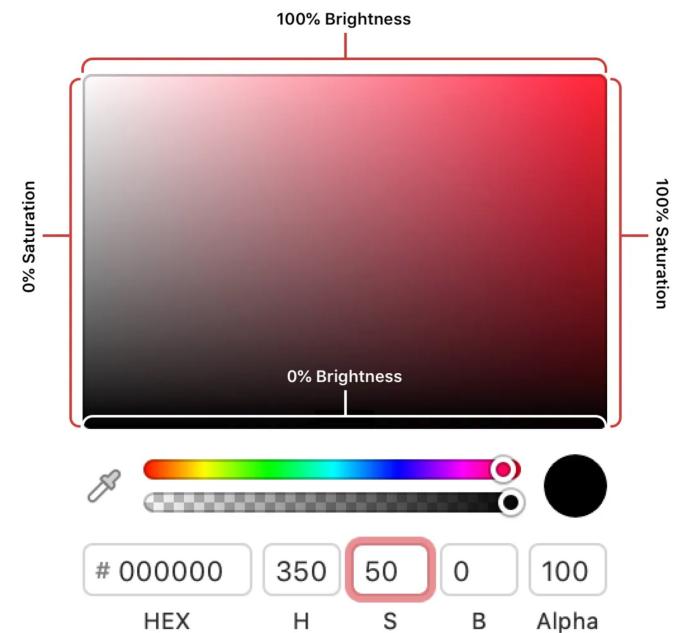
Colour Models

- ◆ Technical Colour Models
 - RGB (red-blue-green): additive model, e.g. used by screens
 - CMYK (cyan-magenta-yellow-black): subtractive model, e.g. used by printers
- ◆ Perceptual Colour Models
 - HSL (hue-saturation-lightness)
 - HSB (often called HSV: hue-saturation-brightness/value)



Source: Wikimedia commons, CC BY-SA 3.0

Brightness/Saturation in Sketch (HSB)

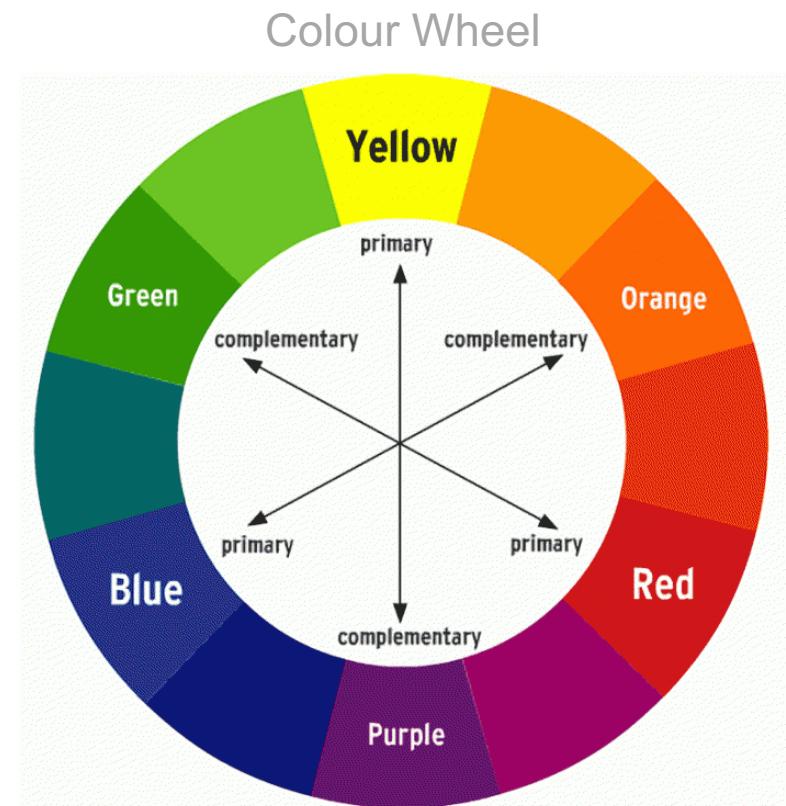


Source: <https://medium.com/innovaccer-design/rgb-vs-hsb-vs-hsl-demystified-1992d7273d3a>



Features of Colour

- ◆ **Encoding Data with Colour:** The Functional Use of Colour
 - Encode data by grouping, differentiating, or classifying
 - Highlight key insights / Key data points
 - ➔ Provide an intuitive visual guide for comparison
- ◆ **Decorations:** The Aesthetic Role of Colour
 - Set tone and mood of a visualization
 - Evoke emotions / Align with brand identity
 - Enhance readability and engagement
 - ➔ But: Avoid excessive use of colour for aesthetic purposes only



Source: <https://thebass.org/learn/lesson-plan-world-of-color/>



Encoding Data with Colour: Types of Colour Schemes

Quantitative Data

- ◆ **Sequential/Converging Colour Scheme:** Used for ordered data, progressing from low to high
 - Examples: heatmaps, population density
- ◆ **Diverging Colour Scheme:** Used when data has a meaningful midpoint, highlighting deviation
 - Examples: financial gains and losses

Categorical Data

- ◆ **Categorical Colour Scheme:** Used to differentiate discrete categories
 - Examples: countries, product types

Encoding Quantitative Data – Sequential Colour Schemes

Quantitative Data: Sequential/Converging Colour Schemes

- ◆ Useful for ordered data
- ◆ Most common: Variations in Lightness/Brightness/Value of one Hue
- ◆ Often divided into discrete classes to facilitate detection of local variations
- ◆ Darkest shades must still be discernible (not "black")
- ◆ Decide: show observable or observed data?

So hoch ist der Strompreis in den Gemeinden

Preis für 2024, in Rappen pro Kilowattstunde



Haushaltstyp H4: 5-Zimmerwohnung mit Elektroherd und Tumbler, angenommener jährlicher Durchschnittsverbrauch von 4500 kWh. Für einzelne Gemeinden liegen noch keine Tarifdaten vor. Bei mehreren Anbietern wird der Schnitt ausgewiesen.

Quelle: Elcom • Grafik: Tim Naef • Kartenmaterial: Bundesamt für Statistik (BFS), GEOSTAT

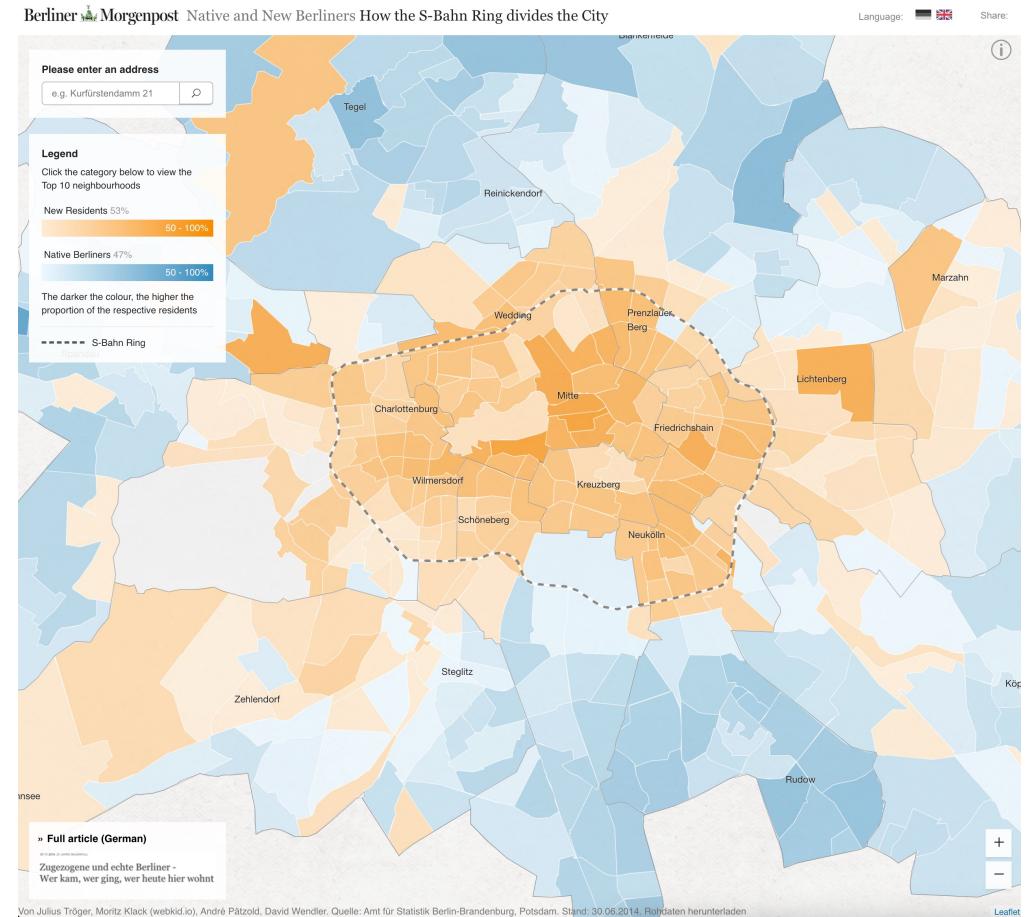
Source: <https://www.aargauerzeitung.ch/schweiz/energie-so-viel-hoher-faellt-die-stromrechnung-in-ihrer-gemeinde-aus-id.2509165>



Encoding Quantitative Data – Diverging Colour Schemes

Quantitative Data: Diverging Colour Schemes

- ◆ Useful for data with a specific breakpoint (“zero” value)
- ◆ Most common: Variations in Brightness of two Hues
- ◆ Use same shade (value) for same increment on both sides of the breakpoint
- ◆ Again
 - Careful with darkest shades
 - Observable vs. observed





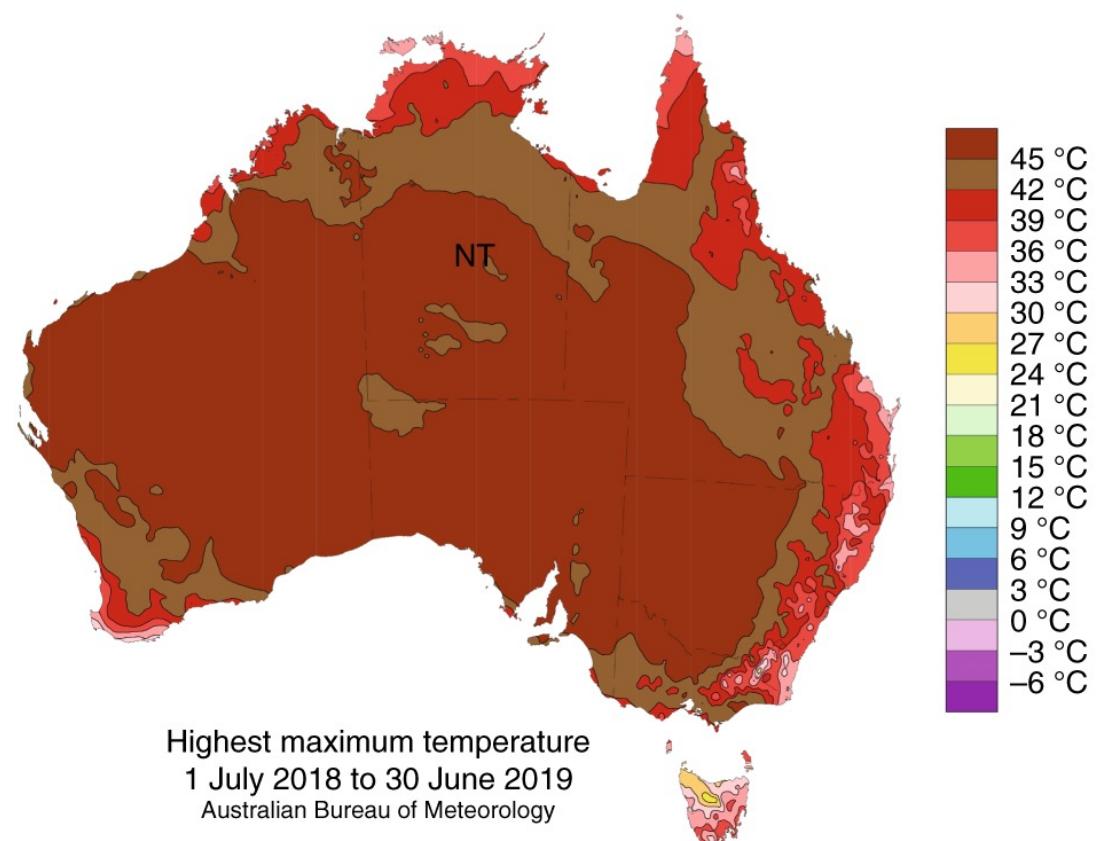
Example: Common Mistake: Use “Rainbow” Scale

Colour Scale used on left

- ◆ Intuitive?
What is hotter, blue or purple?
- ◆ General: red=hot, blue=cold – ok!
But: Green? Yellow? Purple?

Best practises:

- ➔ Vary Hue only at specific breakpoint
- ➔ Otherwise, only vary Brightness



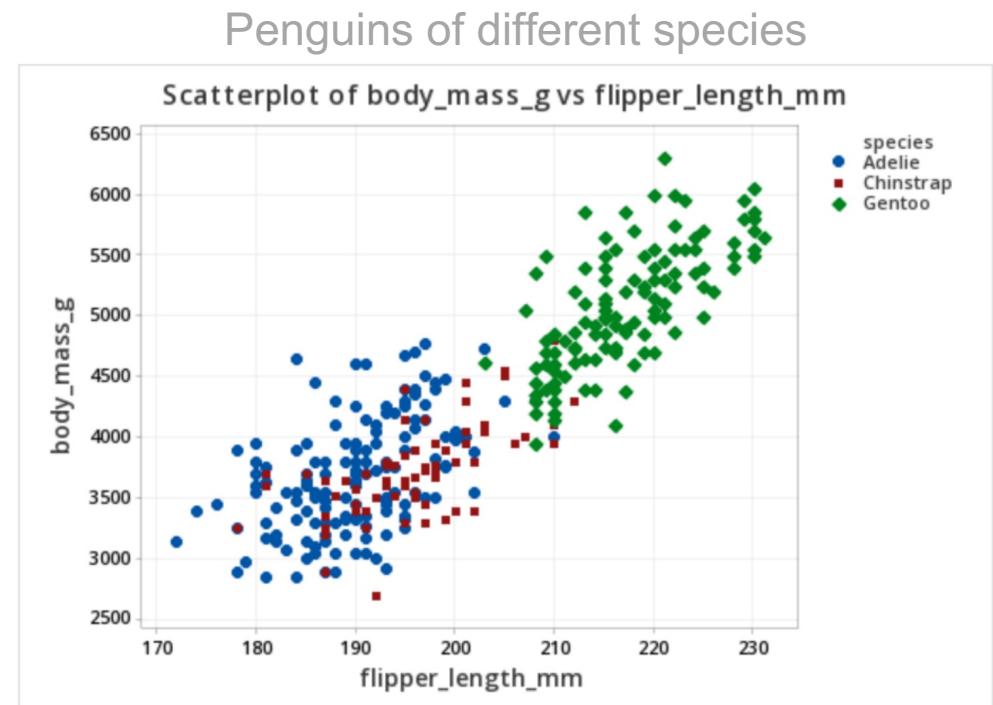
Encoding Categorical Data – Categorical Colour Schemes

Categorical Data: Categorical Colour Schemes

- ◆ Aim: create clear distinctions between unique categories, while not implying any notion of order or magnitude
- ➔ Only for limited number of categories!
(easy <5, harder 5-12, impossible >12)

Options for more Categories:

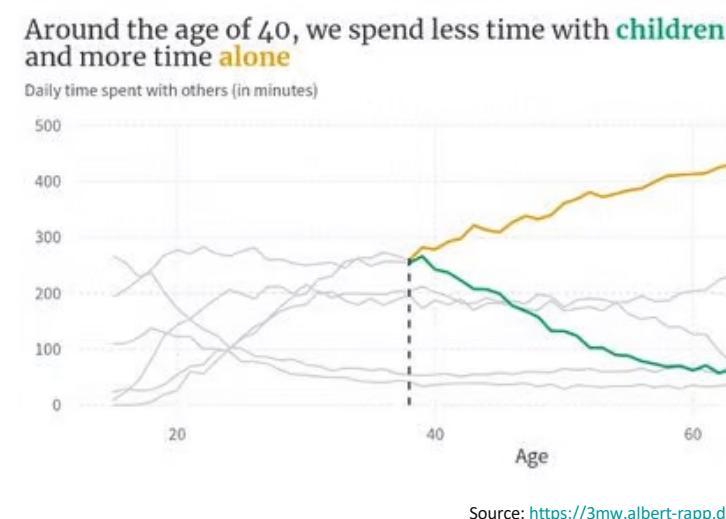
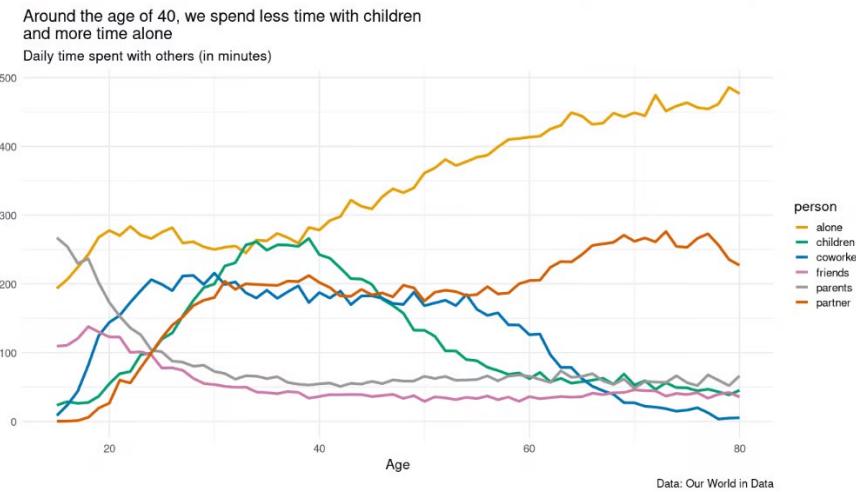
- Use shapes or patterns
- Transform data into fewer categories
- Interactivity: filtering, highlighting





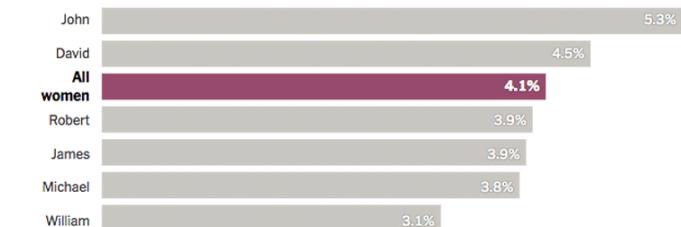
Using Colour to Highlight Key Insights

- ◆ Draw attention to key data points
- ◆ Highlight the most important information



Guys Named John, and Gender Inequality

Share of C.E.O.s of S&P 1500 companies by C.E.O. name



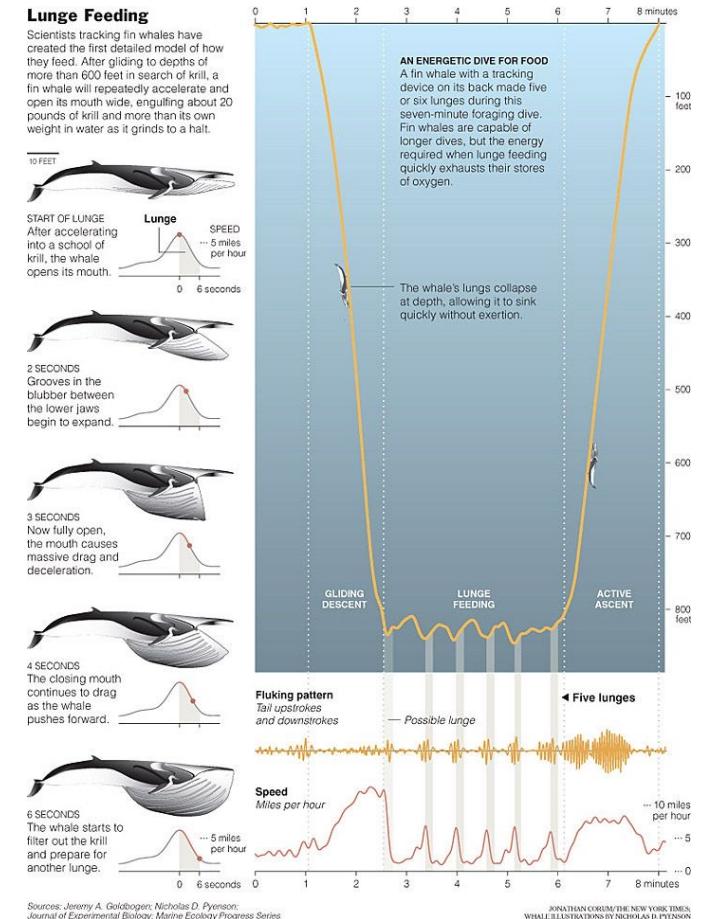
Source: Execucomp

Source: <https://www.latamwill.org/fewer-women-run-big-companies-men-named-john/>



Decorations: The Aesthetic Role of Colour

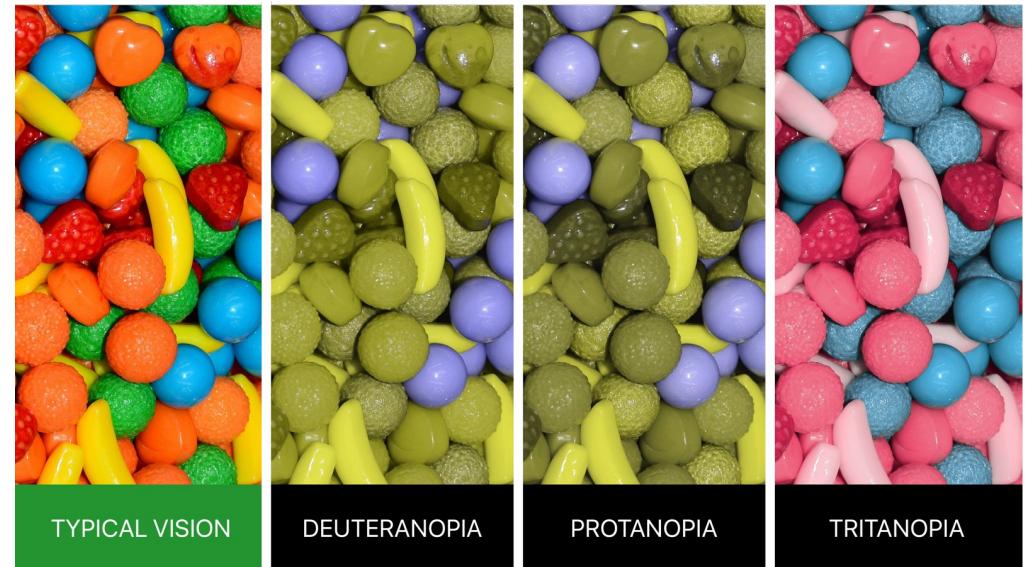
- ◆ Decorations: everything but the data
- ◆ Must not compromise legibility of data
- ◆ Set tone and mood of a visualization
- ◆ No single pathway to achieve this
- ◆ Example
 - Blue-shaded panel gets darker with depth
 - Makes the panel the centerpiece of the chart
 - Thin, grey-shaded columns at bottom of panel show lunge actions
 - Connect to small charts on the left





Designing for Colour-Blind Audiences

- ◆ Approximately 5% of population affected by colour blindness/weakness
 - 8% of men and 0.5% of women
- ◆ Use Colour-blind-friendly palettes
 - For example: <https://colorbrewer2.org/>
- ◆ Use additional cues to differentiate data points: patterns, labels, shapes
 - Also, important if vis is printed or shown on old/weak projectors
- ◆ Test your vis using Colour Blindness Simulators
 - For example: <https://www.color-blindness.com/coblis-color-blindness-simulator/>



Source: <https://www.salesforce.com/blog/how-we-designed-salesforce-maps-to-be-color-blind-friendly/>



Visualization

Annotation / Colour / Composition

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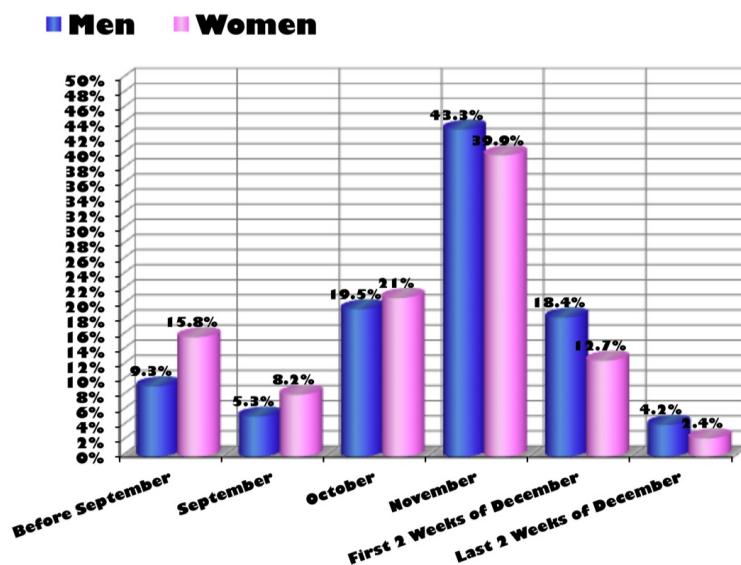


What is Composition in Data Visualization?

Composition = how visual elements are arranged on the page or screen

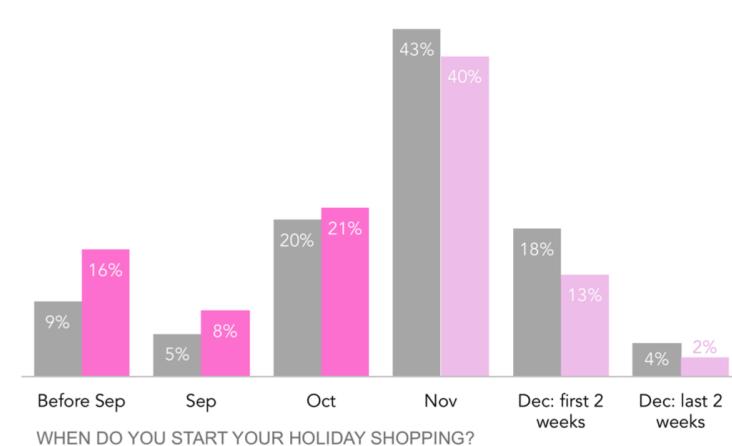
- Can enhances clarity and understanding
- Can lead to confusion or misinterpretation

Shoppers Begins Shopping for Holidays



More women start their holiday shopping early

■ Men ■ Women
% OF TOTAL



Source: <https://www.storytellingwithdata.com/blog/2017/3/29/declutter-this-graph>



Key Principles of Composition

Key Principles of Composition

- ◆ **Hierarchy**: Organize elements so the most important information is seen first
- ◆ **Alignment**: Ensure elements are visually aligned for a clean and orderly layout
- ◆ **Balance**: Distribute visual elements evenly to avoid clutter or empty spaces
- ◆ **Whitespace**: Use space between elements to improve readability and focus, reduce clutter
- ◆ **Flow**: Guide the viewer's eye through the visualization with a logical flow



Creating Visual Hierarchy

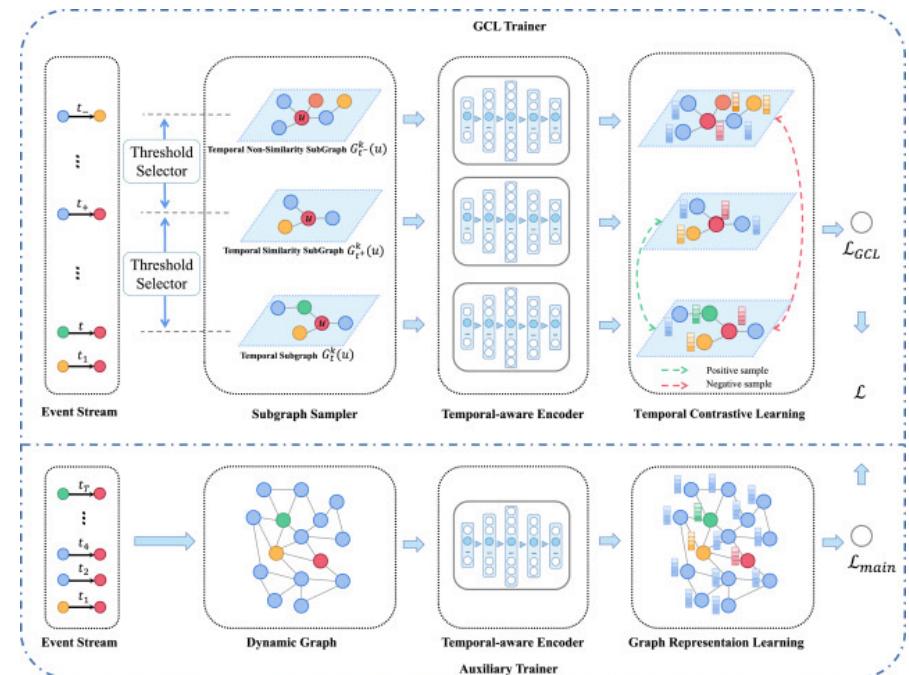
- ◆ **Hierarchy**: ensure that the viewer knows where to look first
- ◆ How to establish hierarchy:
Size, position, colour
 - large fonts / bold colours
→ highlight key data points
 - Smaller, less prominent elements should support, not compete with, the main message





The Role of Alignment and Grid Systems

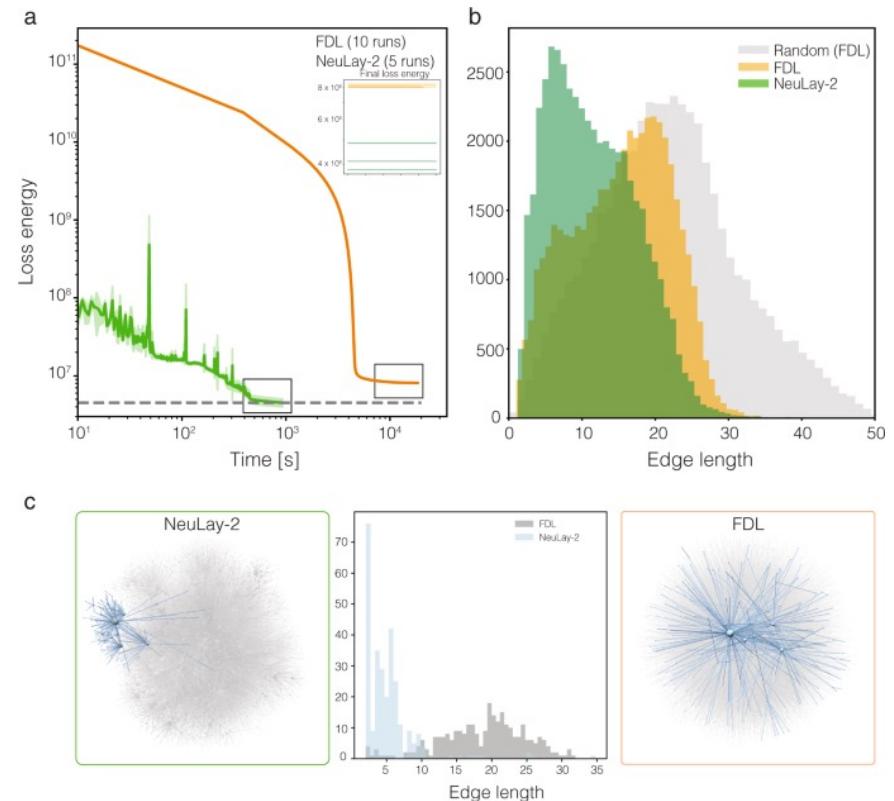
- ◆ Alignment creates order and structure
- ◆ Use a grid system to align elements consistently
- ◆ Grids help ensure visual harmony and balance
- ◆ Misaligned elements can create visual tension or confusion





Balancing Elements

- ◆ **Balancing** = distributing elements evenly across the composition
- ◆ Avoid clustering elements in one area and leaving other areas empty
- ◆ Balance text, charts, and whitespace to create a visually appealing layout

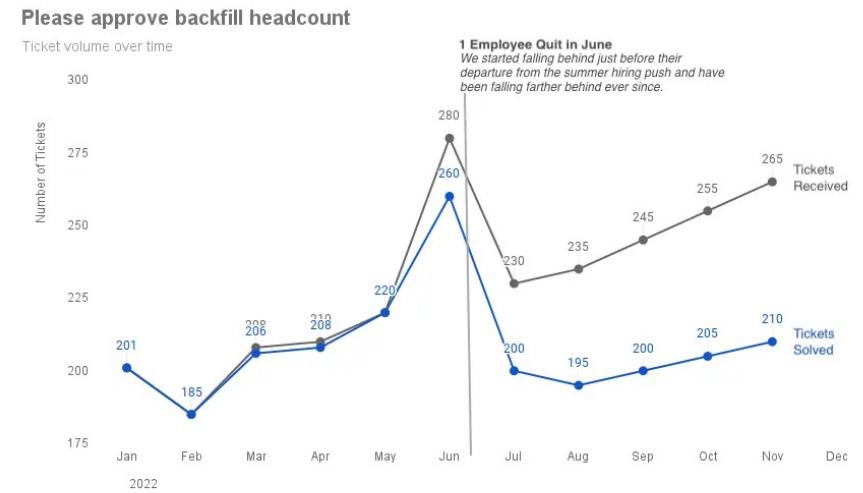
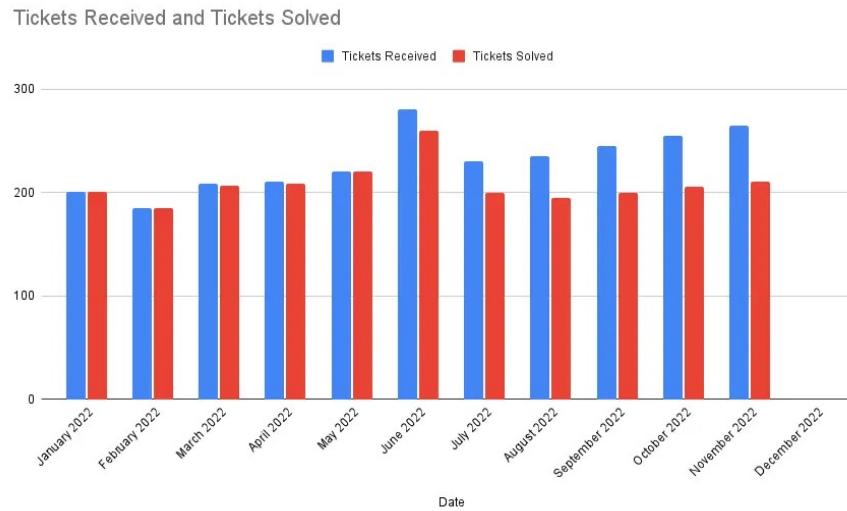


Source: <https://www.nature.com/articles/s41467-023-37189-2>



Whitespace: A Key Element

- ◆ **Whitespace** = empty space between elements
 - ➔ avoid **clutter**
 - ➔ enhance readability
 - ➔ draw attention to key content
 - ➔ prevent visual overload
- ◆ It's a design tool, not wasted space



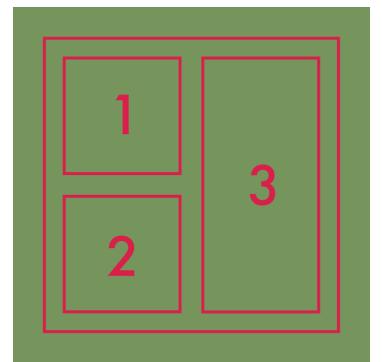
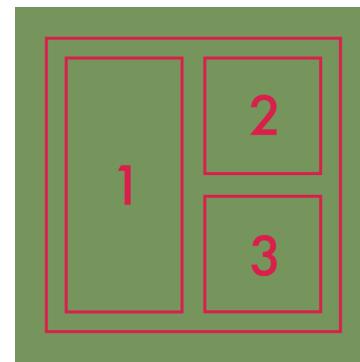
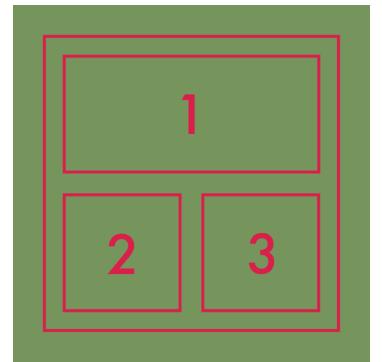
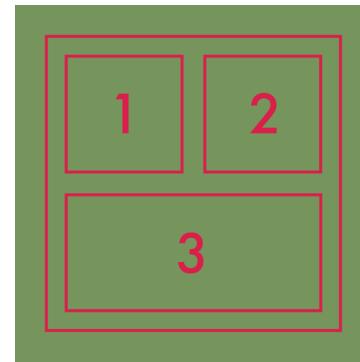
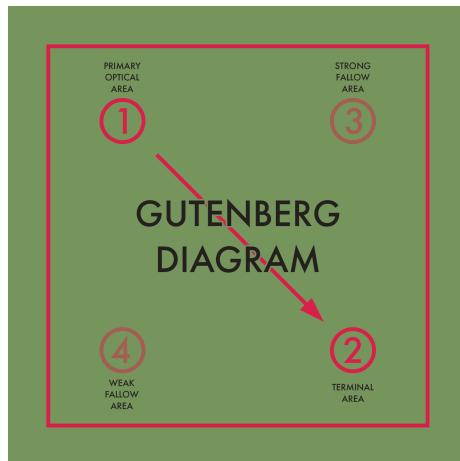
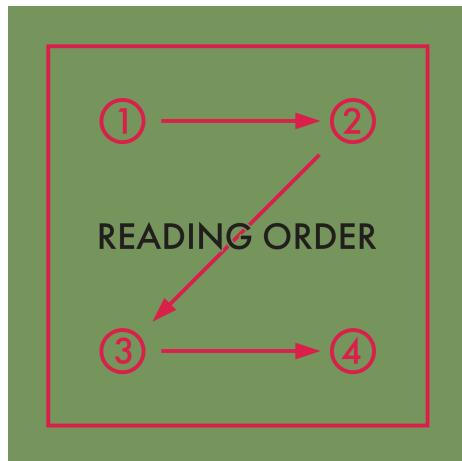
Annotation / Colour / Composition

Source: <https://sglmr.com/blog/post/storytelling-with-data-by-cole-nussbaumer-knaflic/>



Creating Flow

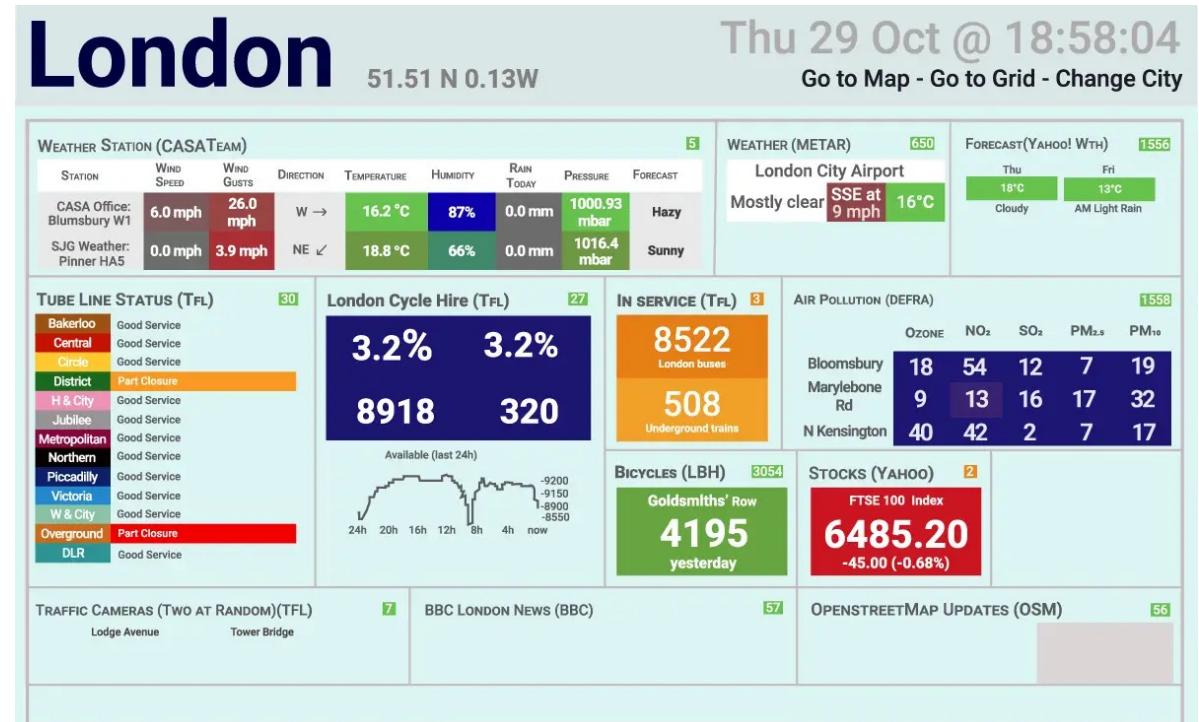
- Flow = visual path, guides the viewer's eye
 - Arrange elements to follow a natural reading order (left to right, top to bottom)
 - Alignment, hierarchy, spacing: direct the flow
- Flow needs to support the storytelling!





Common Composition Pitfalls

- ◆ Overcrowding
→ too much information
- ◆ Lack of visual hierarchy
→ confusion
- ◆ Inconsistent alignment
→ visual disorganization
- ◆ Neglecting whitespace
→ clutter



Source: <https://www.oxagile.com/article/welcome-to-dashboardland-where-bi-mistakes-turn-into-insights/>



Key Takeaways

◆ Annotations

- Add value by guiding the viewer to key insights
- Good = Concise, clear, and visually balanced
- Interactive annotations can enhance user engagement

◆ Colour

- Use colour to clarify, set tone and emotional impact - not clutter
- Choose colour schemes based on the data type
- Highlight key data points with contrasting colours
- Consider accessibility for colour-blind viewers

◆ Composition

- Hierarchy
- Alignment
- Balance
- Whitespace
- Flow



Photo by Dragonfly Ave on Unsplash