Data Visualisation and Dashboarding

Week 2 – Perception and Gestalt

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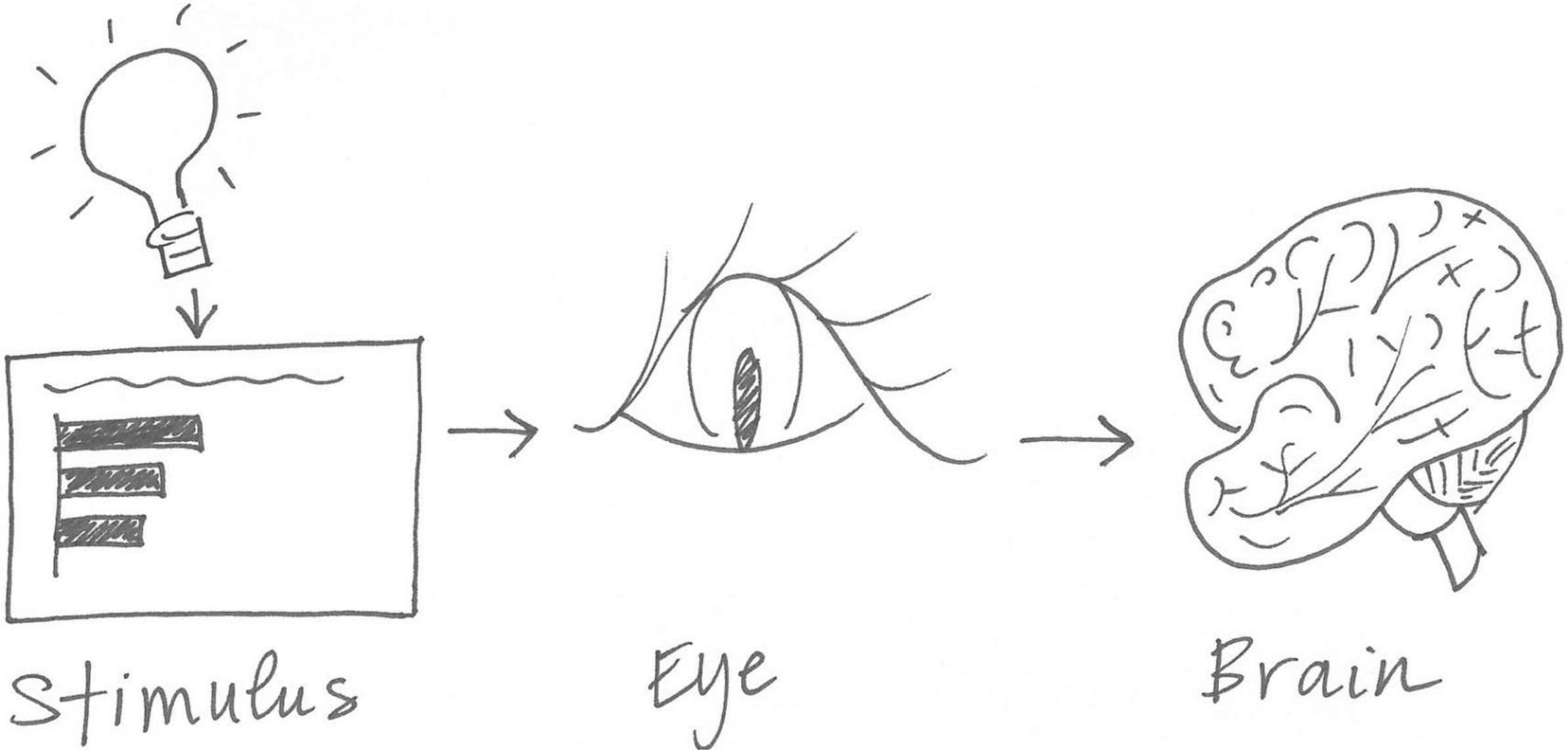

Stimulus
Eye
Brain

Perception and vision

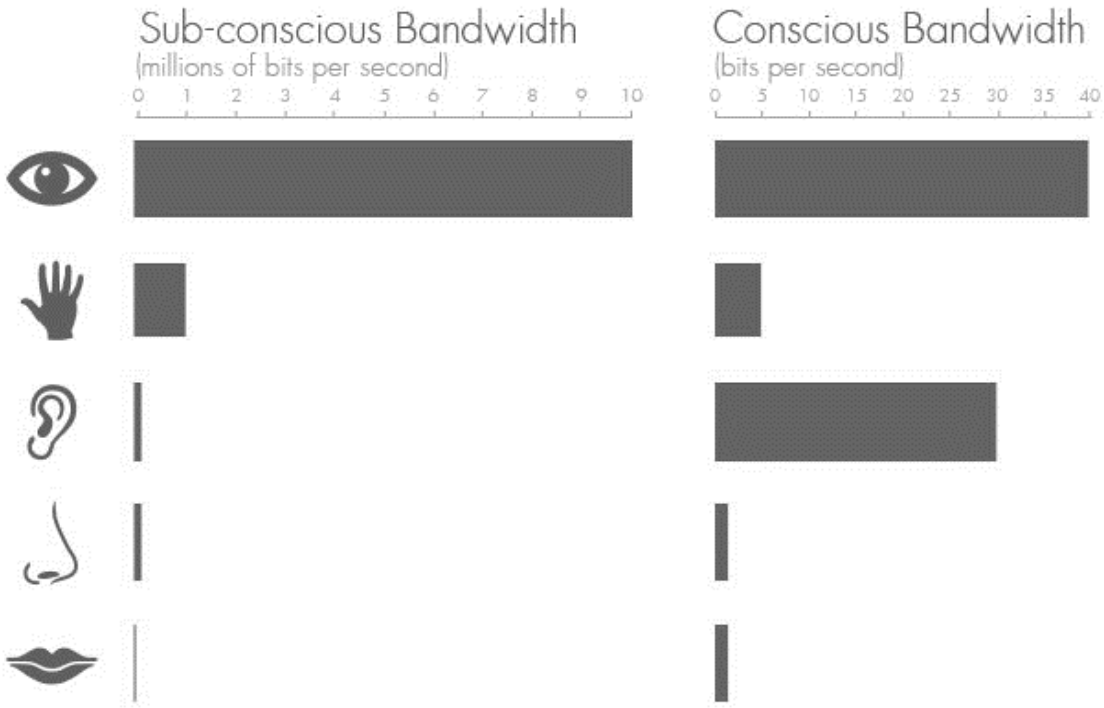
From latin *perceptio*: a taking, receiving, collecting, gathering.

“The ability to see, hear, or become aware of something through the senses.”

Visual sense is most important sense

Visual perception makes only sense if we consider eyes and brain

We can only make sense of sensory information using experience/memory/learned behaviour

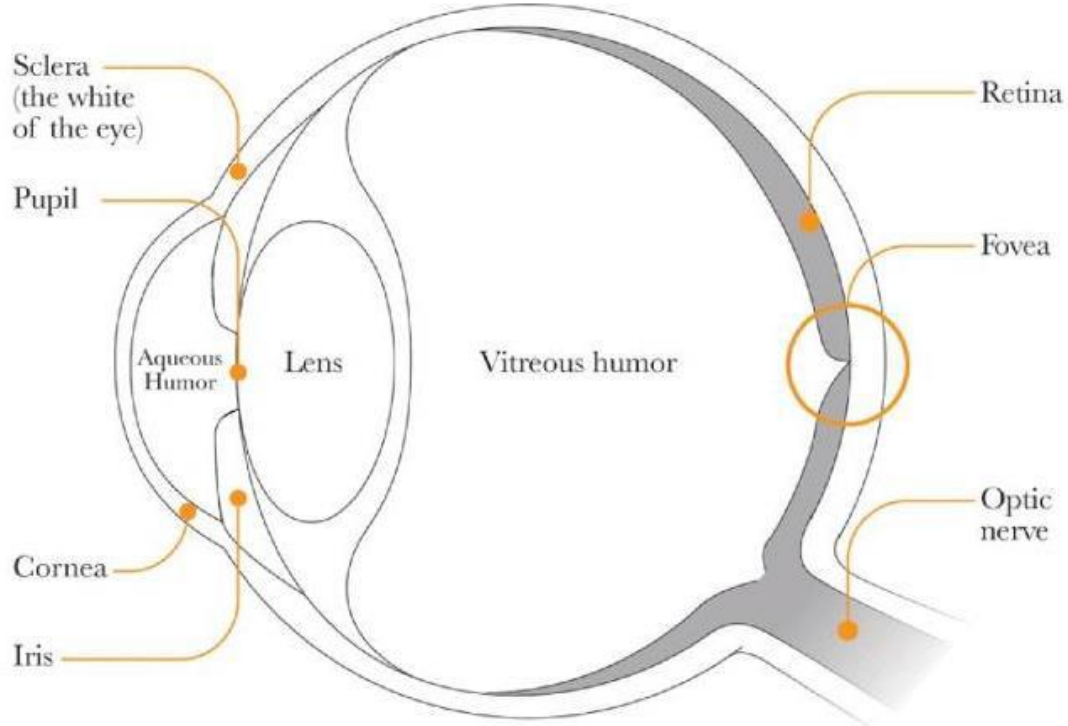


Visualisation from Stephen Few’s ‘Information Dashboard Design’

The most important sense: Sight

The eye has four main activities:

1. Lens focuses light onto the retina
2. Pupils control the amount of light received
3. Photoreceptors convert light into electrical impulses
4. Electrical signals are passed to the optic nerve and then processed by the brain



‘The functional art’ Alberto Cairo 2013

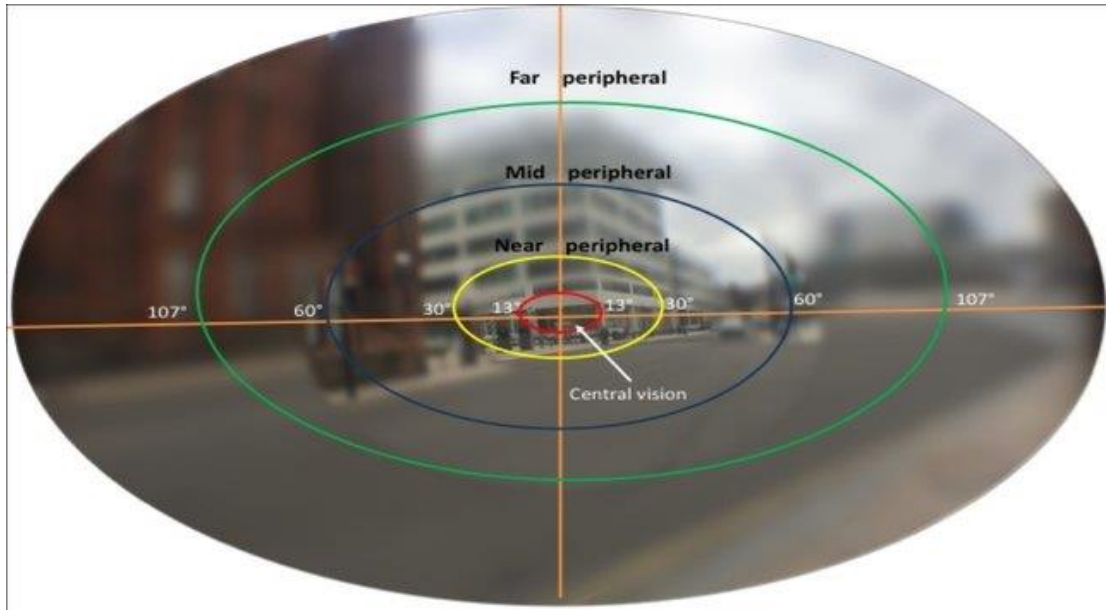
What do we actually see?

Best visual acuity in fovea.

Narrow cone of vision.

Brain is using high-speed scanning process that is both voluntary and involuntary to best use the narrow fovea and surrounding parafovealhigh-quality vision. For example, as you are reading this text, your eye uses the foveal range to read two or three words you are reading now. The parafovealrange is making your brain aware of the 10-15 words surrounding this.

Need to consider visual scanning speed for data visualisations



Human field of view.

Visual processing

Brain needs to make sense of signals passed from eye.

First part of process is iconic memory.

E.g. when looking at a face, brain recognises it is a face.

Visual working memory

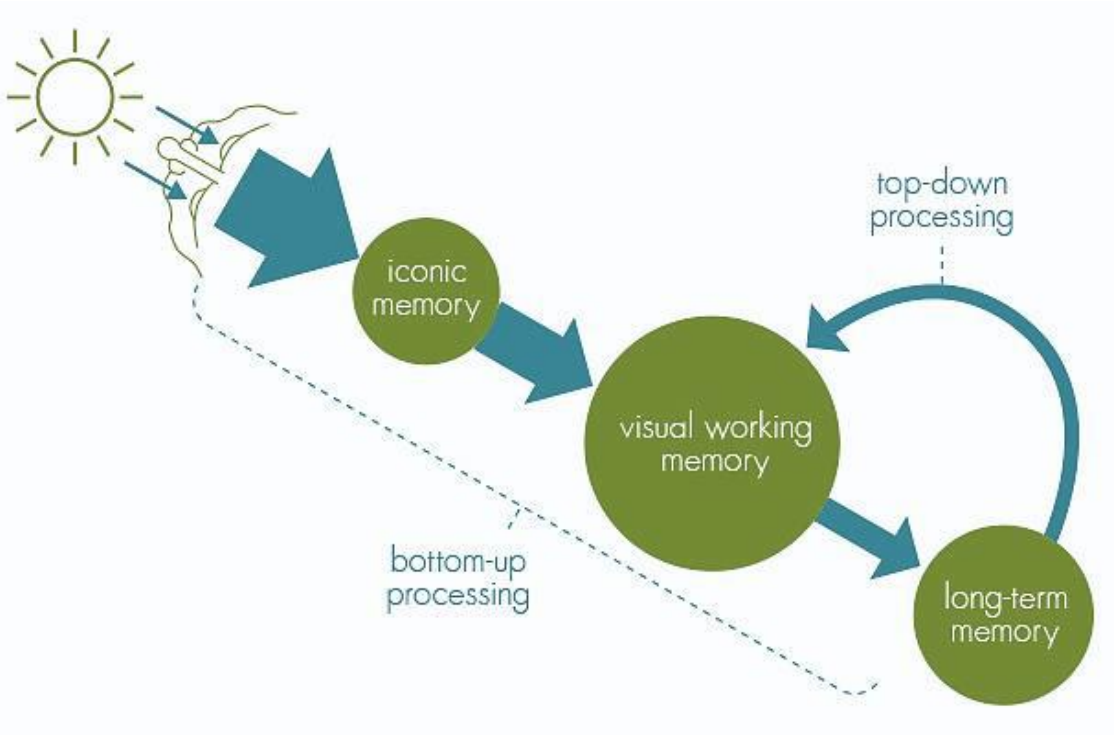
What is noticeable about the face?

Passed to long-term memory

Hey, I know that face

Visual perception can be fooled.

Face in the moon



‘The functional art’ Alberto Cairo 2013

Face or moon?

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Chihuahua or muffin?

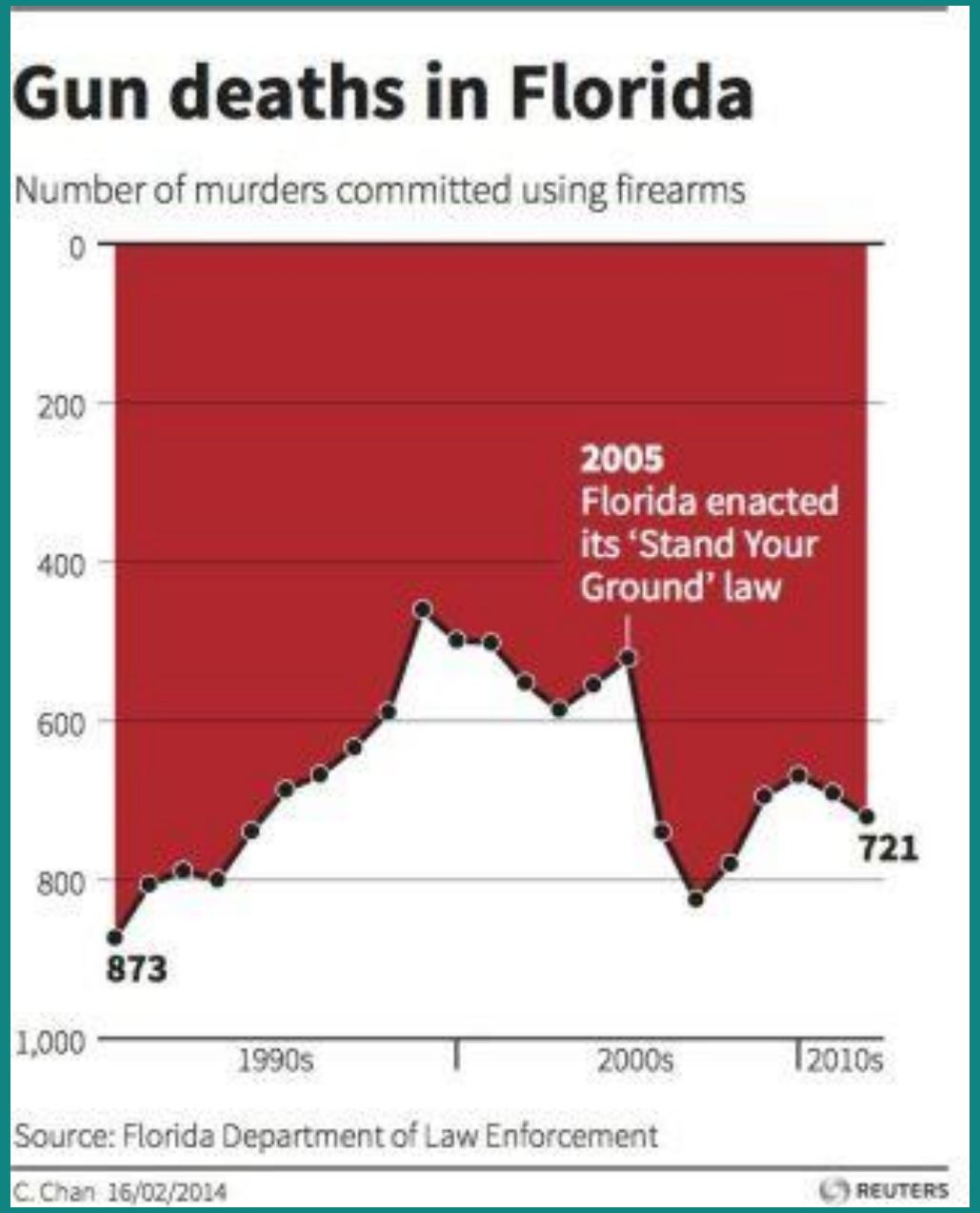
A little experiment…

Next slide shows chart showing gun deaths in Florida over a period of time

Florida enacted the “Stand your Ground” law in 2005

Did gun deaths increase or decrease after 2005?

Increase or decrease?



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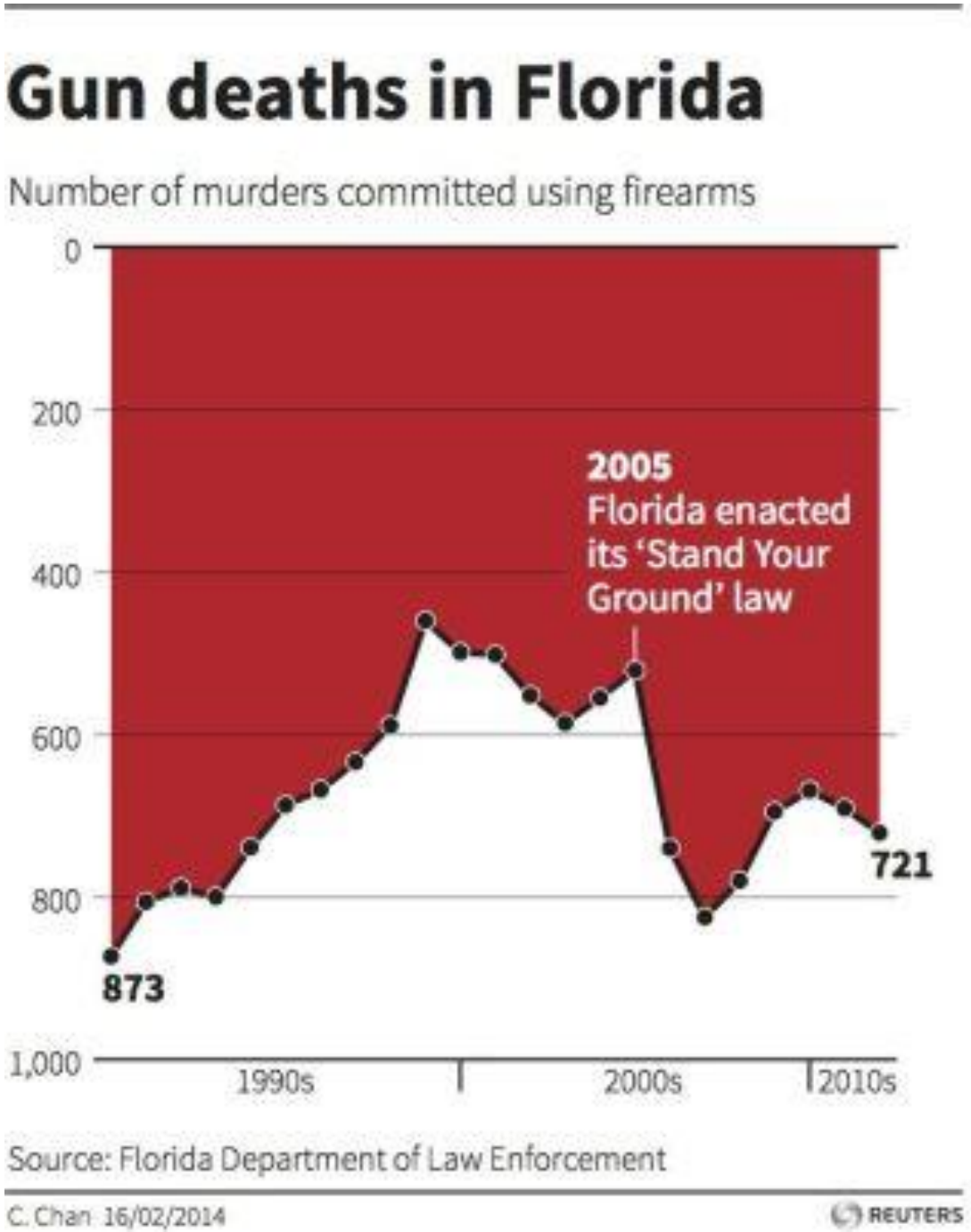
Be mindful of foreground/background!

Graphic on the left depicts gun deaths in Florida

Y-axis is inverted…

Graphic might be perceived as an area chart with the white area

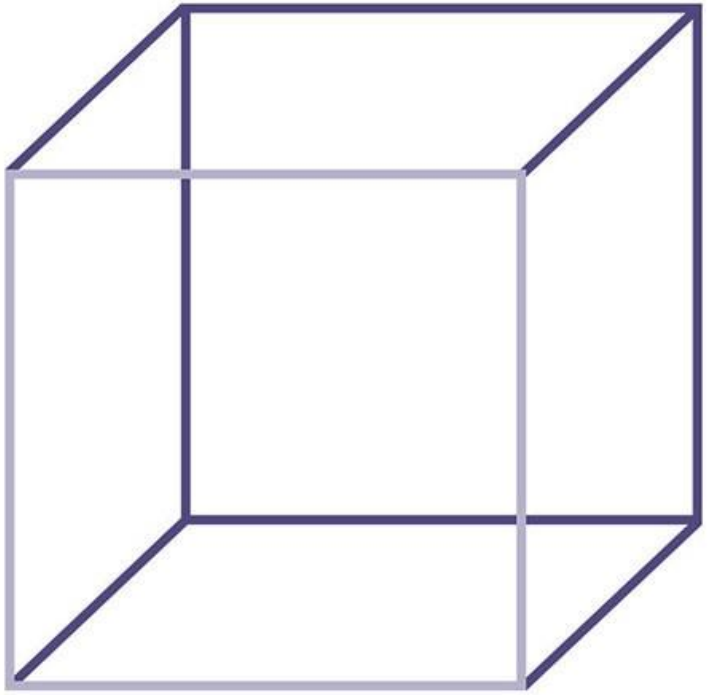
Did gun deaths go up or down after the “Stand Your Ground law”?



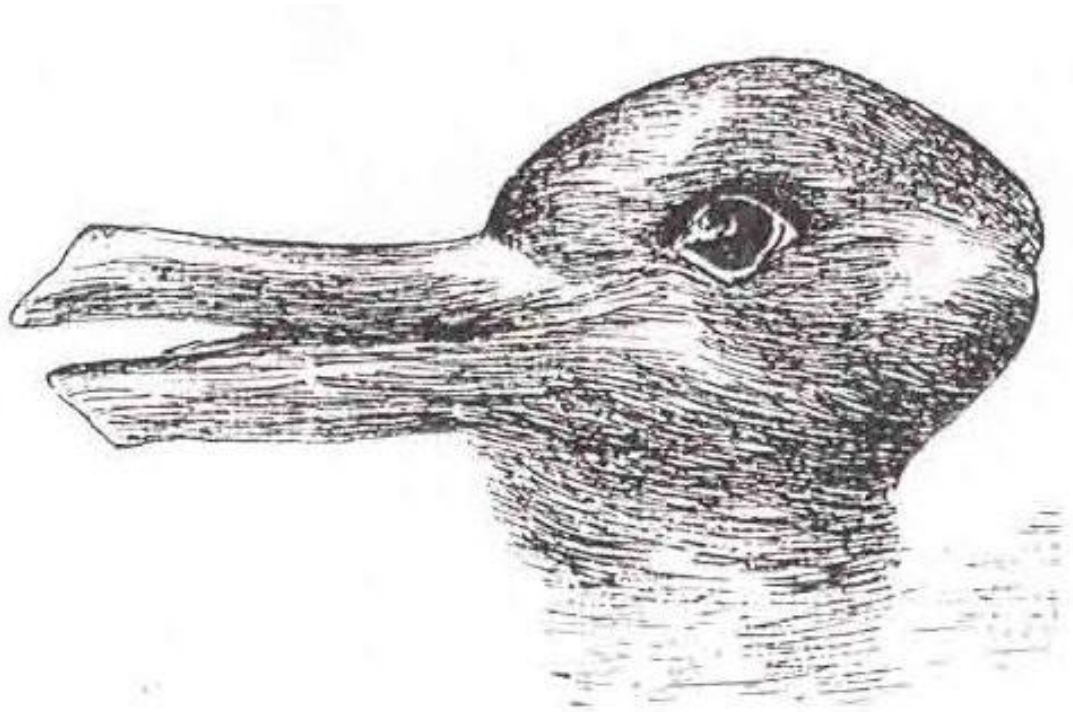
The Necker cube

Ambiguous Figure

Look at the cube and think about where the front face of the cube is. Is it above or below the back face?

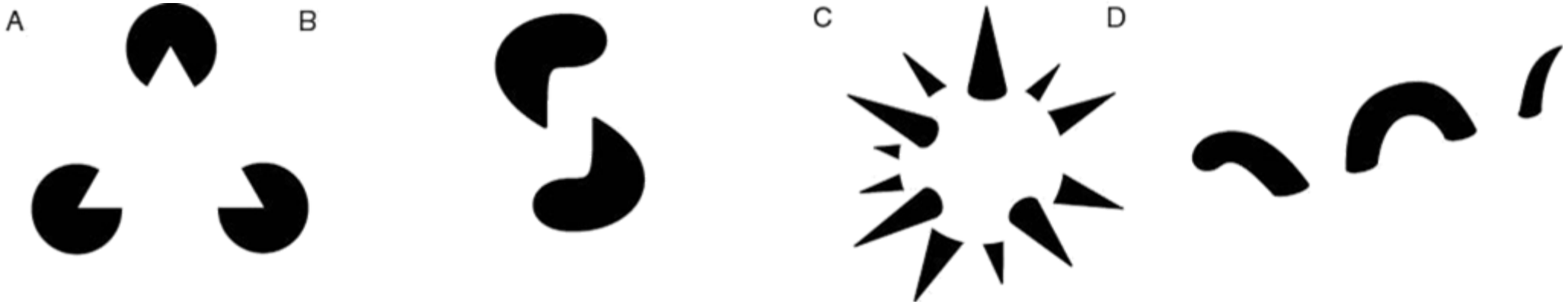


Duck or Rabbit?



Rubin’s Vase

Constructive perception



A: Kanizsa triangle

B: S-shape

C: Three-dimensional ball

D: Nessie

Constructive perception

A: Kanizsa triangle

B: S-shape

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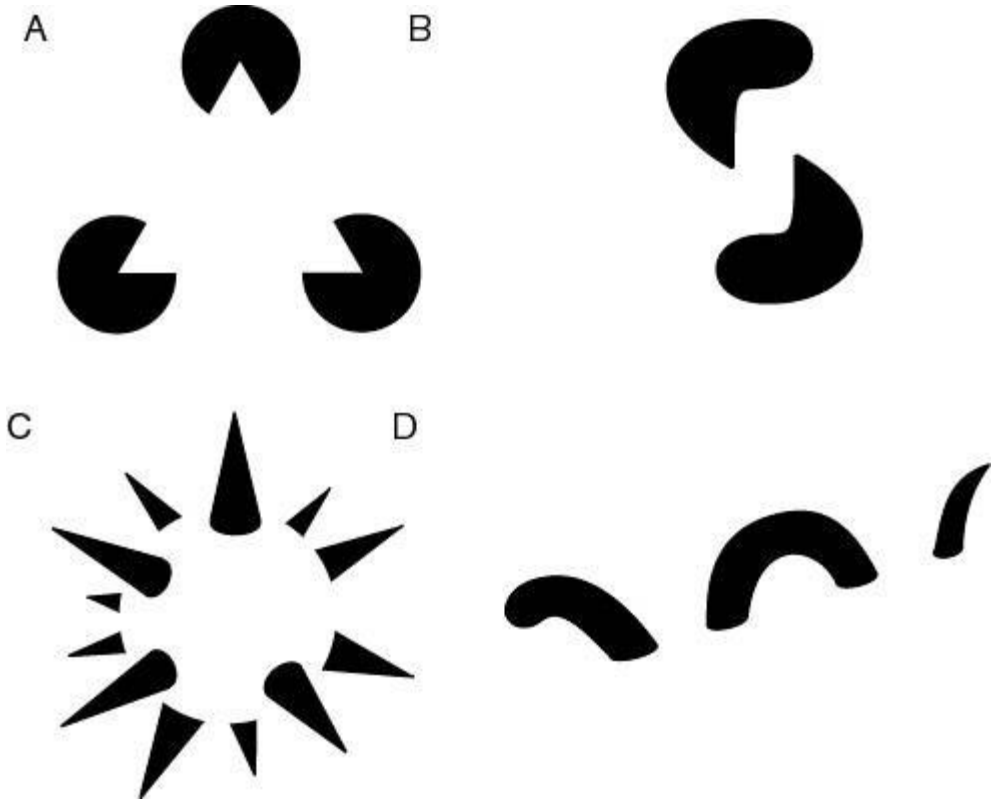
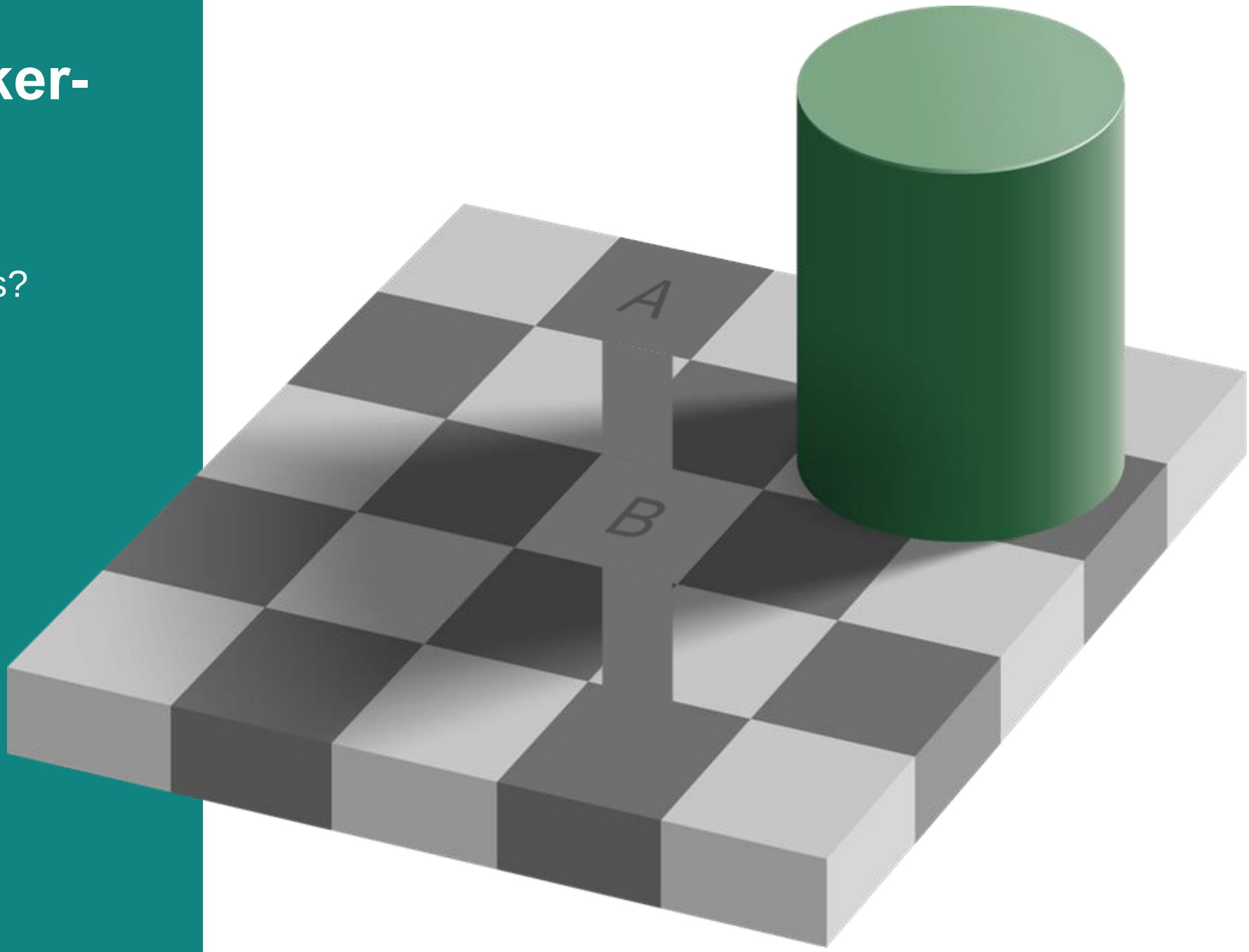


Adelson’s Checker-Shadow illusion

Are A and B different shades?



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After **7.6 Million** tweets it's time to seperate the fact from fiction

- **3,622,960 Visitors** to romanoriginals.co.uk to romanoriginals.co.uk in 48 hours
- **2,214,343** uses of #TheDress
- **Covered on over 150 Networks** including BBC Worldwide, SKY, CNN, FOX, ABC, CBS, Globo TV, NTN24, Nippon TV and more...

- **70%** of people asked actually saw White and Gold instead of Blue and Black
- **73 Million** views of #TheDress across all social media channels
- **34 Minutes** was the amount of time it took for romanoriginals.co.uk to sell out of #TheDress

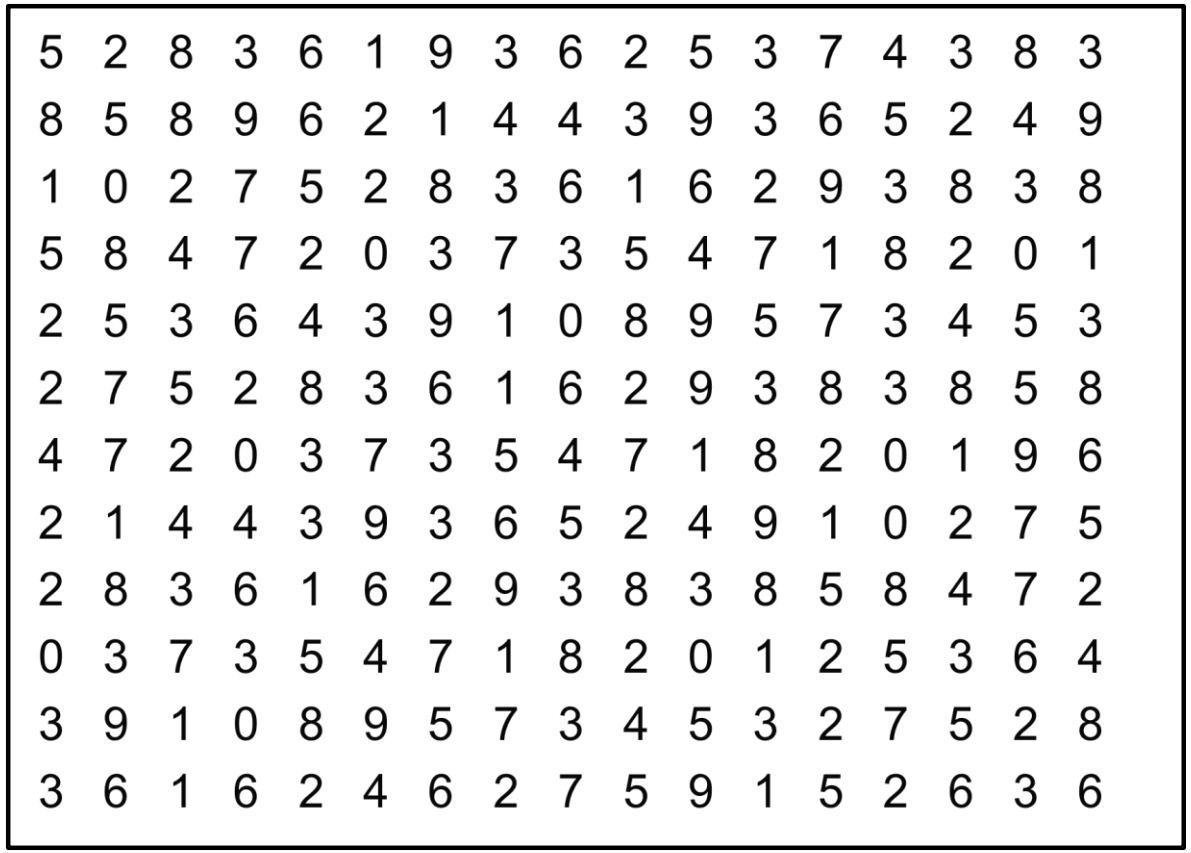
The mind seeks patterns…

When data is presented in certain ways, the patterns can be readily perceived. If we can understand how perception works, our knowledge can be translated into rules for displaying information”

(Colin Ware, 2013)

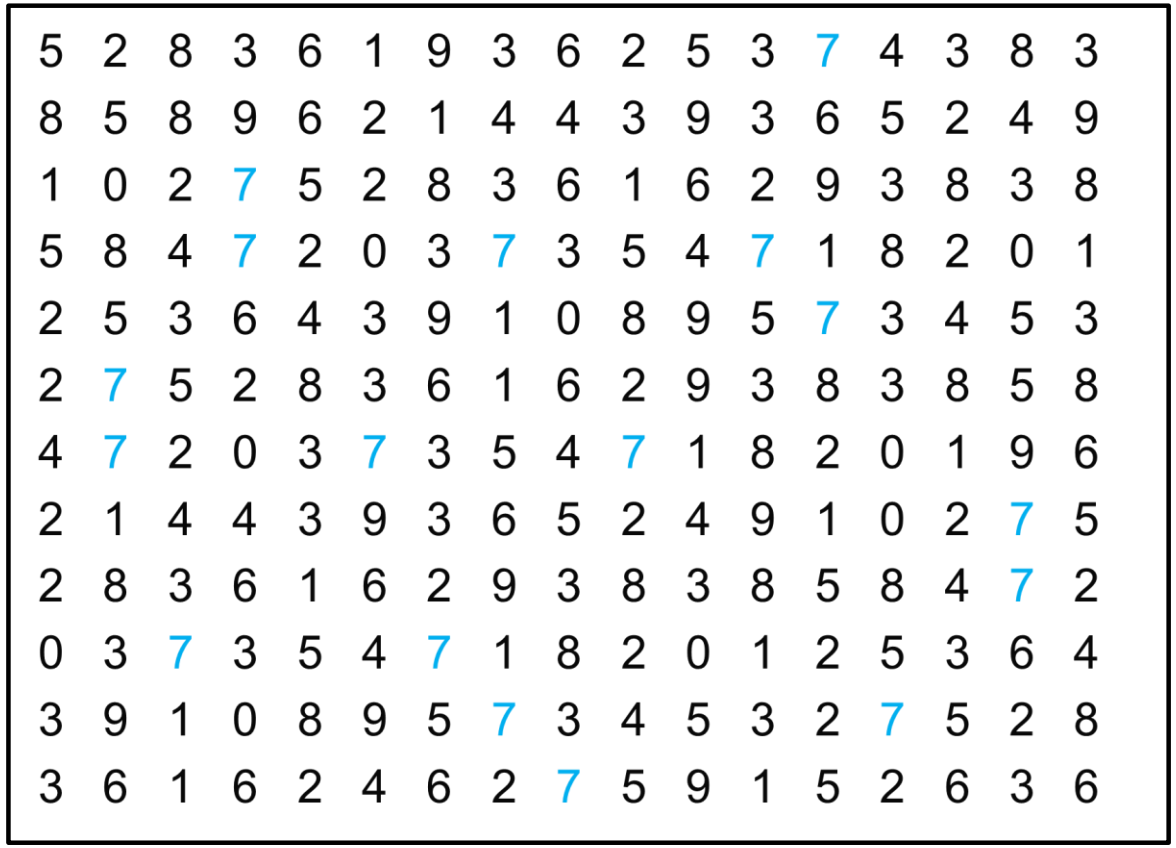
Pre-attentive attributes

How many times does the number seven appear?

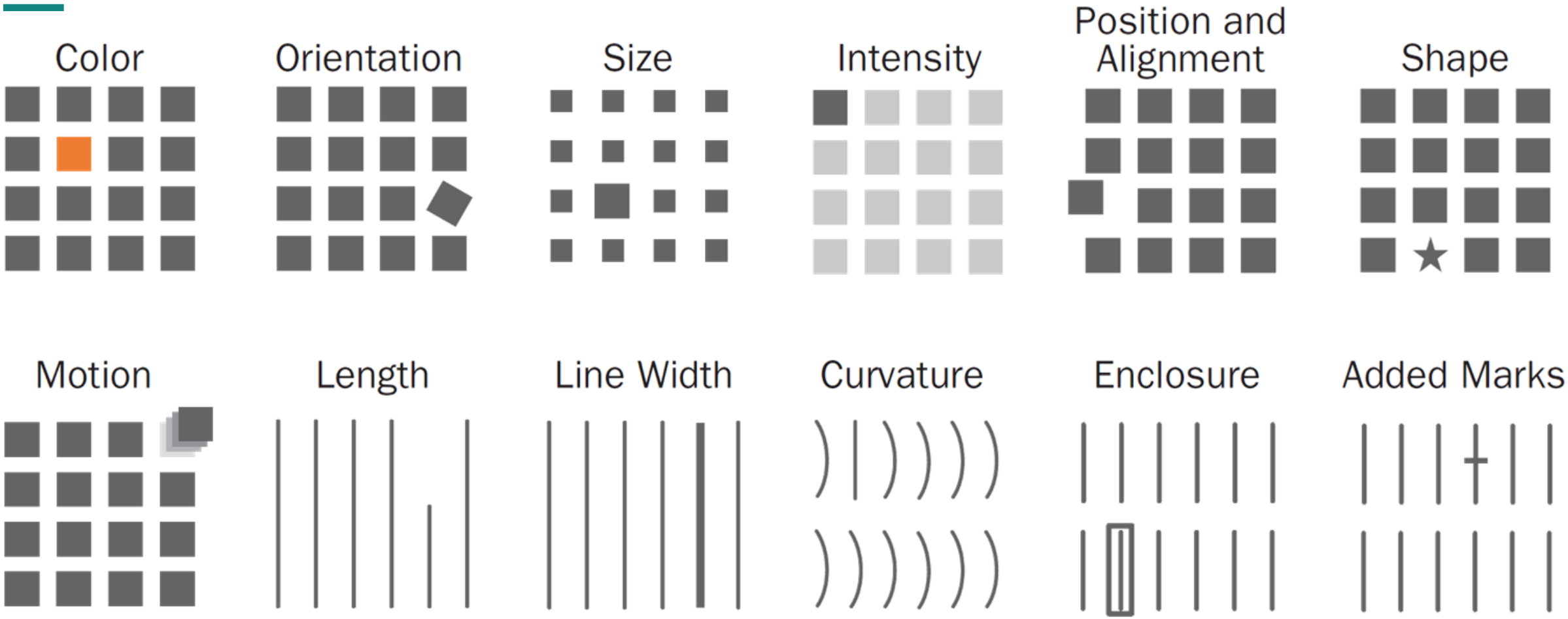


Pre-attentive attributes

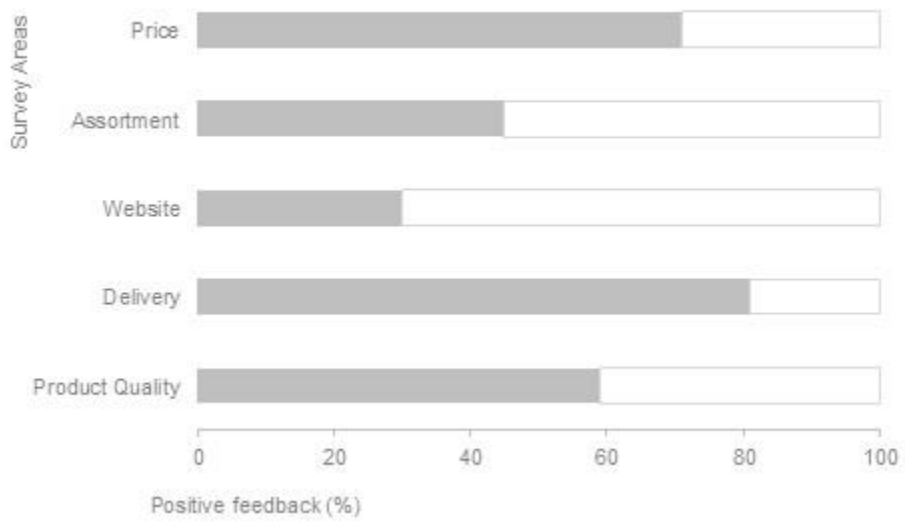
Easier now?

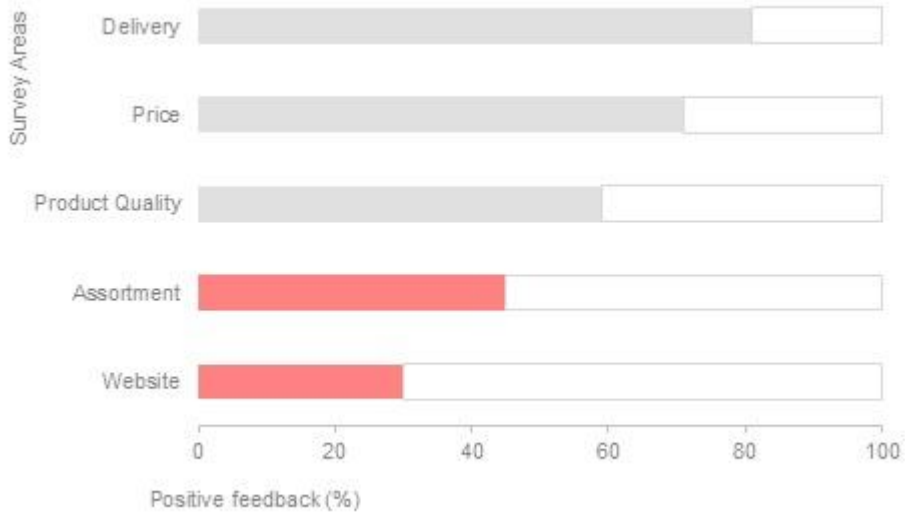


Common pre-attentive attributes



Example: Colours and length





From [Preattentive Attributes in Visualization - An Example (daydreamingnumbers.com)]

Another example

Sales & Profit Table

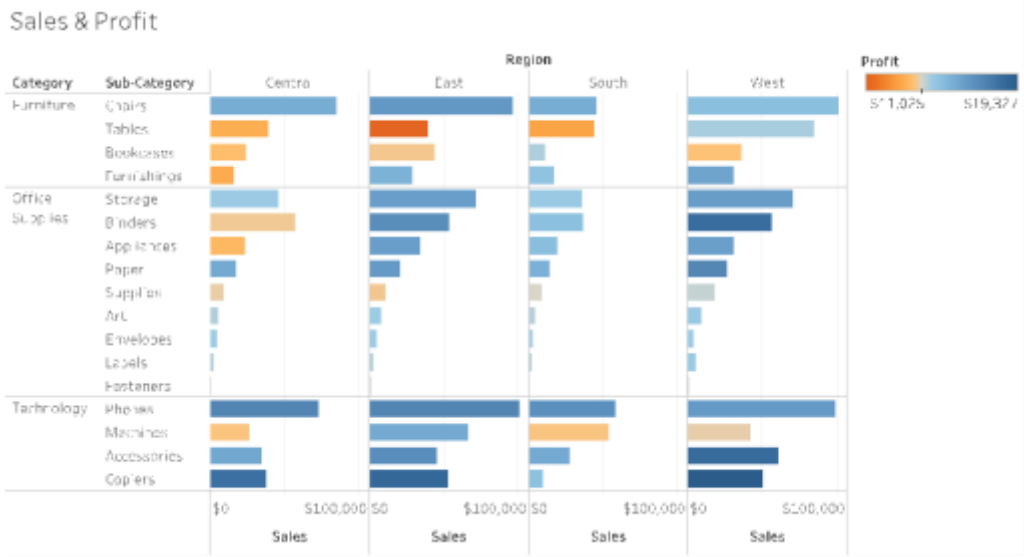
		Region							
		Central		East		South		West	
Category	Sub-Category	Sales	Profit	Sales	Profit	Sales	Profit	Sales	Profit
Furniture	Chairs	85,230.65	6,587.72	95,260.68	8,367.77	45,175.45	6,617.09	101,481.33	4,027.58
	Tables	39,154.97	(3,558.65)	38,738.81	(1,325.33)	43,916.79	(4,623.06)	84,754.56	1,482.61
	Bookcases	24,157.18	(1,397.90)	43,819.33	(1,167.53)	10,899.36	1,339.49	36,004.12	(1,646.51)
	Furnishings	15,254.37	(3,900.22)	29,071.39	9,891.41	17,300.68	3,442.68	30,072.73	7,641.27
Office Supplies	Storage	45,930.12	1,969.84	71,612.58	8,389.37	35,768.06	2,274.30	70,532.86	8,645.32
	Binders	56,923.26	(1,042.64)	52,496.00	11,267.96	37,030.34	3,900.66	55,961.11	16,095.80
	Appliances	23,582.03	(2,639.67)	34,738.47	8,391.47	19,525.33	4,723.94	30,236.34	8,761.21
	Paper	17,481.90	6,971.90	20,172.60	8,015.37	14,150.88	5,847.06	26,663.72	12,119.24
	Supplies	3,467.37	(661.89)	10,760.12	(1,155.14)	8,318.93	1.98	18,127.12	626.05
	Art	5,765.34	1,195.16	7,485.76	2,899.94	4,655.02	1,058.59	9,212.07	2,374.10
	Envelopes	2,636.87	1,777.53	4,375.67	2,812.41	3,345.56	1,765.48	7,118.10	1,908.76
	Labels	2,451.17	1,073.08	2,602.53	1,129.25	2,353.18	1,048.77	5,078.73	2,303.12
	Fasteners	778.03	238.57	819.72	253.99	513.32	173.72	983.22	275.79
Technology	Phones	72,403.28	12,323.03	100,614.98	12,314.69	58,364.44	10,767.28	98,684.35	9,113.74
	Machines	26,797.36	(1,436.07)	65,106.17	6,926.64	53,890.96	(2,436.39)	42,444.12	(618.93)
	Accessories	33,956.06	7,251.63	45,033.37	11,195.86	27,276.75	7,004.54	51,154.12	15,484.60
	Copiers	37,259.57	15,008.84	53,219.16	17,022.84	9,299.76	3,659.91	49,779.24	19,327.24

From [Why Visual Analytics? - Tableau]

Another example

From [Why Visual Analytics? - Tableau]

Another example



From [Why Visual Analytics? - Tableau]

Gestalt Principles

Gestalt

“an organized whole that is perceived as more than the sum of its parts.”

Gestalt psychology

School of psychology that emerged in the early twentieth century in Austria and Germany as a theory of perception

The Gestalt School considered the nature of perception as organised wholes

The suggestion is that we tend to perceive objects as part of a greater whole and as elements of more complex systems.

We can work with the idea that the Whole is greater than the sum of the parts.

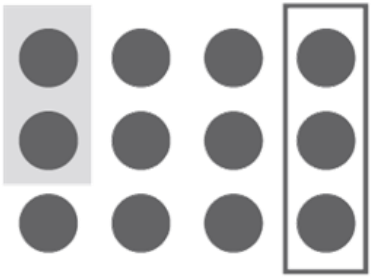
To support this a number of principles/laws were established.

Common Gestalt Principles

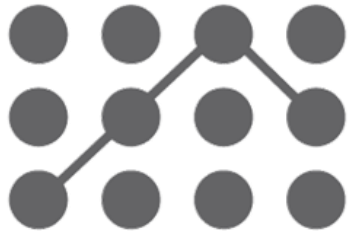
Proximity

Similarity

Enclosure



Connection



Continuity

Closure

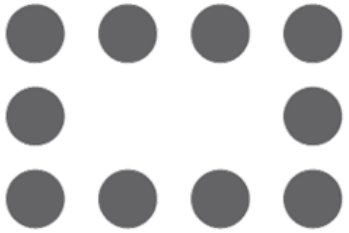
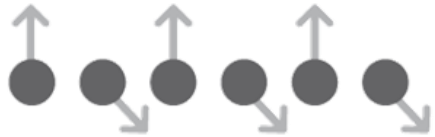


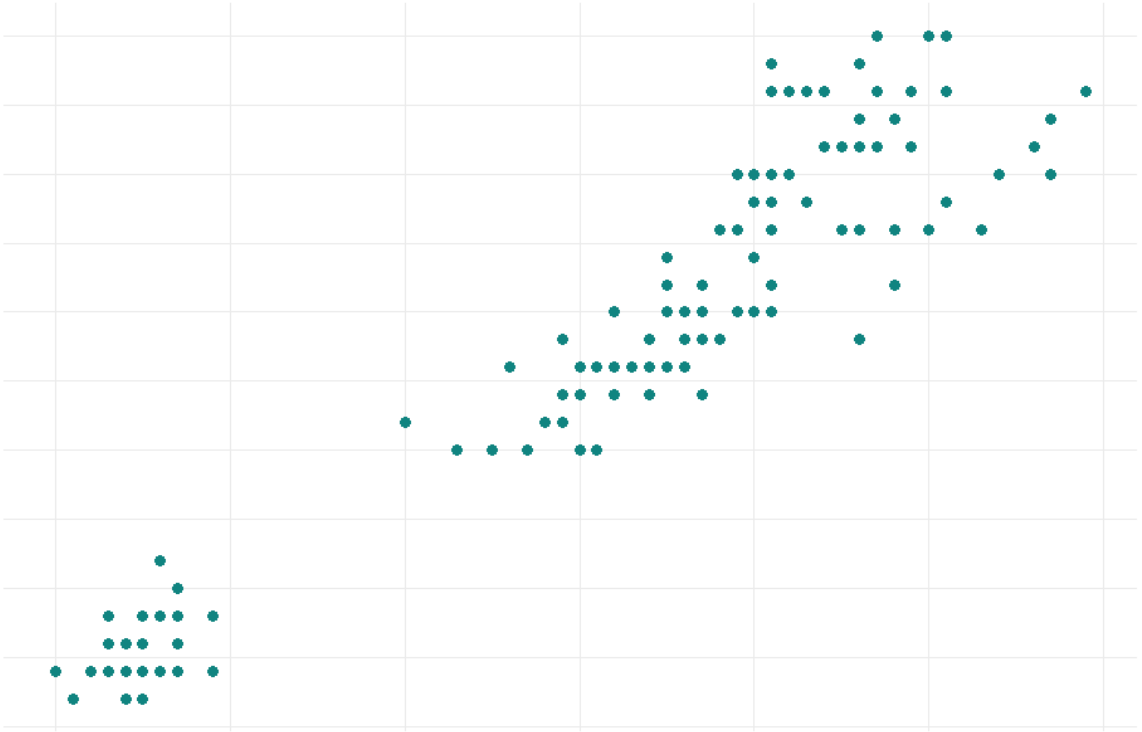
Figure-Ground

Common Fate



Principle of proximity

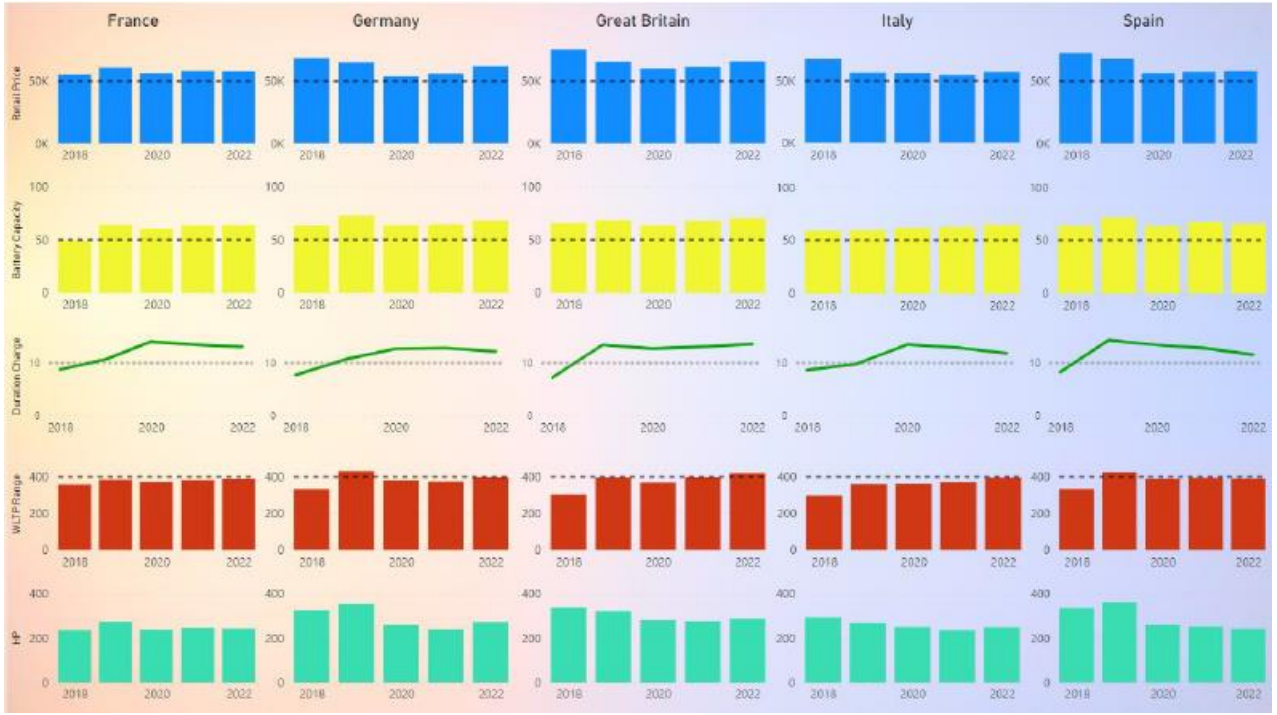
We perceive data elements near to each other as being a related group



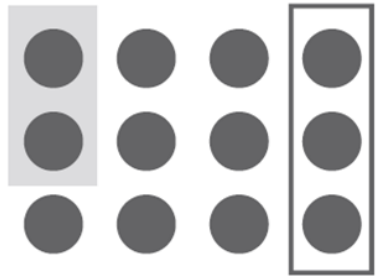
Principle of similarity

When items are alike in their properties, we group them together.

Similarity could be based on size, shape, colour, etc.



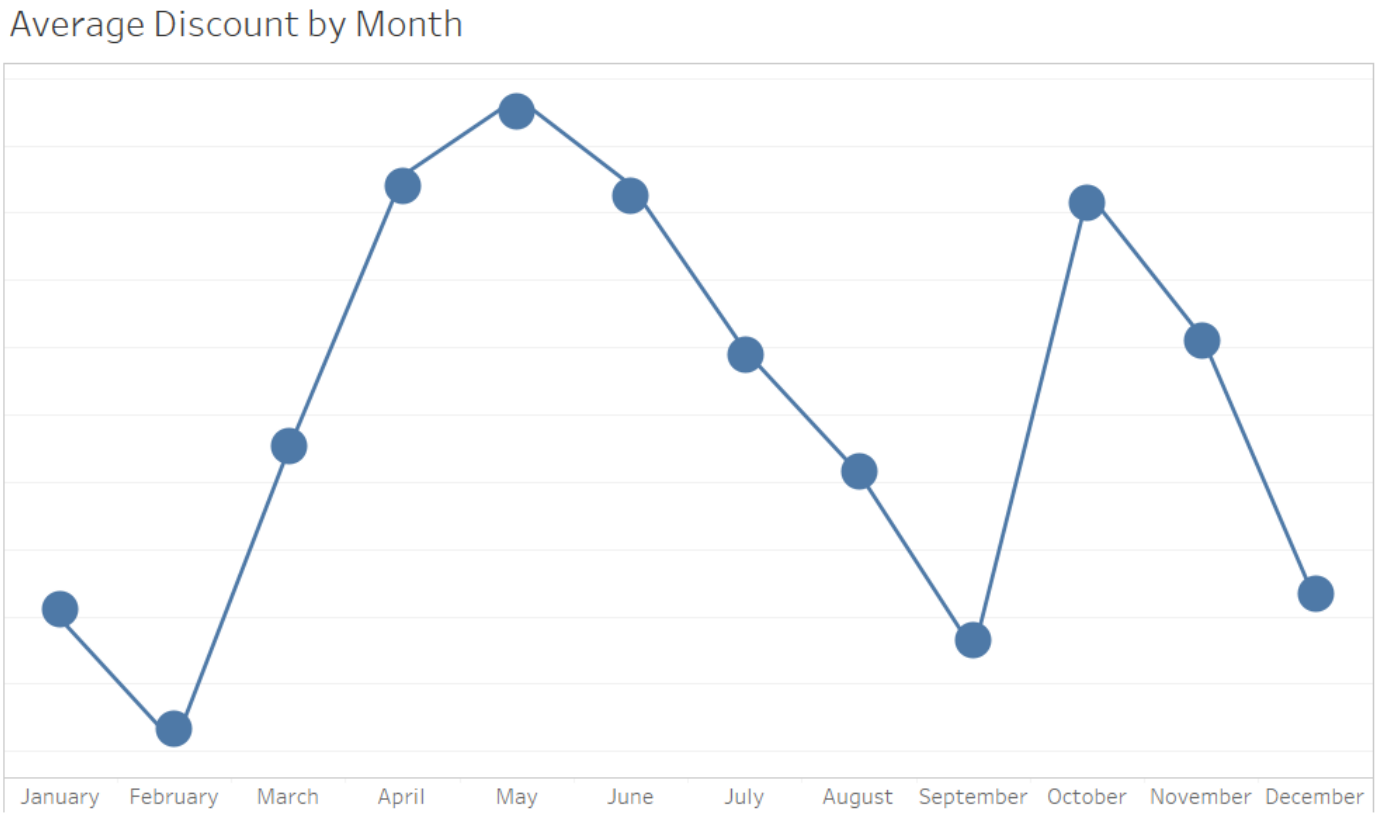
Principle of enclosure



Items surrounded by something such as a line or object, the elements will be perceived as being a group

Principle of connection

Items connected by lines are being related to each other

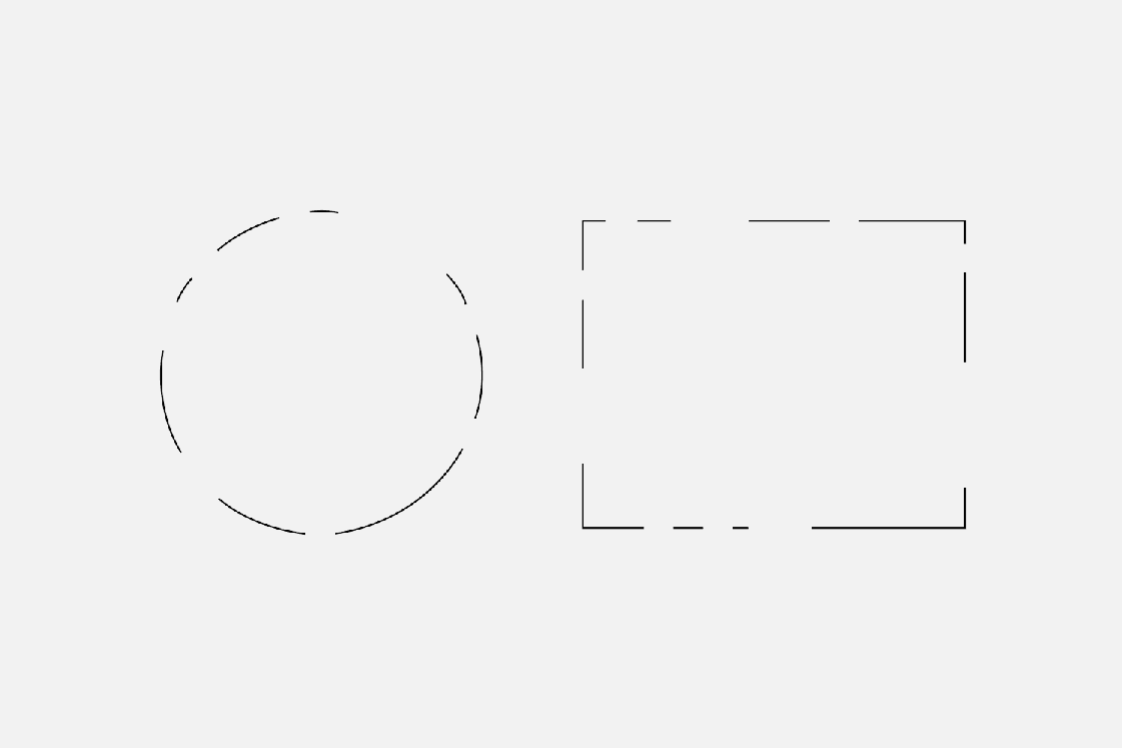


Principle of continuity

When looking at points, we will perceive them as smooth curves or continuous lines, rather than sharp, broken lines

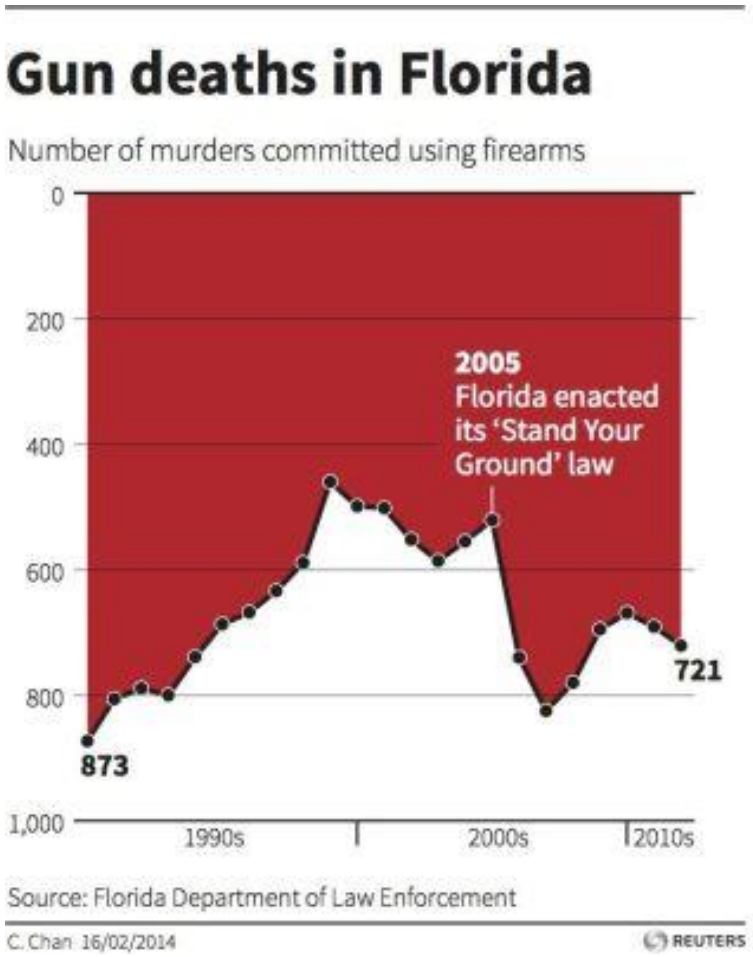
Principle of closure

When we see gaps in lines or formations, we will organise them into complete shapes rather than seeing the parts as separate components



Principle of figure-ground

We see object that appear to be in the foreground as being separate from those in the background

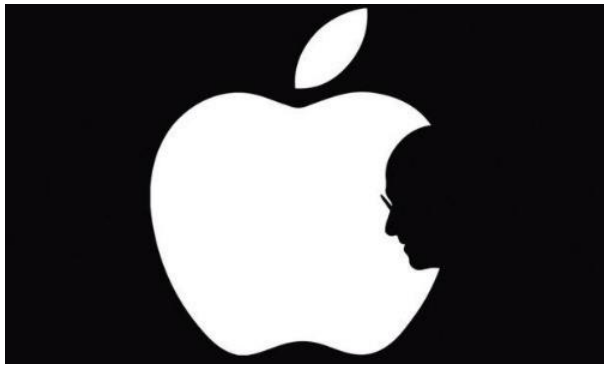


Principle of common fate

If objects move together in the same direction and speed, they are perceived as being a group

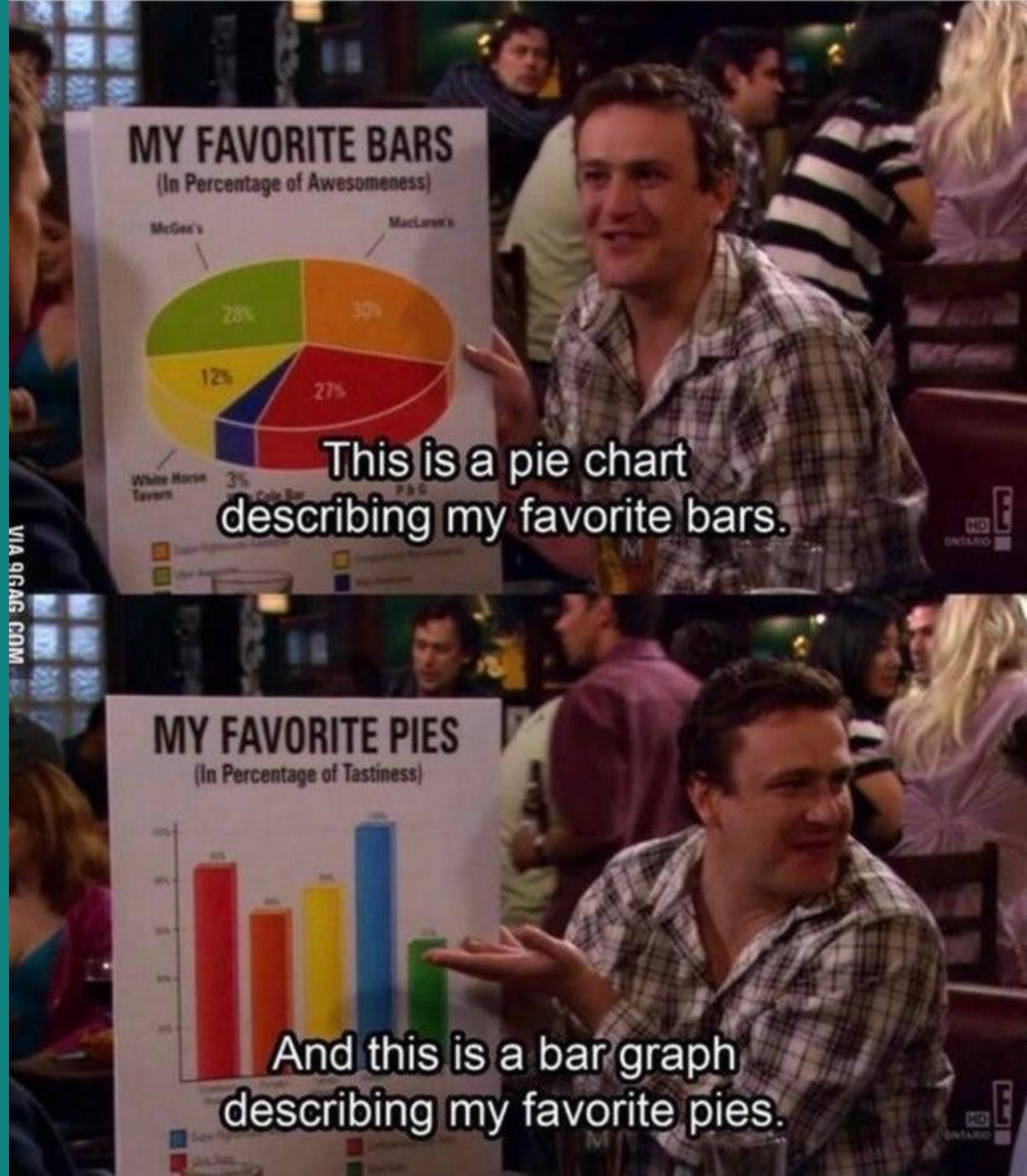
Mainly applicable to animated graphics

More examples



IBM: Proximity, Coca Cola: Continuity, WWF Panda: Closure, Apple: Figure-ground,
Walking dog: Common Fate (but also proximity, closure & continuity)

Chart of the week



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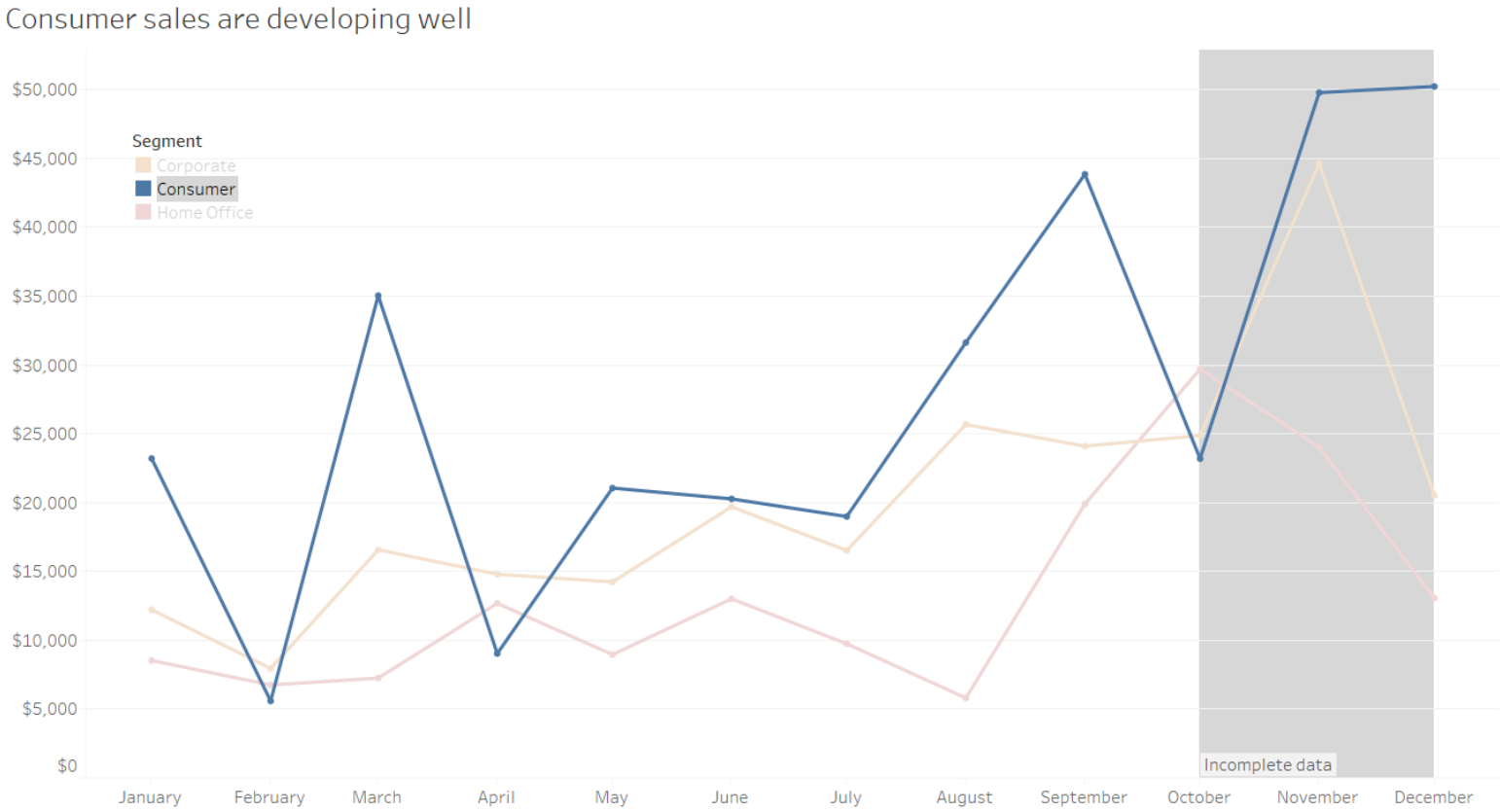
Line chart

Visualise quantitative values over equally spaced time periods

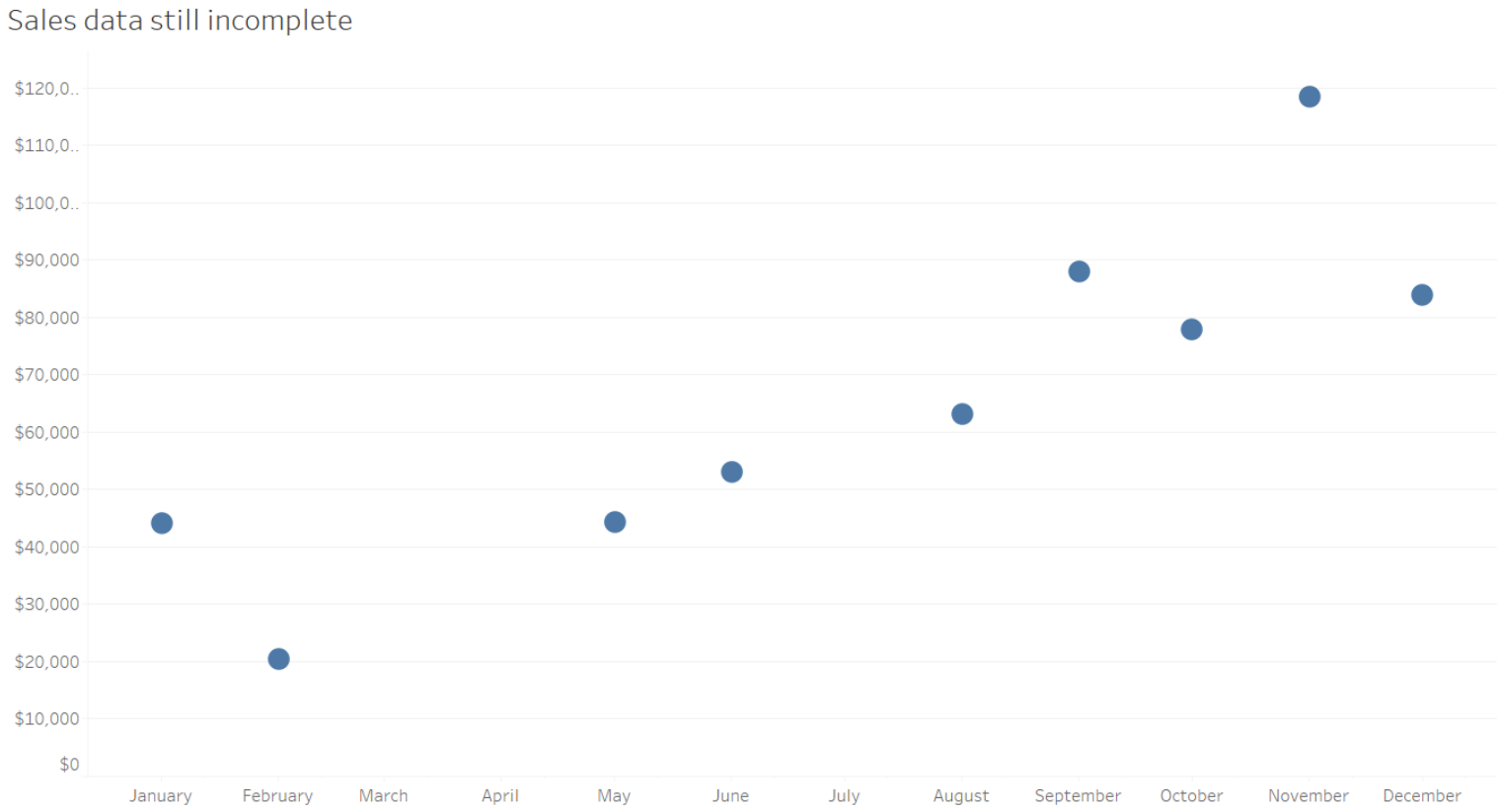
Which Gestalt principles can we observe here?



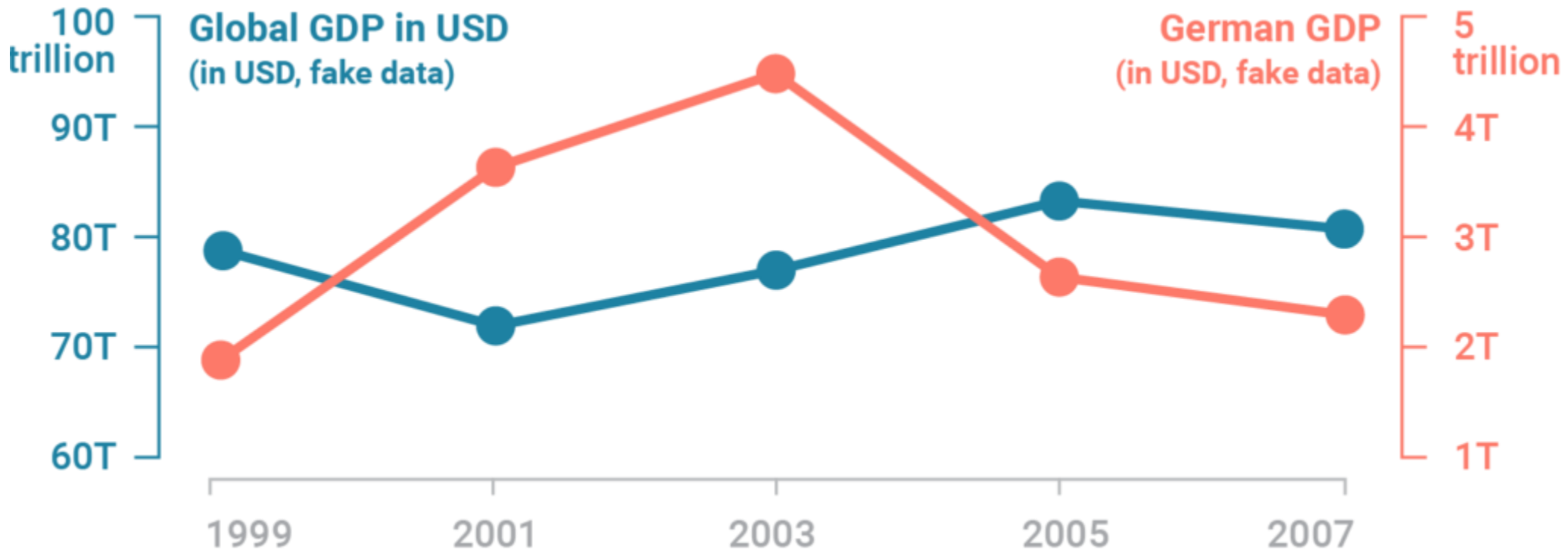
When not to use a line chart…

Don’t use a line chart if the data contains gaps are time periods are not equally spaced

Use scatter chart instead!

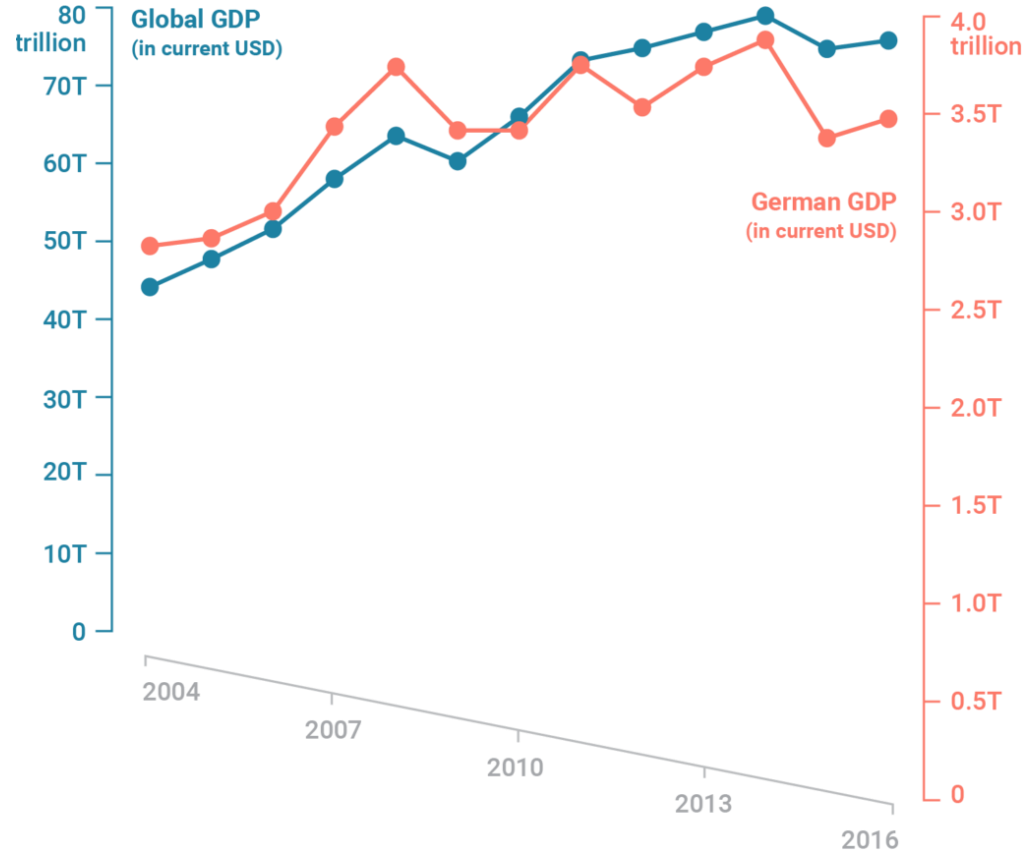


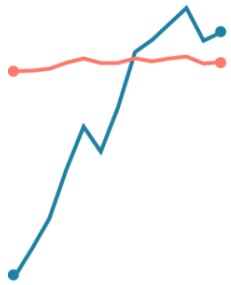
To use two axes or not to use two axes?



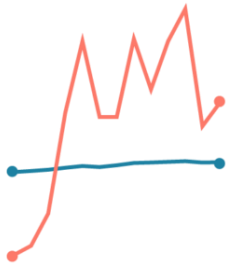
Read more here: [Why not to use two axes, and what to use instead (datawrapper.de)]

Where is the baseline?

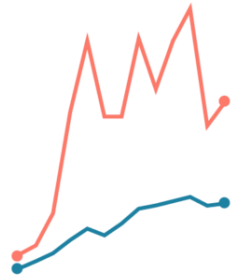




Orange steady,
Blue massively increasing.



Blue steady,
Orange increasing.



Both started at the same level, but Orange increased far more than Blue.

Both started at the same level, but Blue increased far more than Orange.

Both started with the same increase, then Blue raced to the top.

Both steady.

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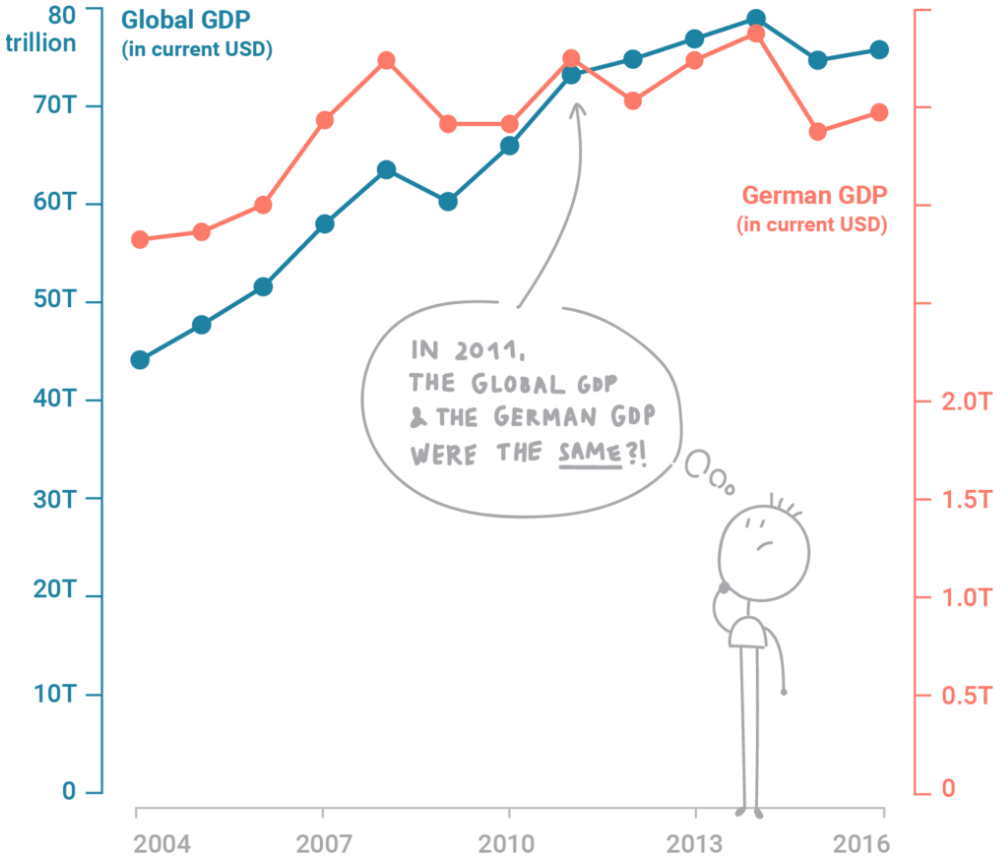
Even the same zero baseline can mislead



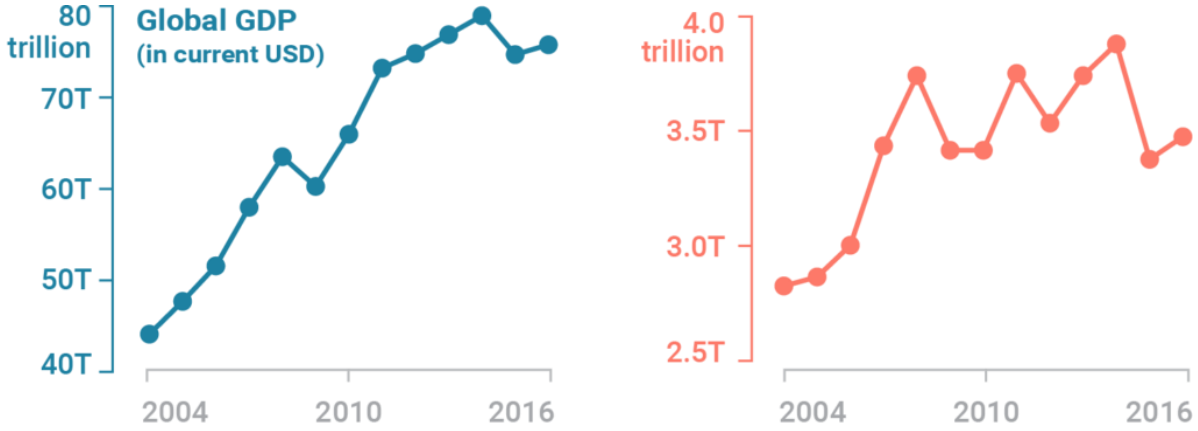
Humans have a tendency to set things in relation if they're close-by

We automatically compare lines and points to each other

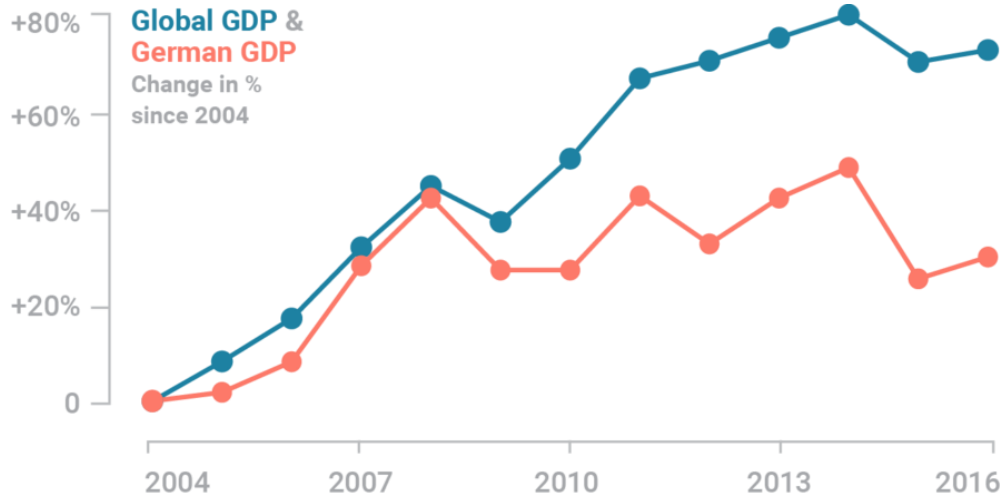
Dual-axis line charts tend to be hard to read, use with caution!

Alternatives

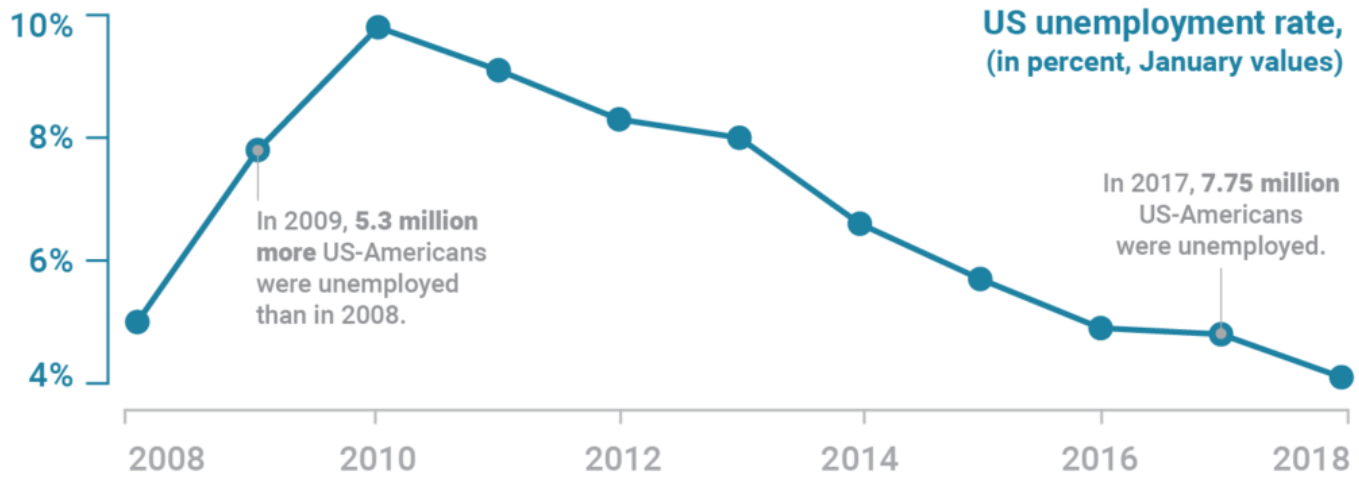
Side-by-side charts



Indexed charts



Prioritise and label



Only show more important data series

Add annotations to give context

This can be a great alternative for dual-axis charts that present absolute and relative numbers of the same measure

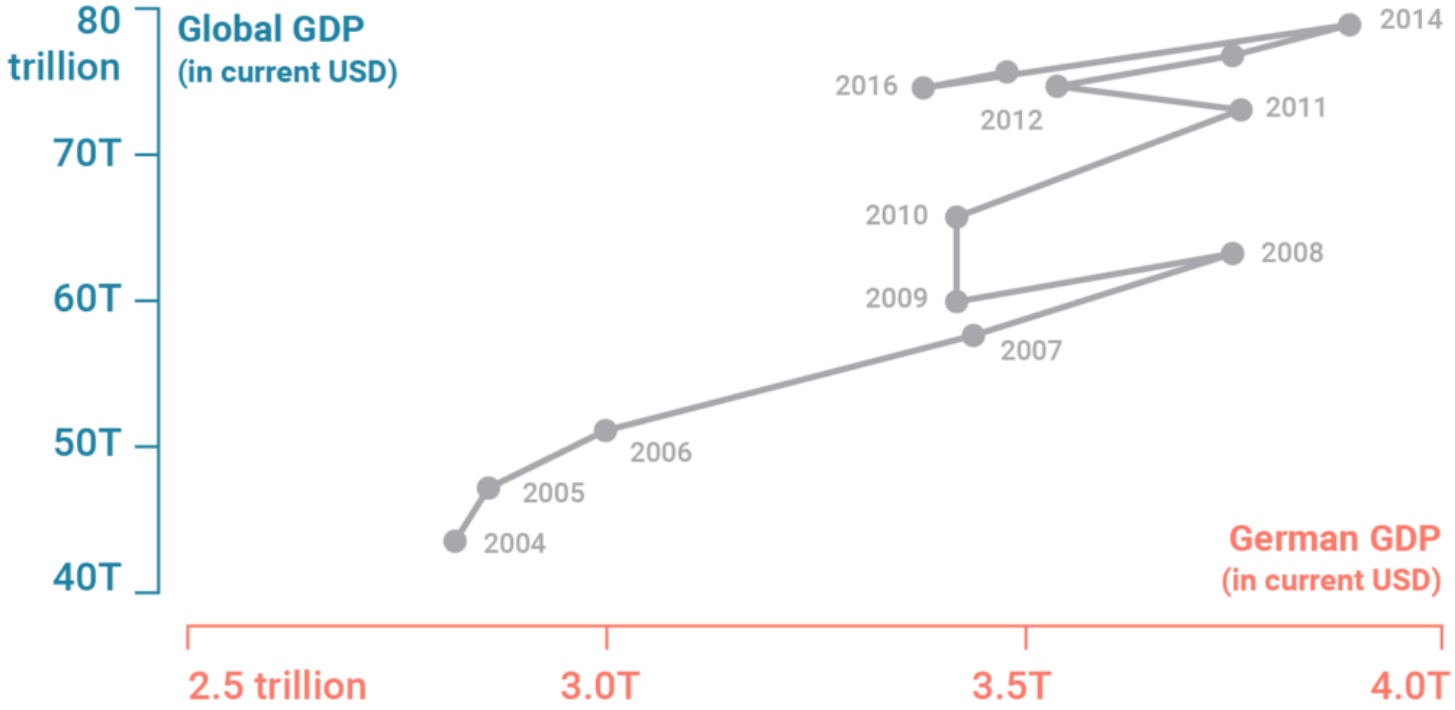
Connected Scatterplots

Keep one variable on the y-axis

Place second variable on x-axis (instead of time)

Time moves along line

Very unintuitive, but may reveal interesting insights



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