



The Art and Science of Data Visualisation

Andy Kirk

Data Visualisation Specialist & Founder of visualisingdata.com

Thank you for joining today's webinar

2 quick housekeeping notes:

- This webinar will be recorded and available on-demand to view later or share with colleagues. You'll receive an email later this week with details.
- Please type your questions into the chat box and we'll get to them during Q&A portion at end of presentation.

Today's presenters



Andy Kirk

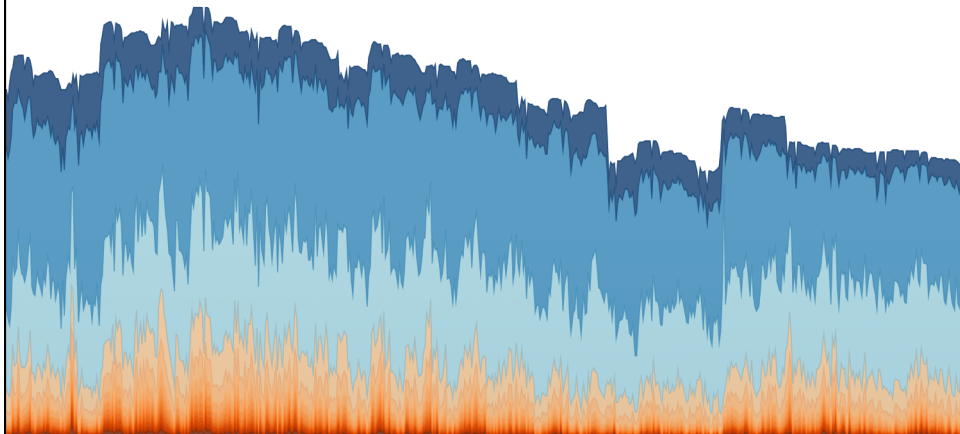
Data Visualisation
Specialist and Founder,
visualisingdata.com



Andy Cotgreave

Social Media Manager,
Tableau Software

Help **people**
see and **understand**
their **data**



The Tableau Revolution

Fast and easy analytics for everyone



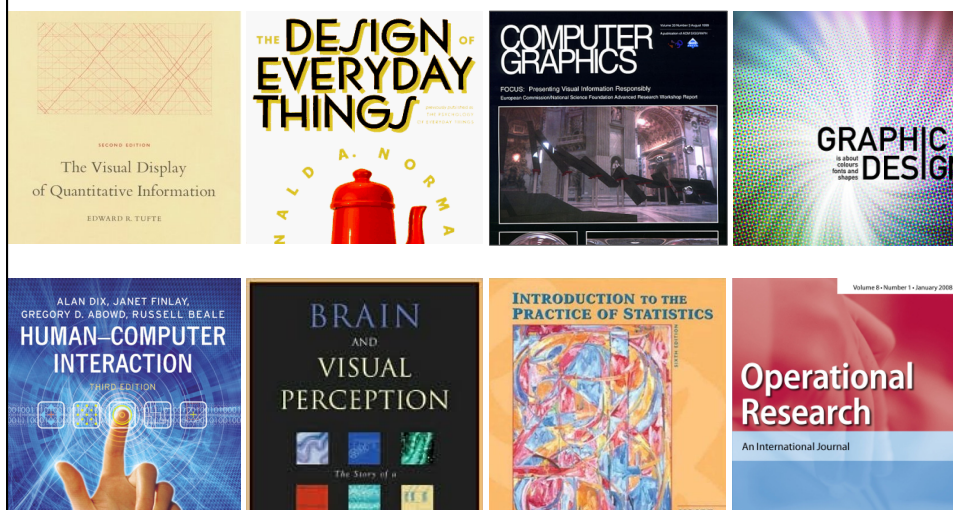
THE ART AND SCIENCE OF DATA VISUALISATION

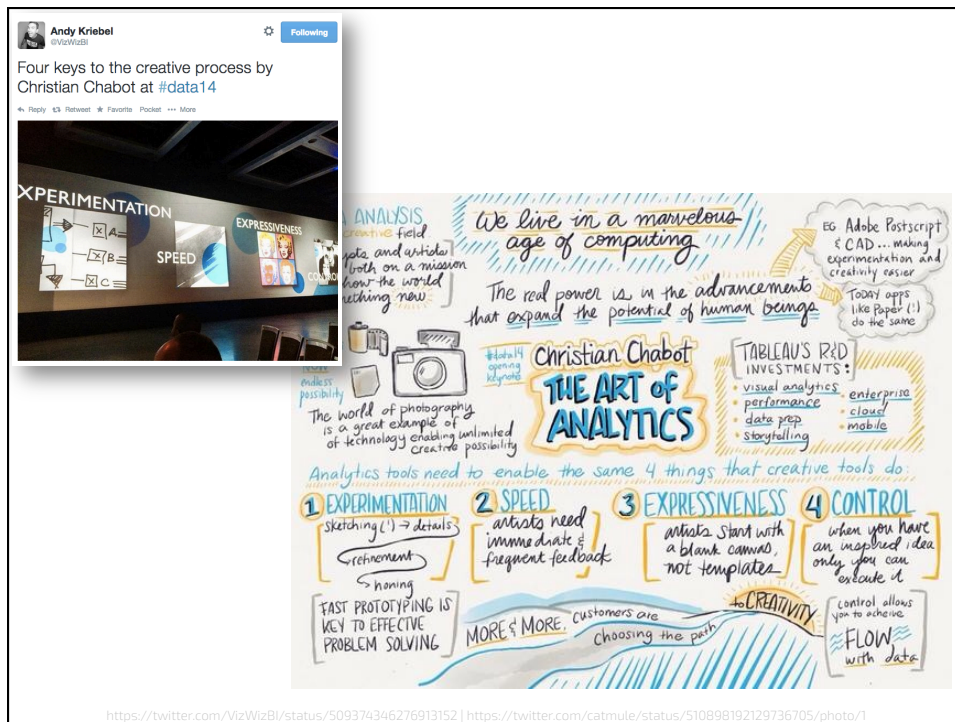
Andy Kirk
@visualisingdata

Blog editor, trainer, lecturer, researcher, author,
design consultant, speaker, twitterer, impostor...



A fascinating recipe of different sensibilities





The converging characteristics of contemporary data visualisation design

Science

Art



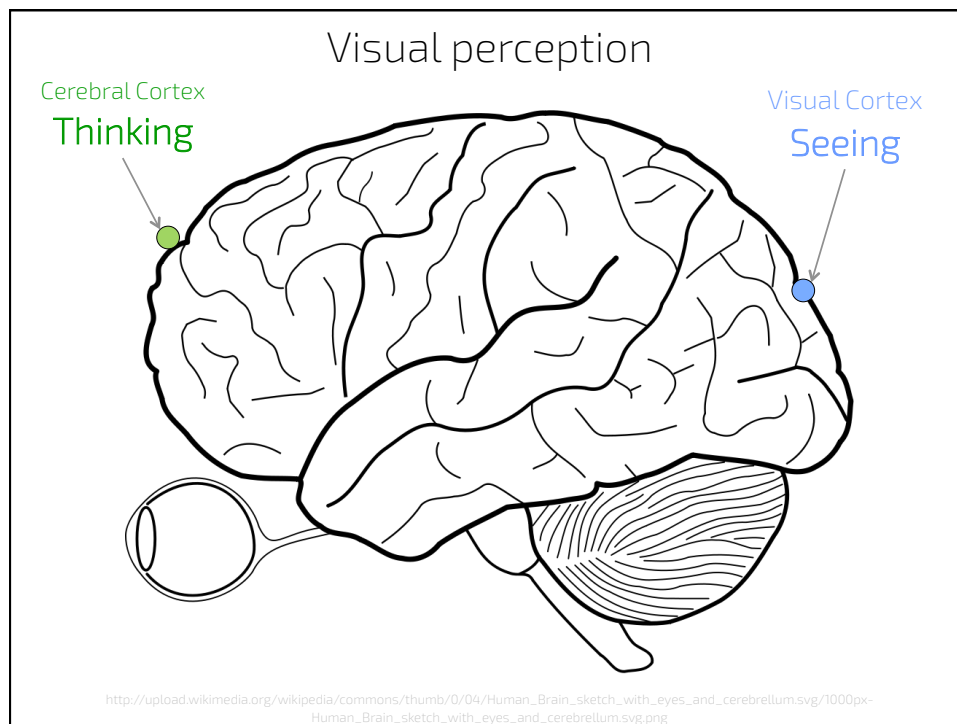
<http://www.hybridtweaks.com/wp-content/uploads/2012/07/valuev-holyfield.jpg>

SCIENCE
Truth, evidence, rules

Getting visualisation right is much *more a science* than an art, which we can only achieve by studying human perception.

Stephen Few

http://www.interaction-design.org/encyclopedia/data_visualization_for_human_perception.html



Visual perception



Law of Similarity:

Items that are similar tend to be grouped together.

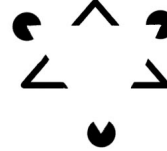
In the image above, most people see vertical columns of circles and squares.



Law of Pragnanz:

Reality is organized or reduced to the simplest form possible.

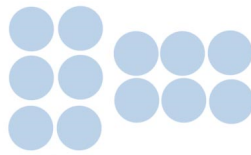
For example, we see the image above as a series of circles rather than as many much more complicated shapes.



Law of Closure:

Objects grouped together are seen as a whole.

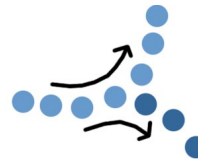
We tend to ignore gaps and complete contour lines. In the image above, there are no triangles or circles, but our minds fill in the missing information to create familiar shapes and images.



Law of Proximity:

Objects near each other tend to be grouped together.

The circles on the left appear to be grouped in vertical columns, while those on the right appear to be grouped in horizontal rows.



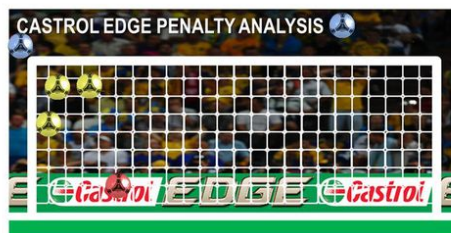
Law of Continuity:

Lines are seen as following the smoothest path.

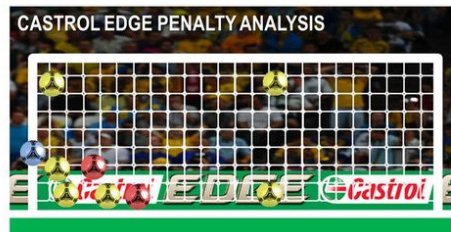
In the image above, the top branch is seen as continuing the first segment of the line. This allows us to see things as flowing smoothly without breaking lines up into multiple parts.

Images from <http://psychology.about.com/od/sensationandperception/ss/gestaltlaws.htm>

Visual perception



DANIELE DE ROSSI – ITALY
ALL TIME

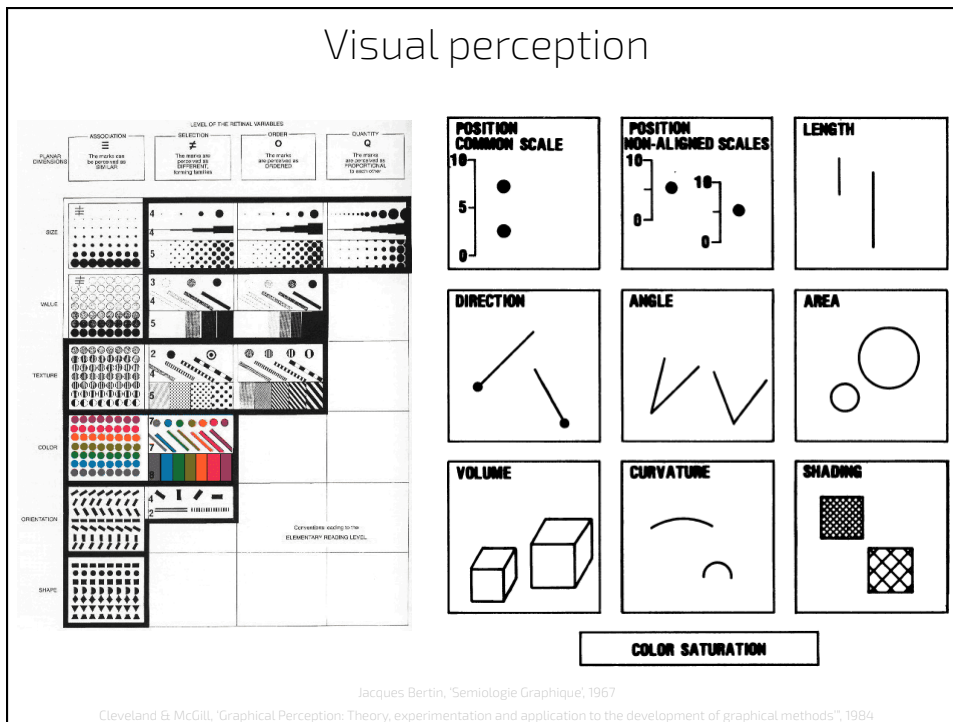


ANDREA PIRLO – ITALY
ALL TIME

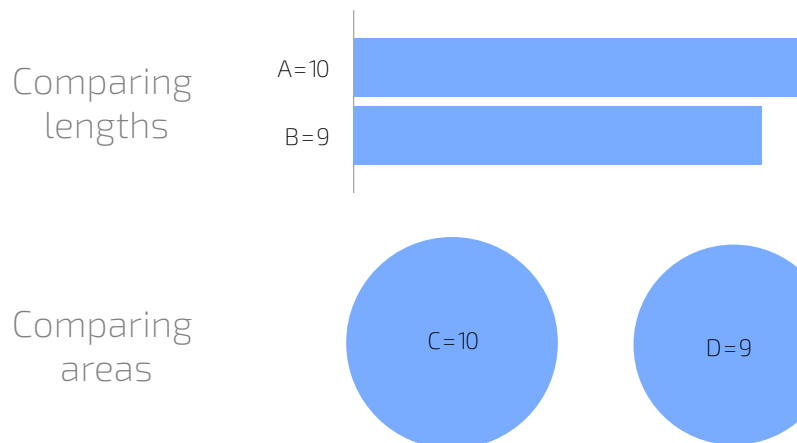


<http://www.mirror.co.uk/sport/football/euro-2012-where-italy-will-place-their-penalties-907506>

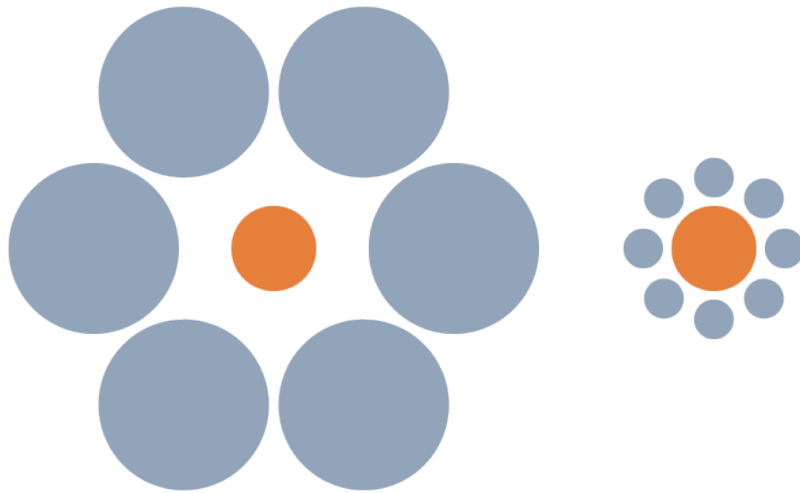
Visual perception



Visual perception

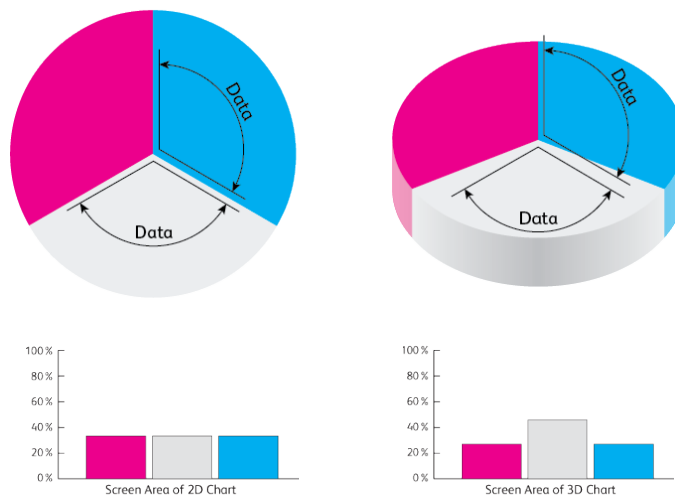


Visual perception



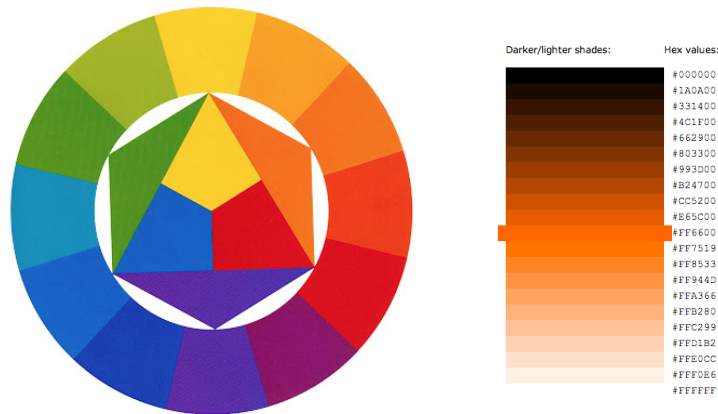
http://en.wikipedia.org/wiki/Ebbinghaus_illusion

Visual perception



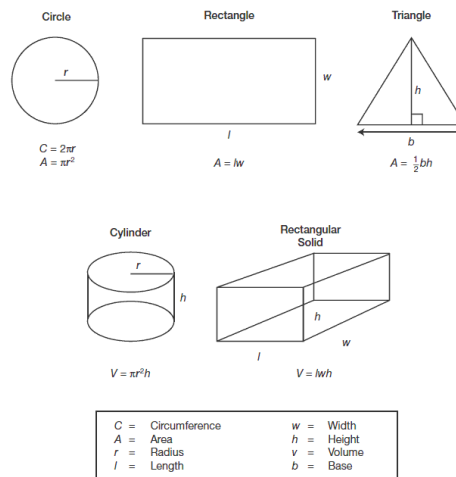
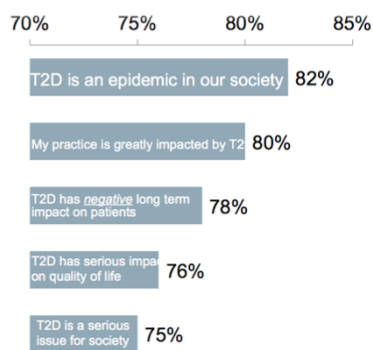
<http://blog.visual.ly/2ds-company-3ds-a-crowd/>

Colour science



<http://bryanchristieblog.blogspot.co.uk/2012/03/my-visual-definition-of-information.html>
http://www.w3schools.com/tags/ref_colorpicker.asp?colorhex=FF66FF

Geometry and mathematics

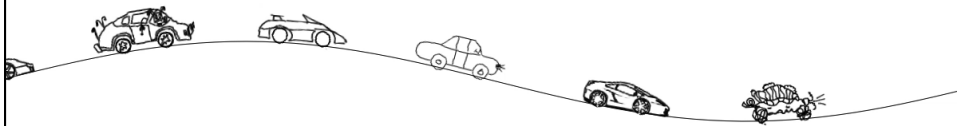


<http://www.education.com/reference/article/geometry1/>

Reduce the reliance on instinct...

Gut feel	→	Data-driven
Taste	→	Justified
Showcasing 'you'	→	Audience-driven
Random approach	→	Systems thinking
Add options	→	Eliminate options

...but everyone has a unique perspective



<http://www.visualisingdata.com/index.php/2013/06/a-short-essay-about-interpretation-doodling-perceptions-and-people/>

Embrace our creative instincts

*There's a strand of the data viz world that
argues that everything could be a bar chart.
That's possibly true but also possibly
[a world without joy.](#)*

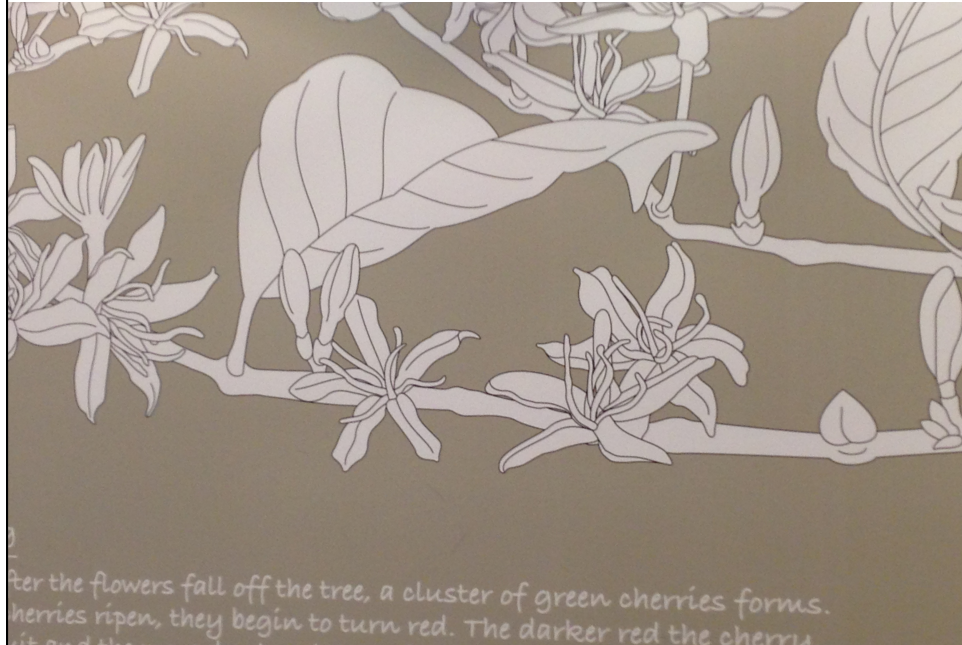
Amanda Cox, New York Times

http://blogs.hbr.org/hbr/hbreditors/2013/03/power_of_visualizations_aha_moment.html

ART

Instinct, judgment, creativity

Be inspired by the world around you



Be inspired by the world around you



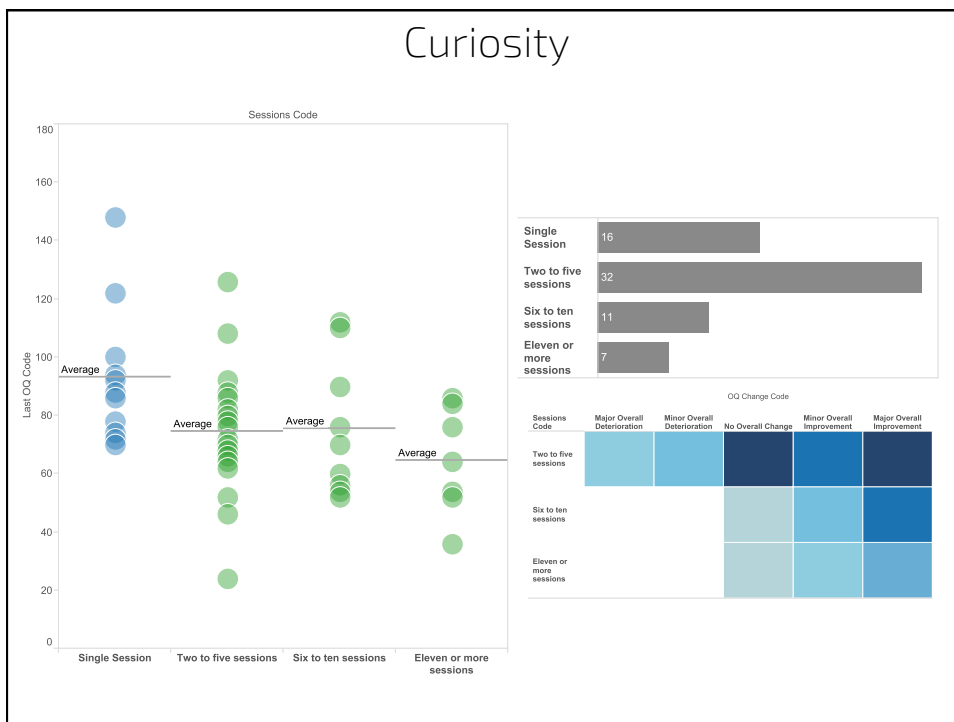
[https://www.google.co.uk/search?q=Argyle+\(pattern\)&safe=off&espv=2&source=lnms&tbm=isch&sa=X&ei=8_a7U_3LLYOV7AagwIHICAGved=0CAVQ_AUoAQ&biw=1946&bih=1234#imgdii=_](https://www.google.co.uk/search?q=Argyle+(pattern)&safe=off&espv=2&source=lnms&tbm=isch&sa=X&ei=8_a7U_3LLYOV7AagwIHICAGved=0CAVQ_AUoAQ&biw=1946&bih=1234#imgdii=_)

Curiosity

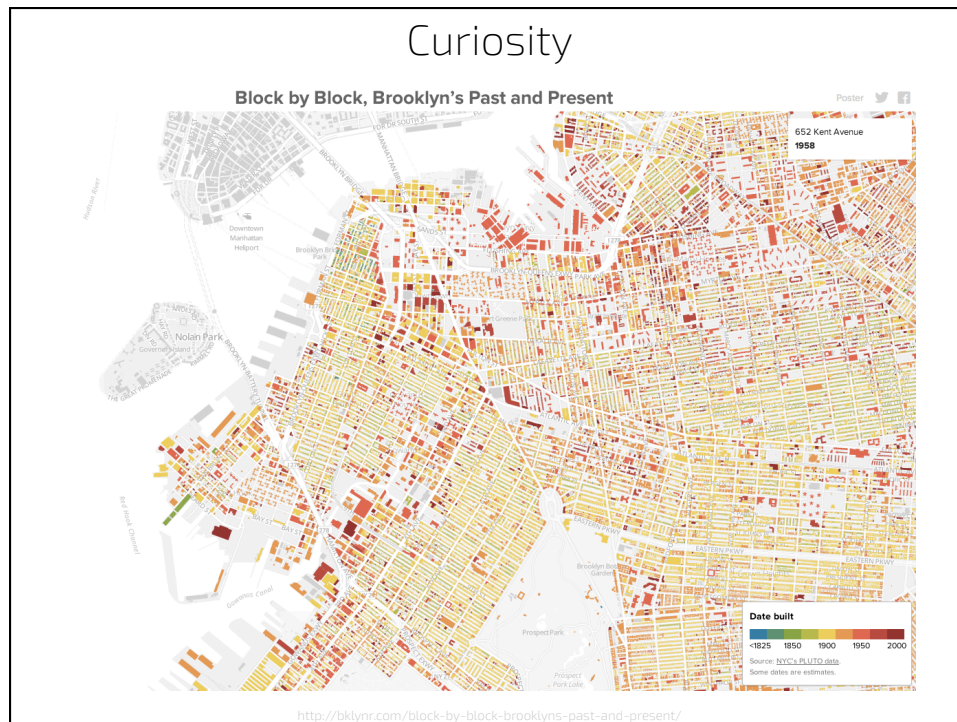


http://cdn0.cosmosmagazine.com/wp-content/uploads/20080314_sherlock_holmes.jpg |
<http://www.idahogoldprospectors.org/wp-content/uploads/2011/10/Gold-Panning.jpg>

Curiosity



Curiosity



The art of the journalist

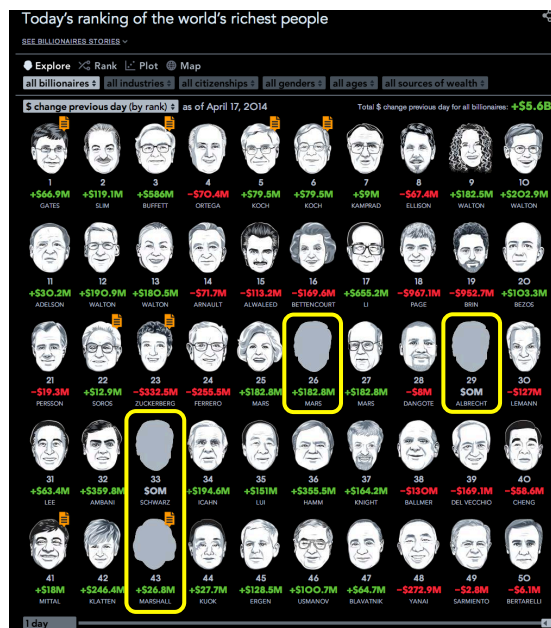


The art of the journalist



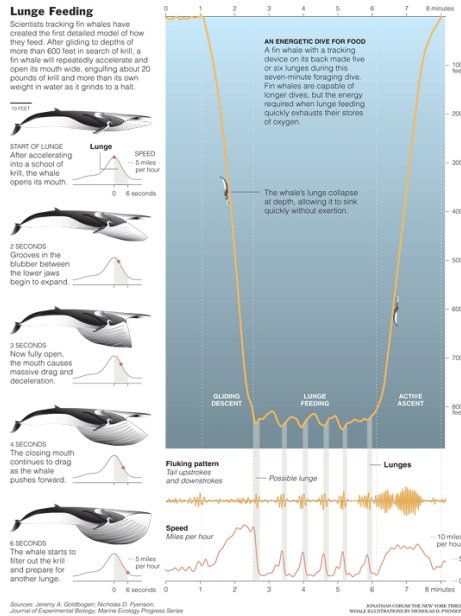
<http://imgur.com/RmXbrDZ.jpg>

The art of the journalist



<http://www.bloomberg.com/billionaires/latest>

The art of the journalist



What is the duration of a single lunge feed?

How deep do whale's dive when feeding?

What is a whale's speed during lunge feeding?

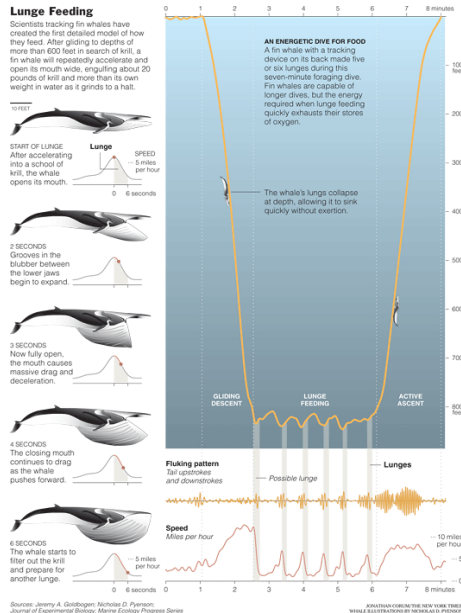
What are the mechanics of the lunge feeding action?

How many tons of krill are consumed in each feed?

How long can a whale maintain the lunge cycle?

<http://13pt.com/projects/nyt071211/>

The art of the journalist



In which seas/oceans do fin whales tend to exist?

What is the population of fin whales?

Is this feeding pattern leading to reduction in krill?

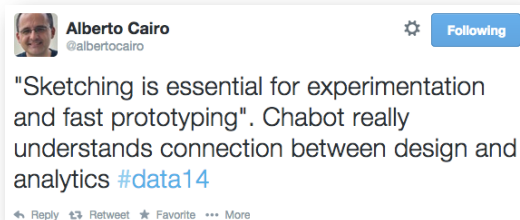
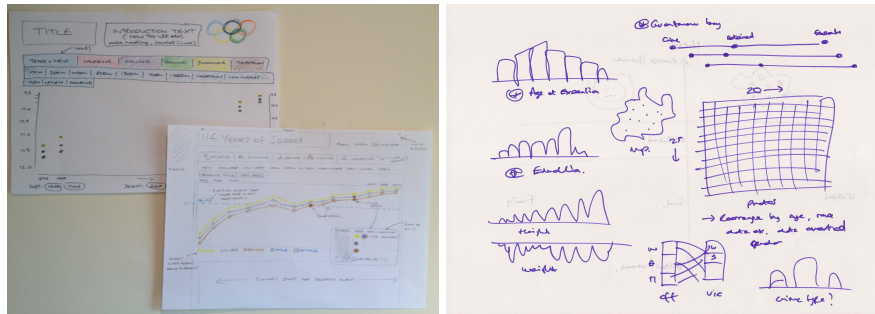
Do all whales follow a similar feeding action?

Does it differ between male/female, young/old?

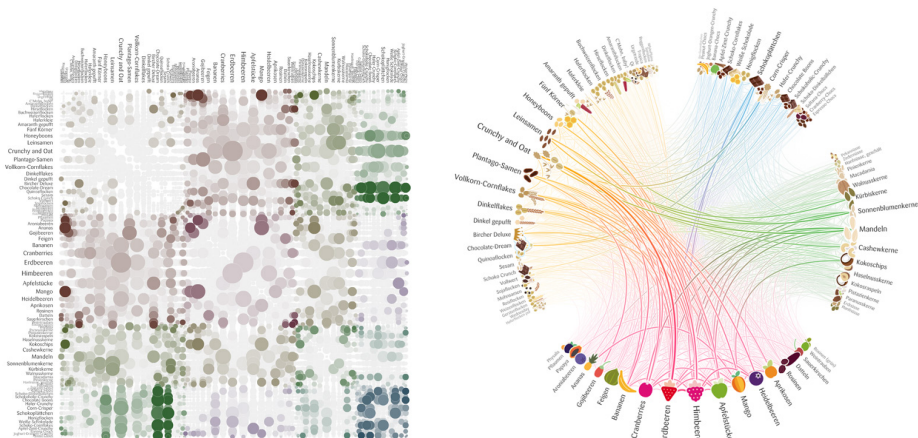
Have these actions changed over time?

<http://13pt.com/projects/nyt071211/>

Importance of sketching



Subject empathy



"I chose the chord diagram over the possibly more revealing matrix design because the matrix doesn't look 'tasty' and muesli shouldn't look like 'fungi'"

Subject empathy

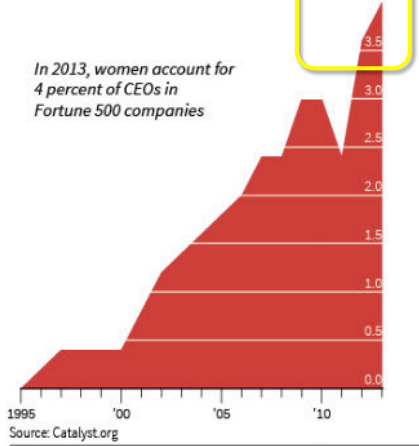
The glass ceiling persists

General Motors named Mary Barra as its next CEO, replacing Al Fazio. The move is a sign of progress in their advancement to the top of Fortune 500 companies.

Women CEOs in Fortune 500 companies

Percent

In 2013, women account for 4 percent of CEOs in Fortune 500 companies



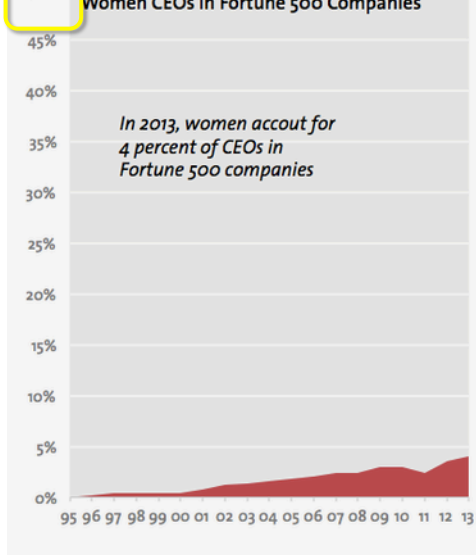
Source: Catalyst.org
S. Culp, 12/10/2013

<http://blogs.reuters.com/data-dive/2013/12/10/gms-new-ceo-is-another-small-crack-in-the-glass-ceiling/>
<http://www.chezoila.com/blog/glass-ceiling>

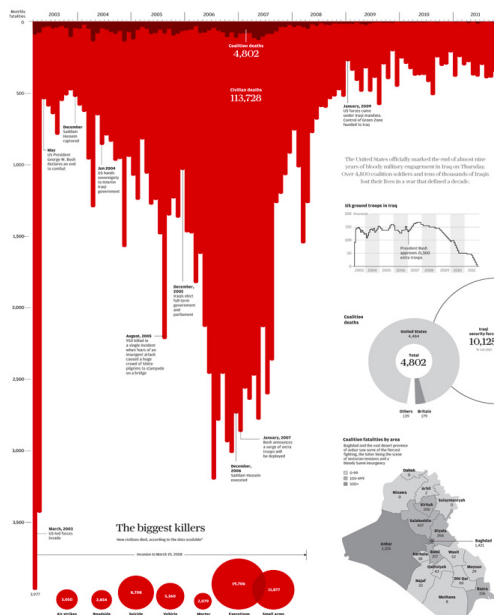
Women CEOs in Fortune 500 Companies

50%

In 2013, women account for 4 percent of CEOs in Fortune 500 companies



Subject empathy



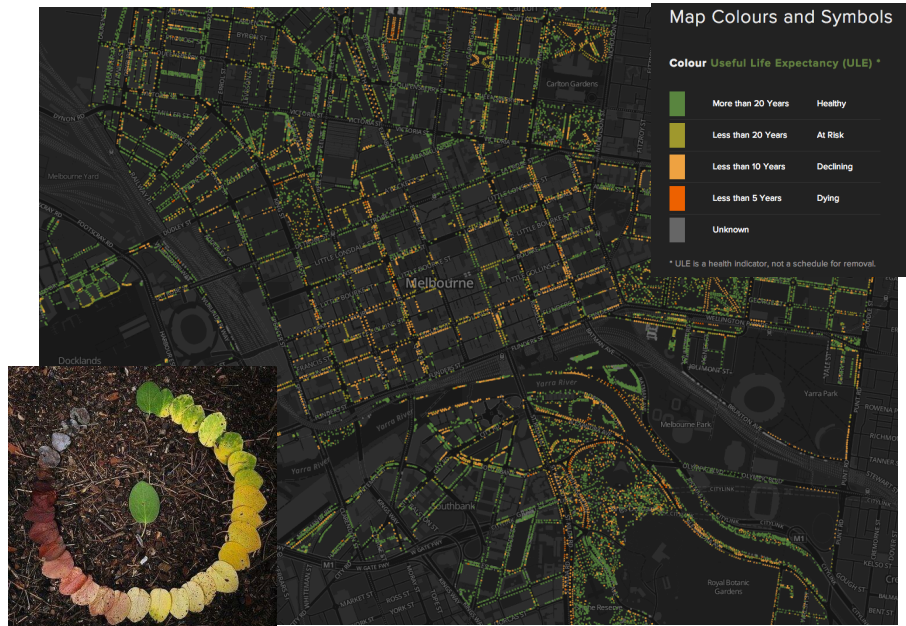
<http://graphics-info.blogspot.hk/2012/09/malofiej-20-look-at-our-participation.html>

Subject empathy



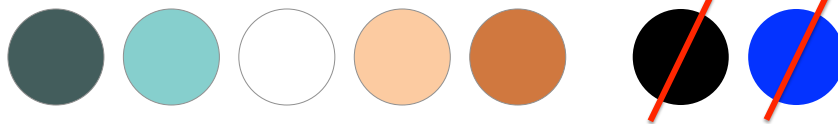
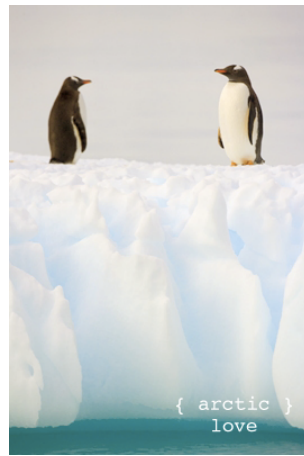
<http://www.chrisjordan.com/gallery/rtn/#prison-uniforms-set>

Subject empathy



<http://melbourneurbanforestvisual.com.au/bigmap.html> | <https://twitter.com/NatGeopix/status/364914136594911233>

Subject empathy

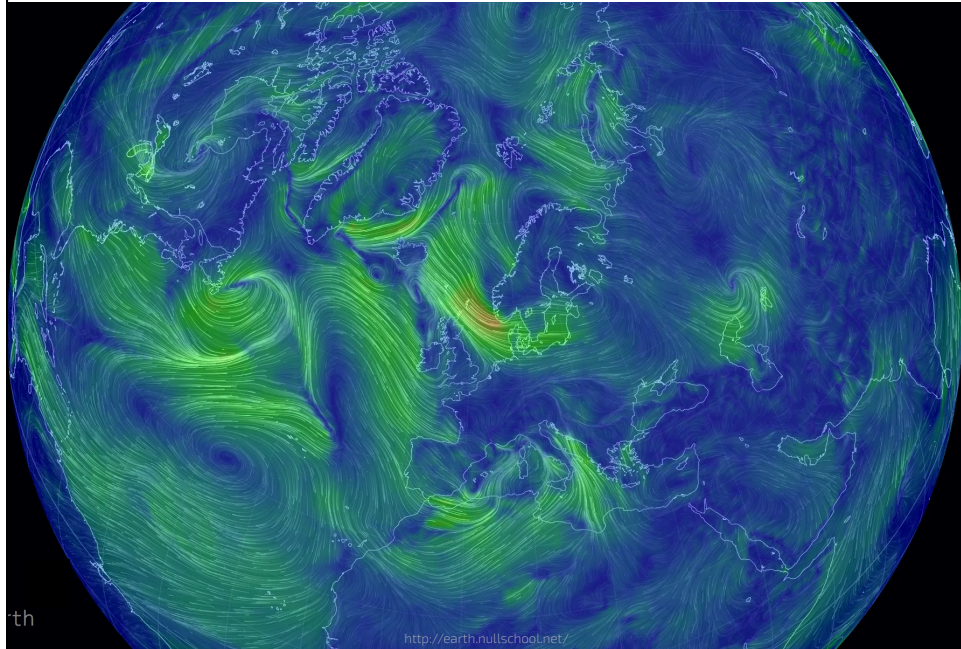


<http://design-seeds.com/palettes/ArcticLove600.png>

Conceptual skills



Technical flair



Experience design

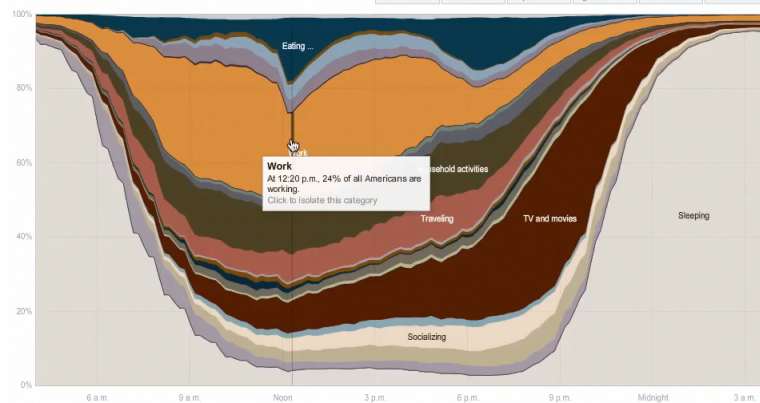
How Different Groups Spend Their Day

The American Time Use Survey asks thousands of American residents to recall every minute of a day. Here is how people over age 15 spent their time in 2008. [Related article](#)

Everyone

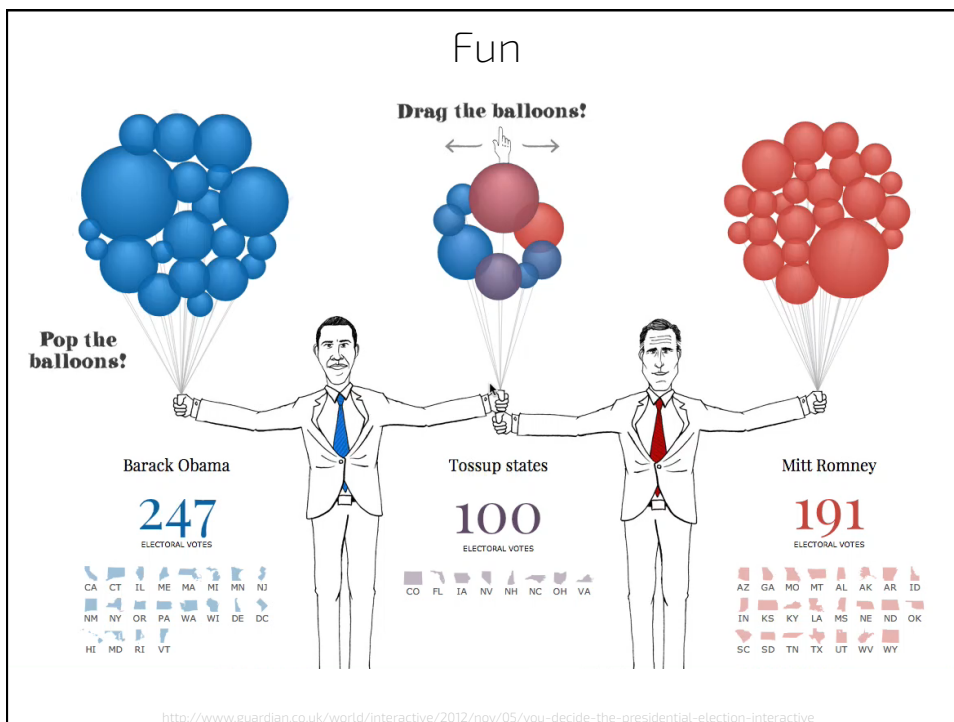
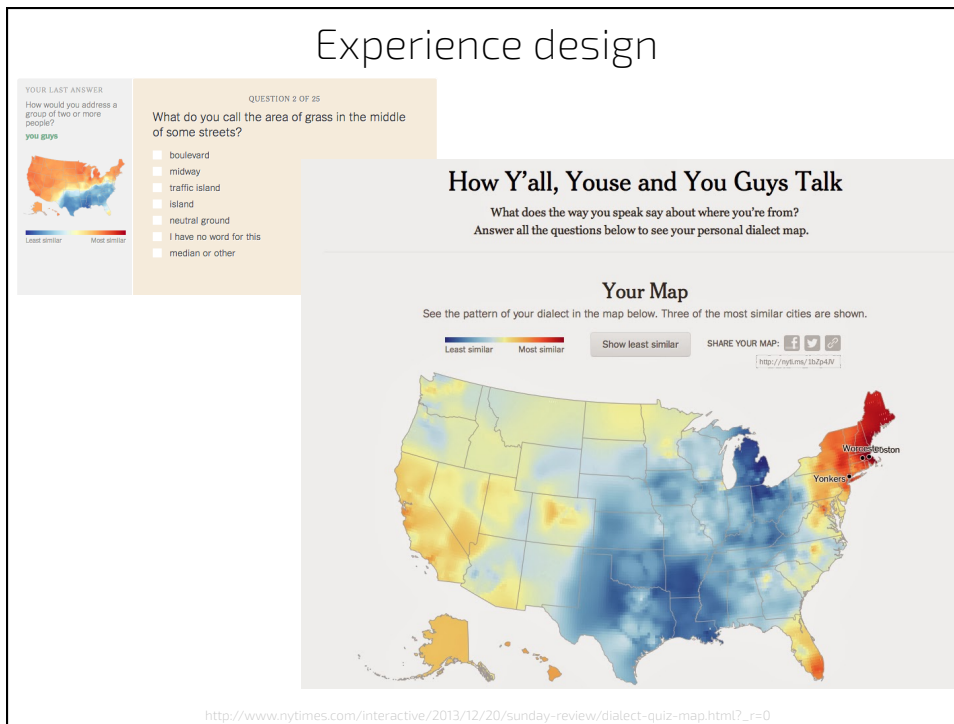
Sleeping, eating, working and watching television take up about two-thirds of the average day.

Everyone	Employed	White	Age 15-24	H.S. grads	No children
Men	Unemployed	Black	Age 25-64	Bachelor's	One child
Women	Not in lab...	Hispanic	Age 65+	Advanced	Two+ children



<http://www.nytimes.com/interactive/2009/07/31/business/20080801-metrics-graphic.html>

Experience design

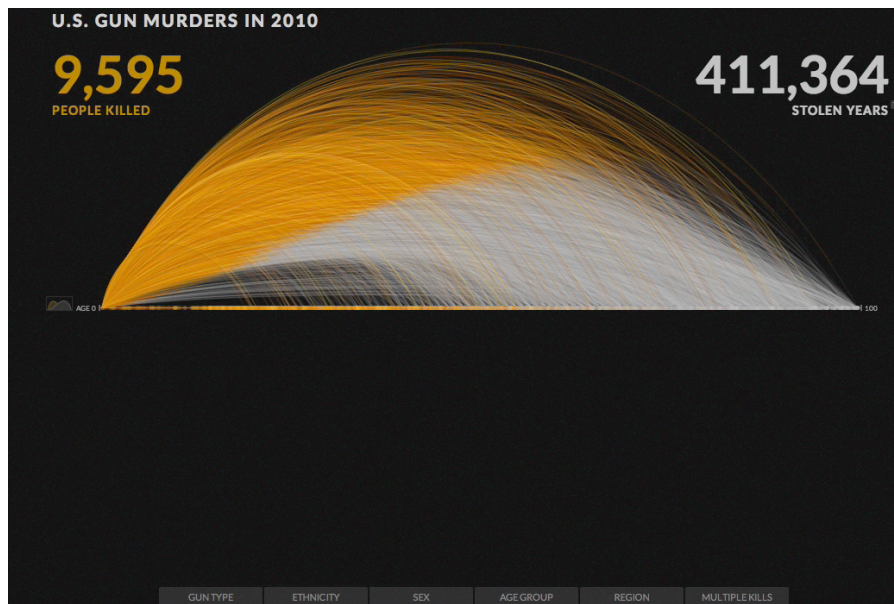


Drama



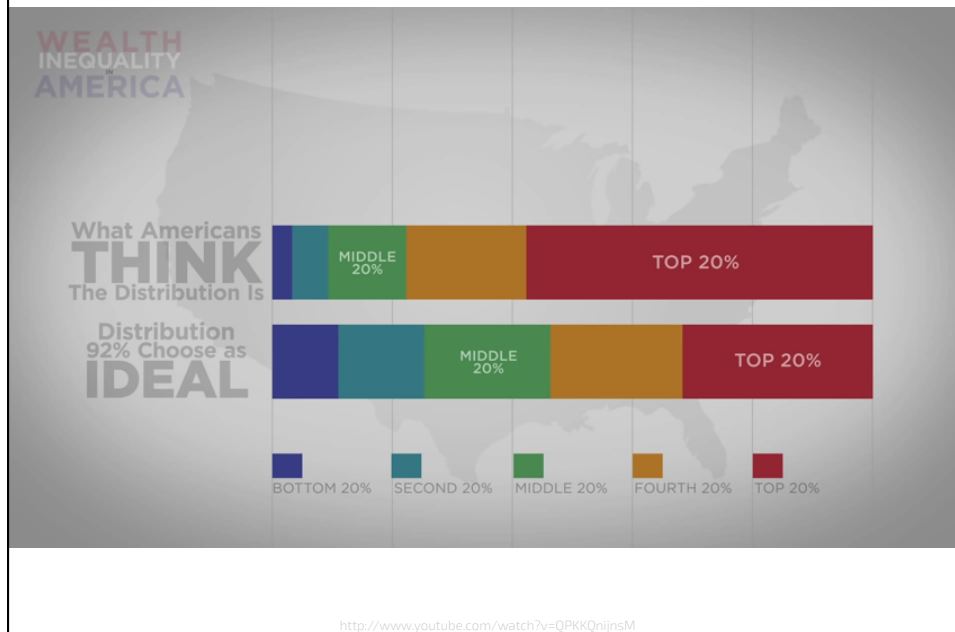
<http://www.youtube.com/watch?v=9tkDK2mZl0o>

Emotion



<http://guns.periscope.com/>



Art of communication



Storytelling




Storytelling

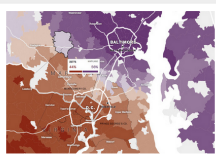
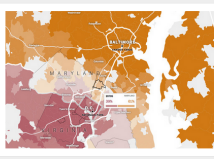






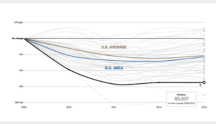
Time	Topic	Duration
00:00:00	Intro	2:33
00:02:33	Our guests: Alberto Cairo and Robert Kosara	0:49
00:03:21	What is a story in data visualization?	2:44
00:06:06	Alberto's article	2:46
00:08:52	Potential meaning	2:22
00:11:14	Book: "The unpersuadables"	0:33
00:11:47	Patternicity	0:31
00:12:18	Sequence + Drama = Story?	1:23
00:13:41	Objectivity vs Subjectivity	2:25
00:16:07	Dramatization	1:34
00:17:41	Story as guiding line, provides embedding context for data, establishing argument structures	3:10
00:20:51	Visualization for different types of audience	1:42
00:22:33	Software performances	5:02
00:27:35	Not every visualization needs to tell a story	5:01
00:32:36	Software performance (Gapminder)	0:58
00:33:34	Vis as experience	2:48
00:36:23	Sequences, annotation, context	0:37
00:38:59	"So what?" — relevance	3:56
00:40:55	"So what?"	3:10
00:44:04	Book: "Statistics as principal argument"	3:28
00:47:33	Vis as experience	3:51
00:51:24	Cognitive aspects	3:25
00:54:49	Narrative nature of memory	3:11
00:58:00	You cannot not tell a story?	2:37
01:00:37	Annotation - Narration - Story	9:38
01:10:15	Proliferation of the term	7:10
01:17:26	Wrapping it up	0:57



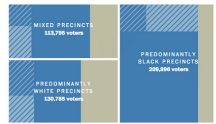
<http://datastori.es/data-stories-35-visual-storytelling-w-alberto-cairo-and-robert-kosara/>

Storytelling



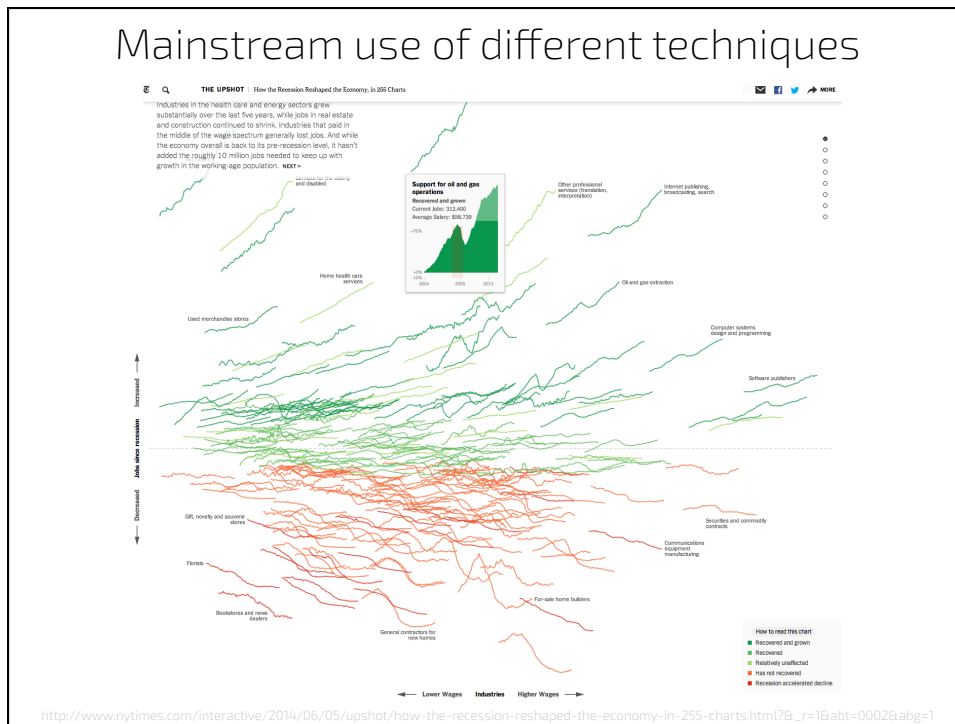




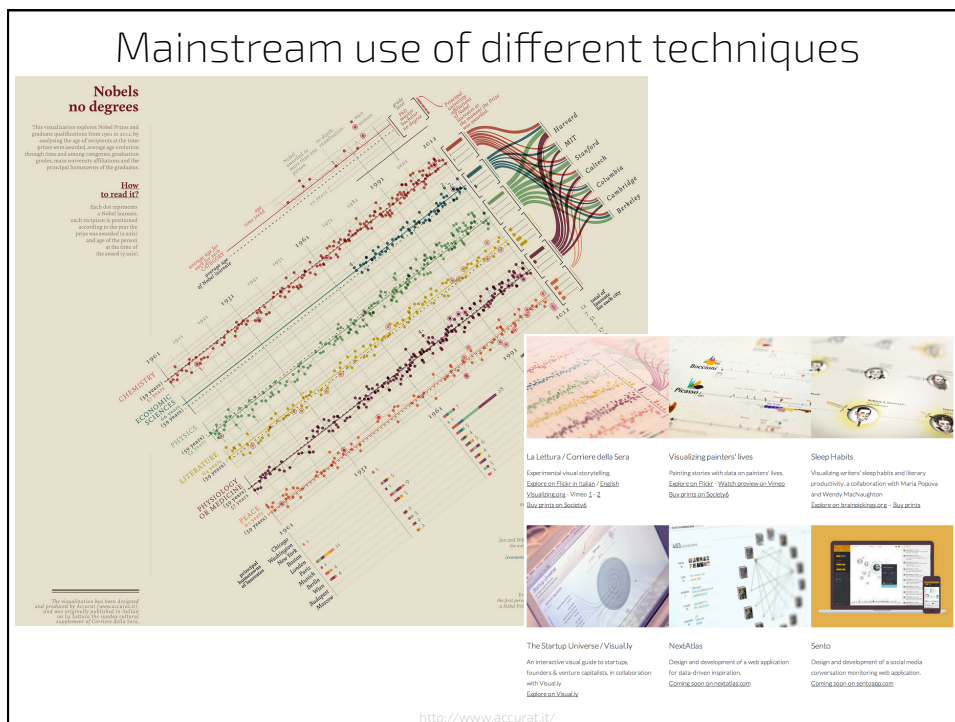




<http://postgraphics.tumblr.com/>

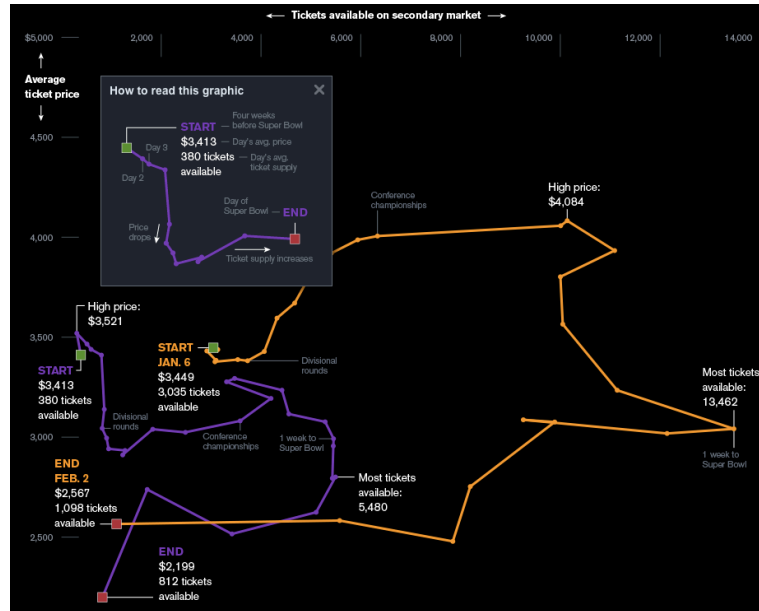
Mainstream use of different techniques



Mainstream use of different techniques

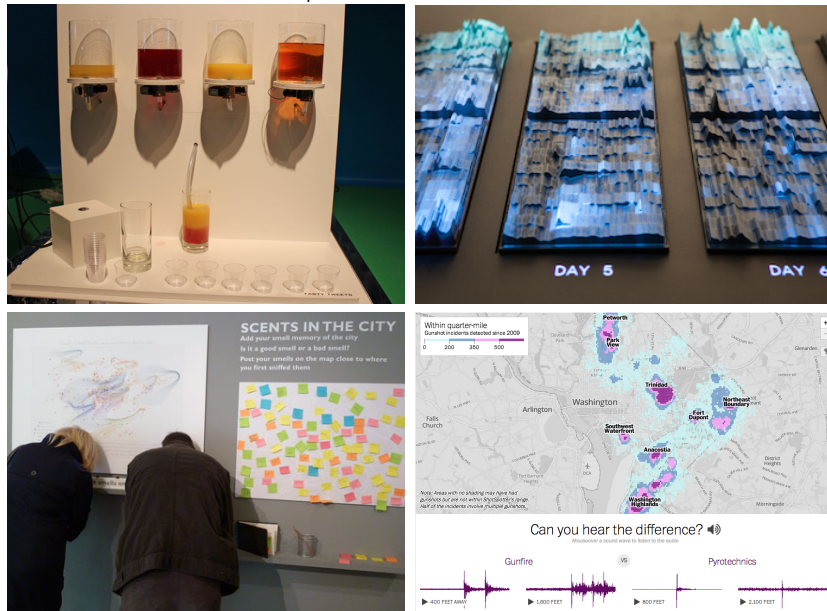


Mainstream use of different techniques



<http://www.bloomberg.com/infographics/2014-01-16/tracking-super-bowl-ticket-prices.html>

Experimentation



<http://cid.ck/education/portfolio/idp12/courses/data-visualisation/projects/tasty-tweets/> | <http://blog.emoto2012.org/> | http://www.sensorymaps.com/maps_cities/edi_smell.html | <http://www.washingtonpost.com/wp-srv/special/local/dc-shot-spotter/>

CONTEXT

"A craft in thinking"

So many choices, so many variables

What is **good**? What is **bad**?

What is **right**? What is **wrong**?

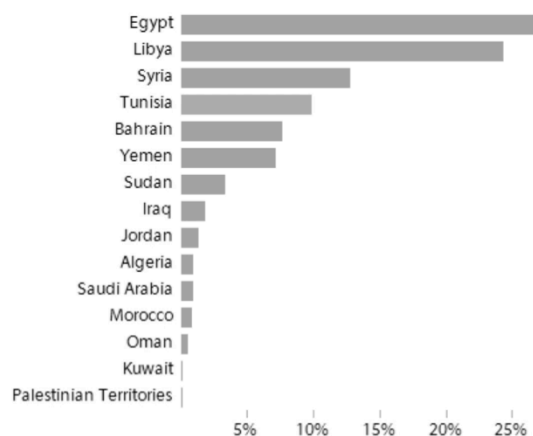
Who is **right**? Who is **wrong**?

Why?!

It always depends...

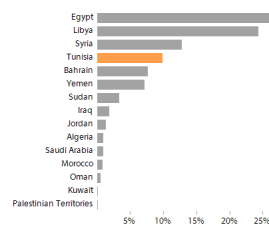
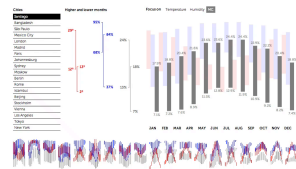
The real craft behind data visualisation design
is how we rationalise **choices**
within a given **context**

The art of choice



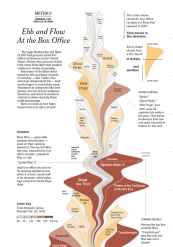
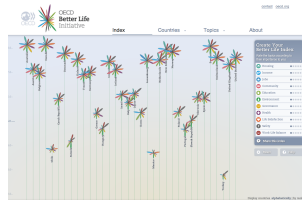
What's the intent?

Read data



Exploratory

Exploratory



Feel data

What's the shape, size and type of your data

Year	RegionCode	RegionName	CountryCode	CountryName	Gender	BMI Value	Low Value	High Value
1991	WPR	Western Pacific	BRN	Brunei Darussalam	Male	23.5	21.1	25.9
1981	EMR	Eastern Mediterranean	YEM	Yemen	Female	23.5	20.2	27
1992	AMR	Americas	CHL	Chile	Female	25.4	23.8	27
2003	AMR	Americas	GUY	Guyana	Male	23.6	21.4	25.8
1997	EUR	Europe	ROU	Romania	Female	24.9	24.1	25.8
1996	AMR	Americas	BRA	Brazil	Male	24.3	23.8	24.7
1990	EUR	Europe	KGZ	Kyrgyzstan	Female	25.6	24.4	26.7
1995	AMR	Americas	BHS	Bahamas	Female	27.5	24.8	30.1
2002	EMR	Eastern Mediterranean	QAT	Qatar	Female	28.3	27.3	29.4
2007	AFR	Africa	ETH	Ethiopia	Female	20.6	19.9	21.4
2003	AFR	Africa	GHA	Ghana	Female	23.6	23.2	24.1
1985	EUR	Europe	LTU	Lithuania	Male	26	25	26.9
1990	EMR	Eastern Mediterranean	BHR	Bahrain	Female	26.3	25.1	27.4
2001	AMR	Americas	DMA	Dominica	Male	24	23	25
1987	EUR	Europe	MNE	Montenegro	Female	25.9	23	28.8
2002	WPR	Western Pacific	FJI	Fiji	Female	28.1	27	29.1
1990	EMR	Eastern Mediterranean	LBY	Libya	Male	25.2	23.9	26.4
1989	WPR	Western Pacific	JPN	Japan	Female	21.6	21.2	22
2006	EMR	Eastern Mediterranean	DJI	Djibouti	Male	23.2	20.9	25.4
2005	AMR	Americas	COL	Colombia	Female	26.1	25.6	26.6
1988	AMR	Americas	CRI	Costa Rica	Female	24.2	22.2	26.2
1998	WPR	Western Pacific	WSM	Samoa	Female	31.1	30.2	32
1987	WPR	Western Pacific	NIU	Niue	Male			
1984	EMR	Eastern Mediterranean	JOR	Jordan	Female	27.9	26.3	29.6
1982	AFR	Africa	CIV	Côte d'Ivoire	Male	21.2	19.1	23.3
2004	AFR	Africa	MUS	Mauritius	Female	25.7	24.6	26.9
1994	EUR	Europe	MCO	Monaco	Male			
1983	WPR	Western Pacific	KOR	Republic of Korea	Female	21.7	20.5	22.9
2005	AFR	Africa	CIV	Côte d'Ivoire	Male	22.3	21.1	23.7
1994	AFR	Africa	ZWE	Zimbabwe	Female	24.7	24.1	25.4
1999	AMR	Americas	MEX	Mexico	Female	27.6	27.1	28
2007	EUR	Europe	SWE	Sweden	Female	25.1	24.2	26
2000	EUR	Europe	TJK	Tajikistan	Female	23.4	21.8	25
1998	AMR	Americas	URY	Uruguay	Female	25.4	23.8	26.9
1988	SEAR	South-East Asia	NPL	Nepal	Female	19.2	17.8	20.6
2009	EUR	Europe	IRL	Ireland	Female	26.7	25.8	27.6
1986	WPR	Western Pacific	PHL	Philippines	Female	21.7	20.5	22.9
1995	AMR	Americas	BLZ	Belize	Male	25.5	24.4	26.7
1984	EUR	Europe	SWE	Sweden	Female	24.5	23.6	25.4
1995	AFR	Africa	TZA	United Republic of Tanzania	Female	22	21.4	22.5

Who is your audience?



<http://probaperception.blogspot.fr/2012/10/the-best-strategy-to-play-guess-who.html>

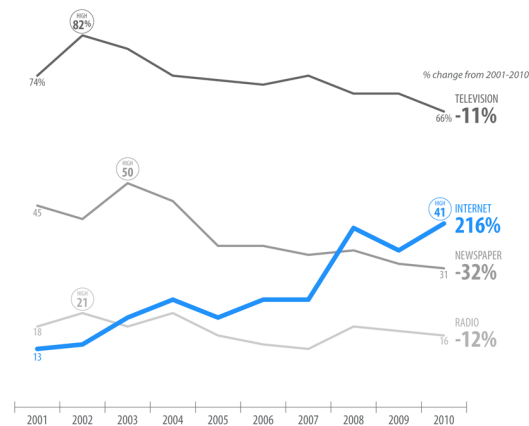
Do they want a light bite?



Do they want a light bite?

Where do you get most of your news about national and international issues?

Percent of respondents identifying main source(s) of news.
Each respondent could volunteer up to two sources.

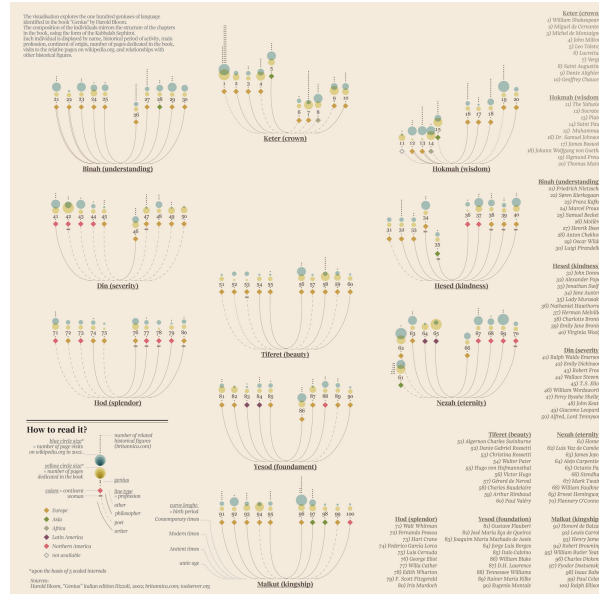


<http://kenedyelliott.com/visualize-this.png>

...or a more involved experience?

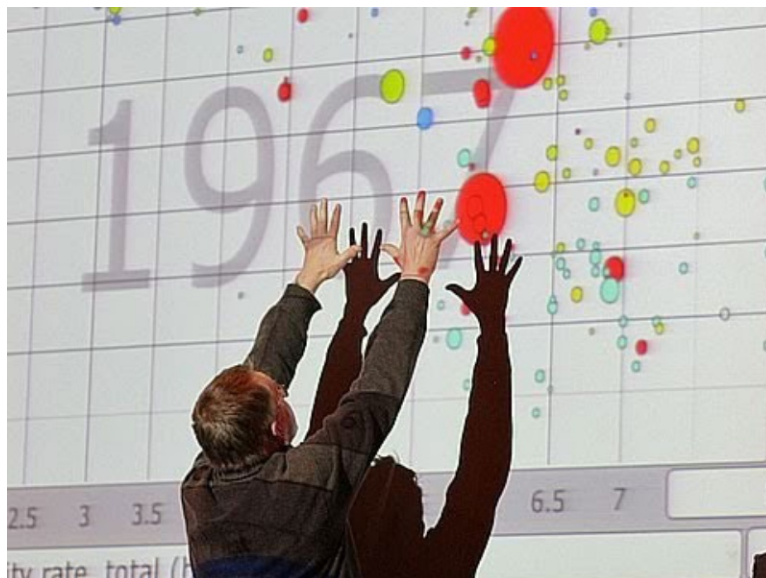


...or a more involved experience?



<http://www.brainpickings.org/index.php/2013/03/27/harold-bloom-genius-visualization/>

What is the setting?



<http://youtu.be/hVimVzgtD6w?t=1m1s>

Format requirements? Technical capabilities?



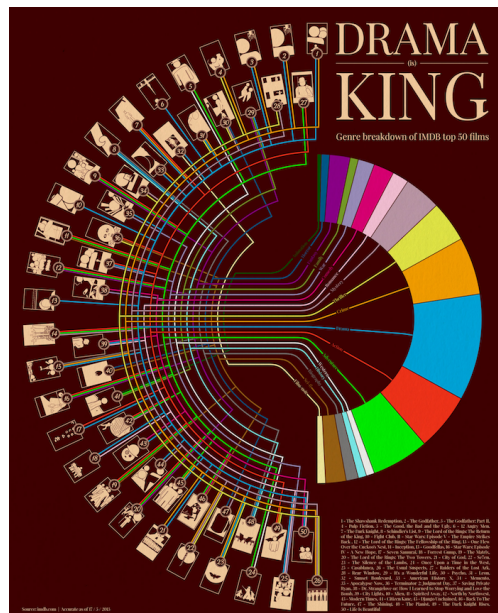
<http://www.innovationsinnewspapers.com/wp/wp-content/uploads/2007/02/independent.jpg>

CLOSING THOUGHTS

Visualisation is a process, not a procedure

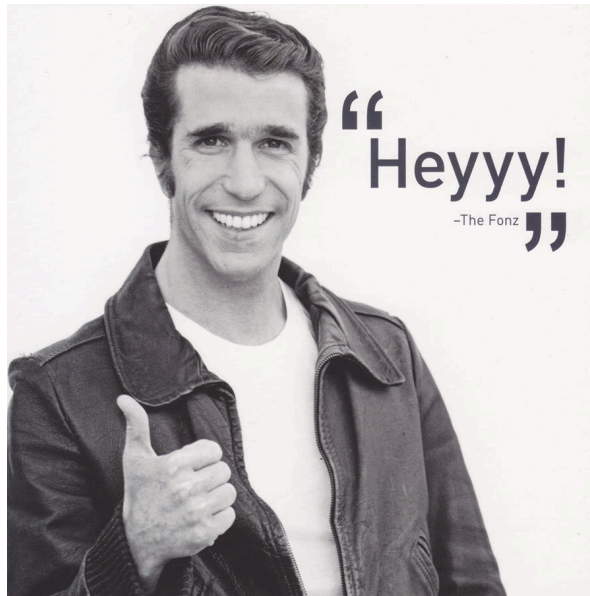


Embracing 'art' is not about striving for 'cool'



<http://www.fastcodesign.com/1672691/imdb-top-50-movies-arranged-by-genre#1>

Cool is a passing phenomena...



<http://www.cardspark.co.uk/the-fonz-greeting-card-tag-idols/>

'Elegance' should be your design pursuit



<http://betterparts.org/images/jaguar-e-type-01.jpg>

The best visualisation is about understanding

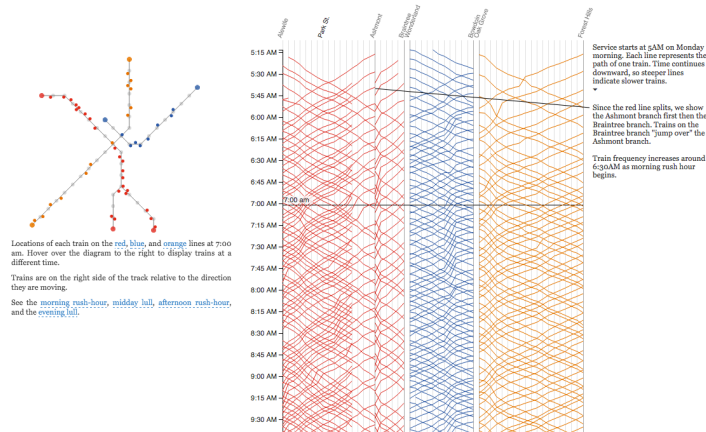
The Trains

In a typical weekday, trains make approximately 1150 trips on the red, orange, and blue lines starting at 5AM and continuing through 1AM the next morning. On Saturdays trains make 870 trips and on Sundays they make 760.

To better understand how the trains operate on a typical day, below are all trips that trains took on the red, orange, and blue lines on Monday February 3 2014. Each vertical line represents a station, and time extends from top to bottom. Steeper lines indicate slower trains. This visualization was first used by Etienne-Jules Marey to visualize train schedules and is typically called a "Marey Diagram."

	Average Number of Trips per Day		
	Weekdays	Saturdays	Sundays
Red	450	350	300
Orange	320	260	220
Blue	380	260	240
Total	1150	870	760

Subway Trips on Monday February 3, 2014



<http://mbtaviz.github.io/>

The craft of thinking has many hats...

Initiator



Journalist



Communicator



Project Manager



Cognitive Science



Design



Computer Science



Data Science



<http://www.visualisingdata.com/index.php/2012/06/article-the-8-hats-of-data-visualisation-design/>



THE ART AND SCIENCE OF DATA VISUALISATION

Andy Kirk
@visualisingdata

Q&A

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<http://www.tableausoftware.com/trial>

