

Introduction to Visual Analytics



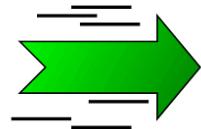
Coming up

To be covered today

- Visual Analytics basics
- Introduction to Design Thinking
- Applied Design Thinking in Visual Analytics
- Visual Analytics in Websites
- Visual Analytics Tools – Interface and Demo Tableau & Power maps

2015 Gartner Magic Quadrant for BI & Analytics Platforms





way to explore and understand data

Gartner vouches it's a  five B.I. trend

- Every company adopting the terms
 - Visual analytics
 - Data visualization

Charts and dashboards tools
claim the Visual analytics label.

So what's is real visual analytics?



Is this Visual Analytics : Cosmos Bank, Taiwan



What Visual Analytics is not

Let's start with what visual analysis is not:

- Any graphical depiction of data alone is not visual analytics
- Virtually any software application can produce a chart, gauge or dashboard.

While charts and dashboards are indeed “visualizations,” they leave out three critical steps of visual analytics

- A chart, for instance, shows conclusions, but not the thoughts behind it.
- Nor can users use a chart to ask questions and think further.
- In a chart, the thinking has taken place already and the resulting visualizations are little more than a show.

Visual Analytics

Visual analytics offers something much more profound. Visual analytics is the process of analytical reasoning facilitated by interactive visual interfaces

Three critical steps in Visual Analytics :

- Exploration – visually
- Analysis – visually
- Collaboration – with others using single view

Visual Analytics

- Visual analytics is a means of exploring and understanding data. It supports and accelerates the analysis process itself. You can ask a question, get the answer, and ask follow-up questions—all within visual interfaces.
- A story unfolds from one visual summary to another. You maintain your train of thought without taking your eyes off the data. Later, you can retrace the story to rethink, explore further and share.
- In short, visual analytics allows you to go in any direction with your thoughts while leveraging your visual perceptual system to guide you down the most useful paths.

Data Visualisation

“Visualizations allow our brains to digest large amounts of data in a comprehensive and understandable way.”



Visualisation trends favour simple

Simple is viral!

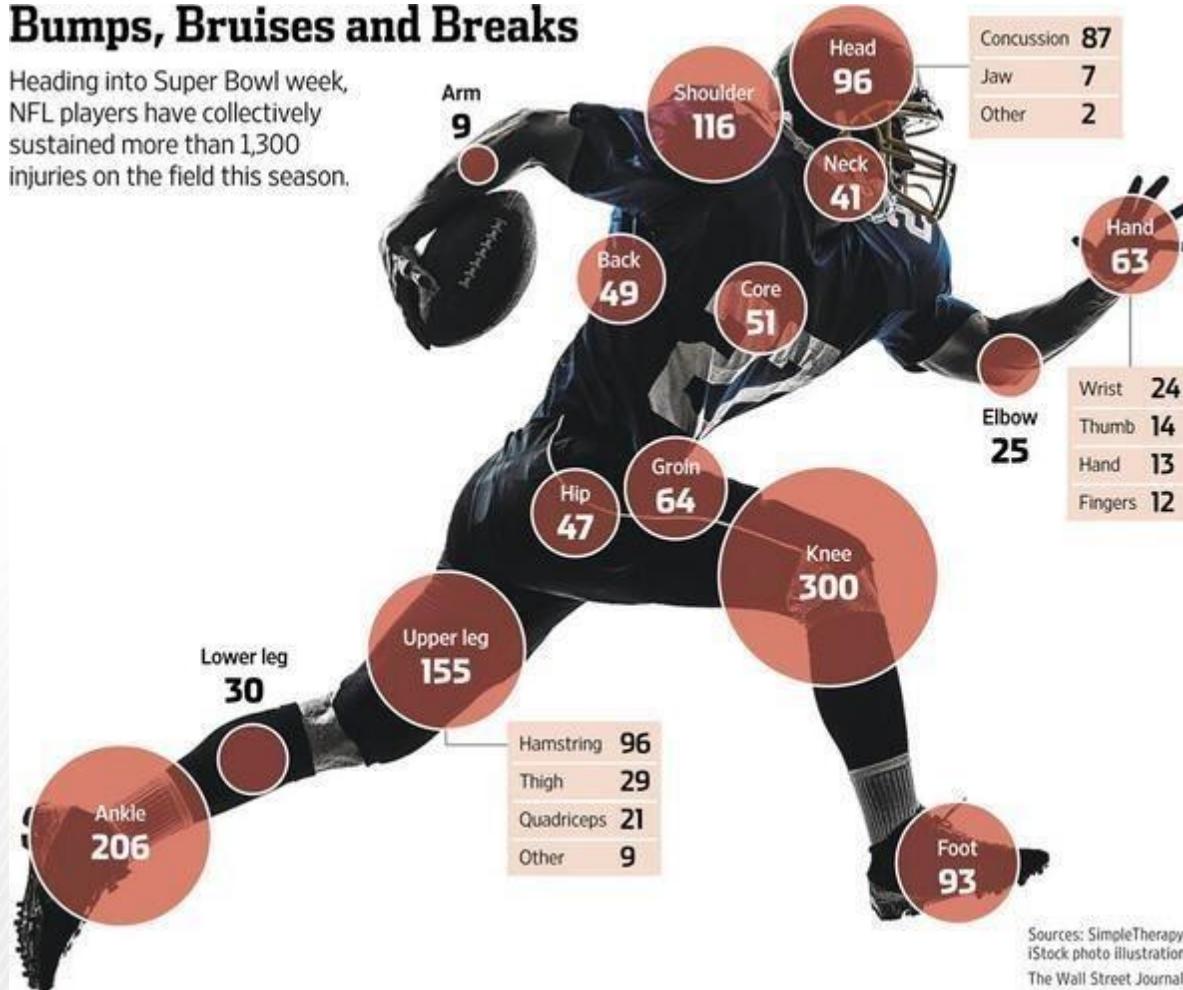
By 2015, **80% of people** accessing the Internet will be doing so from mobile devices.



Visualisation trends : Intuitive, time to count!

Bumps, Bruises and Breaks

Heading into Super Bowl week, NFL players have collectively sustained more than 1,300 injuries on the field this season.



Sources: SimpleTherapy;
iStock photo illustration
The Wall Street Journal

The best visualisations are not always online



Elements of Visual Analytics applications

The 7 Essential Elements

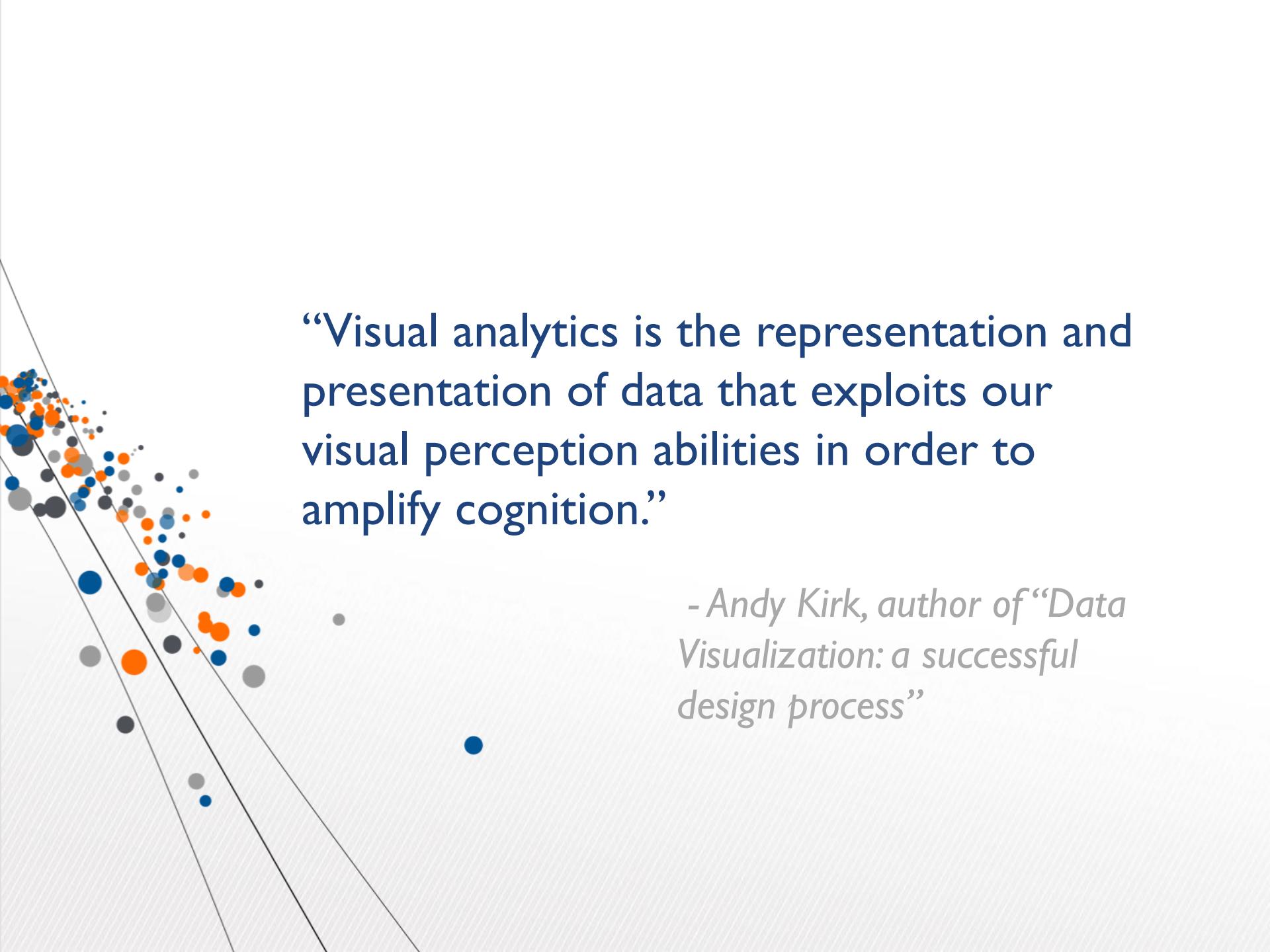
Visual Exploration	Querying, exploring and visualizing data are a single process.
Augmentation of Human Perception	Visual thinking is encouraged and developed - the brain's ability to process pictures far faster than text is leveraged.
Visual Expressiveness	Visual displays have depth, flexibility and multi-dimensional expressiveness.
Automatic Visualization	Effective visualizations are automatically recommended.
Visual Perspective Shifting	Shifting among alternative visualizations of any given data is effortless.
Visual Perspective Linking	Multiple images are intimately linked so a selection on one shows related, relevant data in the others.
Collaborative Visualization	People can easily share and collaborate on useful information visualizations.

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1	0	2	2	7	6	3	3	0	8	8	0	3	1	8	8	1	2	1	7	5	2	9	3	5	8	3	2	5

What is Visual Analytics?



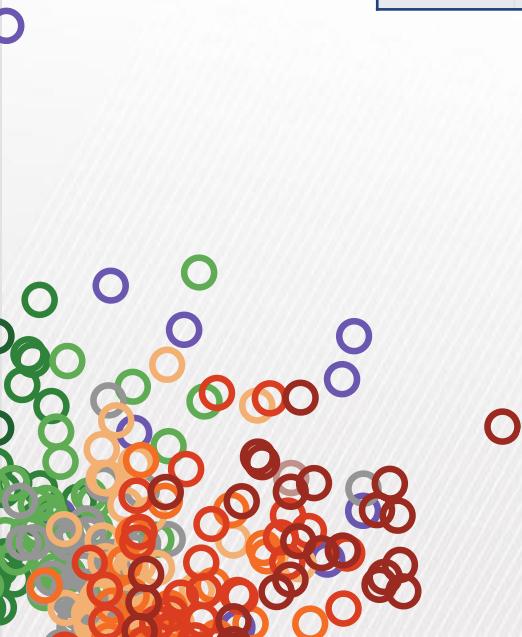


“Visual analytics is the representation and presentation of data that exploits our visual perception abilities in order to amplify cognition.”

- Andy Kirk, author of “Data Visualization: a successful design process”

Let's Look at Some Data

I		II		III		IV	
x	y	x	y	x	y	x	y
10	8.04	10	9.14	10	7.46	8	6.58
8	6.95	8	8.14	8	6.77	8	5.76
13	7.58	13	8.74	13	12.74	8	7.71
9	8.81	9	8.77	9	7.11	8	8.84
11	8.33	11	9.26	11	7.81	8	8.47
14	9.96	14	8.1	14	8.84	8	7.04
6	7.24	6	6.13	6	6.08	8	5.25
4	4.26	4	3.1	4	5.39	19	12.5
12	10.84	12	9.13	12	8.15	8	5.56
7	4.82	7	7.26	7	6.42	8	7.91
5	5.68	5	4.74	5	5.73	8	6.89



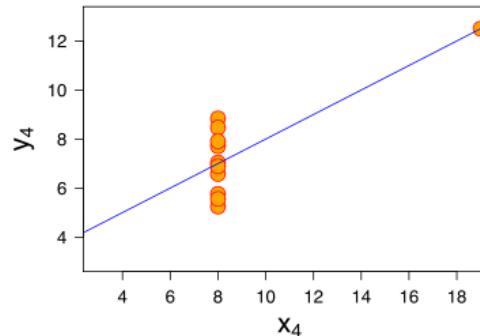
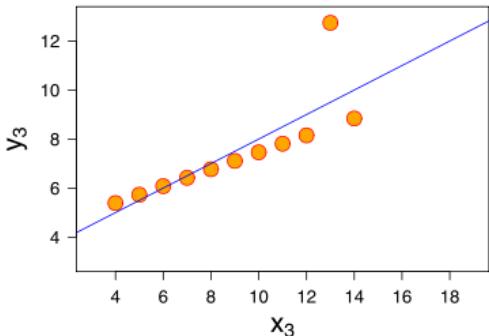
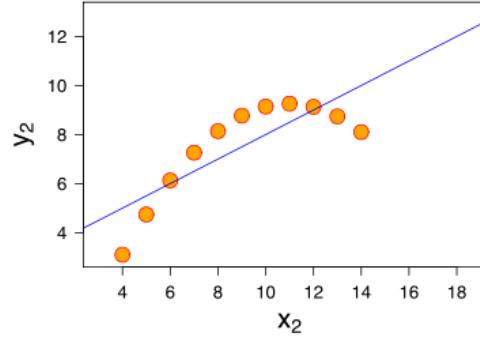
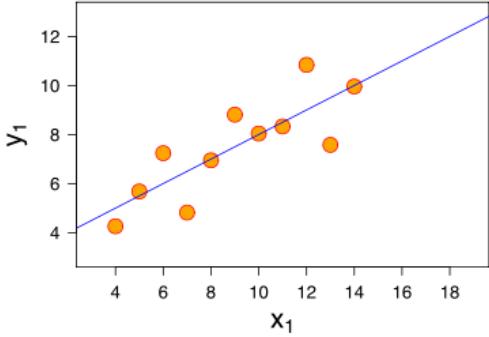
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	I		II		III		IV	
x	y	x	y	x	y	x	y	
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Property	Value
Mean of x in each case	9 (exact)
Variance of x in each case	11 (exact)
Mean of y in each case	7.50 (to 2 decimal places)
Variance of y in each case	4.122 or 4.127 (to 3 decimal places)
Correlation between x and y in each case	0.816 (to 3 decimal places)
Linear regression line in each case	$y = 3.00 + 0.500x$ (to 2 and 3 decimal places, respectively)



Let's Look at Some Data ... Visually



“Anscombe’s Quartet”

Source: Wikipedia

https://en.wikipedia.org/wiki/Anscombe%27s_quartet

Agenda

1. Human Perception and Cognition
2. Visual Analysis Cycle
3. Visualization Best Practices

Human Perception & Cognition



Humans Are Slow at Mental Math

$$\begin{array}{r} 34 \\ \times 72 \\ \hline \end{array}$$



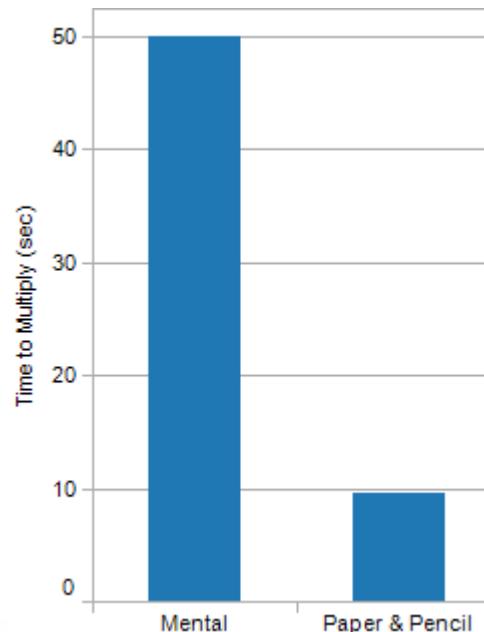
We're Faster When We Use the World

$$\begin{array}{r} 34 \\ \times 72 \\ \hline 68 \\ 23^1 80 \\ \hline 2448 \end{array}$$



Much Faster

$$\begin{array}{r} 34 \\ \times 72 \\ \hline 68 \\ 23^1 80 \\ \hline 2448 \end{array}$$



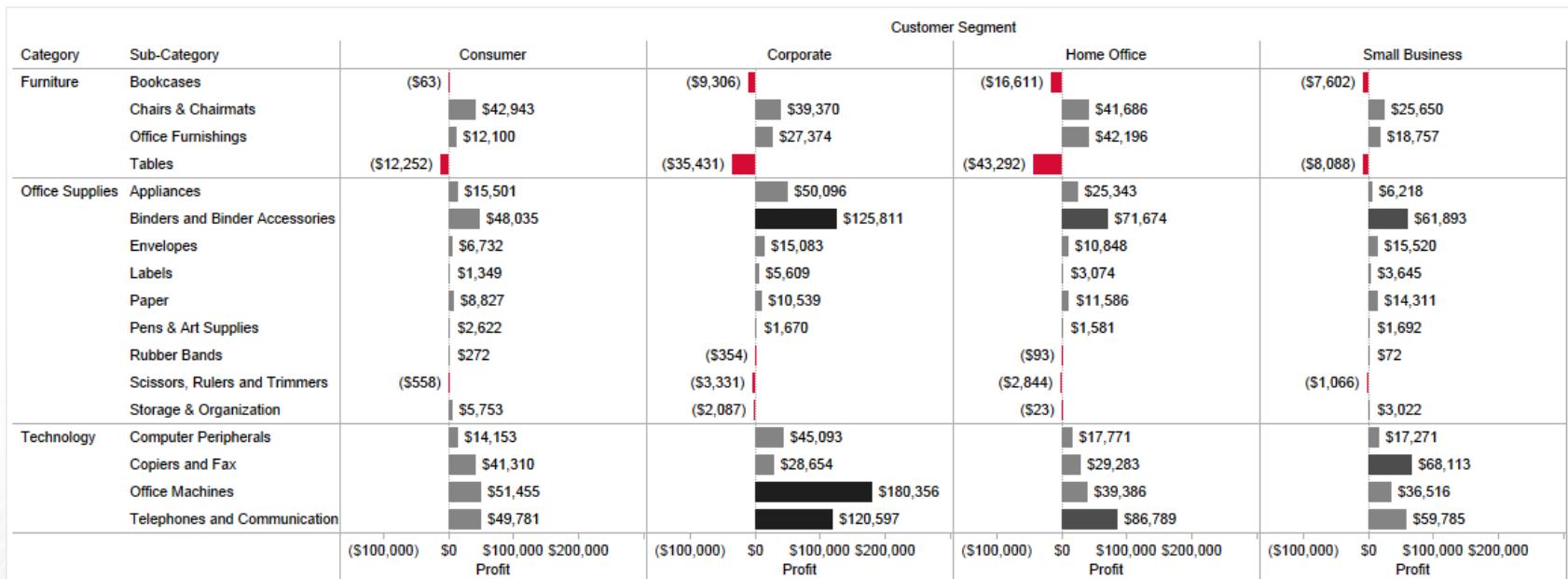
We're Faster When We Can “See” Data

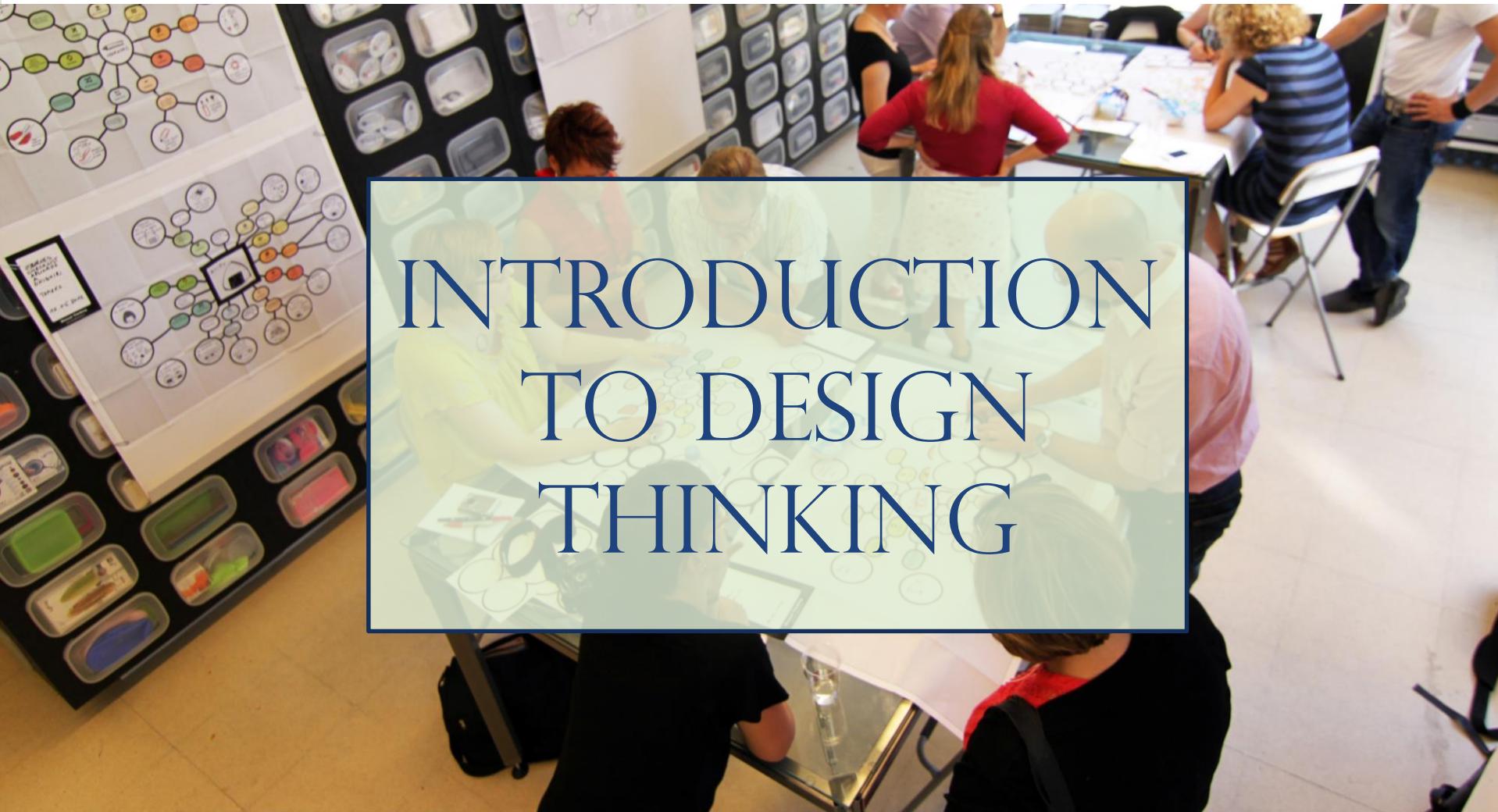
Category	Sub-Category (group)	Customer Segment			Small Business
		Consumer	Corporate	Home Office	
Furniture	Bookcases	-63.02	-9,305.76	-16,610.95	-7,602.40
	Chairs & Chairmats	42,942.97	39,370.10	41,686.28	25,650.38
	Office Furnishings	12,099.80	27,374.47	42,196.25	18,757.40
	Tables	-12,251.51	-35,430.73	-43,292.40	-8,087.89
Office Supplies	Appliances	15,501.48	50,095.94	25,343.06	6,217.58
	Binders and Binder Ac..	48,035.27	125,811.27	71,674.19	61,892.69
	Envelopes, Labels, Pa..	16,907.52	31,230.67	25,508.13	33,476.65
	Pens & Art Supplies	2,621.68	1,670.40	1,580.82	1,691.88
	Rubber Bands	271.85	-353.54	-93.12	72.14
	Scissors, Rulers and ..	-558.10	-3,330.62	-2,844.06	-1,066.47
	Storage & Organization	5,752.65	-2,086.83	-23.24	3,021.57
Technology	Computer Peripherals	14,152.79	45,092.93	17,771.05	17,270.71
	Copiers and Fax	41,310.35	28,654.48	29,283.14	68,113.50
	Office Machines	51,454.78	180,356.22	39,386.23	36,515.70
	Telephones and Com..	49,781.48	120,596.92	86,788.72	59,784.52

We're Faster When We Can “See” Data

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		Consumer	Corporate	Home Office	Small Business
Furniture	Bookcases	-63.02	-9,305.76	-16,610.95	-7,602.40
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Office Supplies	Appliances	15,501.48	50,095.94	25,343.06	6,217.58
	Binders and Binder Ac..	48,035.27	125,811.27	71,674.19	61,892.69
	Envelopes	6,731.55	15,082.58	10,848.34	15,520.13
	Labels	1,349.23	5,608.87	3,073.87	3,645.20
	Paper	8,826.74	10,539.22	11,585.92	14,311.32
	Pens & Art Supplies	2,621.68	1,670.40	1,580.82	1,691.88
	Rubber Bands	271.85	-353.54	-93.12	72.14
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We're Faster When We Can “See” Data







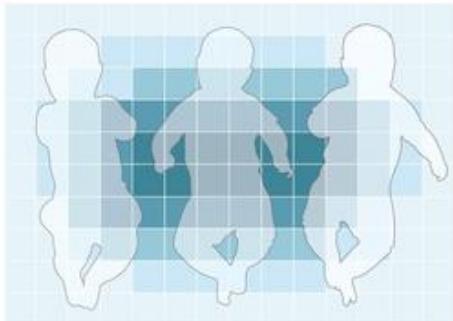
DESIGN THINKING PROCESS | FIREFLY





SO WHAT WENT WRONG ?

OVERHEAD PHOTOTHERAPY



ACTUAL USE IN A TYPICAL BED
IN THE DEVELOPING WORLD

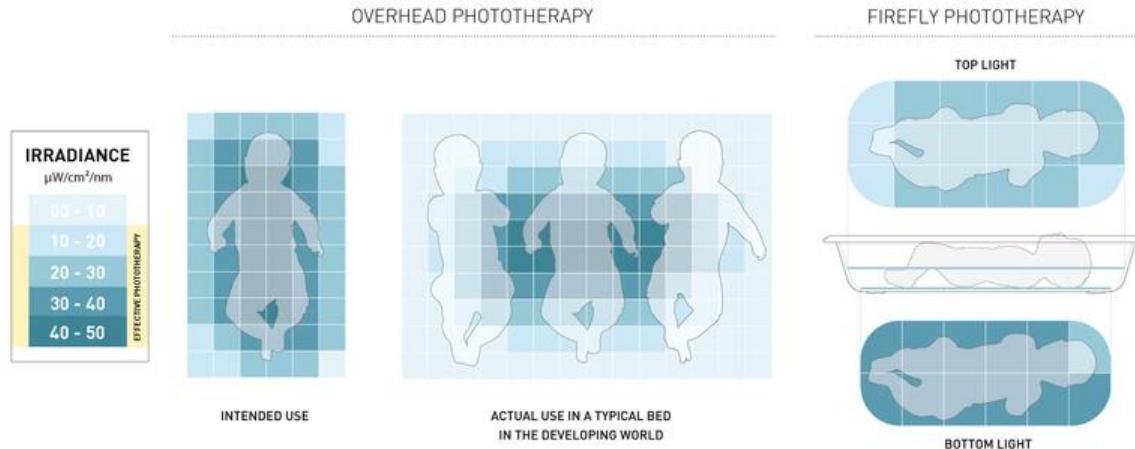


Arresting conclusion?

“Mothers or Hospital staff do not care about user manuals or how the machine was intended to be used”

This does not mean that mothers or staff are ignorant, or irresponsible but that they care about their babies or want to treat as many babies as possible

DESIGN THINKING PROCESS | FIREFLY



US DEPARTMENT OF ENERGY | IDEO CASE STUDY



STYLISH & EFFICIENT
WINDOWS

RETAIL DISPLAYS OF
ENERGY-EFFICIENT
LIGHTING

INFORMATIONAL &
EDUCATIONAL
TOOLS

After an intensive period of field research, in which the IDEO teams sampled consumer opinions in Mobile, Dallas, Phoenix, Boston, Juneau, and Detroit, **it came to an arresting conclusion: people do not care about energy efficiency** (this was the design team's insight through observation). This does not mean that the public is ignorant, profligate, or irresponsible but that “Energy efficiency” is an abstraction that is at best a means of achieving goals that **people really do care about: comfort, style, community.**

CHARACTERISTICS OF DESIGN THINKING

WHAT IS THE ESSENCE OF DESIGN THINKING?



FINDING SIMPLICITY IN COMPLEXITY





FINDING SIMPLICITY IN
COMPLEXITY
BEAUTY AS WELL AS
FUNCTIONALITY

FINDING SIMPLICITY IN
COMPLEXITY
BEAUTY AS WELL AS
FUNCTIONALITY
IMPROVING QUALITY OF
EXPERIENCE

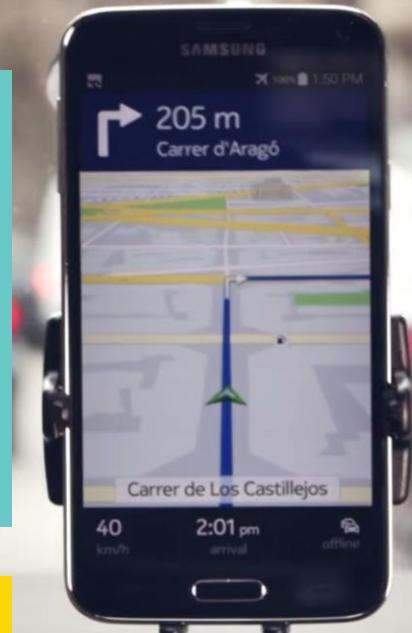


FINDING SIMPLICITY IN
COMPLEXITY
BEAUTY AS WELL AS
FUNCTIONALITY
IMPROVING QUALITY OF
EXPERIENCE
CREATING ELEGANT SOLUTIONS



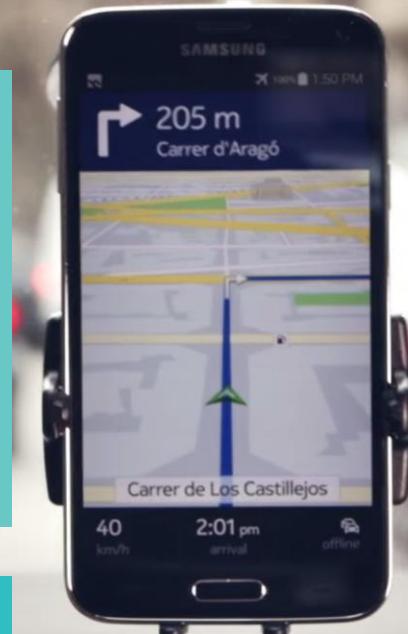
FINDING SIMPLICITY IN
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SERVING THE NEEDS OF THE
PEOPLE



FINDING SIMPLICITY IN
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PEOPLE



WHO IS A DESIGN THINKER?

BEHAVIOURS & ACTIONS



OBSERVATION



OBSERVATION

IMMERSION





OBSERVATION

IMMERSION

EMPATHY

A photograph of a person from behind, wearing a bright red jacket, standing in a field of tall, golden-brown grass. The person's arms are raised high above their head in a gesture of triumph or freedom. The background is a clear, vibrant blue sky.

OBSERVATION

IMMERSION

EMPATHY

OPTIMISM

A photograph of a person from behind, wearing a bright red jacket, standing in a field of tall, golden-brown grass. The person's arms are raised high above their head in a gesture of triumph or freedom. The background is a clear, vibrant blue sky.

OBSERVATION
IMMERSION

EMPATHY

OPTIMISM

MINDSET OF A DESIGN THINKER



HUMAN CENTERED



ACTION ORIENTED



SHOWS, DOESN'T
TELL



RADICALLY
COLLABORATIVE



CULTURE OF
EXPERIMENTATION

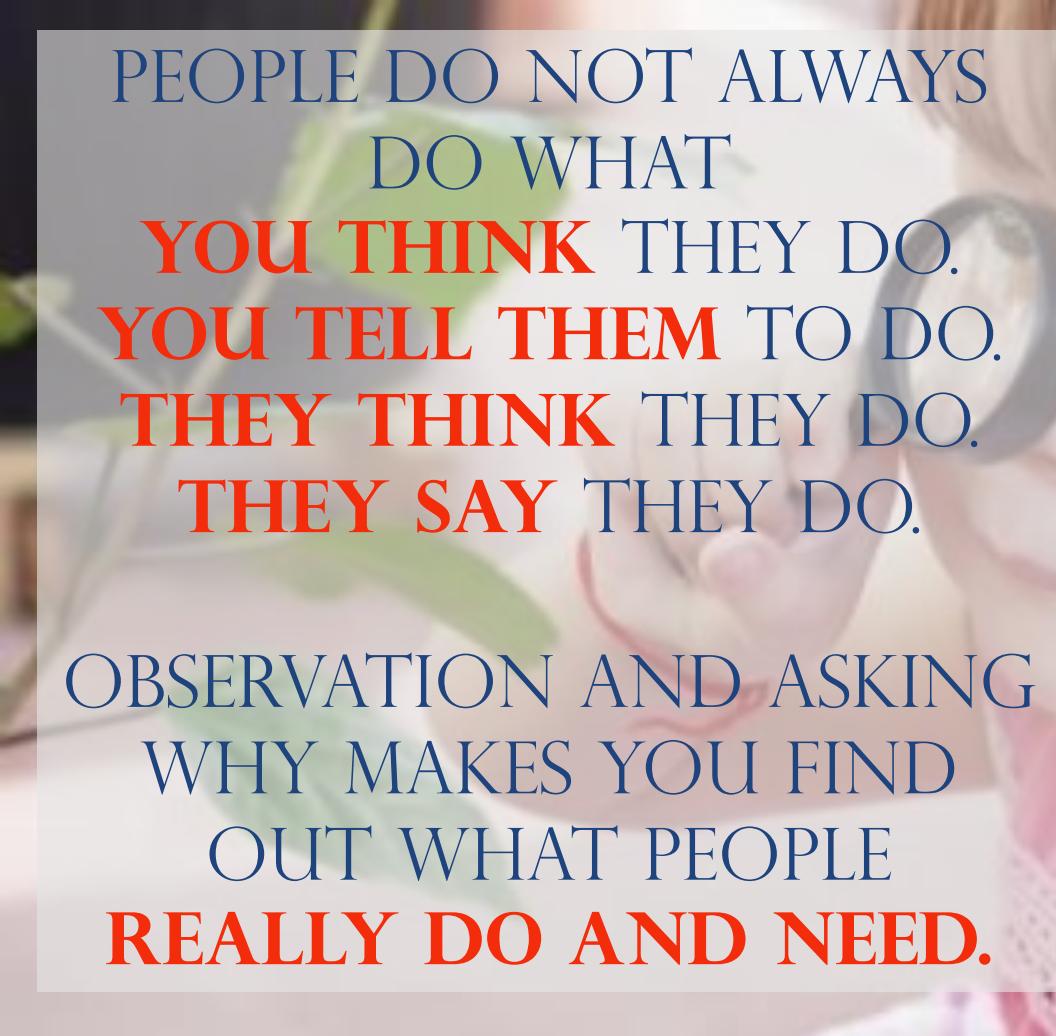


MINDFUL OF THE
PROCESS

DESIGN THINKING

Instead of starting with the speaker,
we started with the ear.

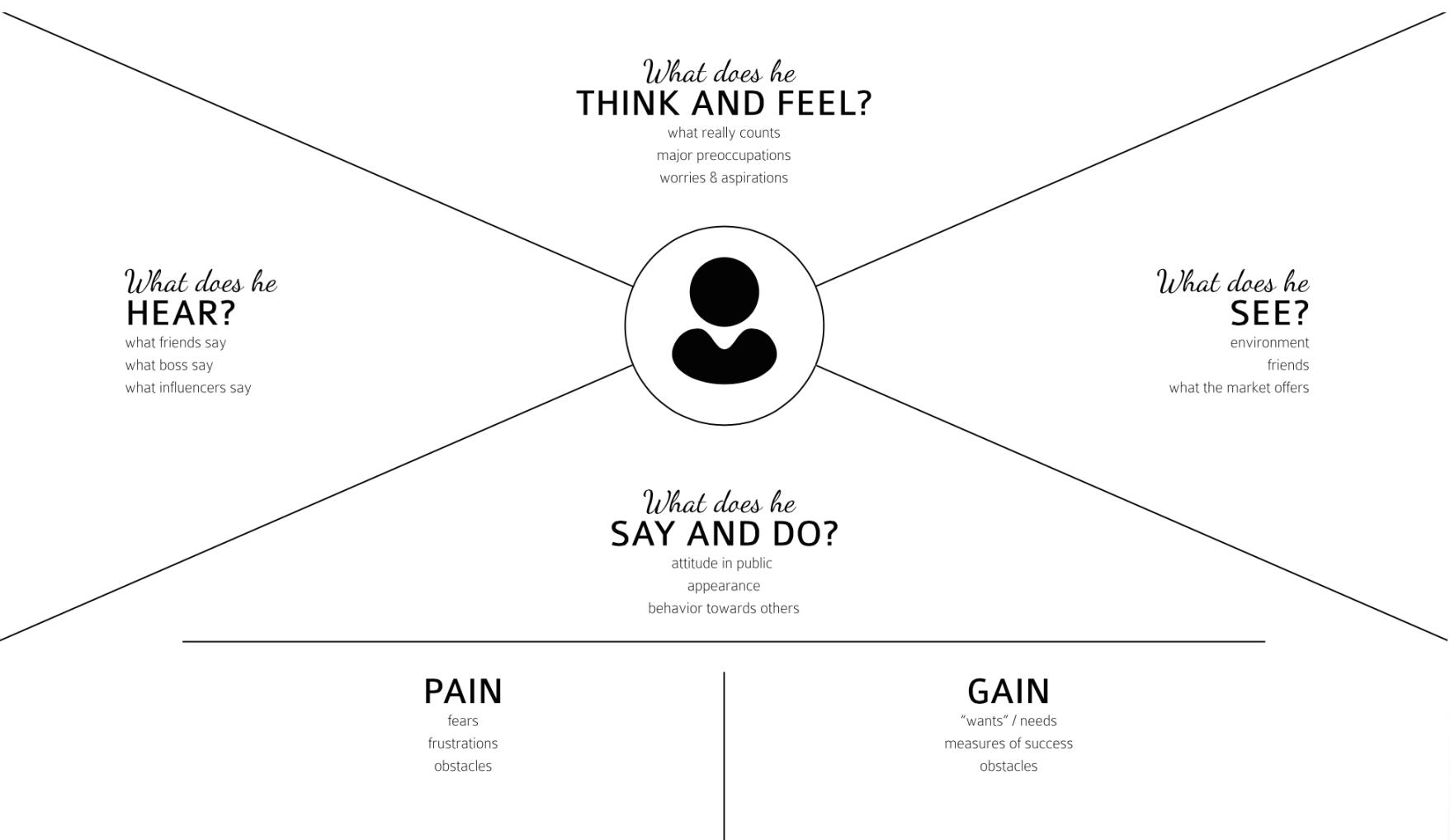




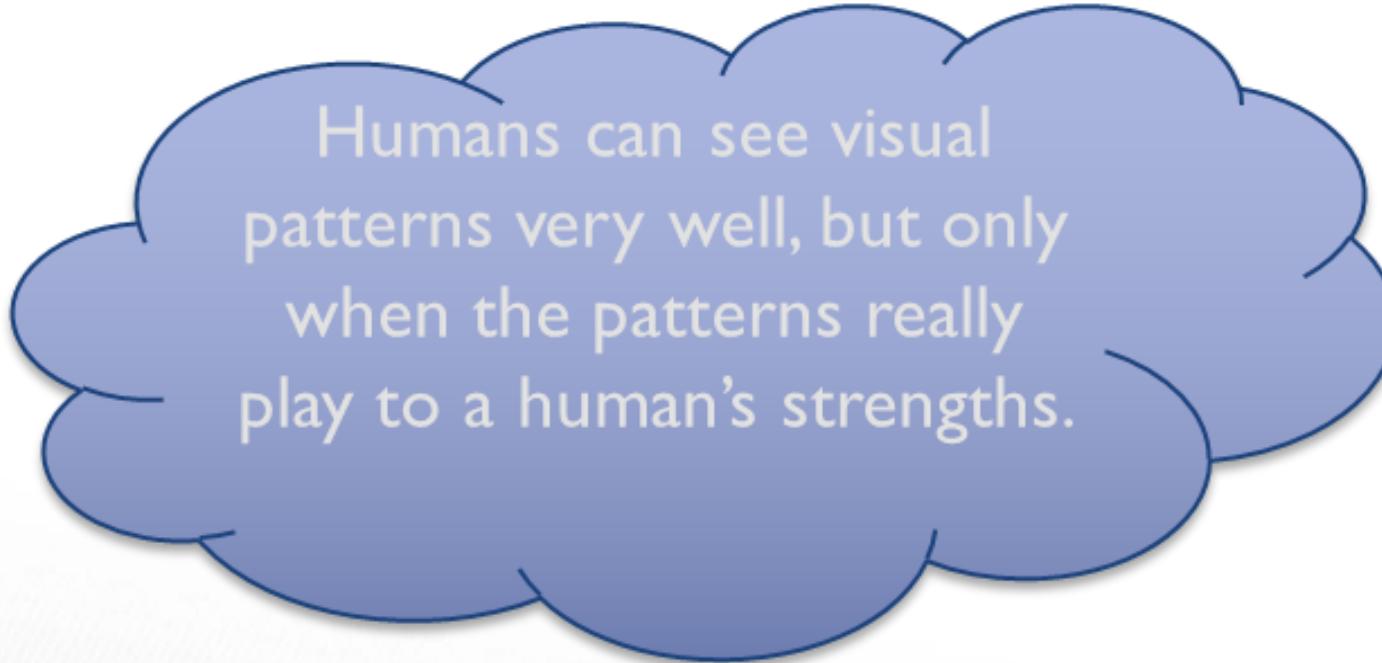
PEOPLE DO NOT ALWAYS
DO WHAT
YOU THINK THEY DO.
YOU TELL THEM TO DO.
THEY THINK THEY DO.
THEY SAY THEY DO.

OBSERVATION AND ASKING
WHY MAKES YOU FIND
OUT WHAT PEOPLE
REALLY DO AND NEED.





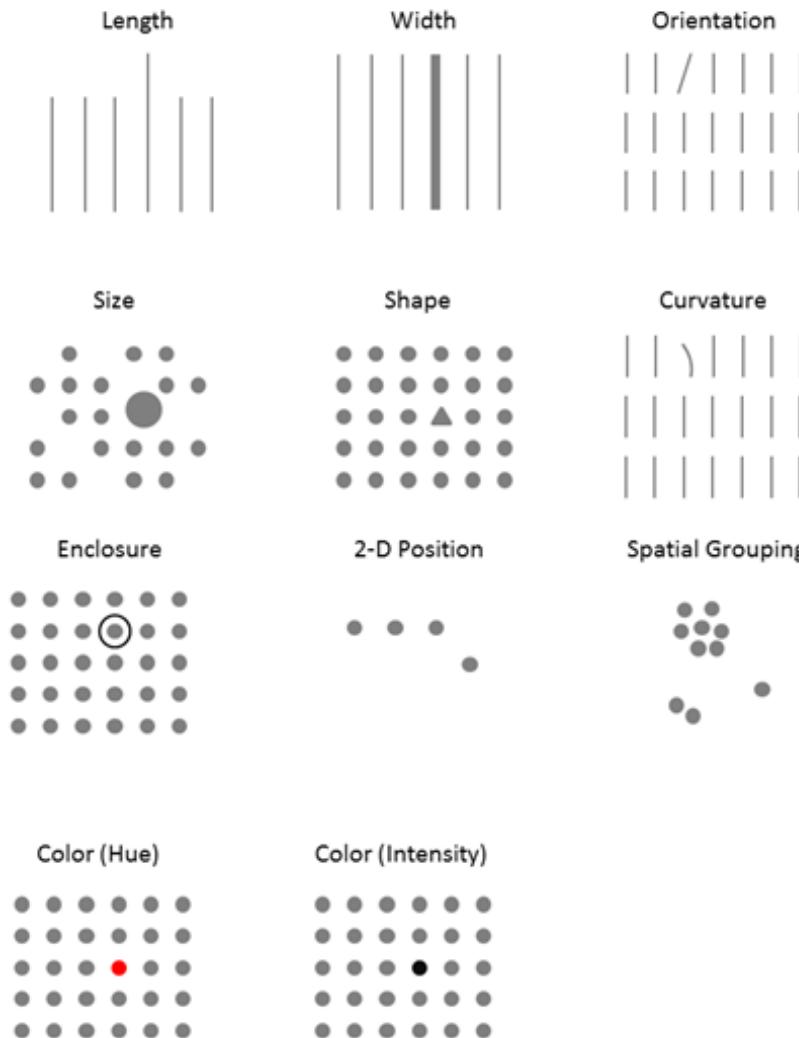
Take home from design thinking



Humans can see visual patterns very well, but only when the patterns really play to a human's strengths.



Preattentive Visual Attributes



8% 0.5%

WE ARE COLORBLIND

HOME ARTICLES EXAMPLES ABOUT CONTACT



Page not found!

Something must have gone wrong! Maybe you followed an outdated or broken link.

We are colorblind is dedicated to making the web (and beyond) a better place for the colorblind. Take a look at the [articles](#) and [examples](#), maybe you'll find what you're looking for there.

If that doesn't work for you, don't hesitate to [contact me](#)!



ABOUT

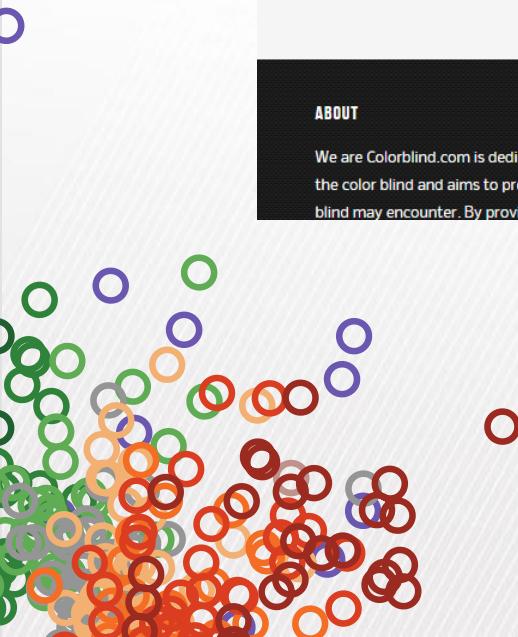
We are Colorblind.com is dedicated to making the web and beyond a better place for the color blind and aims to prevent and fix any existing or future problems the color blind may encounter. By providing reliable information, but also by actively

LATEST ARTICLES

Review: Oxy-Iso glasses
Guest Article- A Mother's Journey

LATEST EXAMPLES

Bad: Twitter Color Picker
Good: Visual Website Optimizer



Disaster : Start overlapping shades of colours that have similar brightness values but have the potential to seriously clash.



This can make eyes of colour blind people water. Reds and blues, purples and reds, pinks and blues or any combination is a disaster

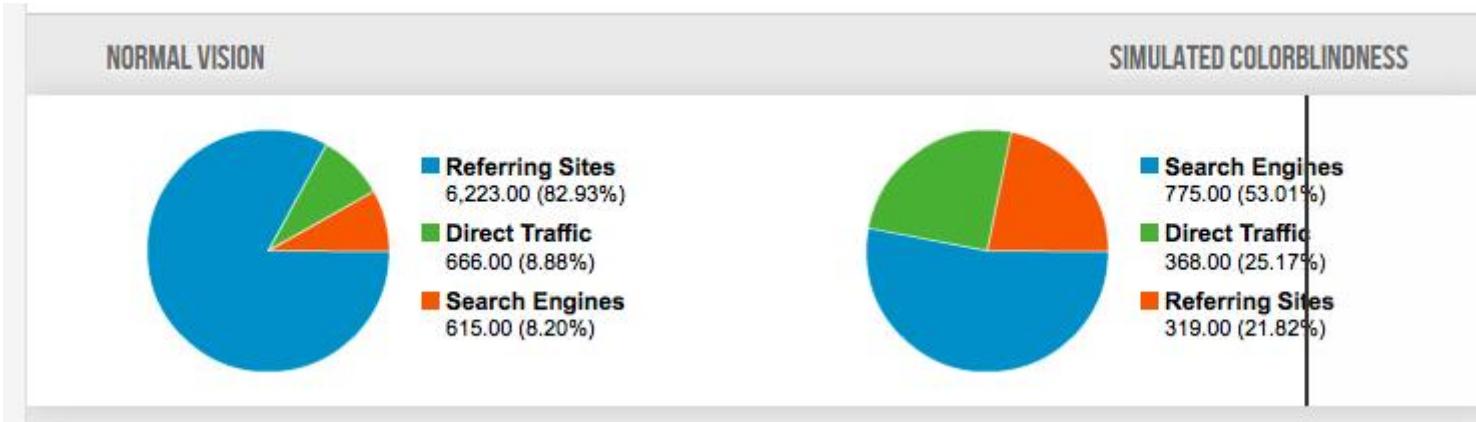


In conclusion

All of this might sound very medical and confusing, but the basics are very simple;

The colorblind have a narrowed color perception. Green is still green and red stays red most of the time, but not as vibrant or bright as a non colorblind would see it. Colors lie closer to each other, especially shades of colors.

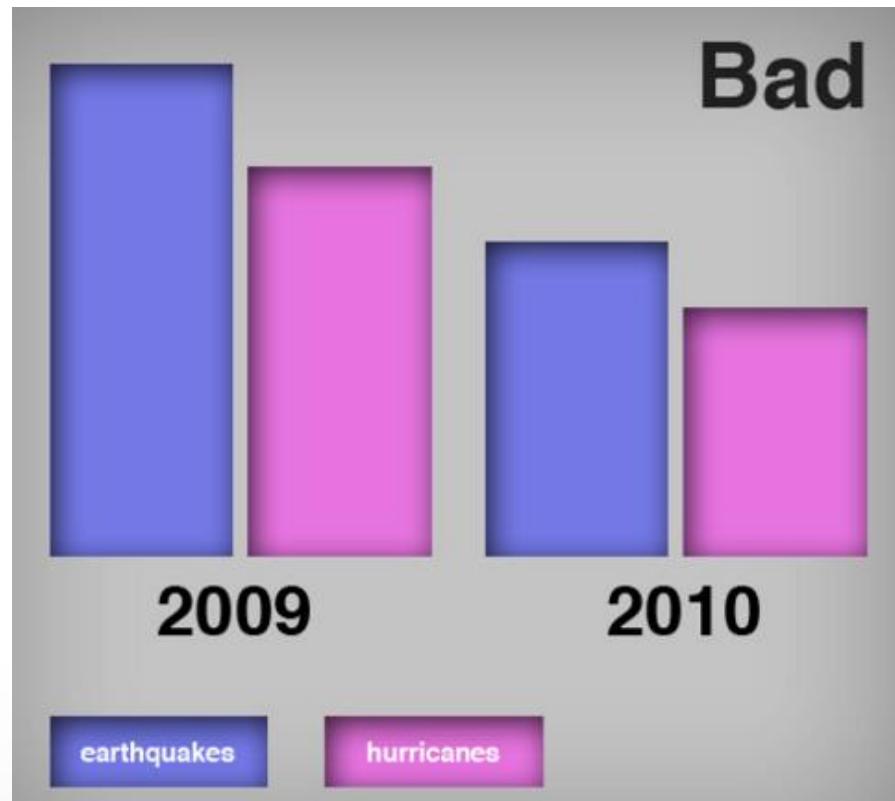




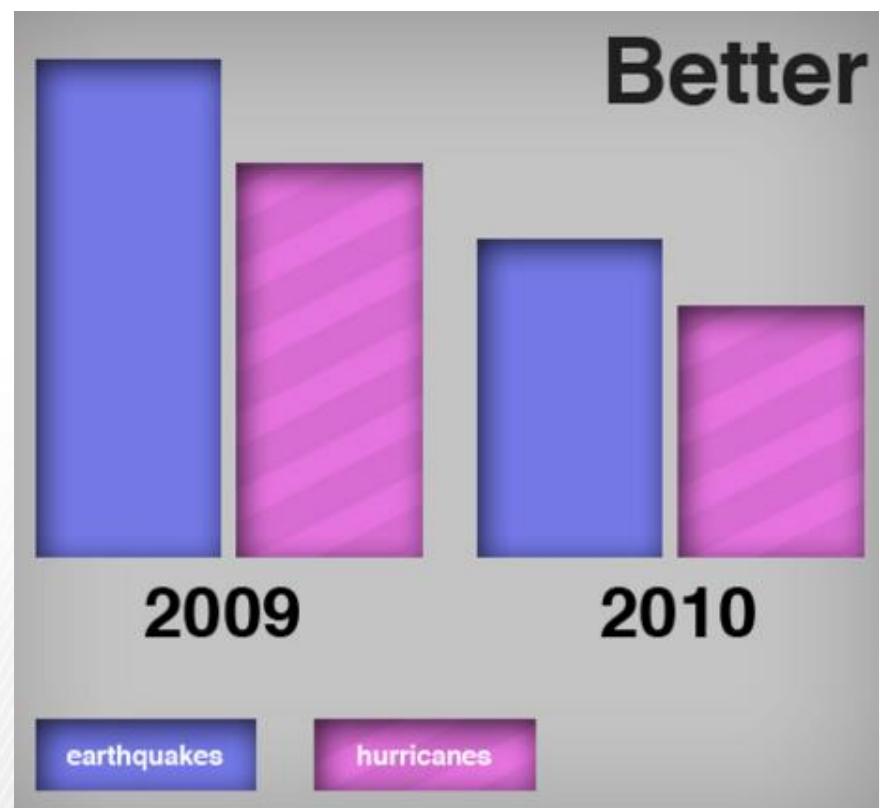
Isn't it amazing that a heavily used product by none other than Google, used by millions of websites and users. It shows that everyone, big and small, makes these mistakes.

Design thinking in Presenting Visual Analytics and Visualisations can prevent this.

Bad



Better

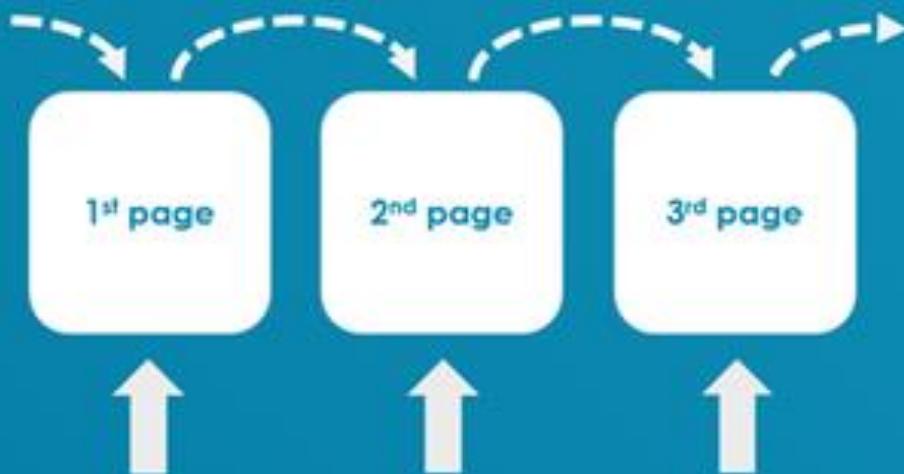


Applied Visual Analytics



Visual Analytic in Website usability

Traditional analytics look at the **transitions between pages**



Visual (in-page)analytics focus on what happens **within** the pages themselves

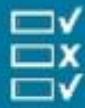
Here are some of the options



Click Tracking



Session Replay



Form Analytics

WHAT WE DESIGN FOR... THE REALITY...

The image shows two side-by-side screenshots of a mobile website for 'mojo.com'. The left screenshot represents 'WHAT WE DESIGN FOR...', showing a clean interface with a search bar at the top, followed by a sidebar menu and a main content area with several cards. The right screenshot represents 'THE REALITY...', showing a much more cluttered and complex interface with many overlapping and partially visible cards, a search bar at the top, and a sidebar menu.

WHAT WE DESIGN FOR...

- Read
- Read
- Read
- Read
- [Pause for reflection]
- Finally, click on a carefully chosen link

THE REALITY...

- Look around feverishly for anything that
 - a) is interesting, or vaguely resembles what you're looking for, and
 - b) is clickable.
- As soon as you find a halfway-decent match, click.
- If it doesn't pan out, click the Back button and try again.

Unlock your business growth like never before

Optimize websites for better user experience and higher conversion

Sign up with

 UsabilityTools

Sign up with Google or register for 14-day free trial.

Areas Of Interest
(AOIs)



Turn your visitors into leads

Mobile

FERRERO

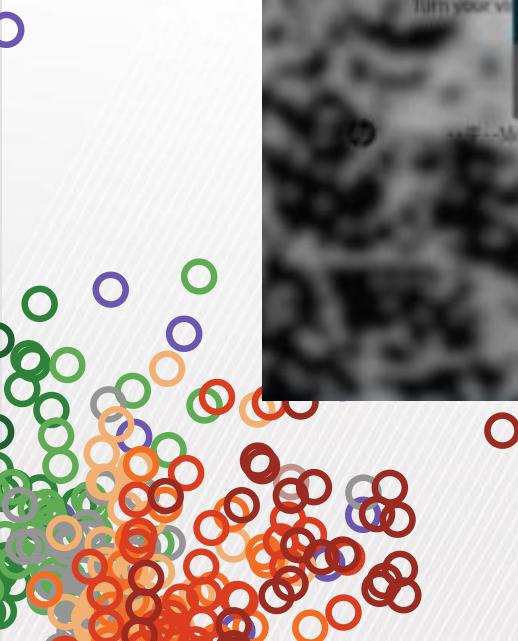
Hewlett

P&G

DHL

ORACLE

Combined solutions for your business. Uniquely designed.



Click tracking

The screenshot shows a heatmap overlay on a UsabilityTools website. The heatmap uses a color gradient from blue to red to indicate click density. A large area of high engagement (red) is centered over the main headline "Unlock your business growth like never before". Other areas of interest include the "Sign up with Google" button, the "14 day free trial" offer, and the product icons below.

UsabilityTools

Home Products Case Studies Pricing Blog Log In Get Free Trial

Unlock your business growth like never before

Optimize websites for better user experience and higher conversion

8+ Sign up with Google or register for 14 day free trial.

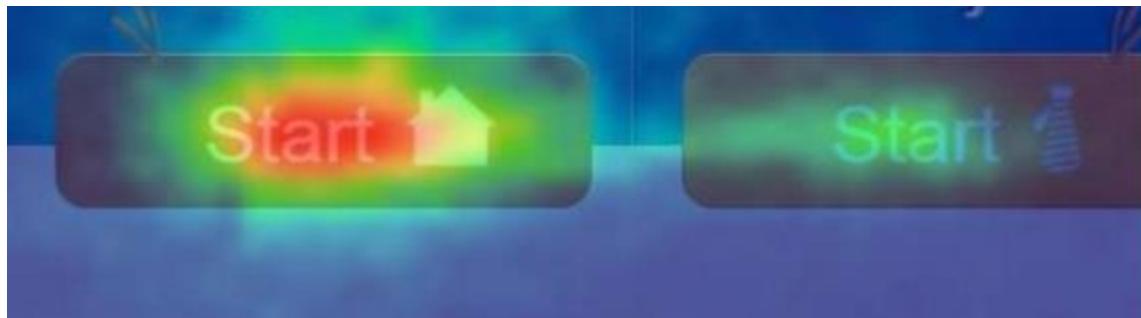
Turn your visitors into clients

Identify opportunities for improvement

Skyrocket customers' engagement

hp P-Mobile FERRERO Logitech P&G DHL ORACLE

Heat maps in site design?



24% clicks at the wrong place, simple design change
and 122% increase in conversions in this site

Applying Design Thinking in Visualization



Best Practices Overview

1. Representing data for humans
2. Color
3. Maps
4. Creating dashboards

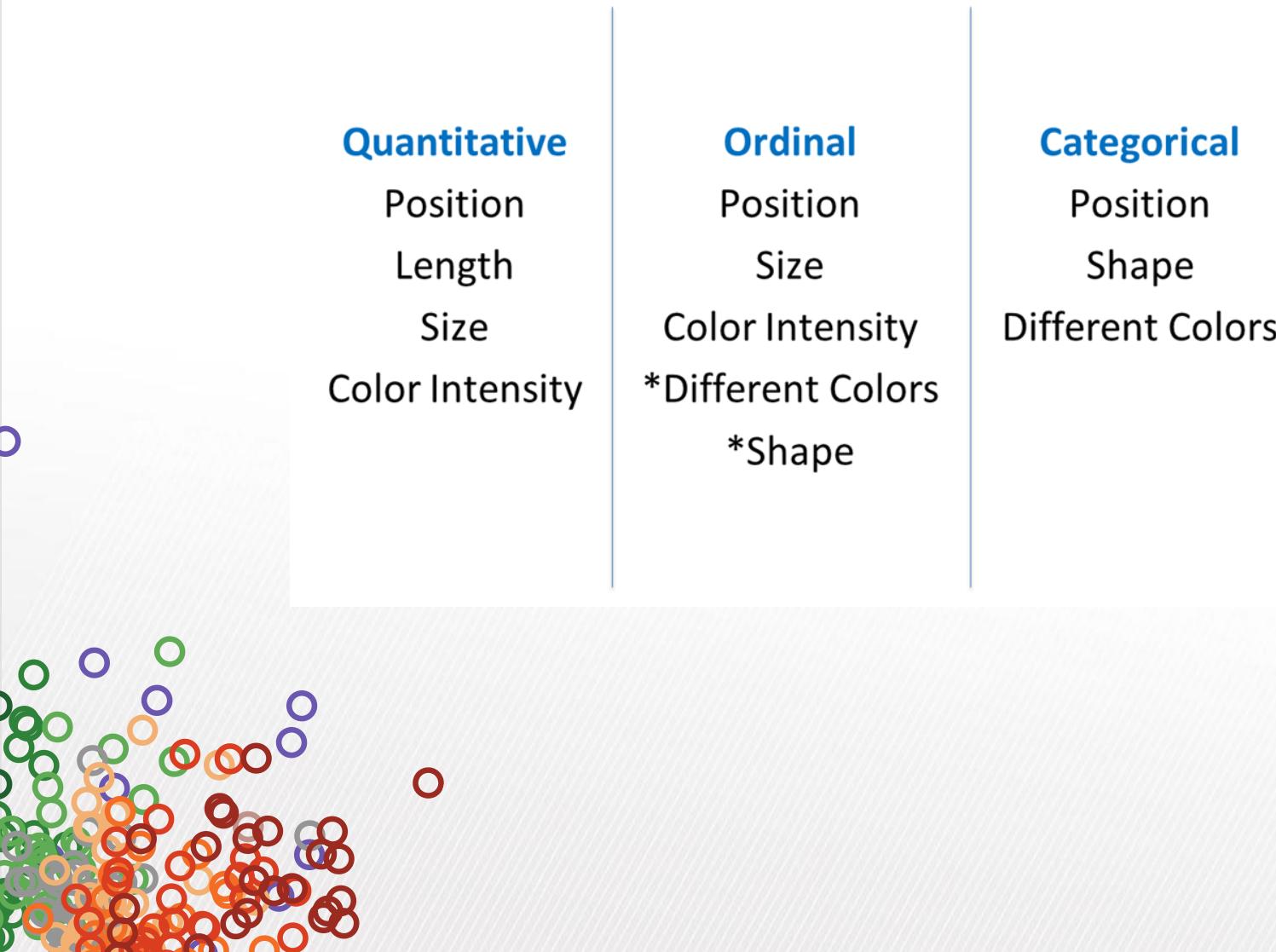


Types of Data

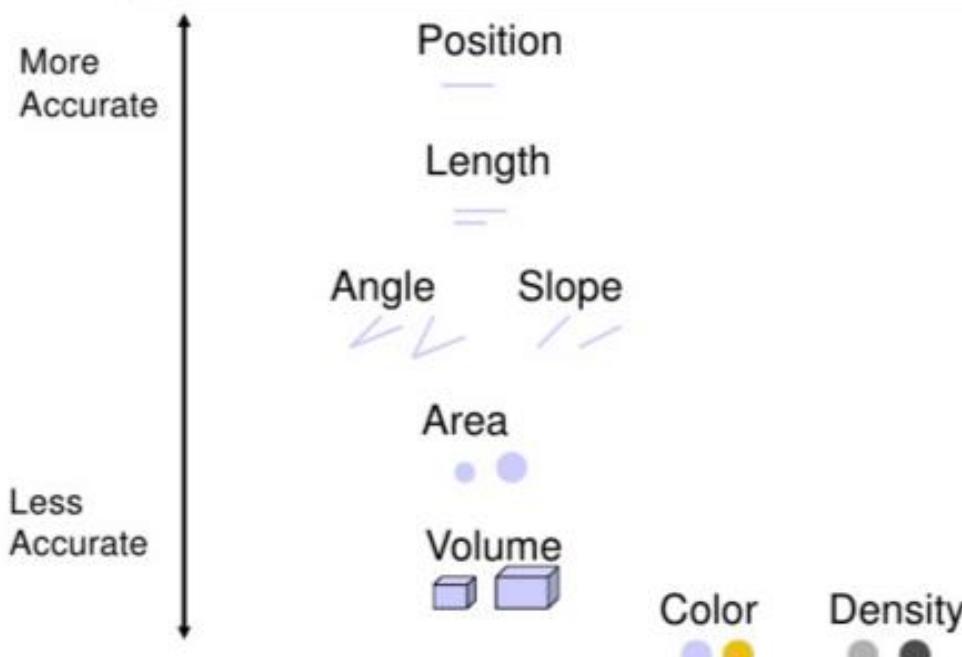
- **Qualitative (nominal / categorical)**
 - Arizona, New York, Texas
 - Sarah, John, Maria
 - Coors, Bud Light, Stella Artois
- **Qualitative (ordinal)**
 - Gold, silver, bronze
 - Excellent health, good health, poor health
 - Love it, like it, hate it
- **Quantitative**
 - Weight (10 lbs, 20 lbs, 5000 lbs)
 - Cost (\$50, \$100, \$0.05)
 - Discount (5%, 10%, 12.8%)



How Do Humans Like Their Data?



Accuracy Ranking of Quantitative Perceptual Tasks



USI

Source: Mackinlay 88 from Cleveland & McGill

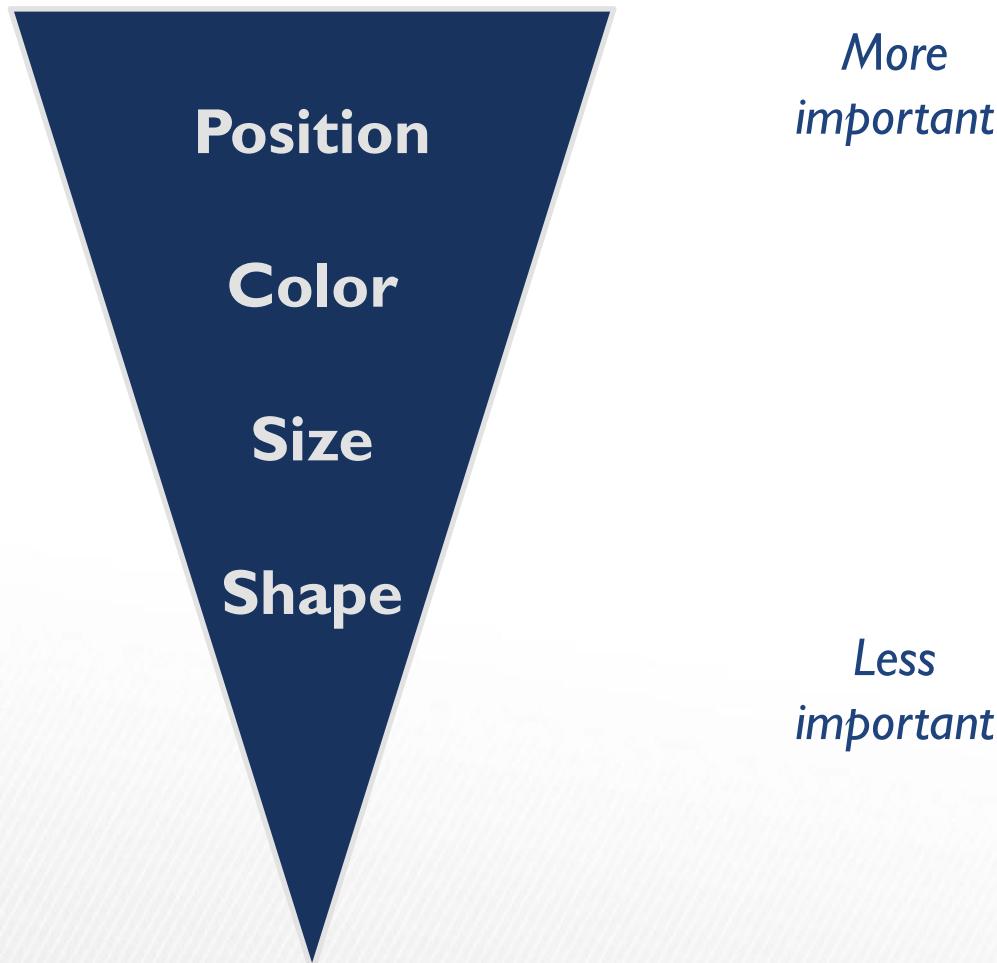
Prof. Dr. Martin J. Eppeler

Visual encoding by data type

	Quantitative	Ordinal	Nominal
More Accurate	Position Length Angle Slope Area Density Saturation Hue Shape	Position Density Saturation Hue Length Angle Slope Area Shape	Position Hue Density Saturation Shape Length Angle Slope Area
	• • • == < / / • • • • • • • • • • • ▲ □	• • • • • • • • • • • • == < / / • • • ▲ □	• • • • • • • • • • • • • == < / / • •
Less Accurate			

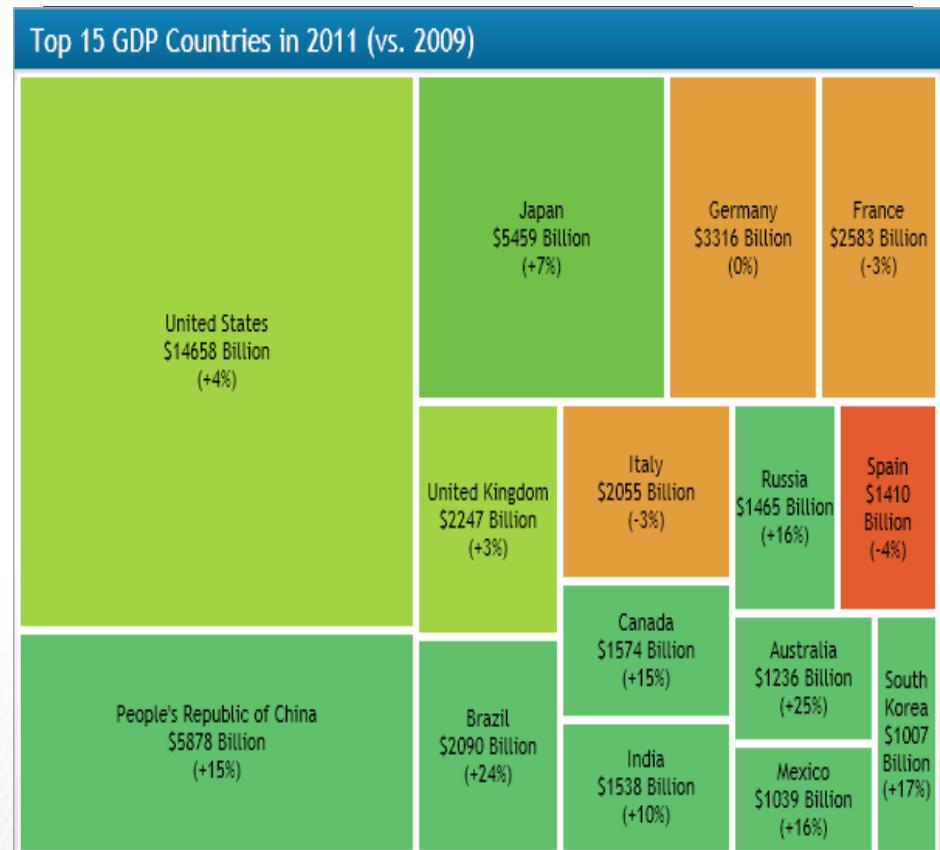


How Do Humans Like Their Data?



How Do Humans Like Their Data?

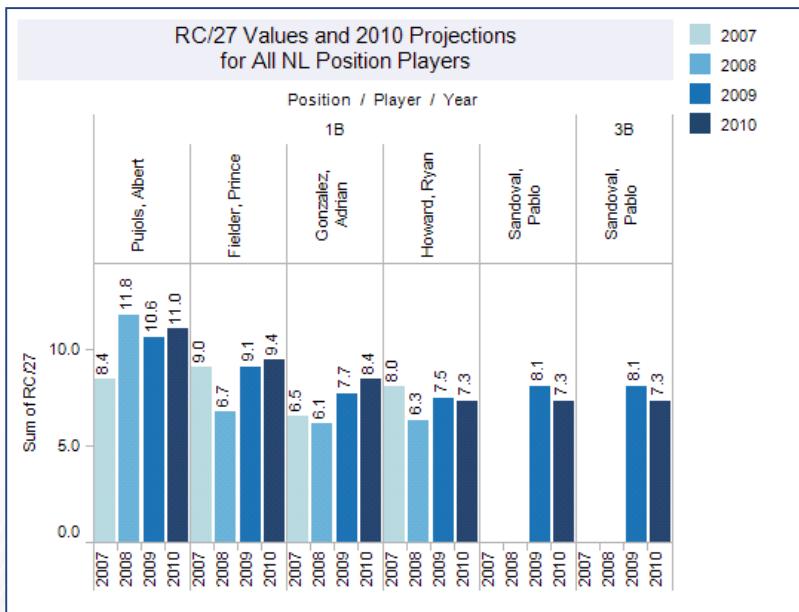
- **Time:** on an x-axis
- **Location:** on a map
- **Comparing values:** bar chart
- **Exploring relationships:** scatter plot
- **Relative proportions:** treemap



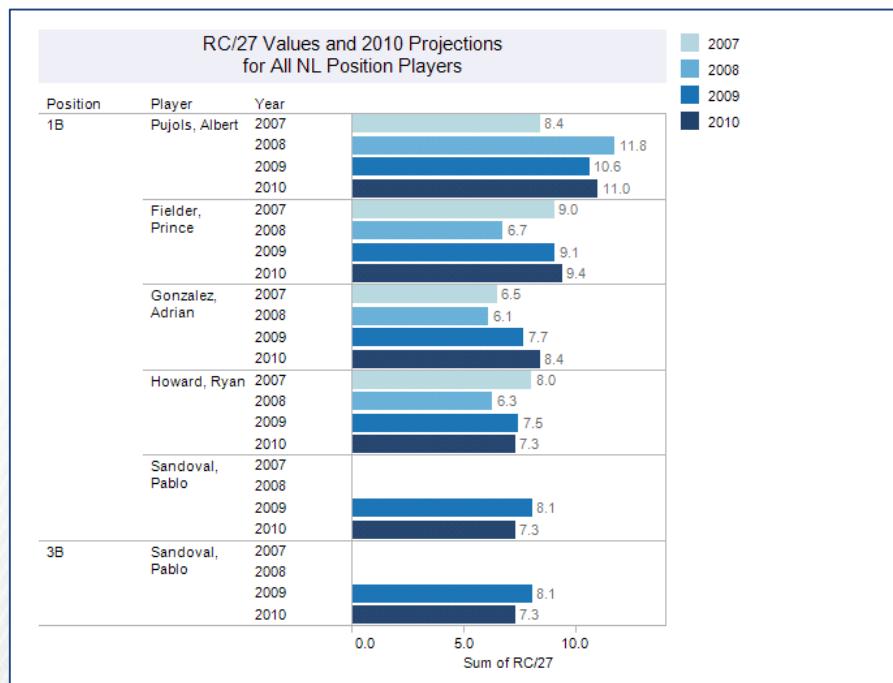
How Do Humans Like Their Data?

Orient data so people can read it easily

Good

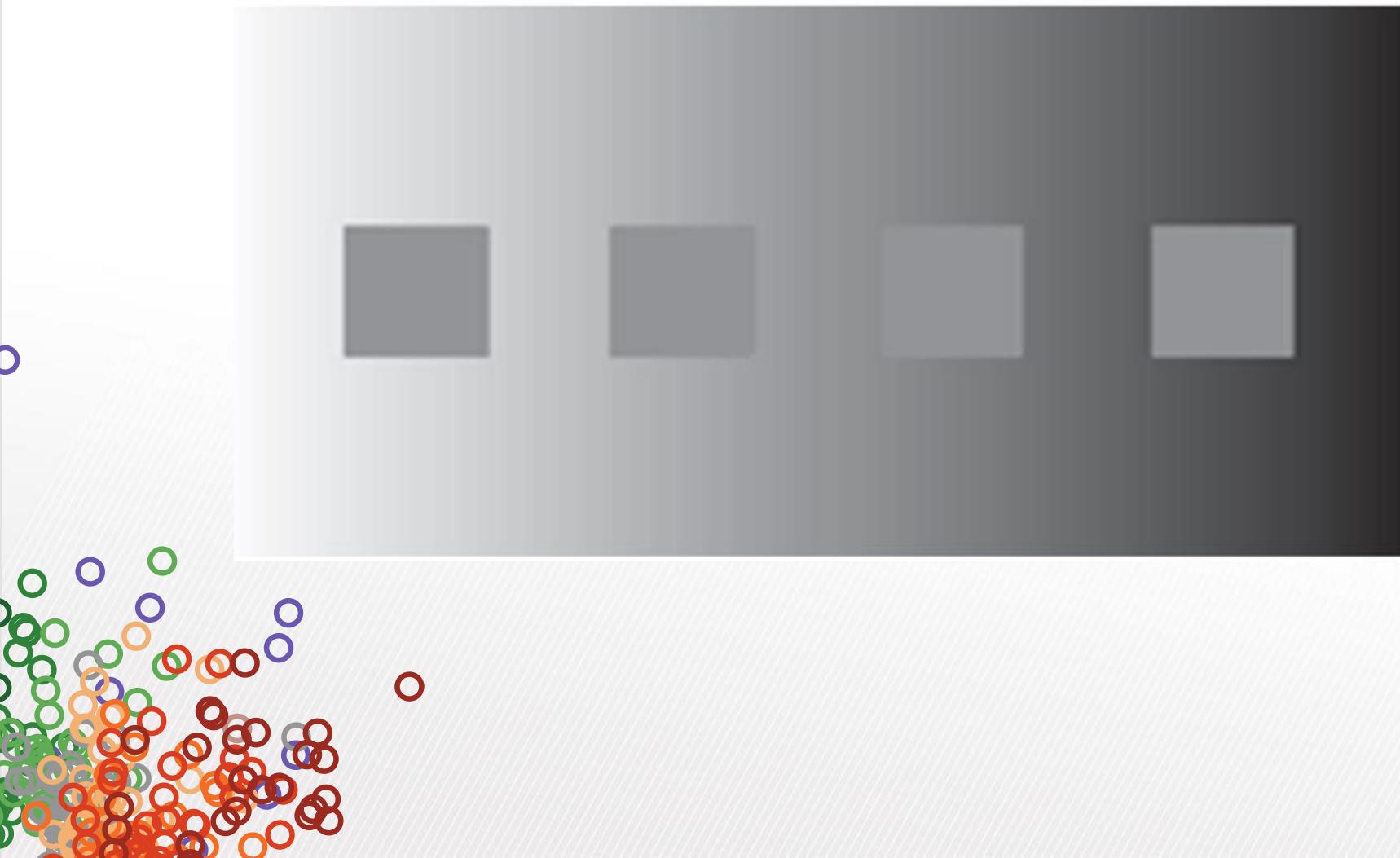


Better



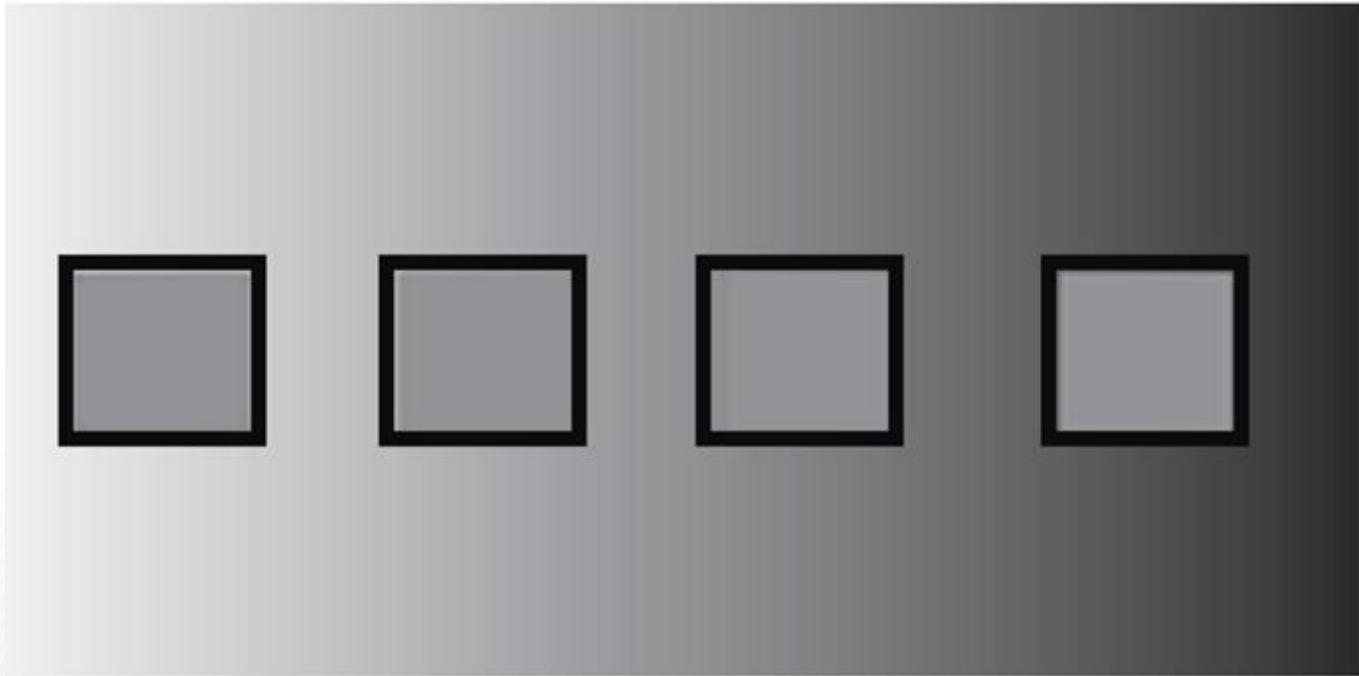
Color Me Impressed

Color perception is relative, not absolute



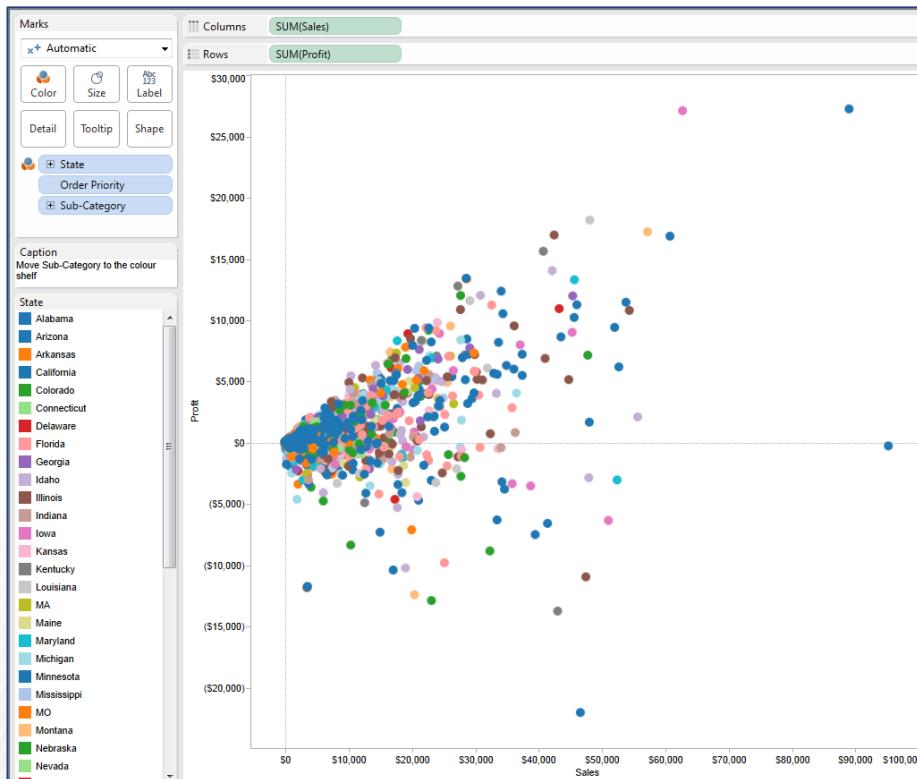
Color Me Impressed

Provide a consistent background



Color Me Impressed

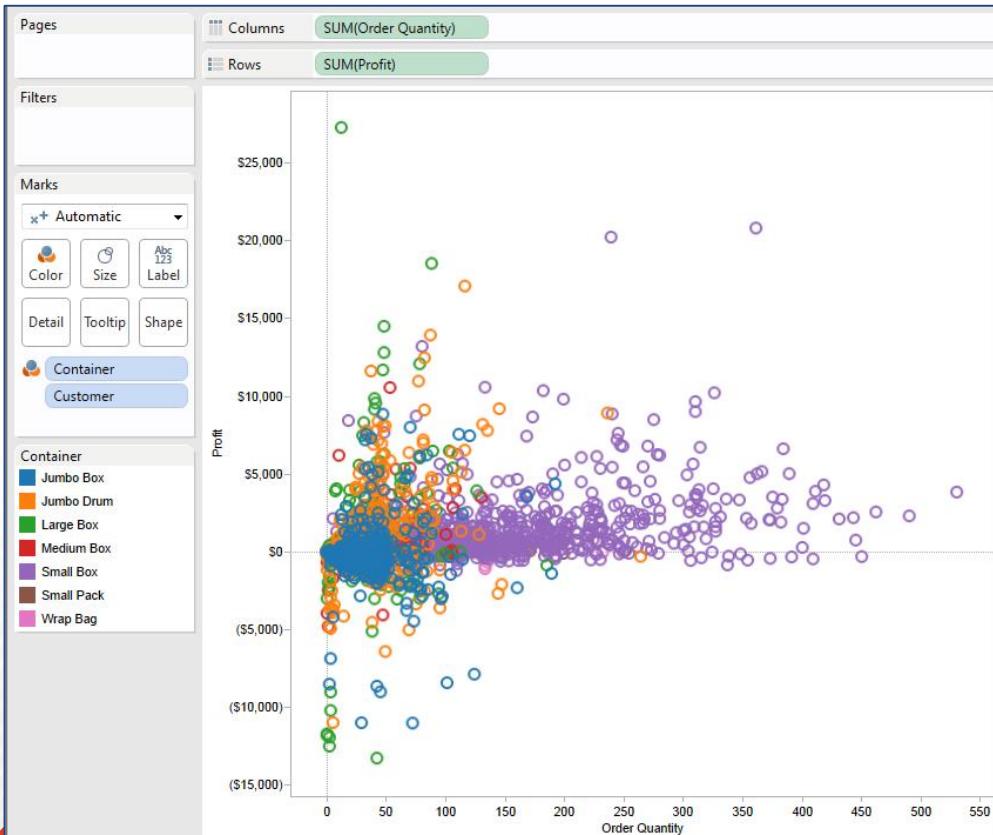
Humans can only distinguish ~8 colors



*This is **not** helpful.*

Color Me Impressed

Humans can only distinguish ~8 colors



*This **is** helpful.*

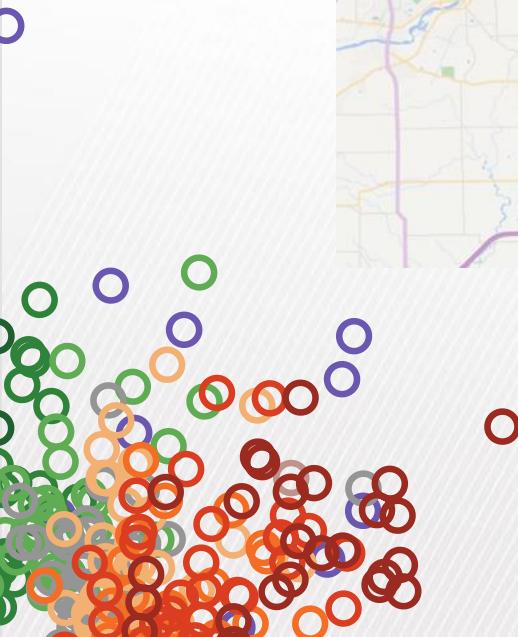
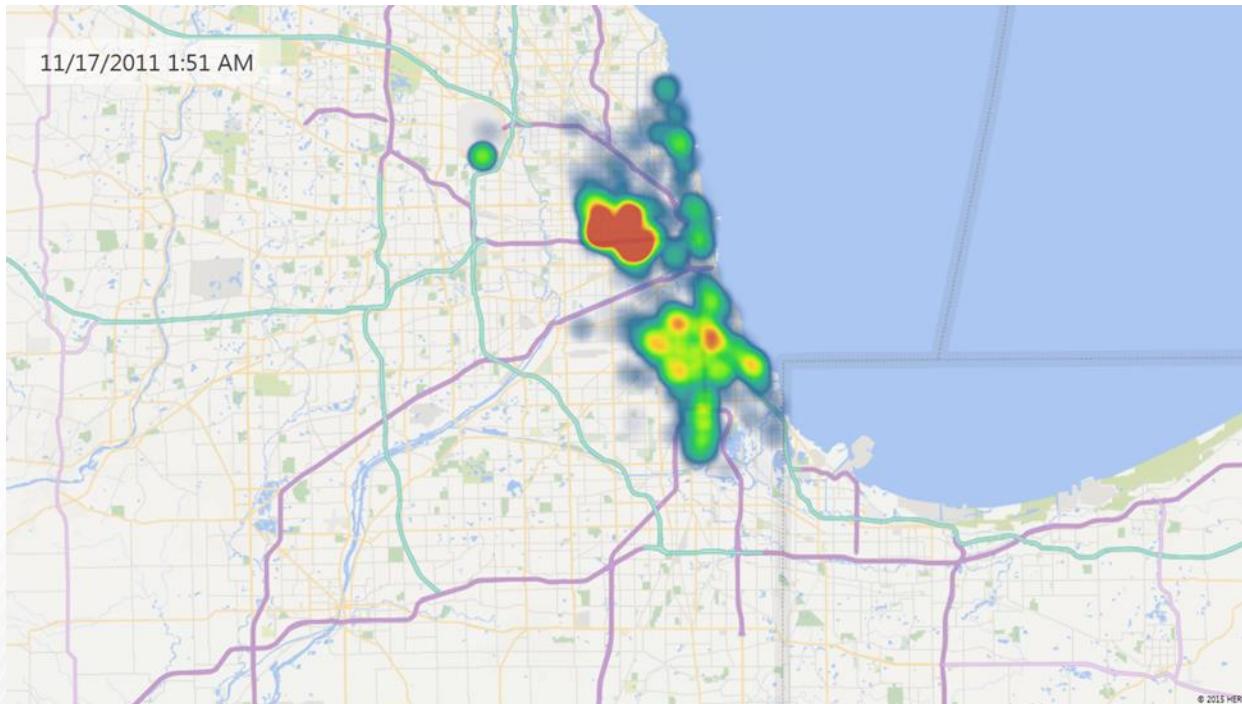
Color Me Impressed

For quantitative data, color intensity and diverging color palettes work well



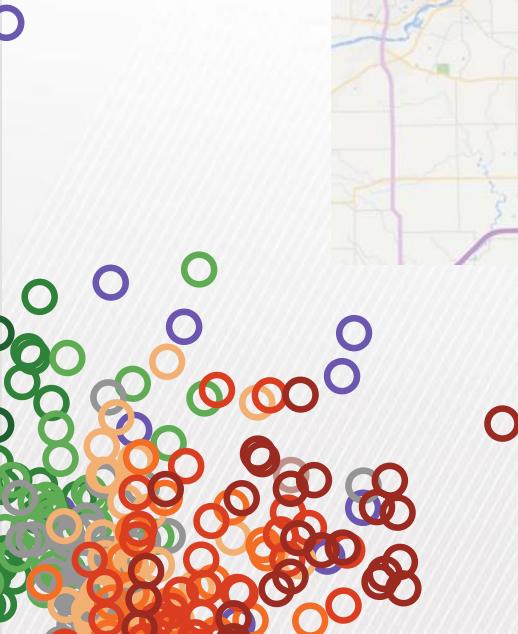
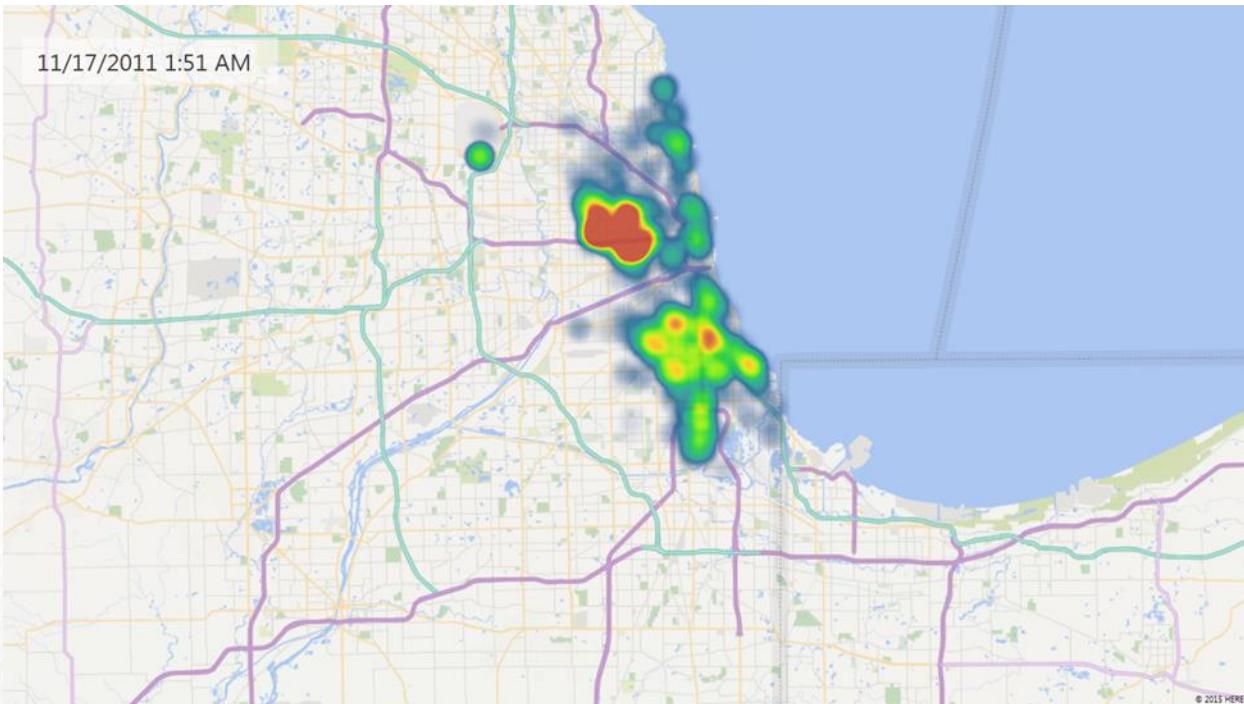
Mapping to Insight

Use maps when location is relevant



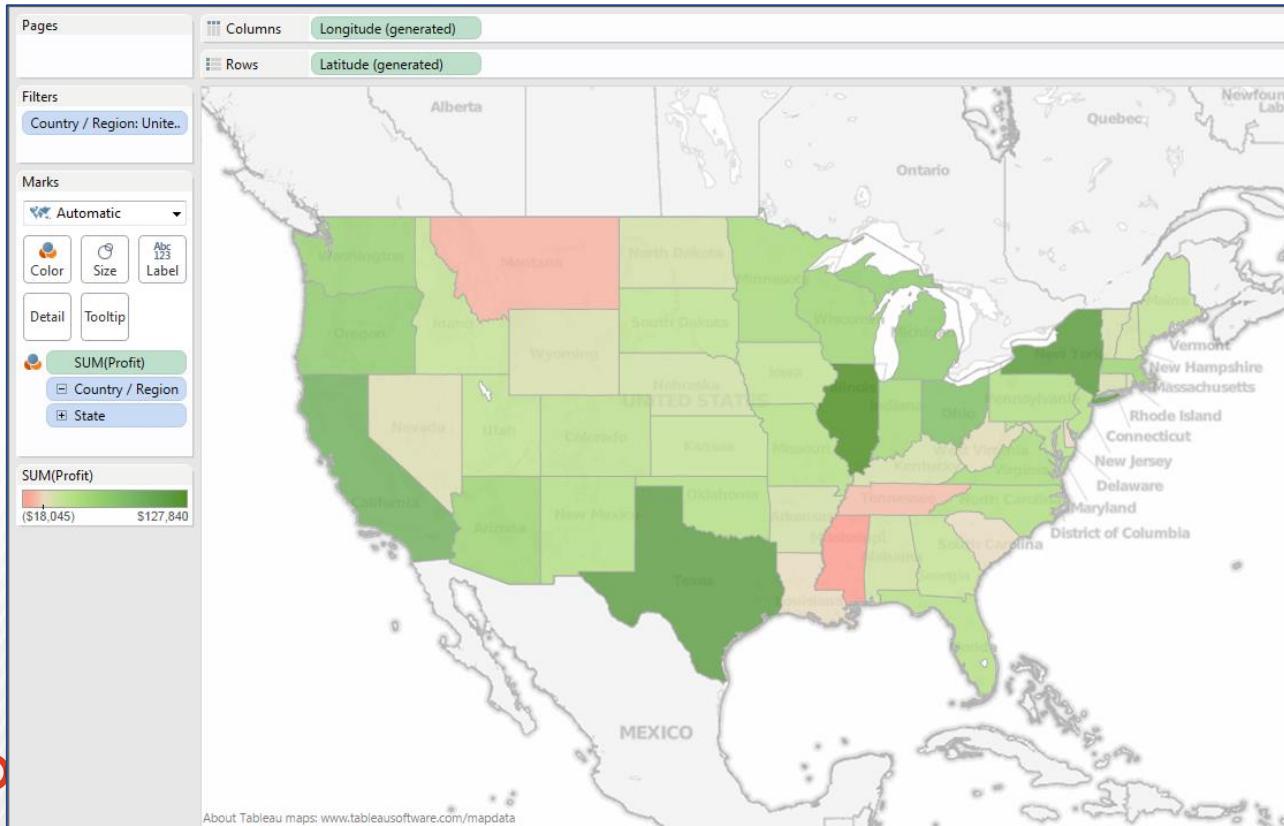
Mapping to Insight

Use maps when location is relevant

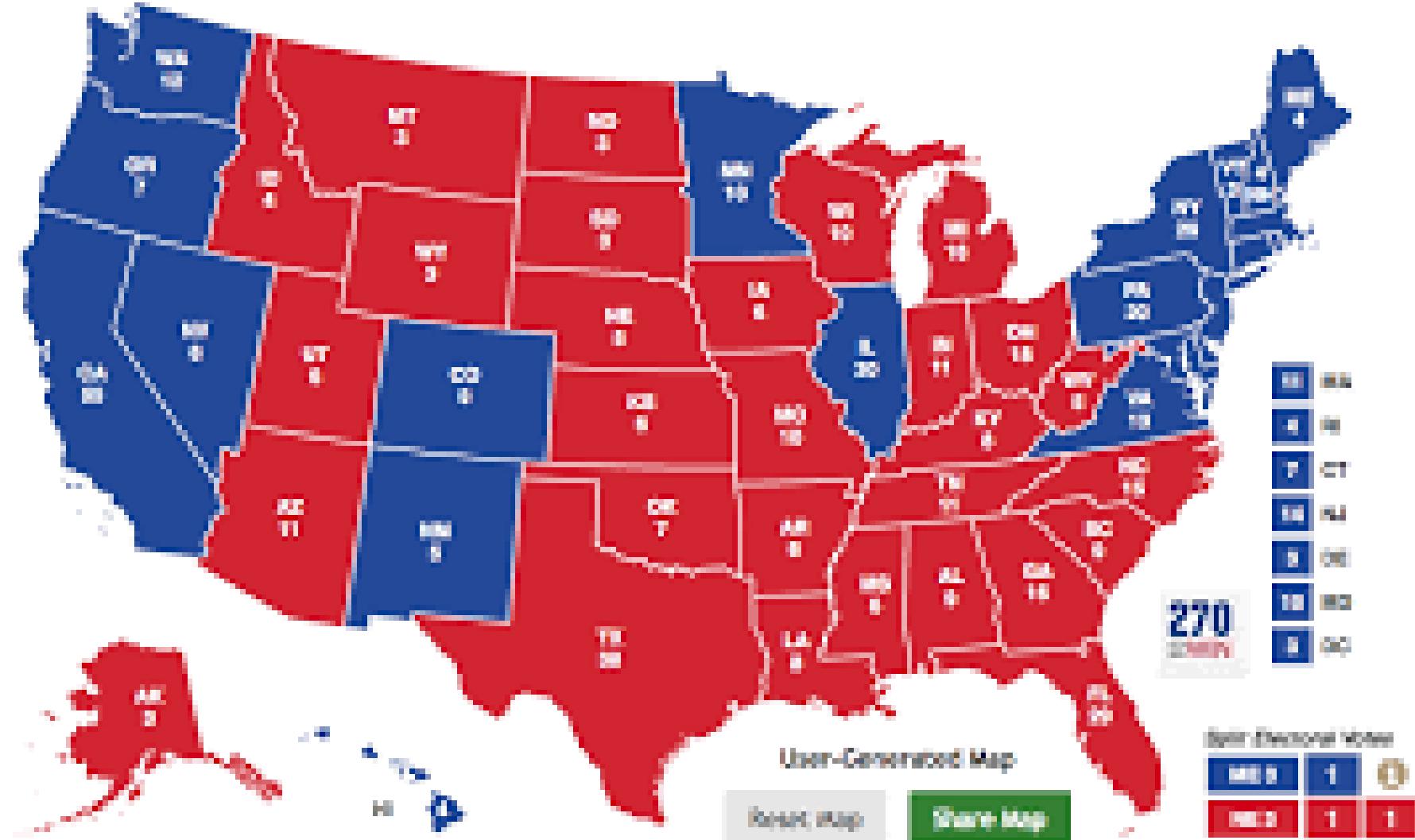


Mapping to Insight

Use filled maps (“choropleth's”) for defined areas and only ONE measure

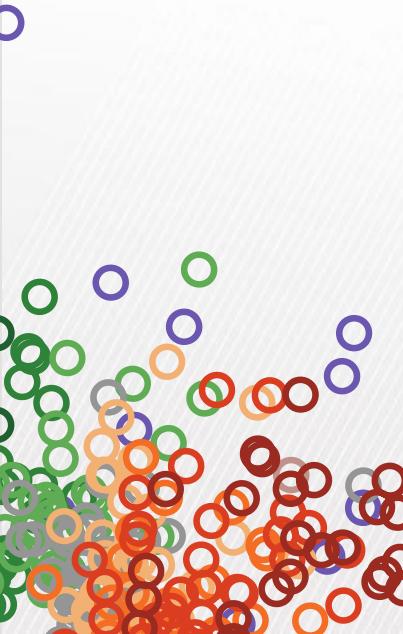
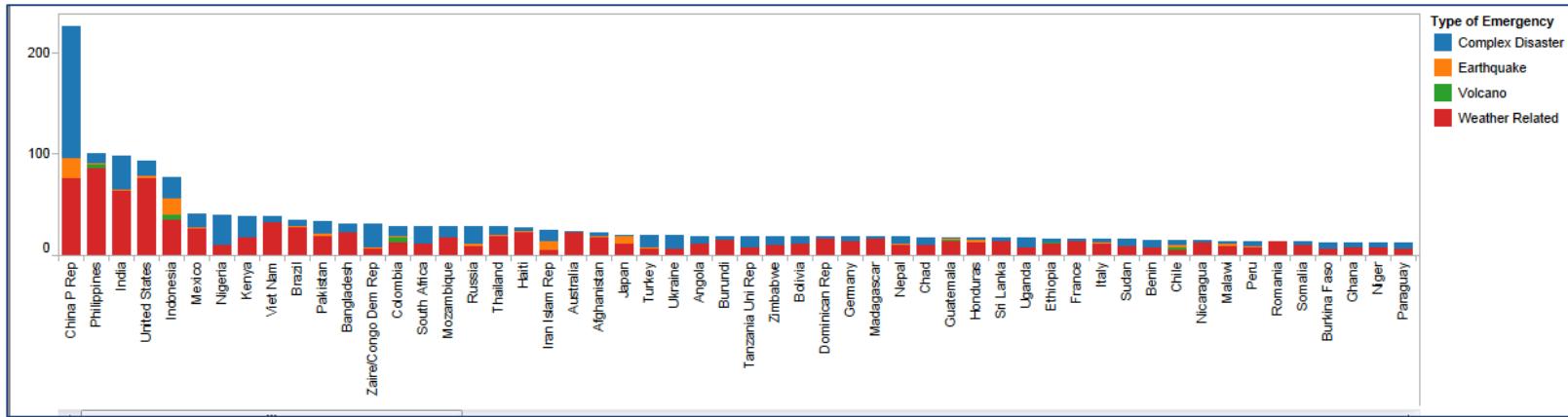


Mapping to Familiar



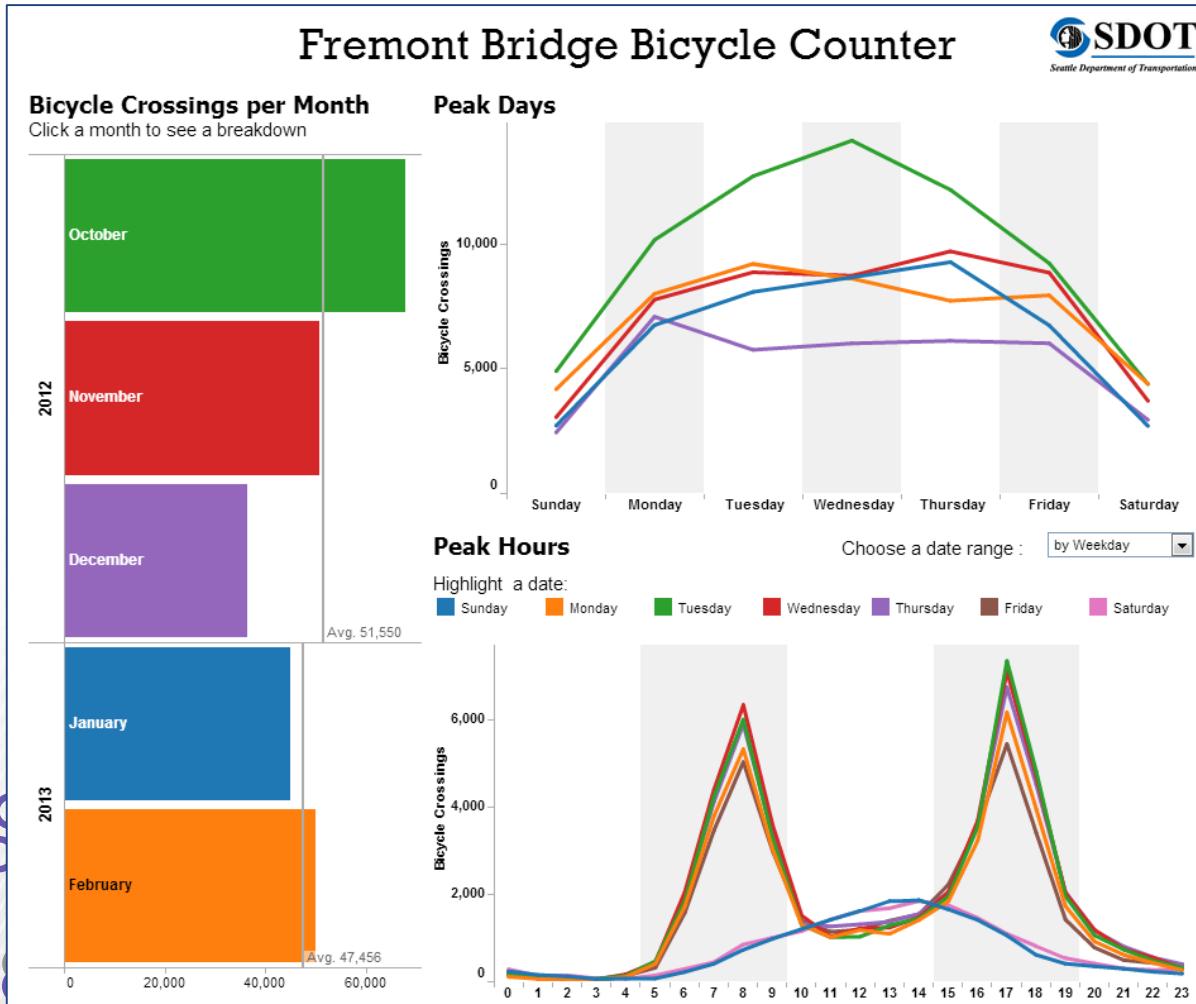
Mapping to Insight

Don't use maps just because you can

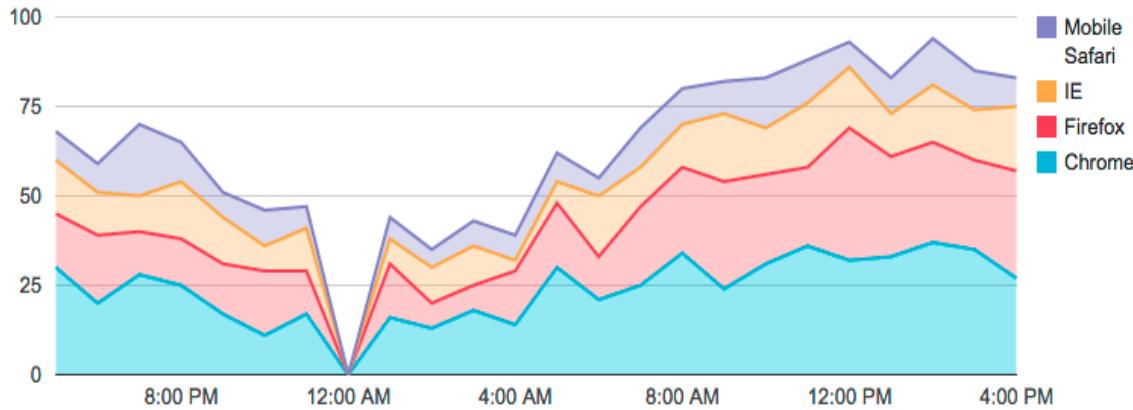


Dashboards

Dashboards bring together multiple views

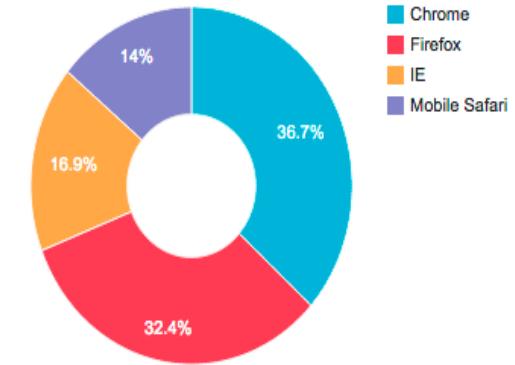


Pageviews by browser (past 24 hours)



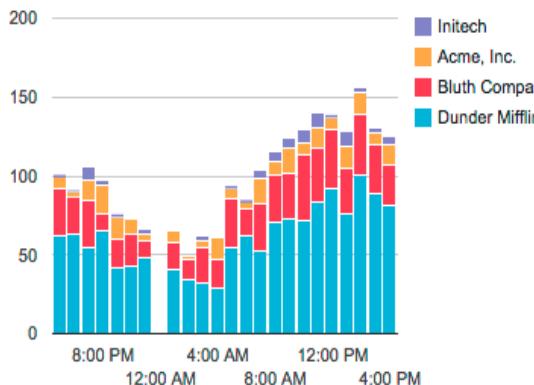
This is a sample text region to describe this chart.

Pageviews by browser (past 5 days)

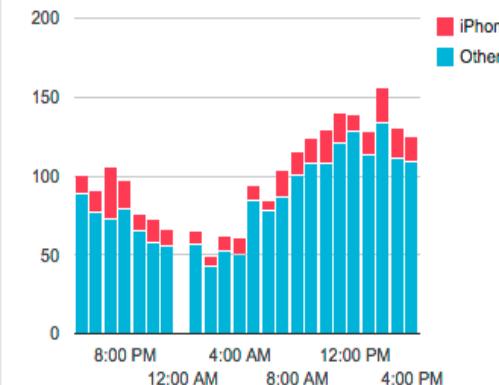


Notes go down here

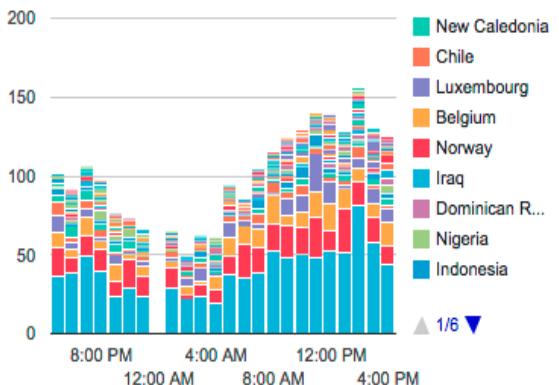
Impressions by advertiser



Impressions by device



Impressions by country



1/6 ▲
▼



5 second usability test

“A five second test is a usability testing method in which the participant is exposed to an image or visualisation for five seconds.

The image is then removed and the participant is asked questions about what they remember seeing. The test is used for evaluating how well a visualisation communicates the purpose and content within.”

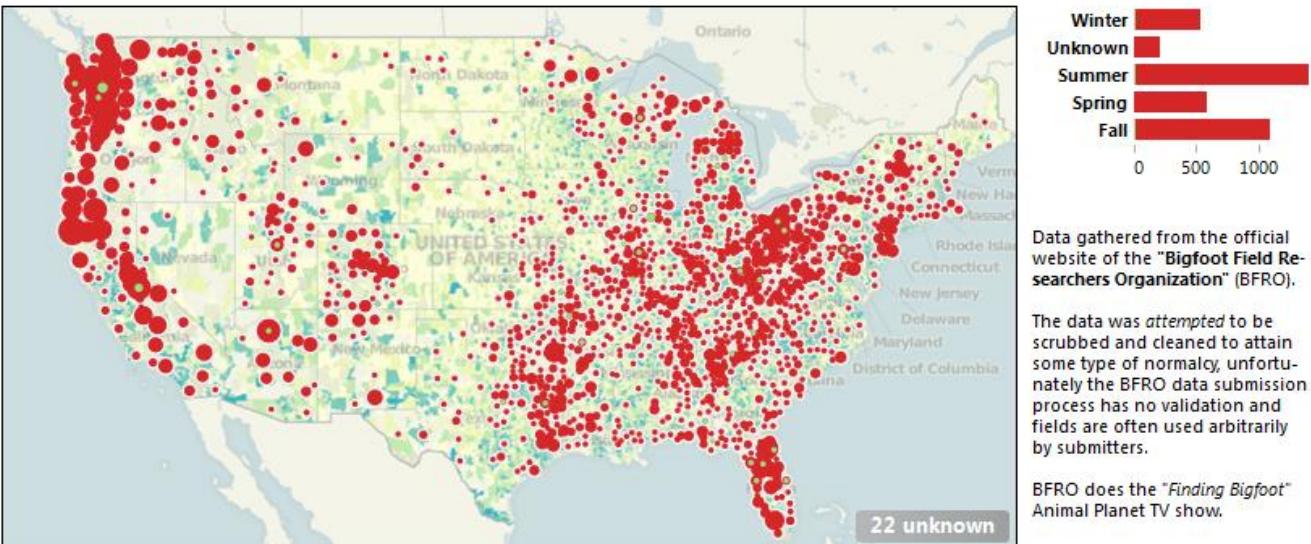
o



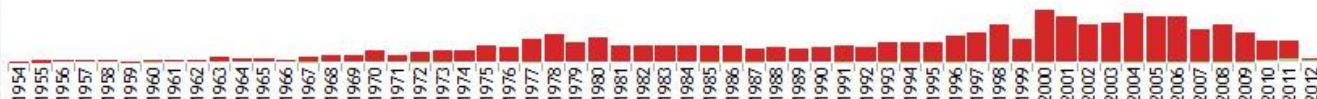
Dashboards

Dashboards should pass the 5-second test

Finding Bigfoot



Click on ANY element of the visualization (location, season, year, detail field) in order to filter by that item.
Select the element AGAIN to go back to the full view.

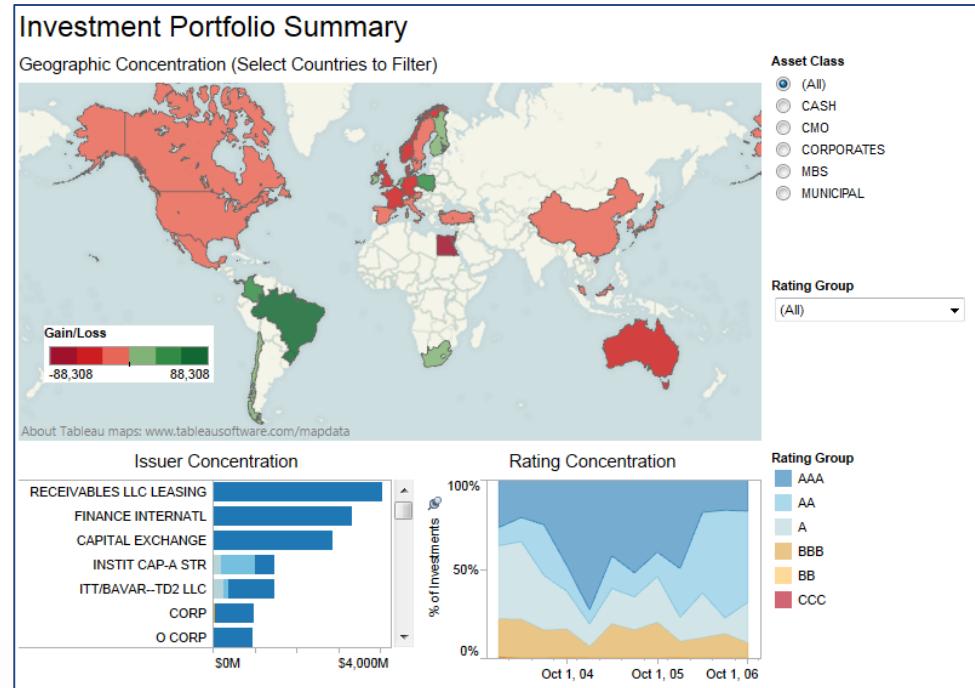


The BFRO classifies sightings according to a system based on the sightings "potential for misinterpretation".

Total Sightings	Class A	Class B	Class C	Unclassified
3,806	1,951	1,696	31	128

Dashboarding for the 5-second Test

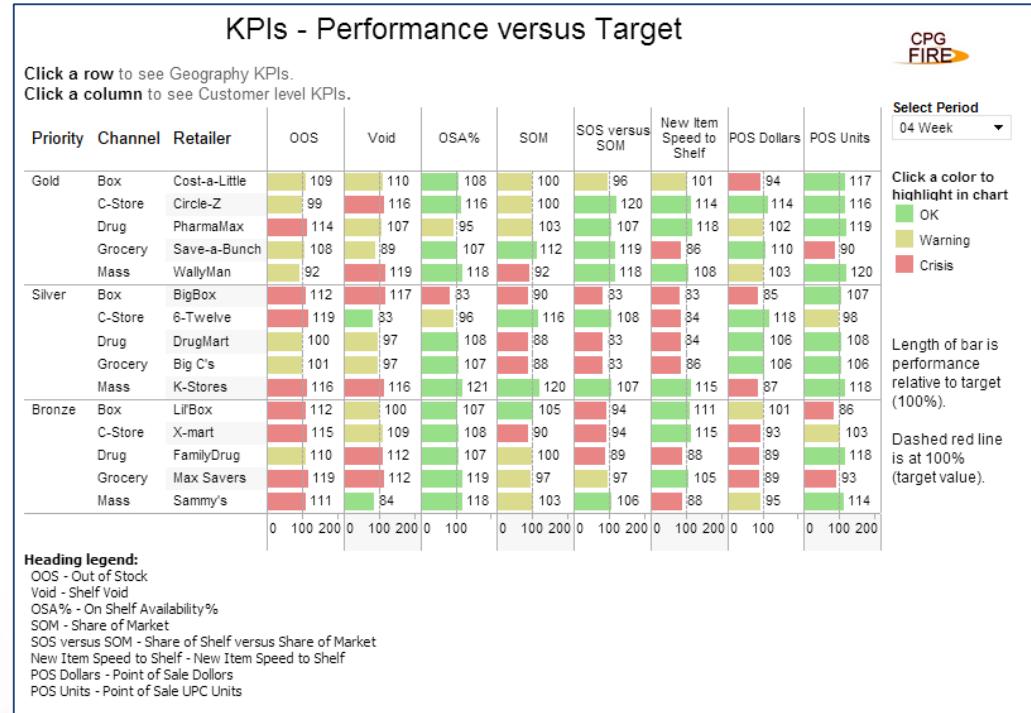
- Most important view goes on top or top-left
- Legends go near their views
- Avoid using multiple color schemes on a single dashboard
- Use 5 views or fewer in dashboards
- Provide interactivity



Dashboarding for the 5-second Test

Use your words!

- Titles
- Axes
- Key facts and figures
- Units
- Remove extra digits in numbers
- Great tooltips



Help people
see and understand
their data

