INSTITUTE FOR DEFENSE ANALYSES

DATAWorks 2020:
Build better graphics:
“I don't remember that briefing, but I do remember that figure.”

Heather Wojton, Project Leader

Brian Vickers
Andrew Flack
Matthew Avery

March 2020

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Executive Summary

IDA analysts strive to communicate clearly and effectively. Good data visualizations can enhance reports by making the conclusions easier to understand and more memorable. The goal of to avoid settling for factory defaults and instead present conclusions through visually appealing and understandable charts.

Issues to consider include choosing the right level of detail, guidelines for different types of graphical elements (titles, legends, annotations, etc.), selecting the right variable encodings (color, plot symbol, etc.), and determining whether to include a chart at all. Most of the time, there's no single "right" answer, so it is important to understand the factors involved and the trade-offs associated with different options.

Brian Vickers, Andrew Flack, Matt Avery

Institute for Defense Analyses

Why spend time revising figures?

People process pictures faster and more efficiently than words. Good data visualizations can tell the story of your data – summarize complexity, show trends, make comparisons, and map distributions – with less mental burden on your audience.

Plus, people love pie charts.

Tip 1: Choose a display matching the story

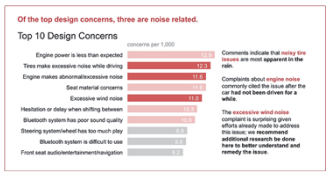
- Not all metrics and displays communicate messages clearly.
- To show changes over time, prefer a line chart (or connected points) rather than bars, points, pies, etc.
- Consider derived metrics if they tell your story better, provided that they reflect patterns in the data honestly.

Tip 2: Guide the viewer

Strategic use of color and annotations can tell the viewer where to look. This is especially important when slides get pulled from briefings and passed around.

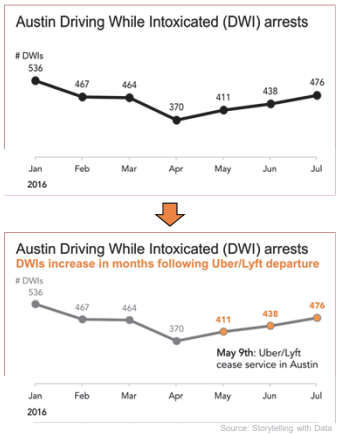
- Keep colors and encoding **consistent** across a presentation.

In this figure, the saturated red color highlights the 3 noise concerns in a Top 10 list.



Tip 3: Give a clear "So what?" takeaway

Subtle changes to titles, subtitles ("DWIs..."), annotations ("**May 9th**..."), and colors can make takeaways much clearer.



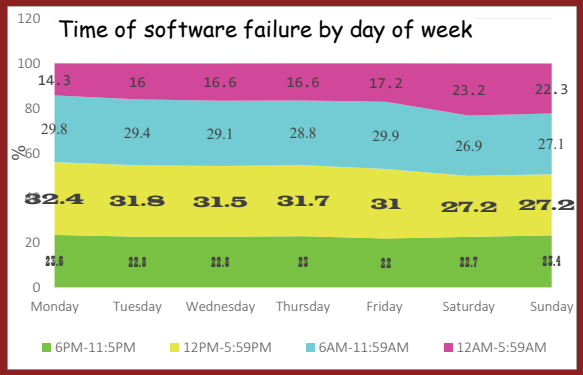
IDA

Good data visualizations can tell your story better than words

"I don't remember the briefing, but I do remember that figure."

Know how to optimize them!

BEFORE



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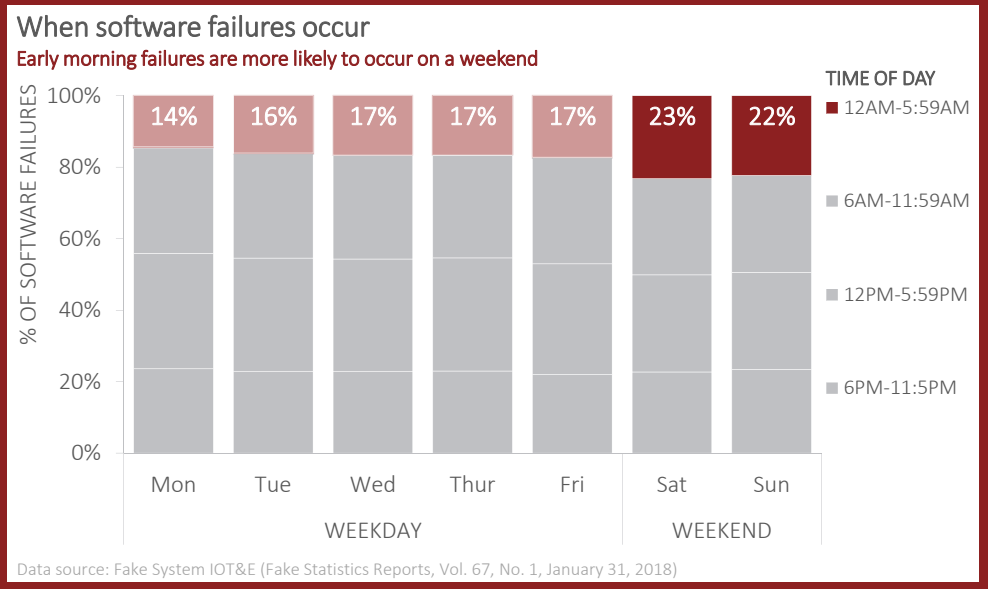
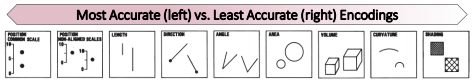


Data source: Fake System IOT&E (Fake Statistics Reports, Vol. 67, No. 1, January 31, 2018)

Choose Accurate Encodings

Research going back to the 80s has shown that some encodings are more accurately decoded than others.

- **Position on a scale and length** are some of the **most accurate** numerical encodings.
- **Shading/transparency and curvature** (e.g., pies) are some of the **most difficult** to decode.



Quick guide to color scales

Match your **color scale** to your **variable type**.
Example: don't use sequential palettes for qualitative data.

Sequential
Ordered data, low to high
- Usability
- Time to acquire

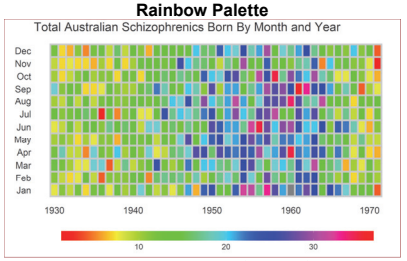
Qualitative
Nominal or categorical data
- Fuel type
- Failure mode

Diverging
Meaningful mid-point
- Likert data
- Deviation from average

Source: Color Brewer

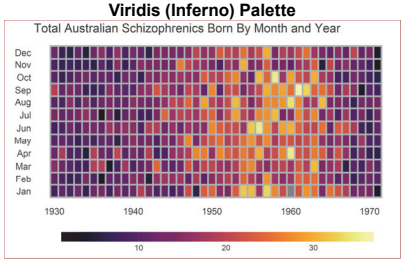
Use **perceptually uniform** palettes: close values have similar *color perception* across full range of palette.

Rainbow Palette



Colorful, but not uniform (low ~ high)

Viridis (Inferno) Palette



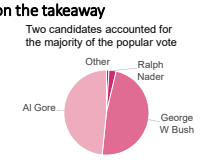
Uniformity makes changes easy to see

Many tools can check palettes against **color blindness** – use them!

Pies aren't always horrible

Finding an effective format **depends on the takeaway**

Pies can work when:
- Interested in relationship of parts to a whole
- Specific values are not important
- Ordering is not important



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IDA analysts strive to communicate clearly and effectively. Good data visualizations can enhance reports by making the conclusions easier to understand and more memorable. The goal of this seminar is to help you avoid settling for factory defaults and instead present your conclusions through visually appealing and understandable charts. Topics covered include choosing the right level of detail, guidelines for different types of graphical elements (titles, legends, annotations, etc.), selecting the right variable encodings (color, plot symbol, etc.), advice on practical implementations, and determining whether to include a chart at all. Most of the time, there's no single "right" answer, so this presentation will include audience discussion to examine the trade-offs associated with different options.

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