

# Introduction to Data Visualization and Storytelling with Data

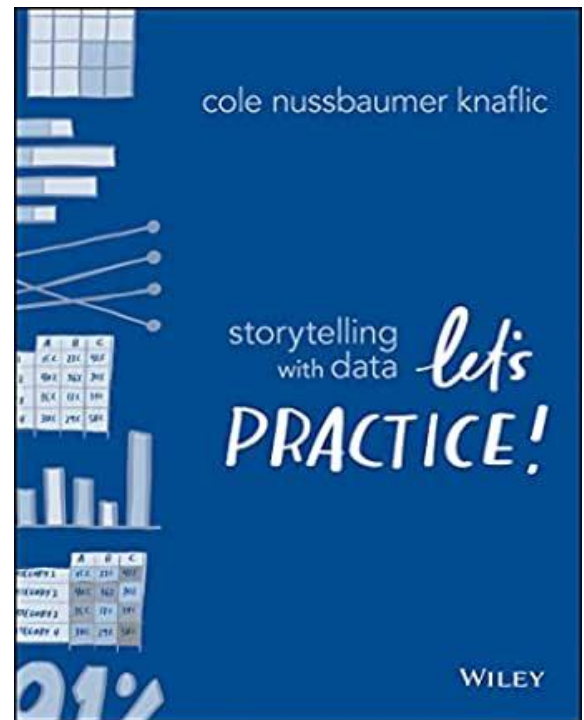
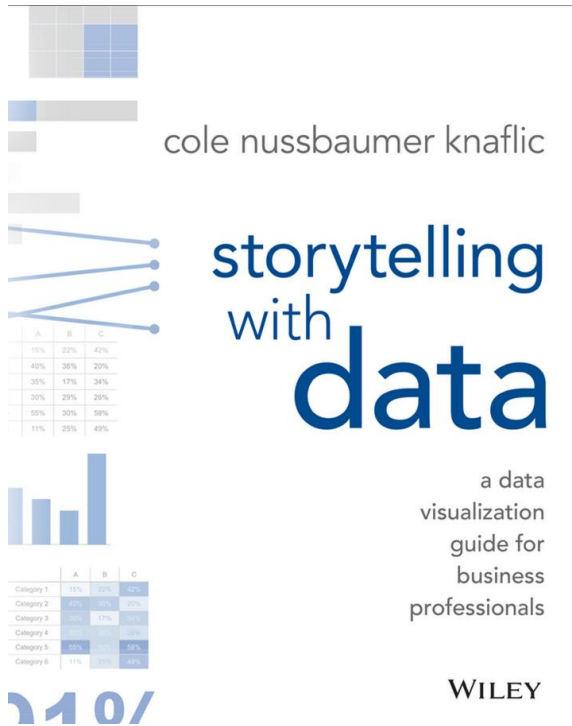
1

Core Content & Picture  
Reference

Cole Nussbaumer Knaflic



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## Introduction to Storytelling with Data

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**Data is a collection of facts such as numbers, descriptions, and observations used in decision making.**

## What is data?

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Structured	Semi-structured	Unstructured
<p><b>Table</b></p>	<pre>## Document 1 ## { "customerID": "103248", "name": { "first": "AAA", "last": "BBB" }, "address": { "street": "Main Street", "number": "101", "city": "Acity", "state": "NY" }, "ccOnFile": "yes", "firstOrder": "02/28/2003" } ## Document 2 ## { "customerID": "103249", "name": { "title": "Mr", "forename": "AAA", "lastname": "BBB" }, "address": { "street": "Another Street", "number": "202", "city": "Bcity", "country": "Gloucestershire", "country-region": "UK" }, "ccOnFile": "yes" }</pre>	

## Data Categories

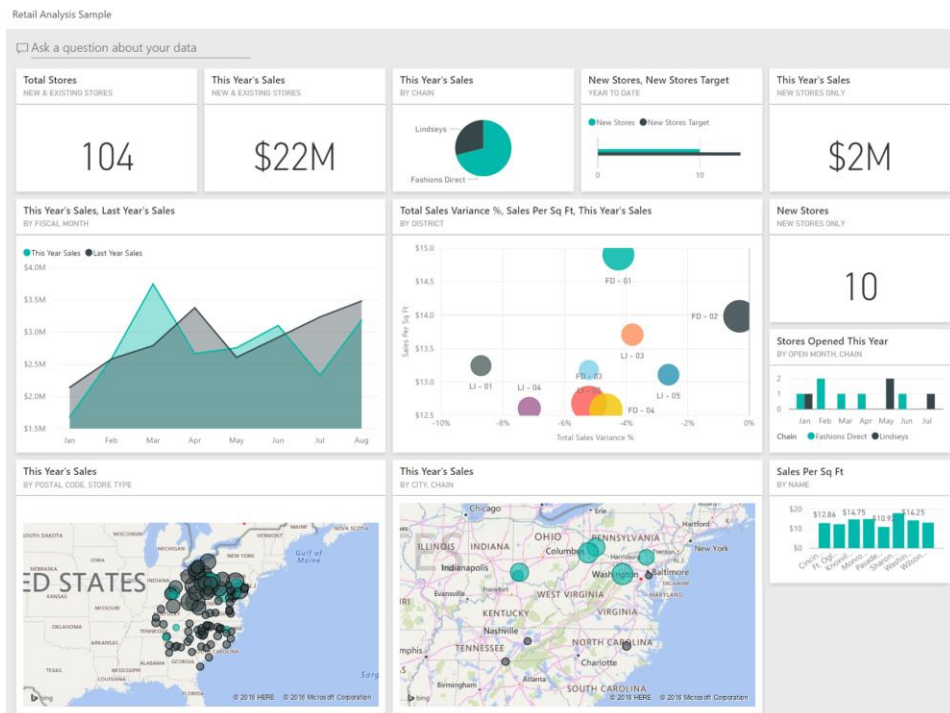
6

DATA SCIENTISTS A.K.A. STATISTICIANS, DATA MANAGERS	DATA ENGINEERS A.K.A. DATA ARCHITECTS, DATABASE ADMINISTRATORS	DATA ANALYSTS A.K.A. BUSINESS ANALYSTS
<b>SKILLS</b> Mathematics, Programming Communication	<b>SKILLS</b> Programming Mathematics Big Data	<b>SKILLS</b> Statistics Communication Business Knowledge
<b>TOOLS</b> SQL, Python, R	<b>TOOLS</b> Hadoop, NoSQL, Python	<b>TOOLS</b> Excel, Tableau, SQL

## Roles in Data

Content Reference : <http://insidebigdata.com/>

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Data or Content



Tools

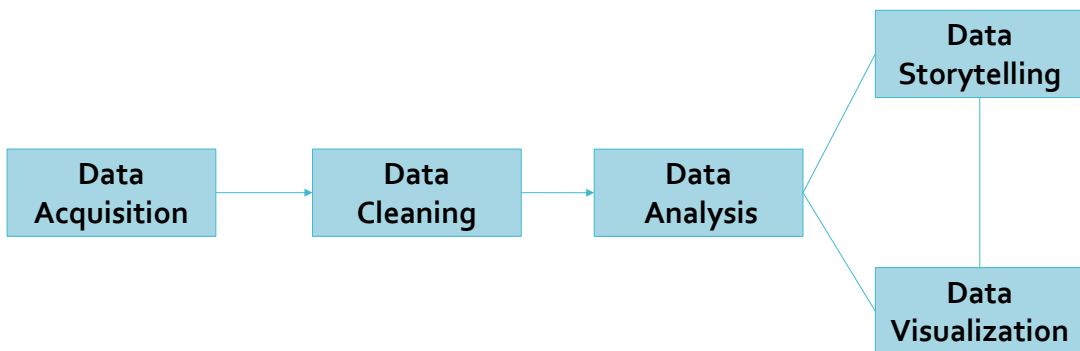


Understand

Data Visualization  
+  
Storytelling

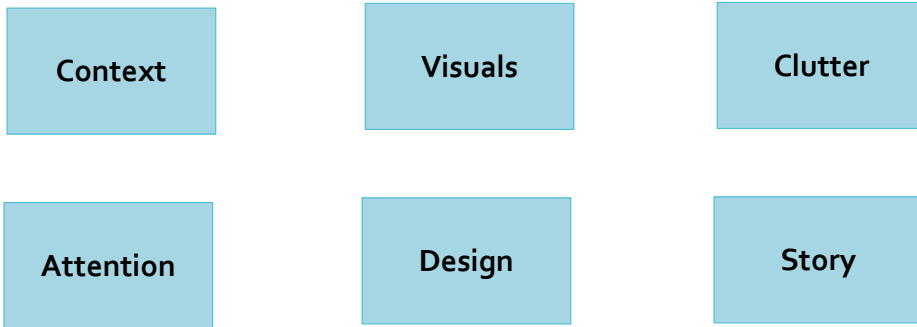
## Storytelling with Data

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## Data-Driven Communication

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Storytelling is an approach

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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The importance of context

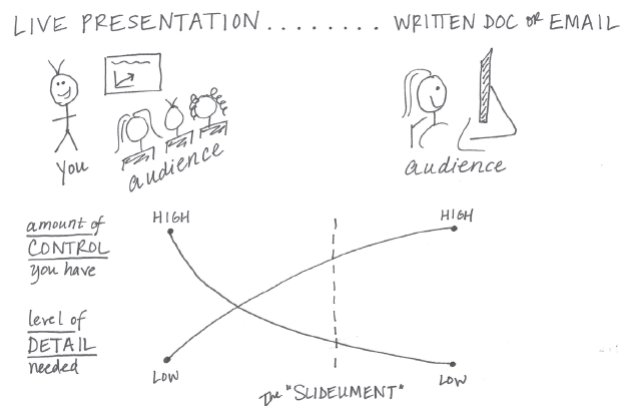
12

# Exploratory vs. Explanatory

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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How will you  
communicate to  
your audience?



## Mechanism

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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**Who :**  
To whom are you communicating?

**What :**  
What do you want your audience to know or do?

**How :**  
How can I make data to support my point?

## Who – What - How

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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The budget committee that can approve funding for continuation of the summer learning program.

The summer learning program on science was a success; please approve budget of \$X to continue.

Illustrate success with data collected through the survey conducted before and after the pilot program.

## Who - What - How Example

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Effective Visual

17

91%

Simple text



Scatterplot

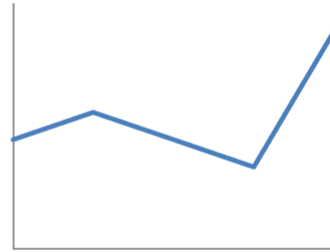
The visuals I use most

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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	A	B	C
Category 1	15%	22%	42%
Category 2	40%	36%	20%
Category 3	35%	17%	34%
Category 4	30%	29%	26%
Category 5	55%	30%	58%
Category 6	11%	25%	49%

Table



Line

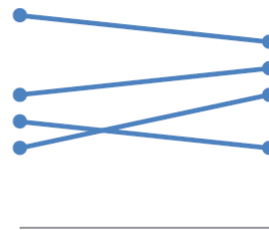
## The visuals I use most

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

19

	A	B	C
Category 1	15%	22%	42%
Category 2	40%	36%	20%
Category 3	35%	17%	34%
Category 4	30%	29%	26%
Category 5	55%	30%	58%
Category 6	11%	25%	49%

Heatmap

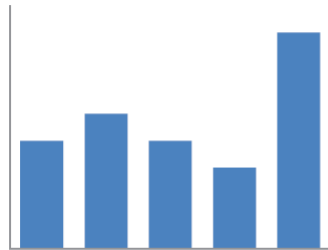


Slopegraph

## The visuals I use most

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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Vertical bar

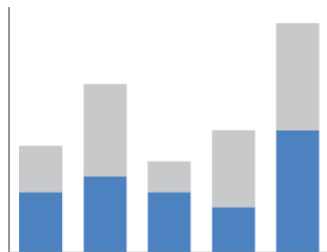


Horizontal bar

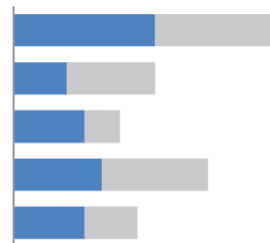
## The visuals I use most

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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Stacked vertical bar

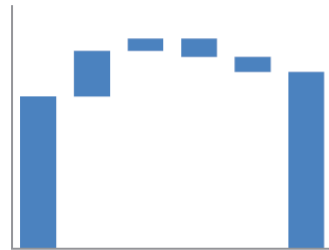


Stacked horizontal bar

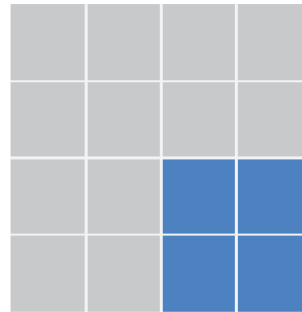
## The visuals I use most

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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Waterfall



Square area

## The visuals I use most

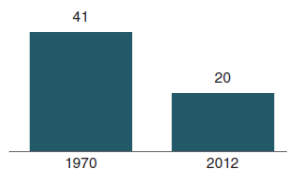
Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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## Simple Text

### Children with a "Traditional" Stay-at-Home Mother

*% of children with a married stay-at-home mother with a working husband*



Note: Based on children younger than 18. Their mothers are categorized based on employment status in 1970 and 2012.

Source: Pew Research Center analysis of March Current Population Surveys Integrated Public Use Microdata Series (IPUMS-CPS), 1971 and 2013

Adapted from PEW RESEARCH CENTER



# 20%

of children had a **traditional stay-at-home mom** in 2012, compared to 41% in 1970

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# Table

Heavy borders

Group	Metric A	Metric B	Metric C
Group 1	\$X.X	Y%	Z,ZZZ
Group 2	\$X.X	Y%	Z,ZZZ
Group 3	\$X.X	Y%	Z,ZZZ
Group 4	\$X.X	Y%	Z,ZZZ
Group 5	\$X.X	Y%	Z,ZZZ

Light borders

Group	Metric A	Metric B	Metric C
Group 1	\$X.X	Y%	Z,ZZZ
Group 2	\$X.X	Y%	Z,ZZZ
Group 3	\$X.X	Y%	Z,ZZZ
Group 4	\$X.X	Y%	Z,ZZZ
Group 5	\$X.X	Y%	Z,ZZZ

Minimal borders

Group	Metric A	Metric B	Metric C
Group 1	\$X.X	Y%	Z,ZZZ
Group 2	\$X.X	Y%	Z,ZZZ
Group 3	\$X.X	Y%	Z,ZZZ
Group 4	\$X.X	Y%	Z,ZZZ
Group 5	\$X.X	Y%	Z,ZZZ

- Borders should be used to improve the legibility of your table.
- Think about pushing them to the background by making them grey, or getting rid of them altogether.
- The data should be what stands out, not the borders.

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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- Using a table in a live presentation is rarely a good idea.
- As your audience reads it, you lose their ears and attention to make your point verbally.



## Tables in live presentations

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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# Heatmap

Table

	A	B	C
Category 1	15%	22%	42%
Category 2	40%	36%	20%
Category 3	35%	17%	34%
Category 4	30%	29%	26%
Category 5	55%	30%	58%
Category 6	11%	25%	49%

Heatmap

LOW-HIGH

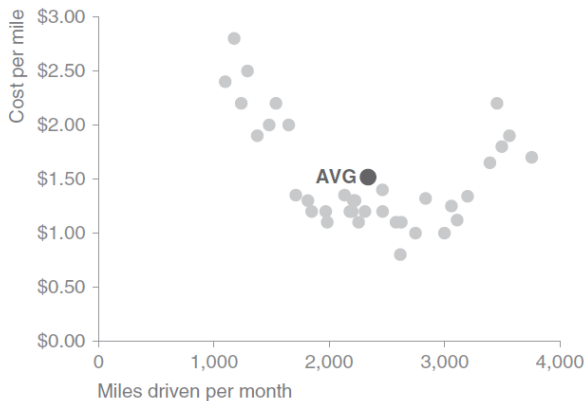
	A	B	C
Category 1	15%	22%	42%
Category 2	40%	36%	20%
Category 3	35%	17%	34%
Category 4	30%	29%	26%
Category 5	55%	30%	58%
Category 6	11%	25%	49%

Use color saturation to highlight cells and Too many colors not good  
 \*\*\* Color should be used strategically \*\*\*

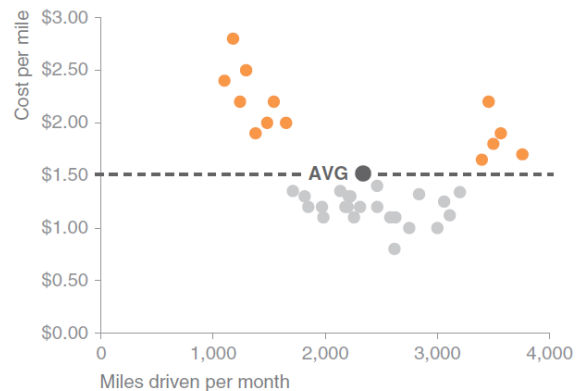
Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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Cost per mile by miles driven



Cost per mile by miles driven

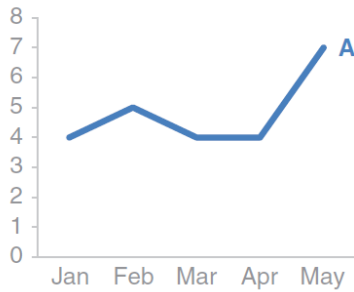


## Graphs – Points (Scatterplot)

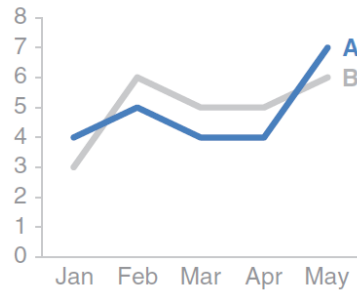
Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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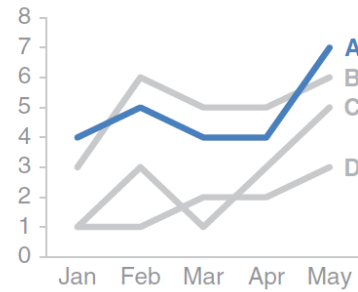
Single series



Two series



Multiple series



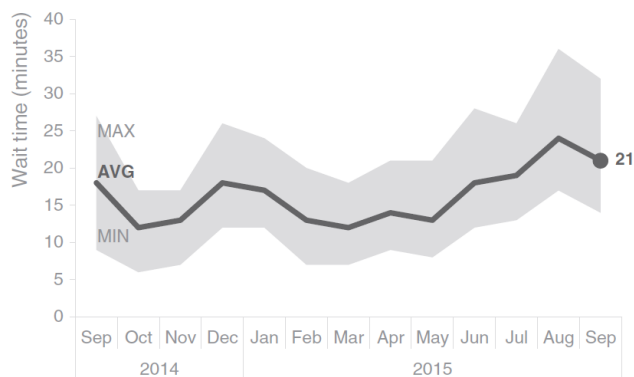
## Graphs – Line

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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Passport control wait time

Past 13 months



Showing average within a range in a line graph

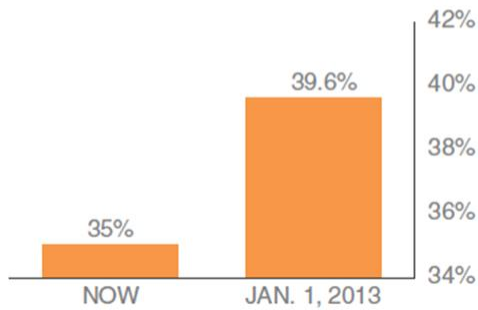
## Graphs – Line

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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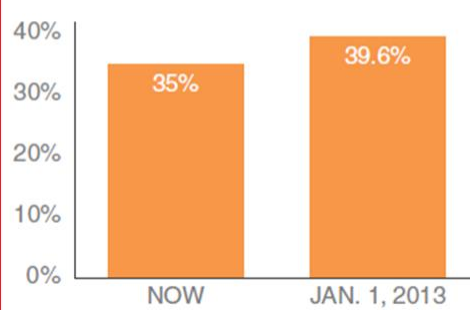
**Non-zero baseline:** as originally graphed

IF BUSH TAX CUTS EXPIRE  
TOP TAX RATE



**Zero baseline:** as it should be graphed

IF BUSH TAX CUTS EXPIRE  
TOP TAX RATE



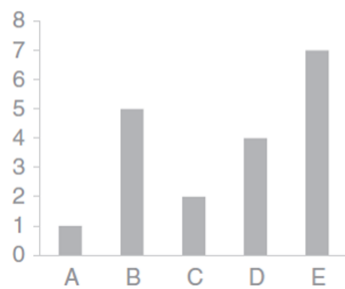
always use  
zero  
baseline

## Bar

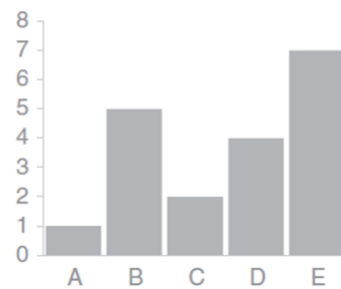
Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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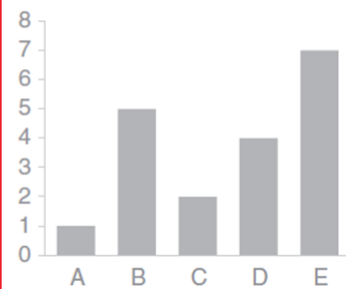
Too thin



Too thick



Just right



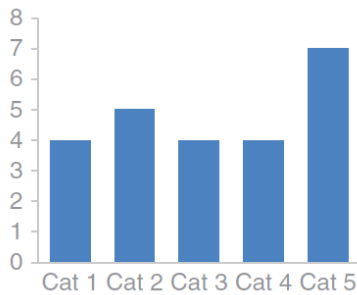
## Bar - Space

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

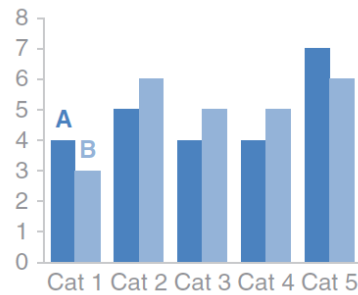
32



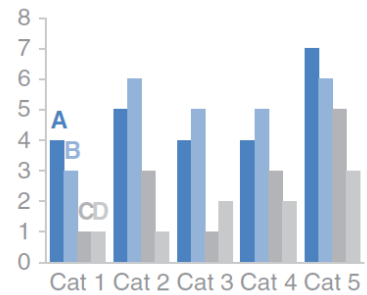
Single series



Two series



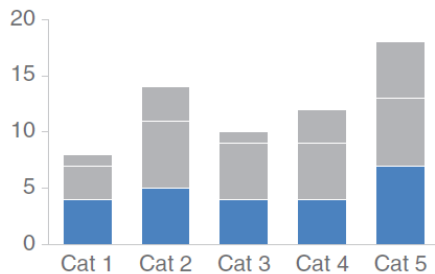
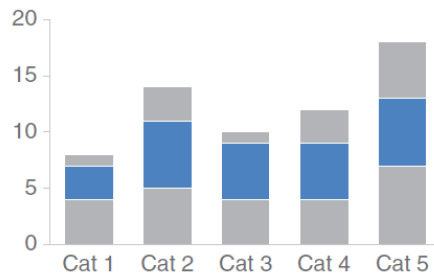
Multiple series



## Vertical Bar Chart

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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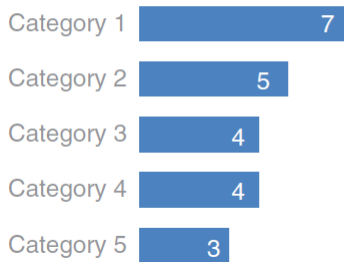
Comparing **these** is easyComparing **these** is hard

## Stacked Vertical Bar Chart

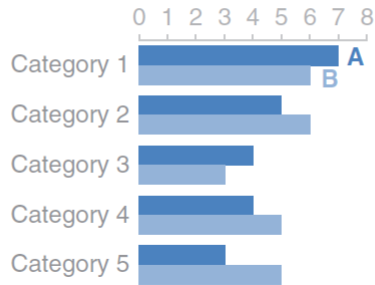
Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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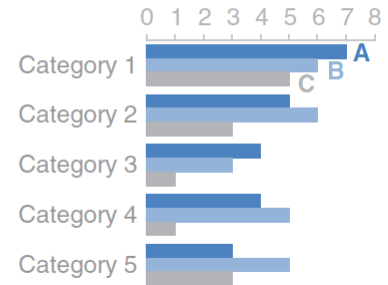
Single series



Two series



Multiple series

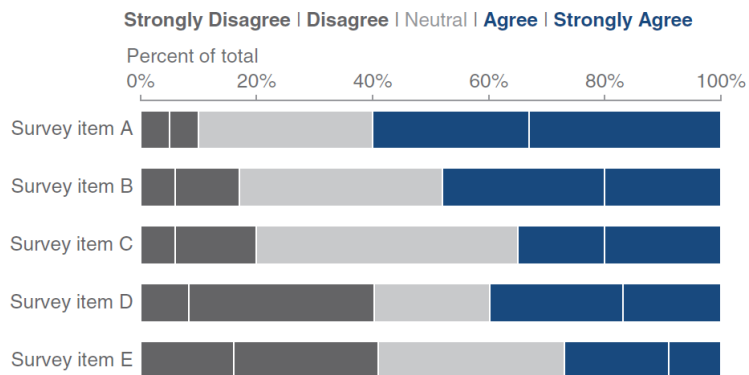


## Horizontal Bar Chart

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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Survey results

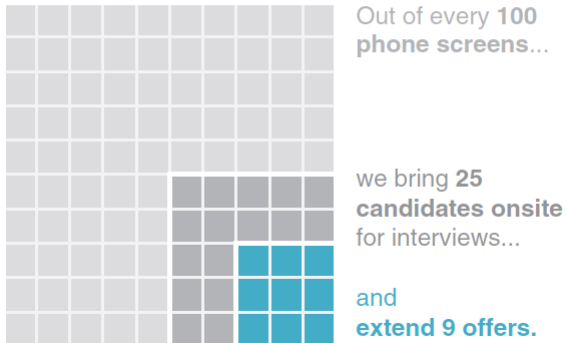


## Stacked Horizontal Bar Chart

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## Interview breakdown

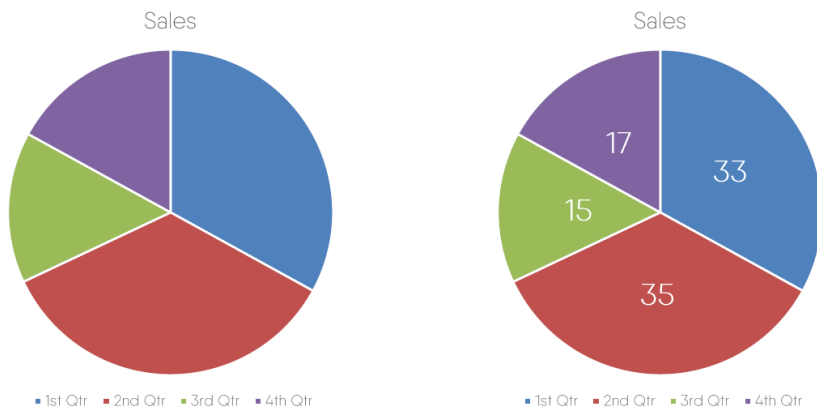


Human eyes not good with area.

## Area

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

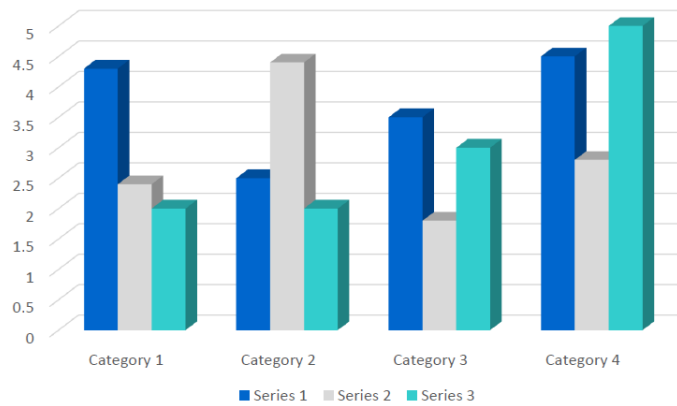
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## Pie – Not Good Idea

Content Reference : Kasidis Satangmongkol (Data Rockie)

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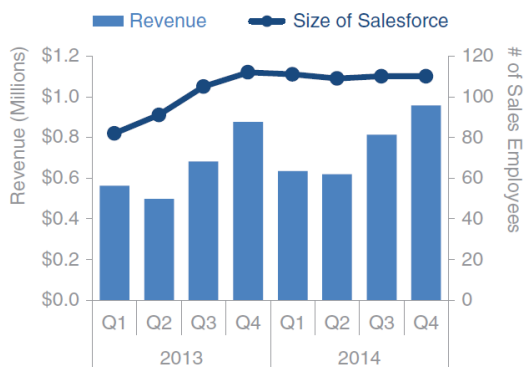


## Never use 3D

Content Reference : Kasidis Satangmongkol (Data Rockie)

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Secondary y-axis

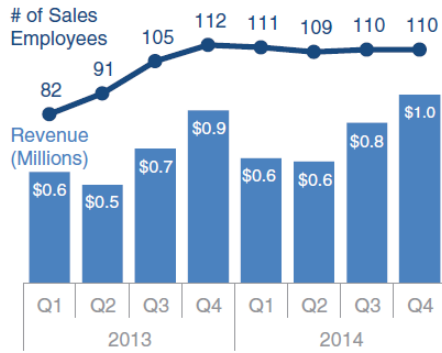
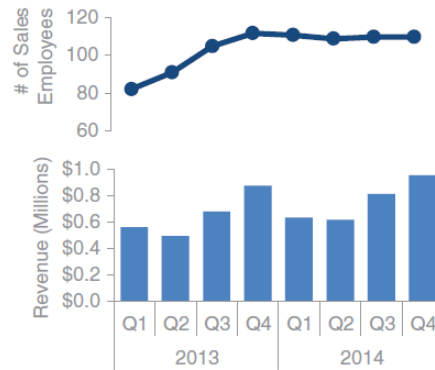


It takes time for audience to understand the chart

## Secondary axis generally not a good idea

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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Alternative 1: **label directly**Alternative 2: **pull apart vertically**

## Strategies for avoiding a secondary y-axis

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

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## Identify & Eliminate Clutter

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Contrast



Repetition



Alignment



Proximity

## Design Principle

Content Reference : Apirak Panatkool - Founder of UX Academy & Skooldio

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### Heading

#### Sub-Headline

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus. Duis vehicula elit nulla, eleifend egestas nisl vehicula nec. Nullam varius est dui, nec accumsan lectus posuere ut. Nullam viverra purus laoreet euismod tempor.

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus. Duis vehicula elit nulla, eleifend.



### Heading

#### Sub-Headline

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus. Duis vehicula elit nulla, eleifend egestas nisl vehicula nec. Nullam varius est dui, nec accumsan lectus posuere ut. Nullam viverra purus laoreet euismod tempor.

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus. Duis vehicula elit nulla, eleifend.



## Contrast

Content Reference : Apirak Panatkool - Founder of UX Academy & Skooldio

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## Heading

### Sub-Headline

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus. Duis vehicula elit nulla, eleifend egestas nisl vehicula nec. Nullam varius est dui, nec accumsan lectus posuere ut. Nullam viverra purus laoreet euismod tempor.

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus. Duis vehicula elit nulla, eleifend.

## Heading

### Sub-Headline

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus. Duis vehicula elit nulla, eleifend egestas nisl vehicula nec. Nullam varius est dui, nec accumsan lectus posuere ut. Nullam viverra purus laoreet euismod tempor.

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus. Duis vehicula elit nulla, eleifend.



# Proximity

Content Reference : Apirak Panatkool - Founder of UX Academy & Skooldio

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Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare\*

Curabitur, semper vitae urna ac adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus.

\*Ornare imperdiet blandit lectus. Morbi tristique

Continue

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus. Morbi tristique urna ut volutpat ornare\* Curabitur semper vitae urna ac tempus.



\*ornare imperdiet blandit lectus. Morbi tristique

Continue

Adipiscing elit. Sed neque nisl, blandit vel ipsum eu, imperdiet blandit lectus.

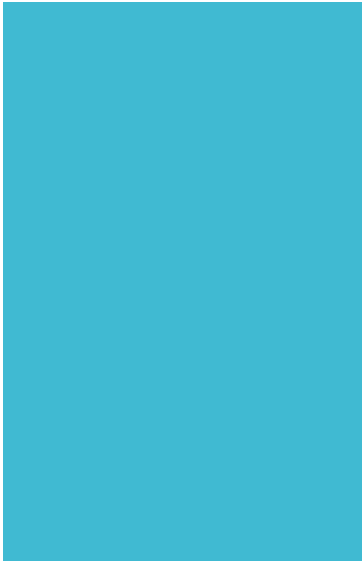
Morbi tristique urna ut volutpat ornare. Curabitur semper vitae urna ac tempus.



# Alignment

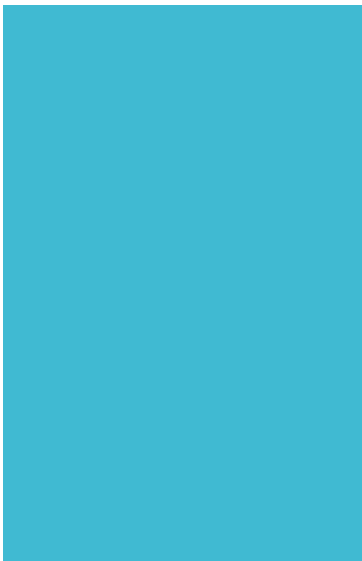
Content Reference : Apirak Panatkool - Founder of UX Academy & Skooldio

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**Ny Bokning**

Responsible Person:

Categories:

Date:

Time (Minutes):

Start Time:

End Time:

Price:  \$

Course: ☐

Free: ☐

Reason:

Payment Date:

Partly Paid: ☐ \$

Unpaid: ☒

Fully Paid: ☐

Cash: ☐

Card: ☐

Account: ☐

Comment:

Remainder: ☐

SMS-Text:

Status:

Content Reference : Apirak Panatkool - Founder of UX Academy & Skooldio

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**Ny Bokning**

Responsible Person:

Categories:

Date:

Time (Minutes):

Start Time:

End Time:

Price:  \$

Course: ☐

Free: ☐

Reason:

Payment Date:

Partly Paid: ☐ \$

Unpaid: ☒

Fully Paid: ☐

Cash: ☐

Card: ☐

Account: ☐

Comment:

Remainder: ☐

SMS-Text:

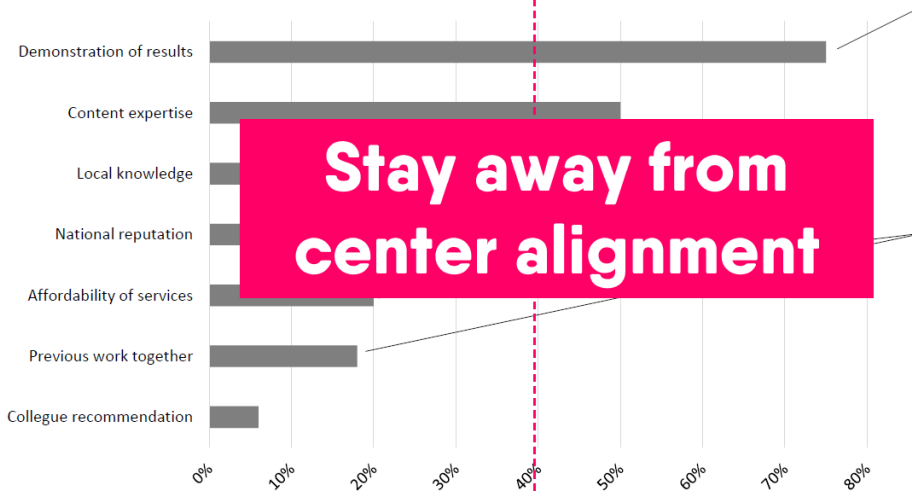
Status:

Content Reference : Apirak Panatkool - Founder of UX Academy & Skooldio

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## Demonstrating effectiveness is most important consideration when selecting a provider

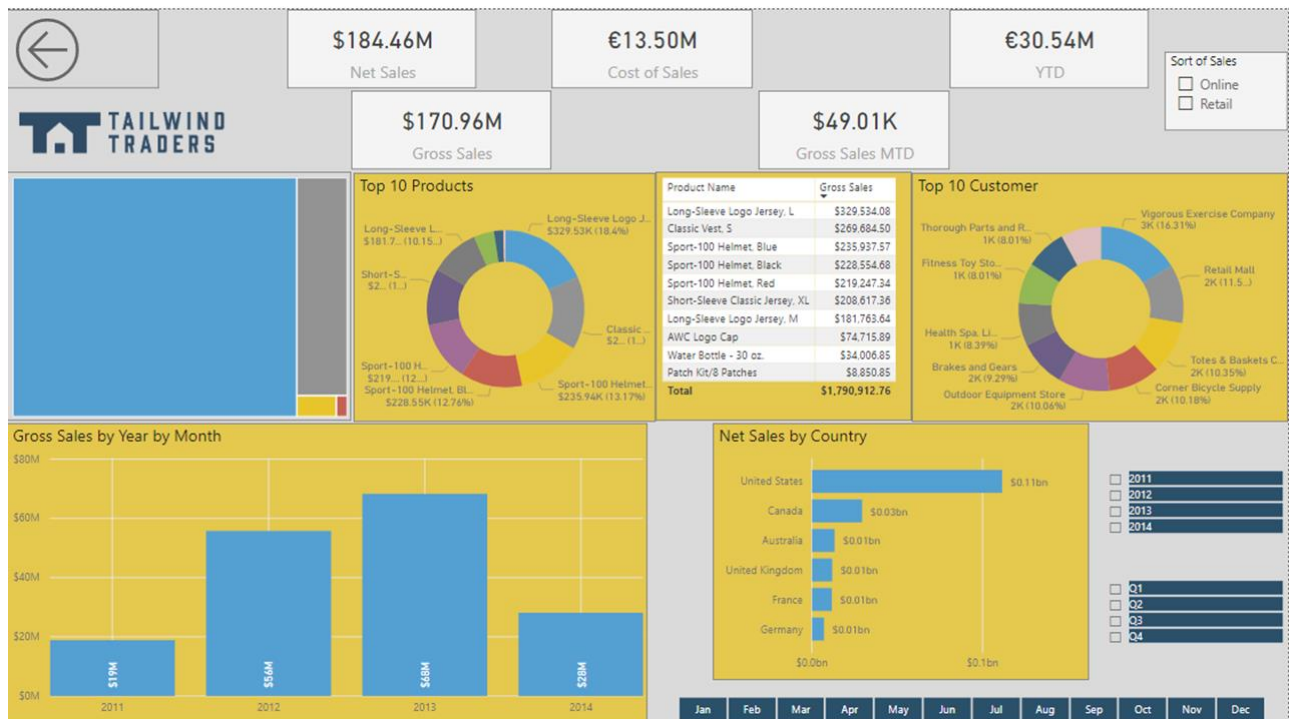
In general, what attributes are the most important to you in selecting a service provider?  
Choose up to 3 answers



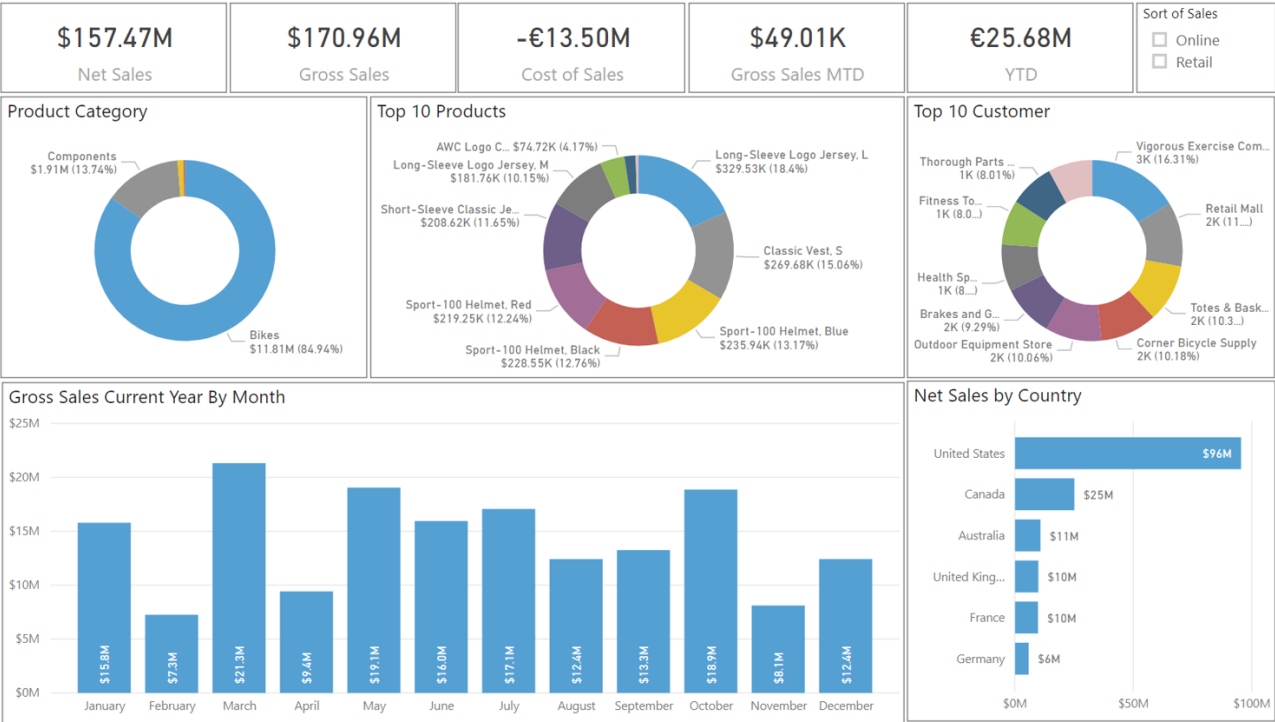
Content Reference :  
Kasidis  
Satangmongkol  
(Data Rockie)

Data source: Storytelling with data by Cole. Page 81.

51



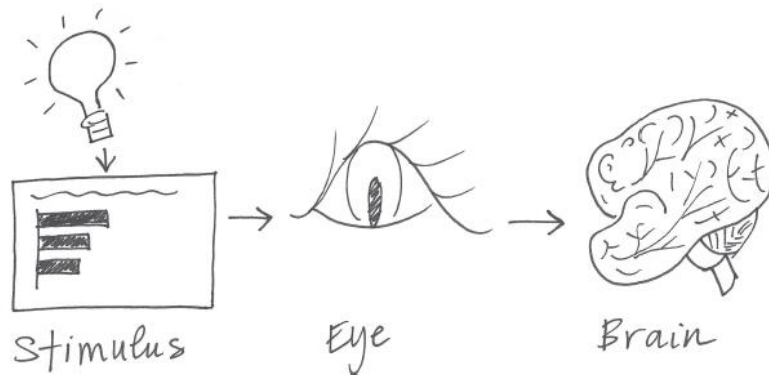
52



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Focus Attention

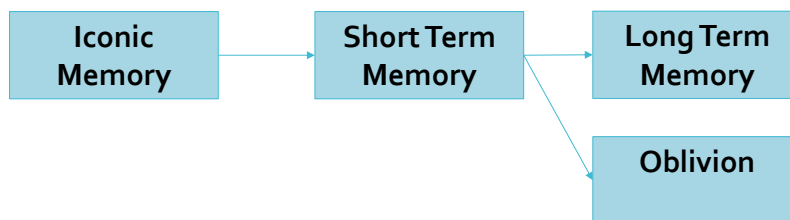
54



## You see with your brain

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

55



## A brief lesson on memory

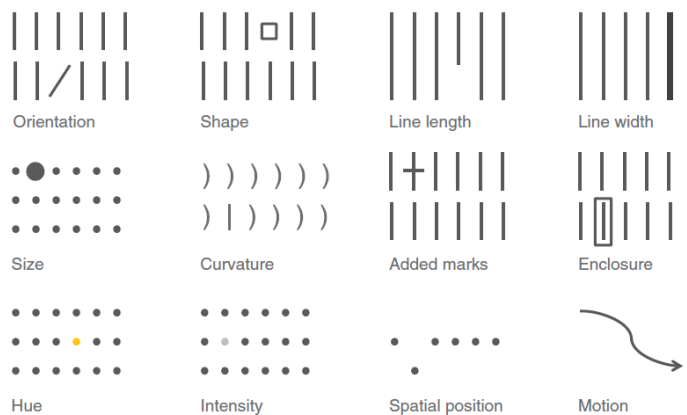
Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

56

**We can enable our audience to see what we want them to see before they even know they're seeing it.**

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley

57



## Preattentive Attributes

Content Reference : storytelling with data - Cole Nussbaumer Knaflic @Wiley  
Adapted from Stephen Few's Show Me the Number, 2004

58

Preattentive Attributes in Text

Bold

What are we doing well? Great products. These products are clearly best in their class. Replacement parts are shipped when needed. You sent me gaskets without me having to ask. Problems are resolved promptly. Bev in billing office was quick to resolve a billing issue I had. **General customer service exceeds expectations.** The account manager even called to check in after normal business hours. You have a great company, keep up the good work!

Color

What are we doing well? Great products. These products are clearly best in their class. Replacement parts are shipped when needed. You sent me gaskets without me having to ask. Problems are resolved promptly. Bev in billing office was quick to resolve a billing issue I had. General customer service exceeds expectations. The account manager even called to check in after normal business hours. You have a great company, keep up the good work!

Italics

What are we doing well? Great products. These products are clearly best in their class. Replacement parts are shipped when needed. You sent me gaskets without me having to ask. Problems are resolved promptly. Bev in billing office was quick to resolve a billing issue I had. General customer service exceeds expectations. *The account manager even called to check in after normal business hours.* You have a great company, keep up the good work!

Size

What are we doing well? Great products. These products are clearly best in their class. Replacement parts are shipped when needed. You sent me gaskets without me having to ask. Problems are resolved promptly. Bev in billing office was quick to resolve a billing issue I had. General customer service exceeds expectations. *The account manager even called to check in after normal business hours.* You have a great company, keep up the good work!

Enclosure

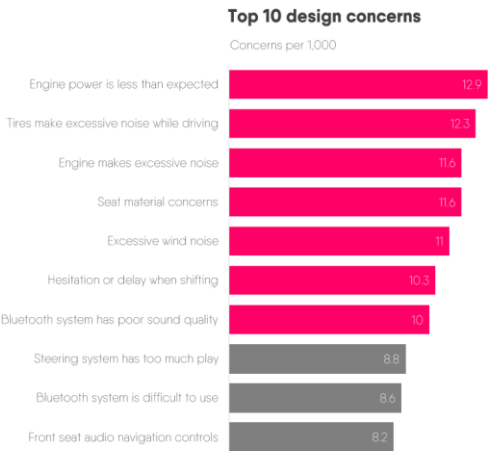
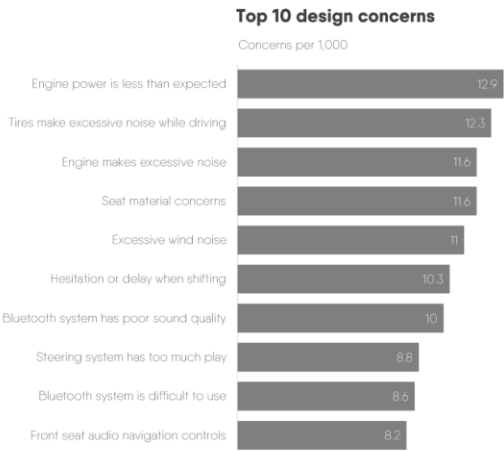
What are we doing well? Great products. These products are clearly best in their class. Replacement parts are shipped when needed. You sent me gaskets without me having to ask. Problems are resolved promptly. Bev in billing office was quick to resolve a billing issue I had. General customer service exceeds expectations. The account manager even called to check in after normal business hours. You have a great company, keep up the good work!

Underline

What are we doing well? Great products. These products are clearly best in their class. Replacement parts are shipped when needed. You sent me gaskets without me having to ask. Problems are resolved promptly. Bev in billing office was quick to resolve a billing issue I had. General customer service exceeds expectations. The account manager even called to check in after normal business hours. You have a great company, keep up the good work!

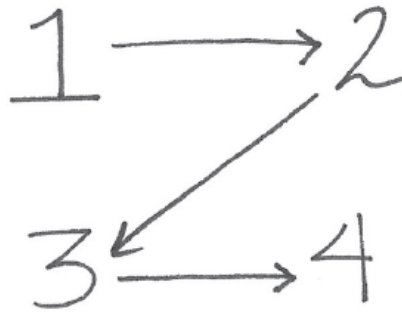
Content Reference : Kasidis Satangmongkol (Data Rockie)

Preattentive Attributes in Graphs



7 of the top 10 design concerns have 10 or more concerns per 1,000

Content Reference : Kasidis Satangmongkol (Data Rockie)



The zigzag “z” of taking in information on a screen or page

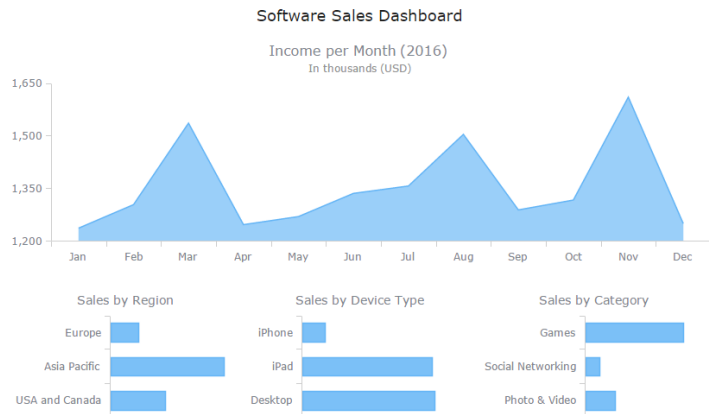
Content Reference : storytelling with data - Cole Nussbaumer Knaflitz @Wiley

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Think like a Designer

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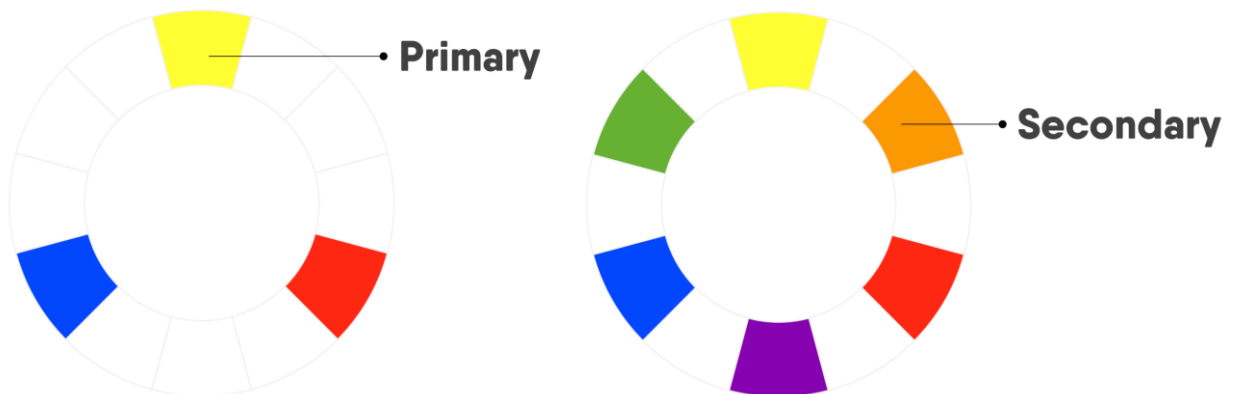
- **Affordance**
- **Accessibility**
- **Aesthetics**
- **Acceptance**



## Good Chart

Content Reference : <https://www.anychart.com/blog/2017/04/05/chart-captions-title-graph-tips/>

63

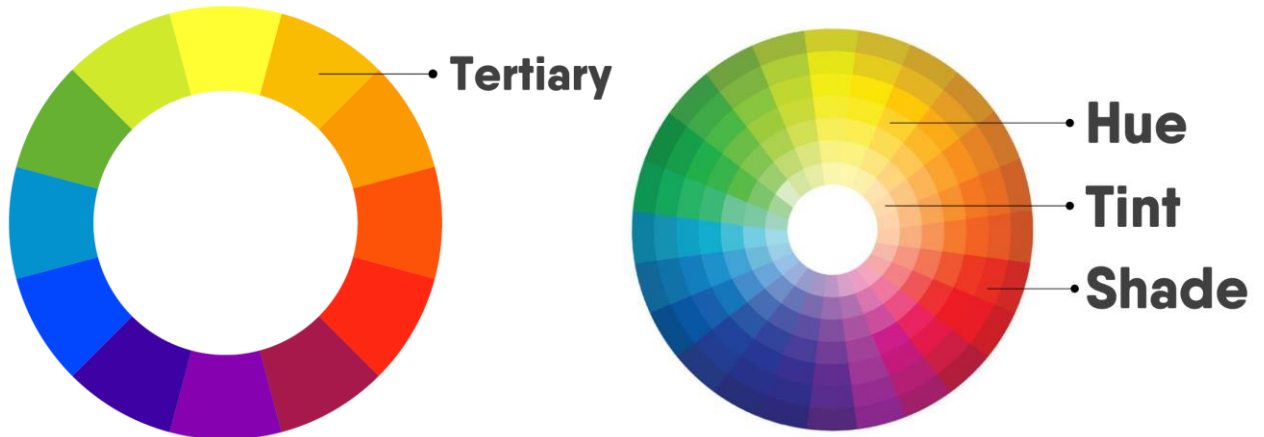


## Color

Content Reference : Kasidis Satangmongkol (Data Rockie)

64





Color

Content Reference : Kasidis Satangmongkol (Data Rockie)

65

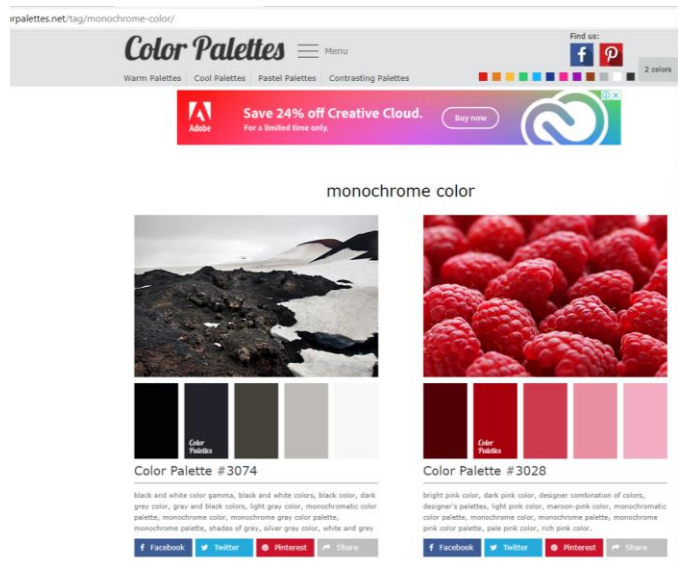


Color Selection - Monochrome

Content Reference : Thanachart Ritbumroong, Ph.D. (NIDA)

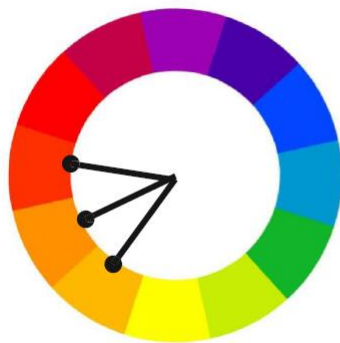
66

# Color Selection - Monochrome



<https://colorpalettes.net/tag/monochrome-color/>

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## Color Selection - Analogous

Content Reference : Thanachart Ritbumroong, Ph.D. (NIDA)

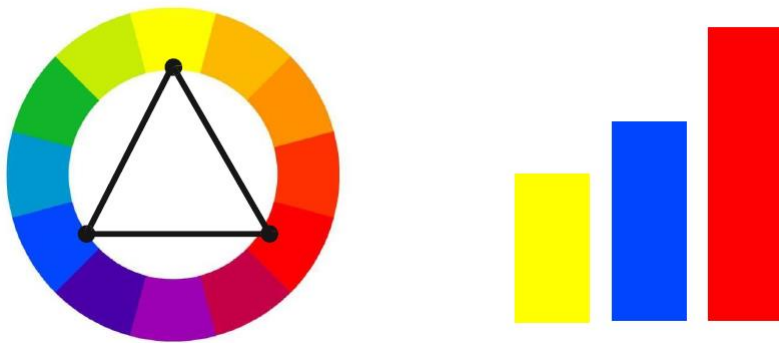
68



## Color Selection - Complimentary

Content Reference : Thanachart Ritbumroong, Ph.D. (NIDA)

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## Color Selection - Triad

Content Reference : Thanachart Ritbumroong, Ph.D. (NIDA)

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... The End ...

