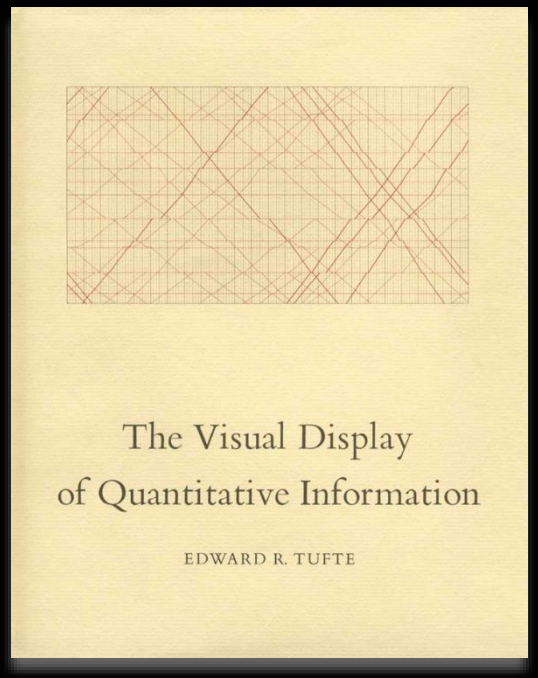
Visualisierungstechniken

Statistische Grafiken | ein assoziativer Spaziergang nach Edward R. Tufte

"Visualization gives you answers to questions you didn't know you had."



Principles of Graphical Excellence

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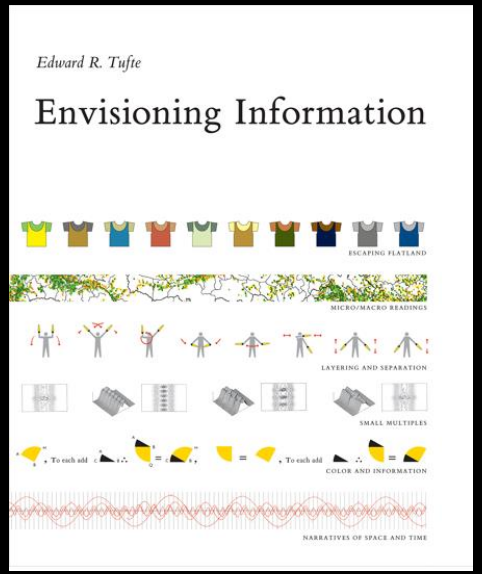
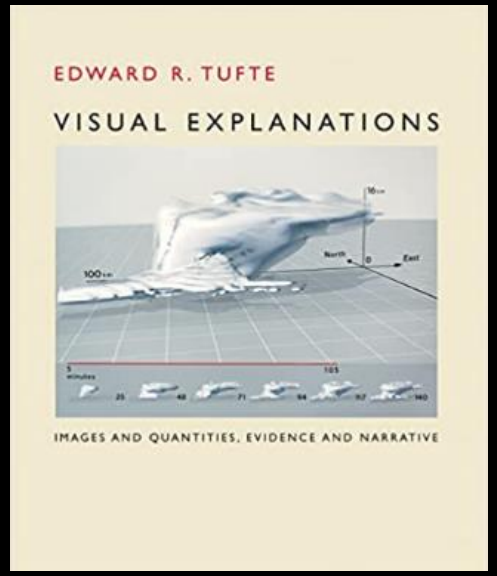
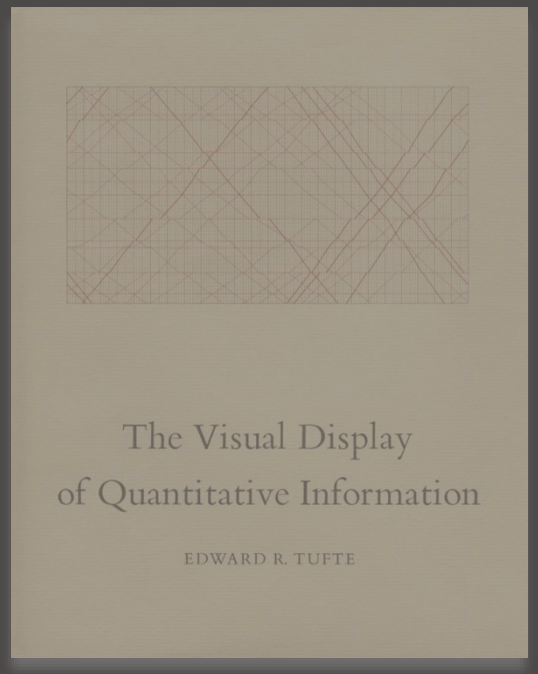
"Graphical excellence is nearly always multivariate."

"Graphical excellence requires telling the truth about the data."







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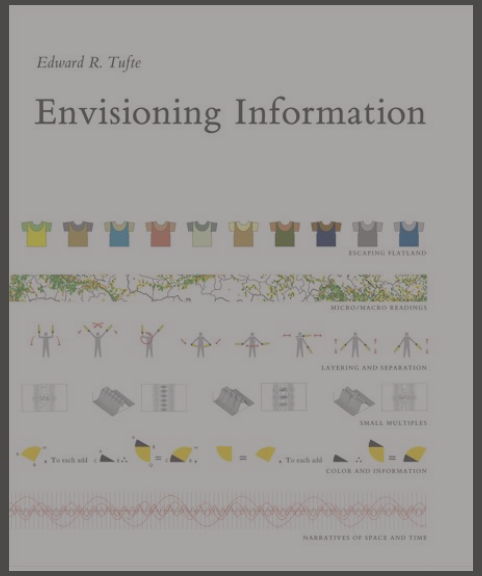
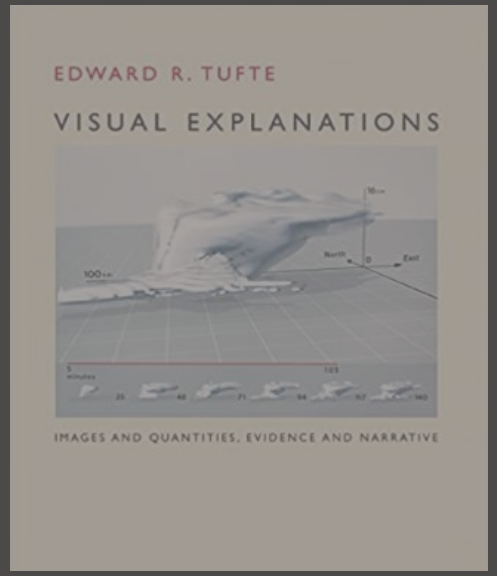
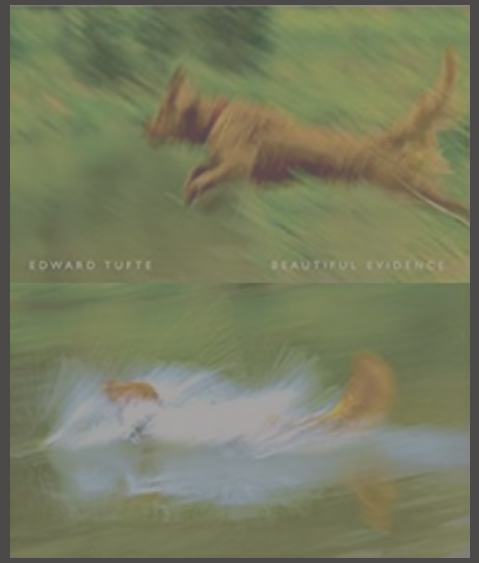







Schwarz-grün gibt mehr für Werbung aus
ORF 2 HD
WERBEAUSGABEN
je Ressort 2022
Quelle: parlamentarische Anfragen
12,4 Mio.
10 Mio.
380.000
58.000
ORF.AT
Gewessler
Nehammer
Raab
Edtstadler
ZIB 2

Die häufigsten Reisebeschwerden 1999

Angaben in Beschwerden nach Ländern in Prozent

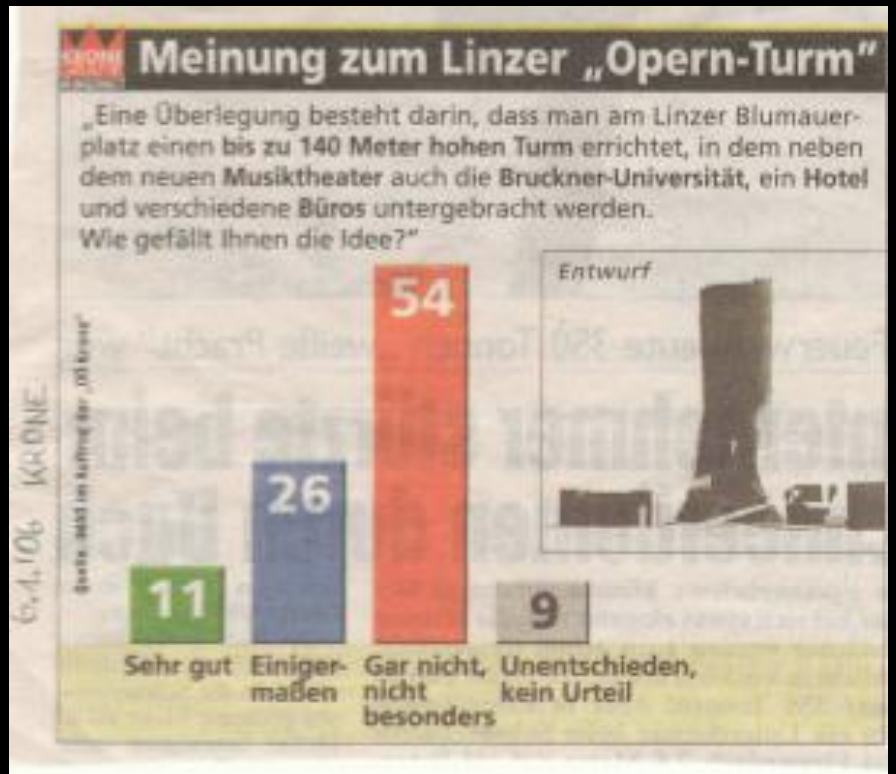
Fotos: MEV, Foto Clip

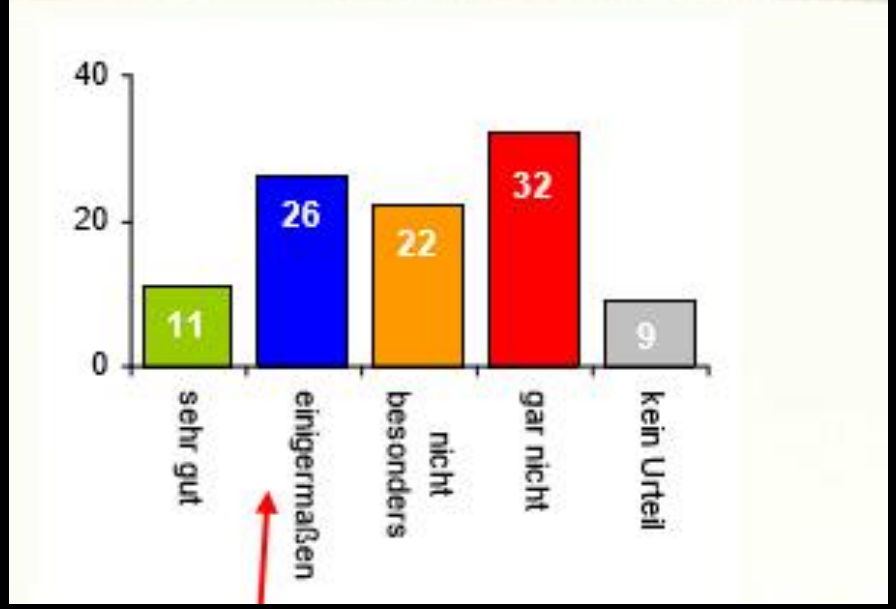
Krone-Grafik: Der Auer

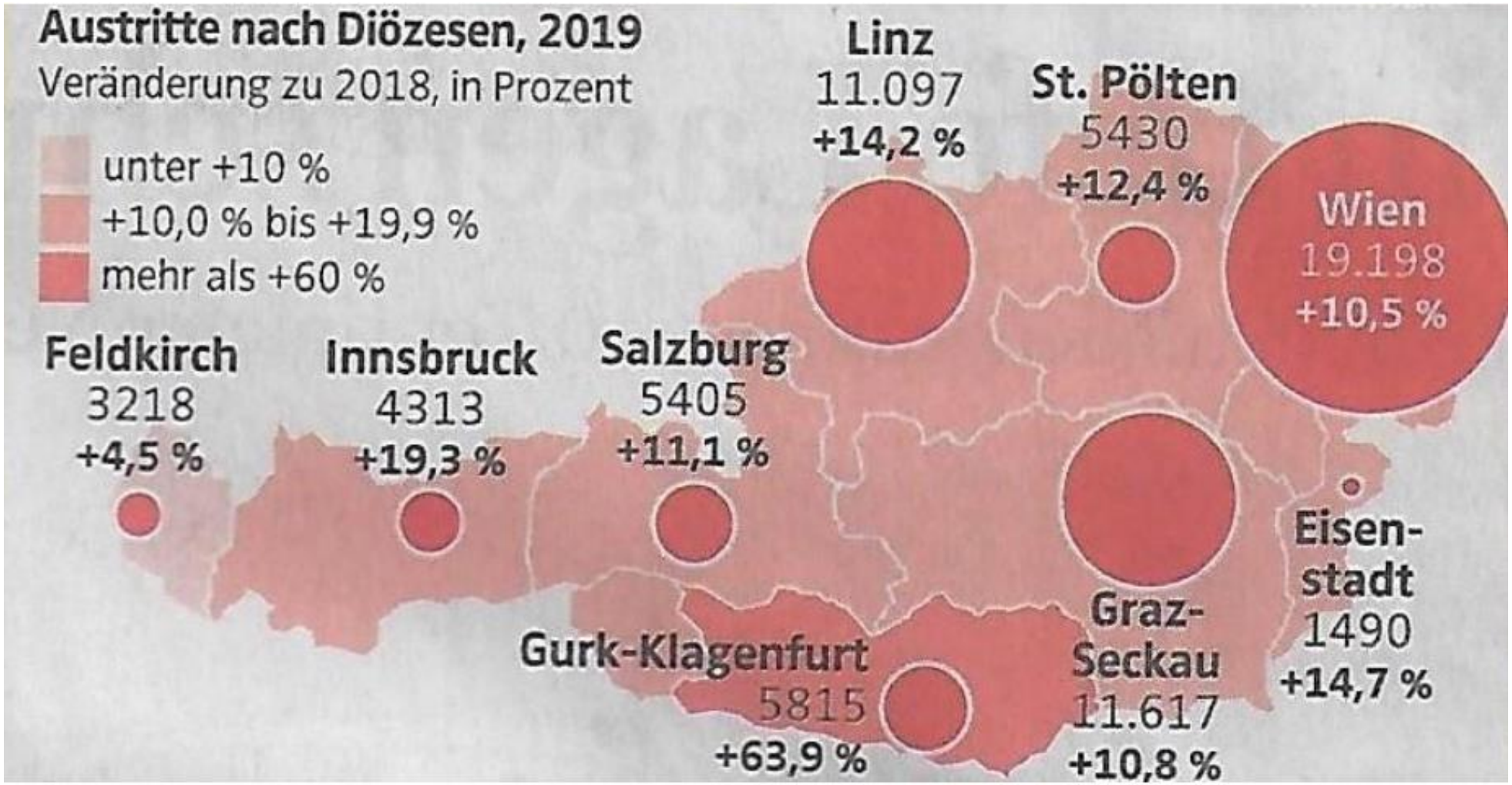
Was Chefs können sollen

Kommunizieren zu können, ist die wichtigste Anforderung, die in Zukunft an Führungskräfte gestellt wird, so eine Umfrage von Career 2009. An zweiter Stelle rangiert unternehmerisches Denken, gefolgt von Lösungs- und Zielorientiertheit. Auch sehr wesentlich: Die Fähigkeit, Konflikte zu lösen.

n im WEEKEND Magazin, 9. Woche 2013)

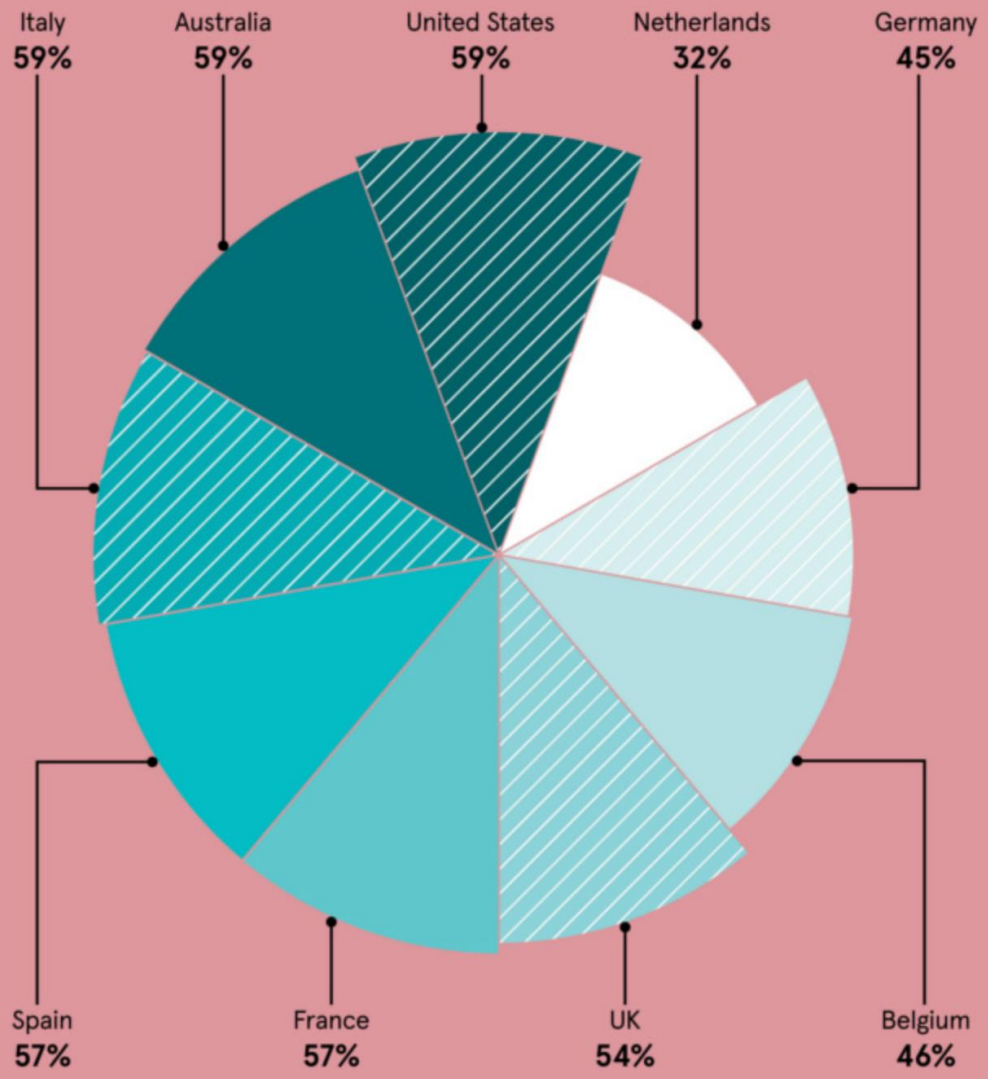




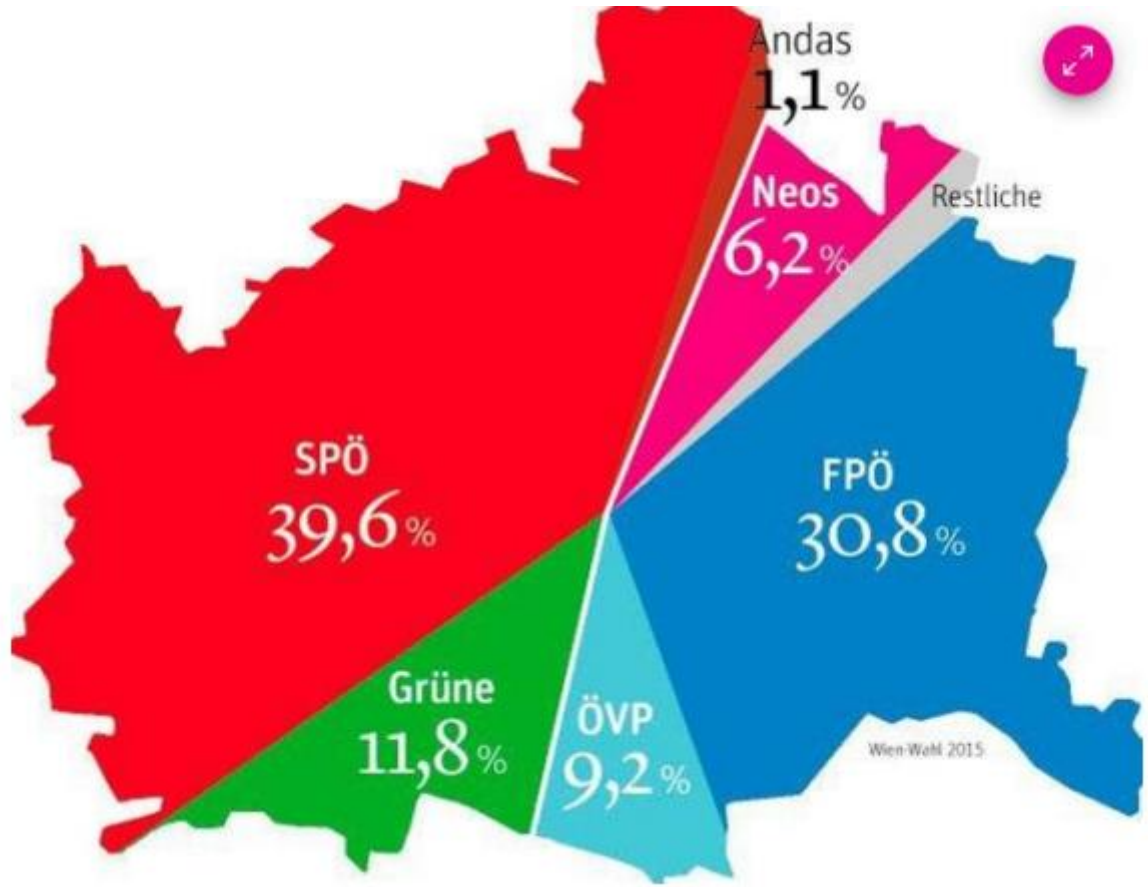

Austritte nach Diözesen, 2019
Veränderung zu 2018, in Prozent
unter +10 %
+10,0 % bis +19,9 %
mehr als +60 %
Linz
11.097
+14,2 %
St. Pölten
5430
+12,4 %
Wien
19.198
+10,5 %
Feldkirch
3218
+4,5 %
Innsbruck
4313
+19,3 %
Salzburg
5405
+11,1 %
Eisen-
stadt
1490
+14,7 %
Graz-
Seckau
11.617
+10,8 %
Gurk-Klagenfurt
5815
+63,9 %

WORKING INTO RETIREMENT

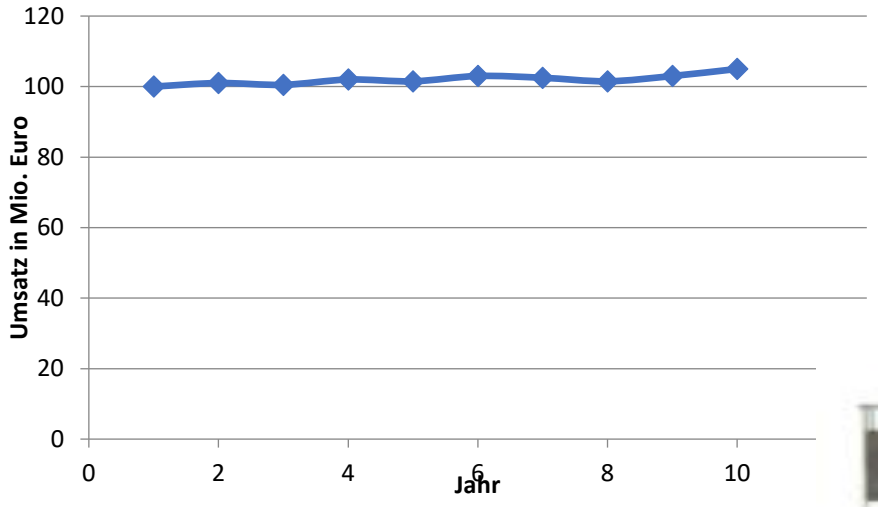
Percentage of employees who expect to keep earning money in retirement

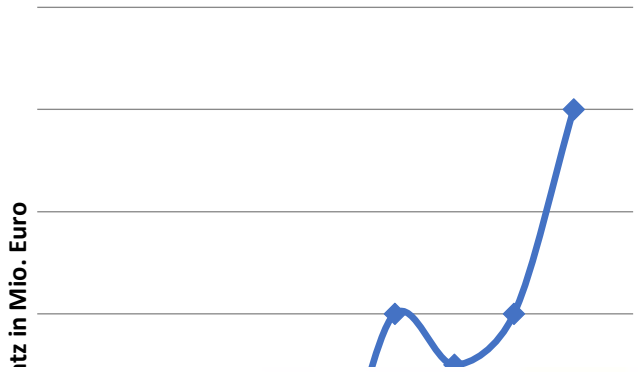


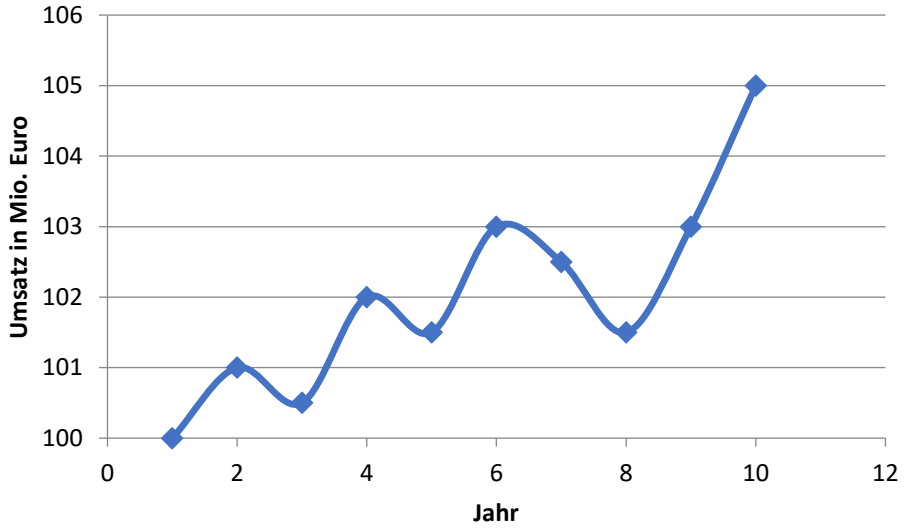
ING 2019


Andas
1,1 %
Neos
6,2 %
Restliche
SPÖ
39,6 %
FPÖ
30,8 %
Grüne
11,8 %
ÖVP
9,2 %
Wien-Wahl 2015

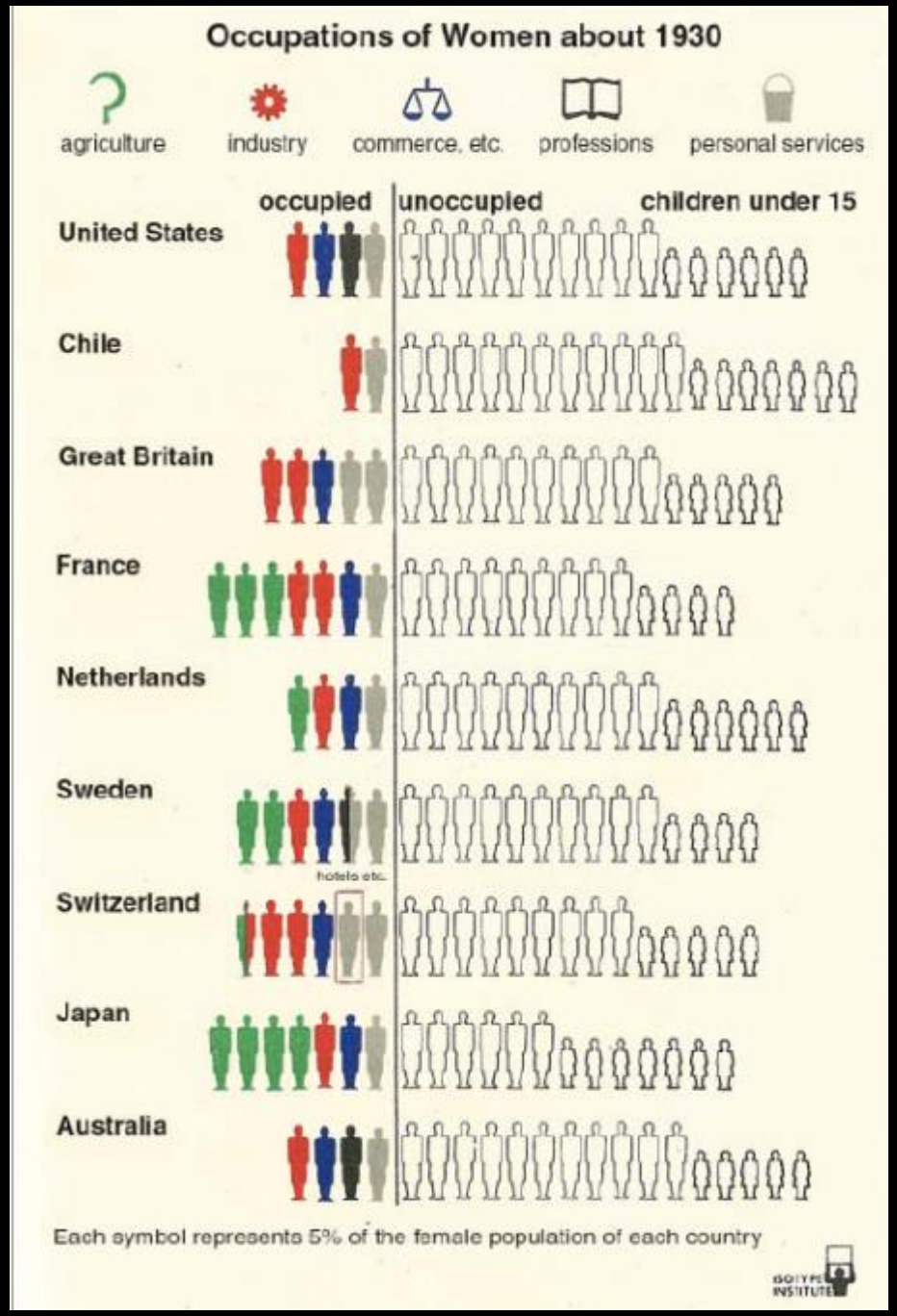
Jahr	Umsatz [Mio. €]
1	100
2	101
3	100,5
4	102
5	101,5
6	103
7	102,5
8	101,5
9	103
10	105





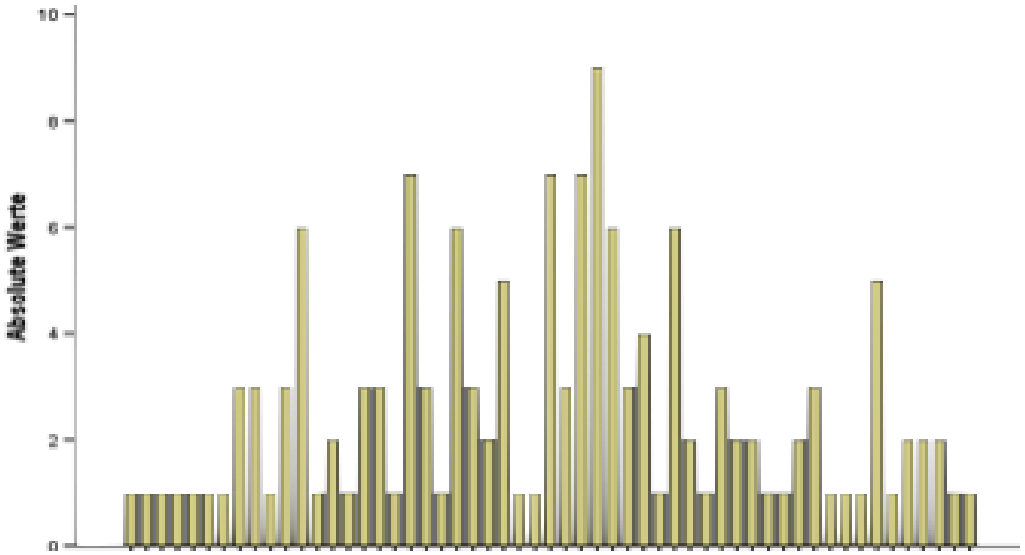


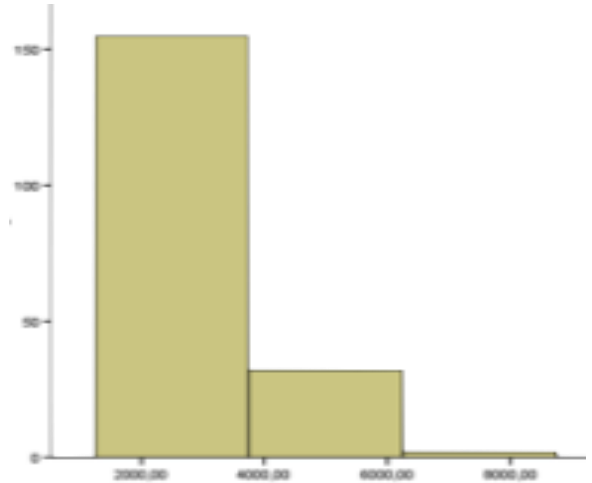
(KRONEN ZEITUNG, 3.10.2010, S.53)

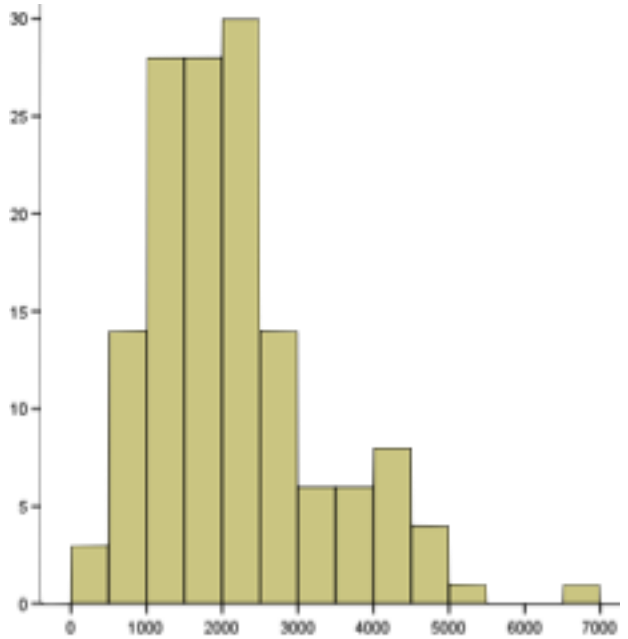


Otto Neurath (1882, Wien – 1945, Oxford)
Wiener Kreis
ISOTYPE
(International System Of TYpographic Picture Education)

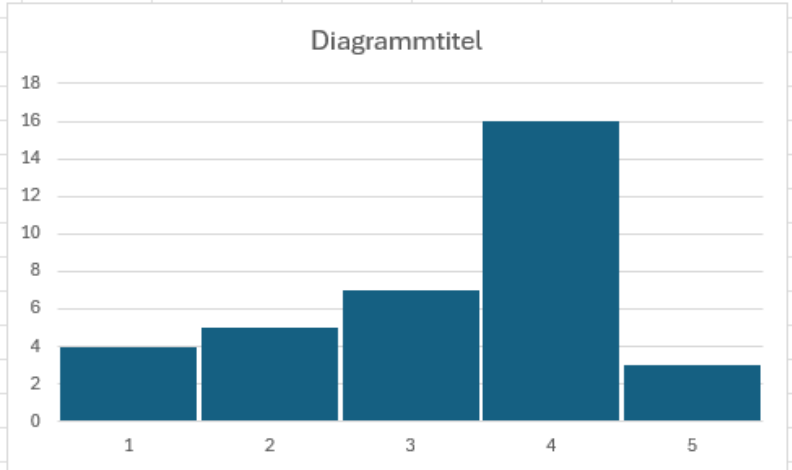
-> Gesellschafts- und Wirtschaftsmuseum Wien, Vogelsanggasse

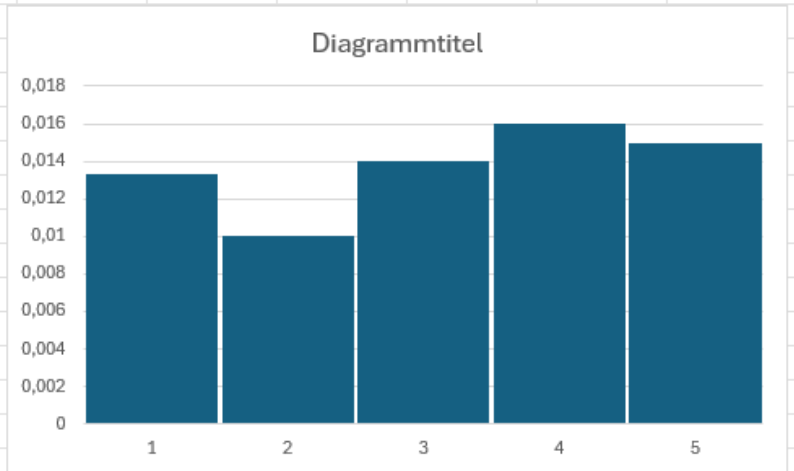

Absolute Werte
10
8
6
4
2
0


150
100
50
0

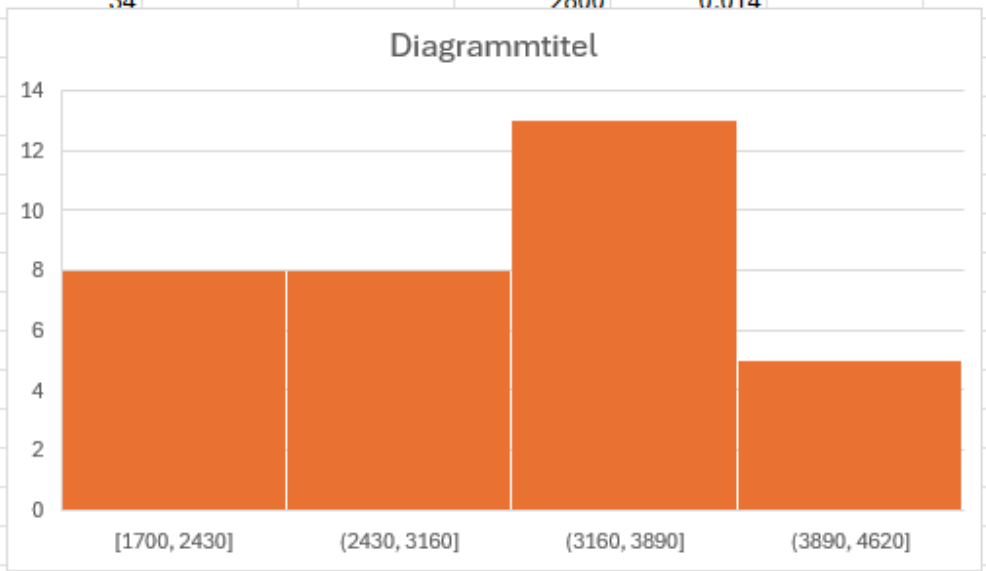

30
25
20
15
10
5
0
0
1000
2000
3000
4000
5000
6000
7000

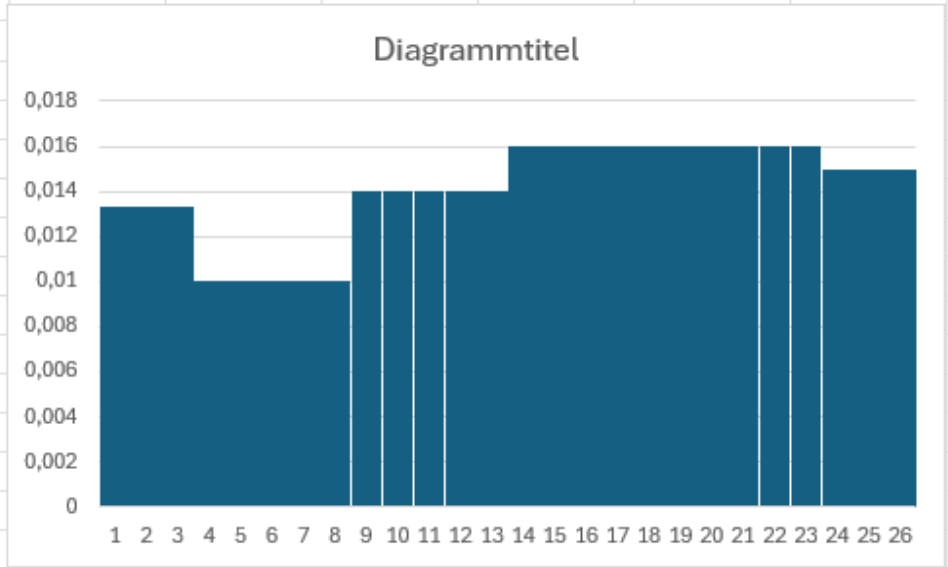
Mitarbeiterr	Gehalt in Euro			von	bis	
1	2000			1700	2000	4
2	2200			2000	2500	5
3	1900			2500	3000	7
4	2200			3000	4000	16
5	2200			über 4000	5000	3
6	2600					
7	3200					
8	3200					
9	2400					
10	2550					
11	1700					
12	3000					
13	3500					
14	3400					
15	2600					
16	2700				300	0,01333333
17	3300				500	0,01
18	3900				500	0,014
19	4150				1000	0,016
20	3500				200	0,015
21	4100					
22	2900					
23	3600					
24	4000			1700	0,01333333	
25	4200			1800	0,01333333	
26	2900			1900	0,01333333	
27	3200			2000	0,01	
28	3220			2100	0,01	
29	3300			2200	0,01	

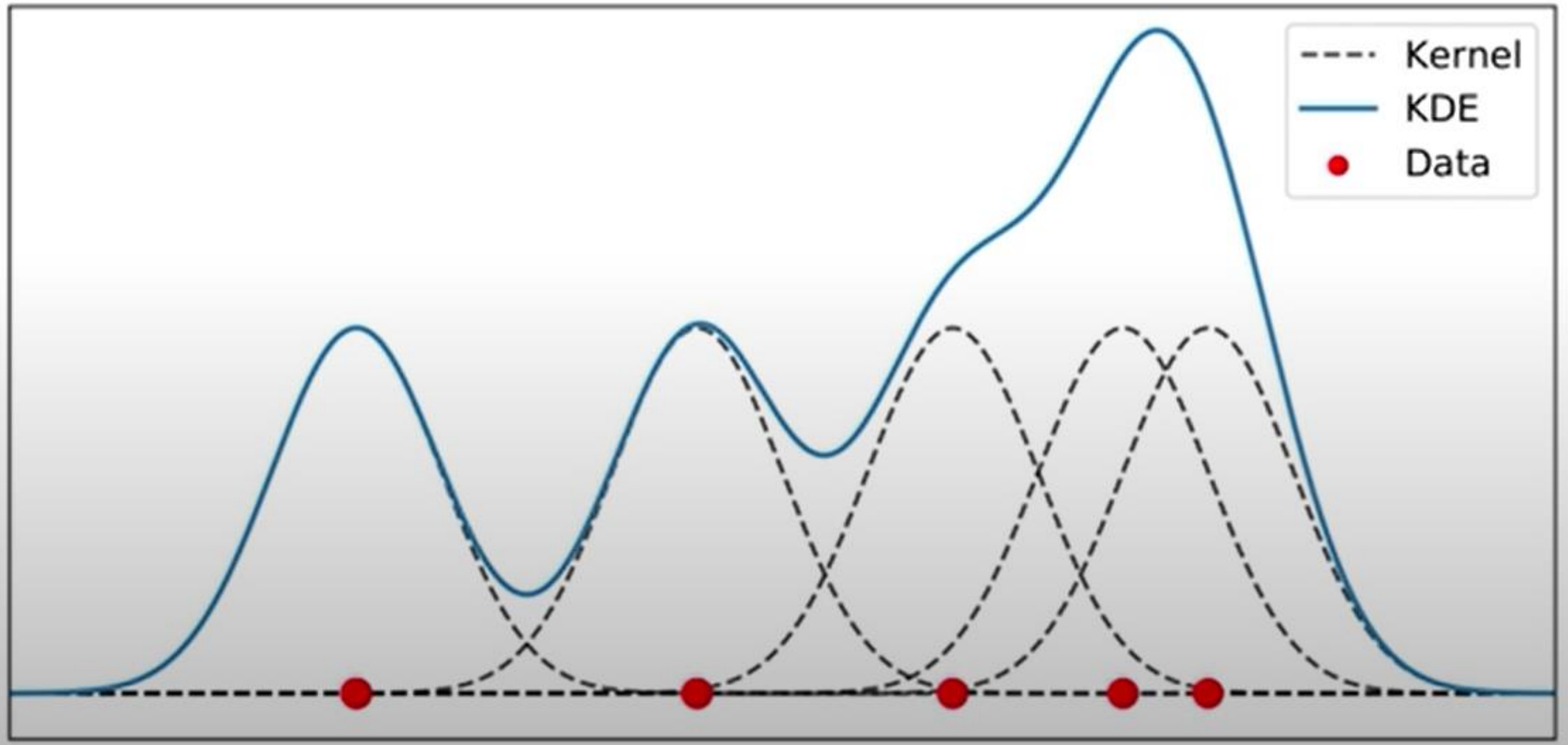




29	3300	2200	0,01
30	3050	2300	0,01
31	2290	2400	0,01
32	3800	2500	0,014
33	3200	2600	0,014
34	3330	2700	0,014
	34	2800	0,014

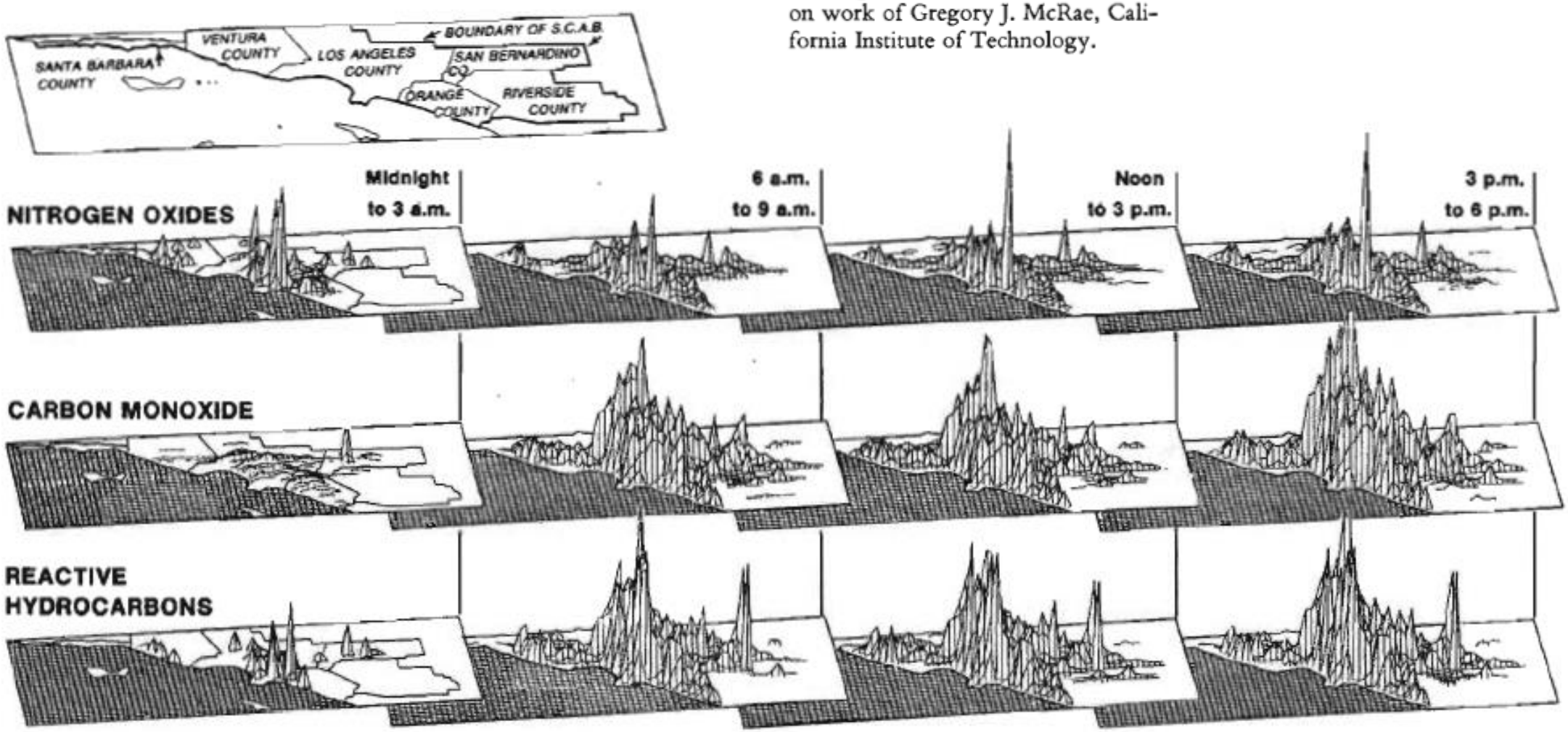




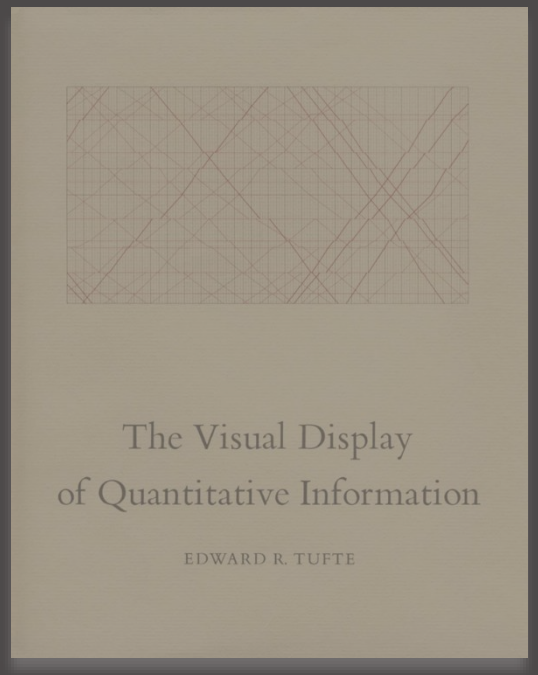

Kernel
KDE
Data


HOC OPVS HIC LABOR EST
VIRTVTI AC GENIO
OLYMPICOR ACADEMIA THEATRVM HOC
A FVNDAMENTIS EREXIT
ANN MDLXXXIIII PALLADIO ARCHIT


25
20
15
10
5
0



Los Angeles Times, July 22, 1979; based on work of Gregory J. McRae, California Institute of Technology.



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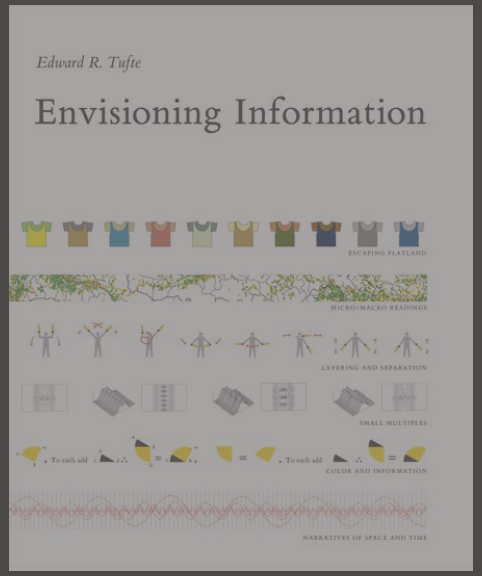
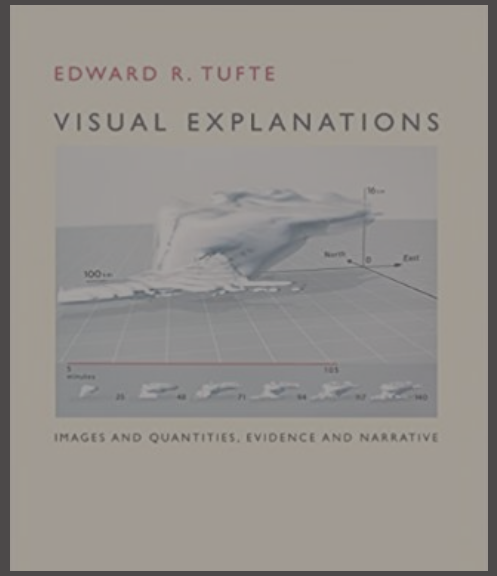
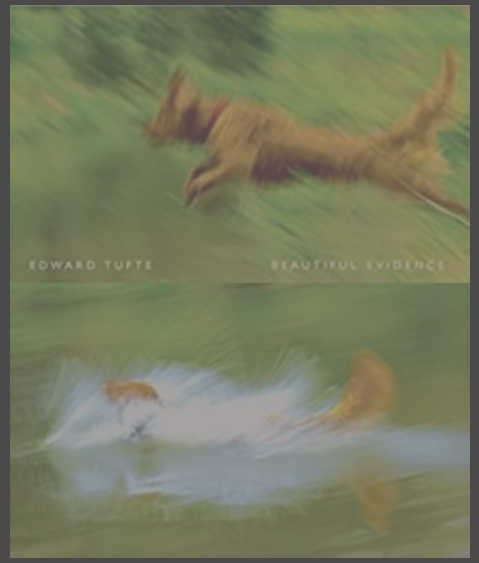






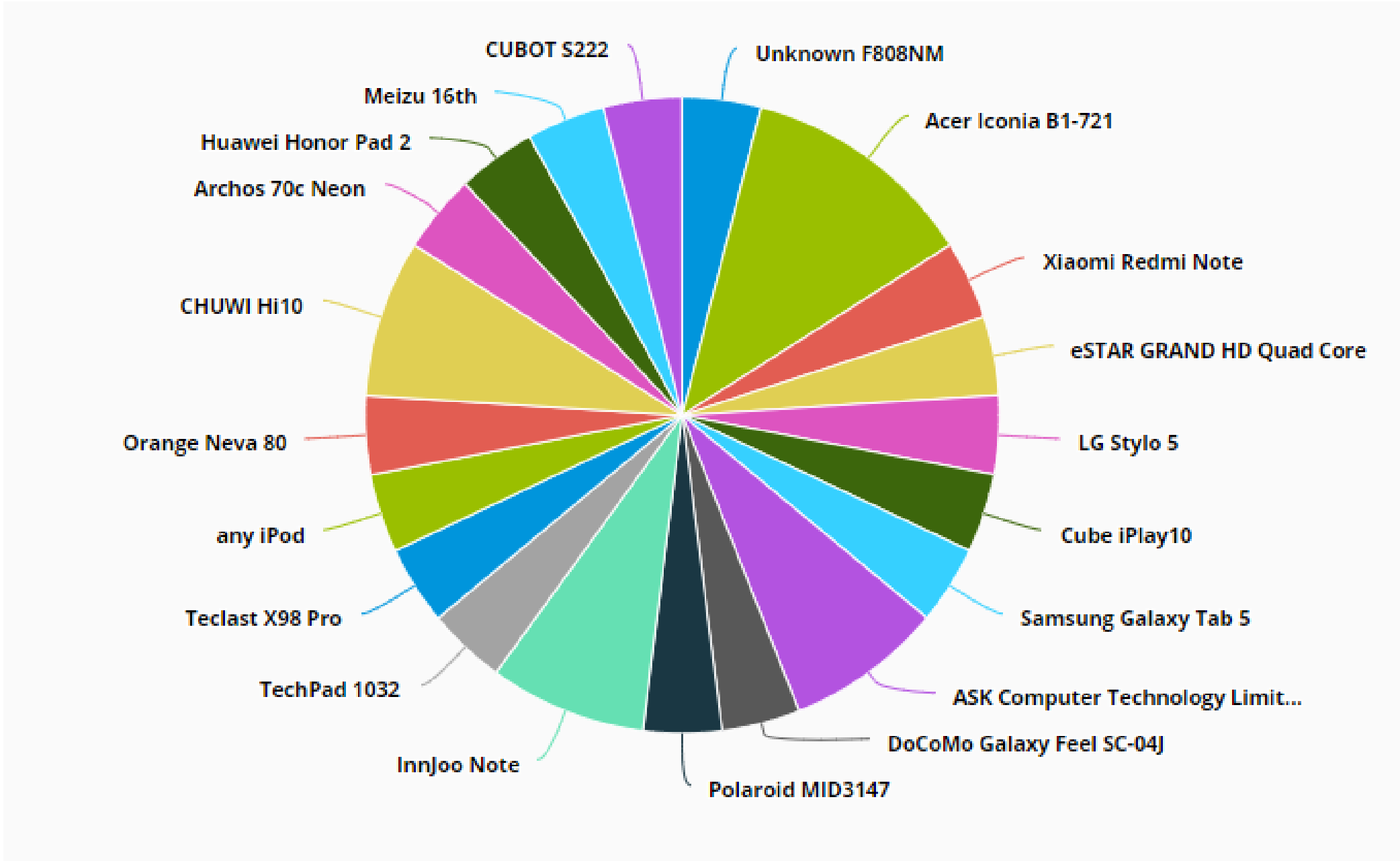
VON KATJA BERLIN

Wofür Frauen sich rechtfertigen müssen

- Nur Kinder
- Nur Karriere
- Kinder und Karriere
- Keine Kinder und keine Karriere

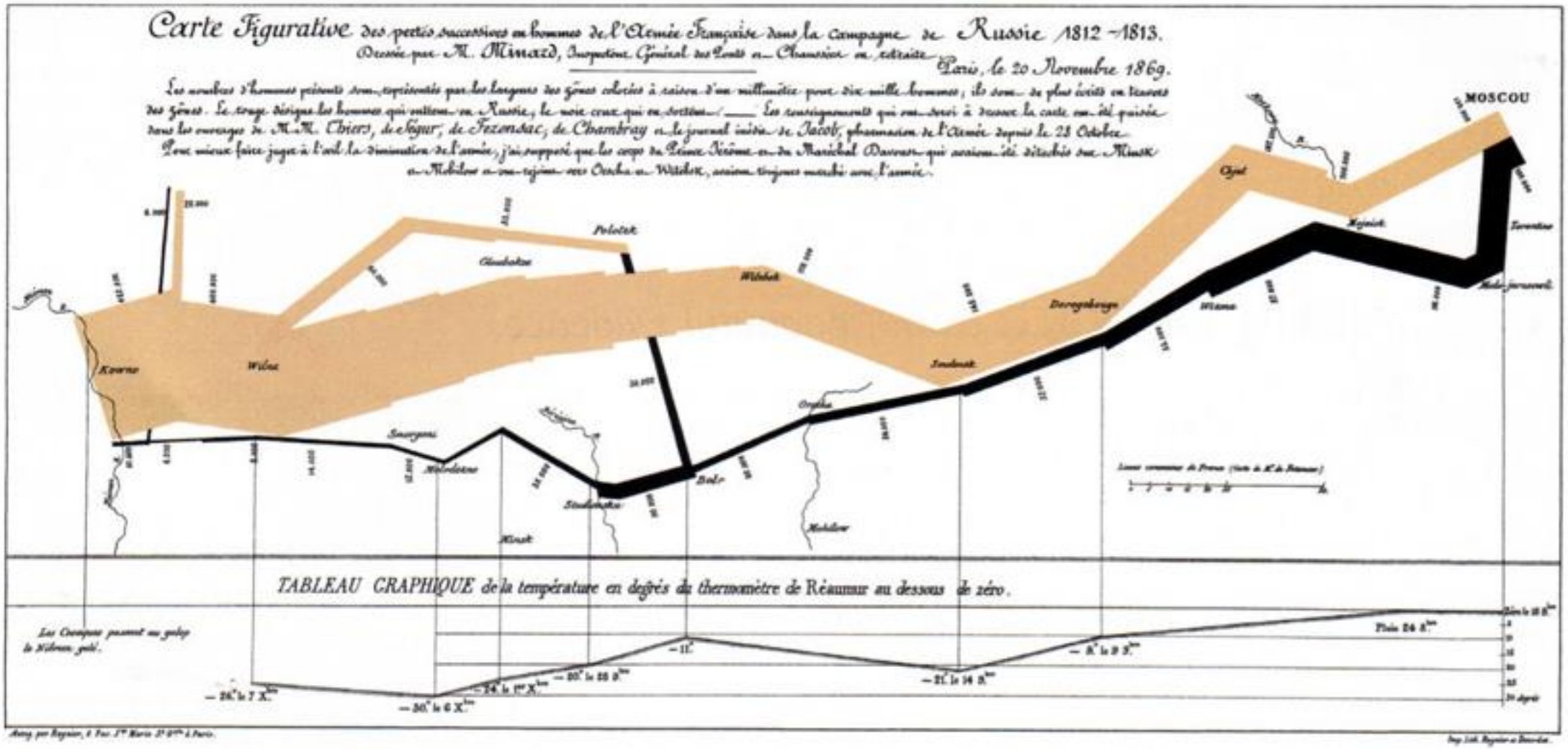
Was wir denken, wenn wir uns moderne Kunst anschauen

- Toll. Die aggressive Farbgestaltung im Kontrast zu dem vergänglichen Material bringt den gesellschaftskritischen Ansatz des Künstlers zum Ausdruck.
- Toll. Das kann ich auch.

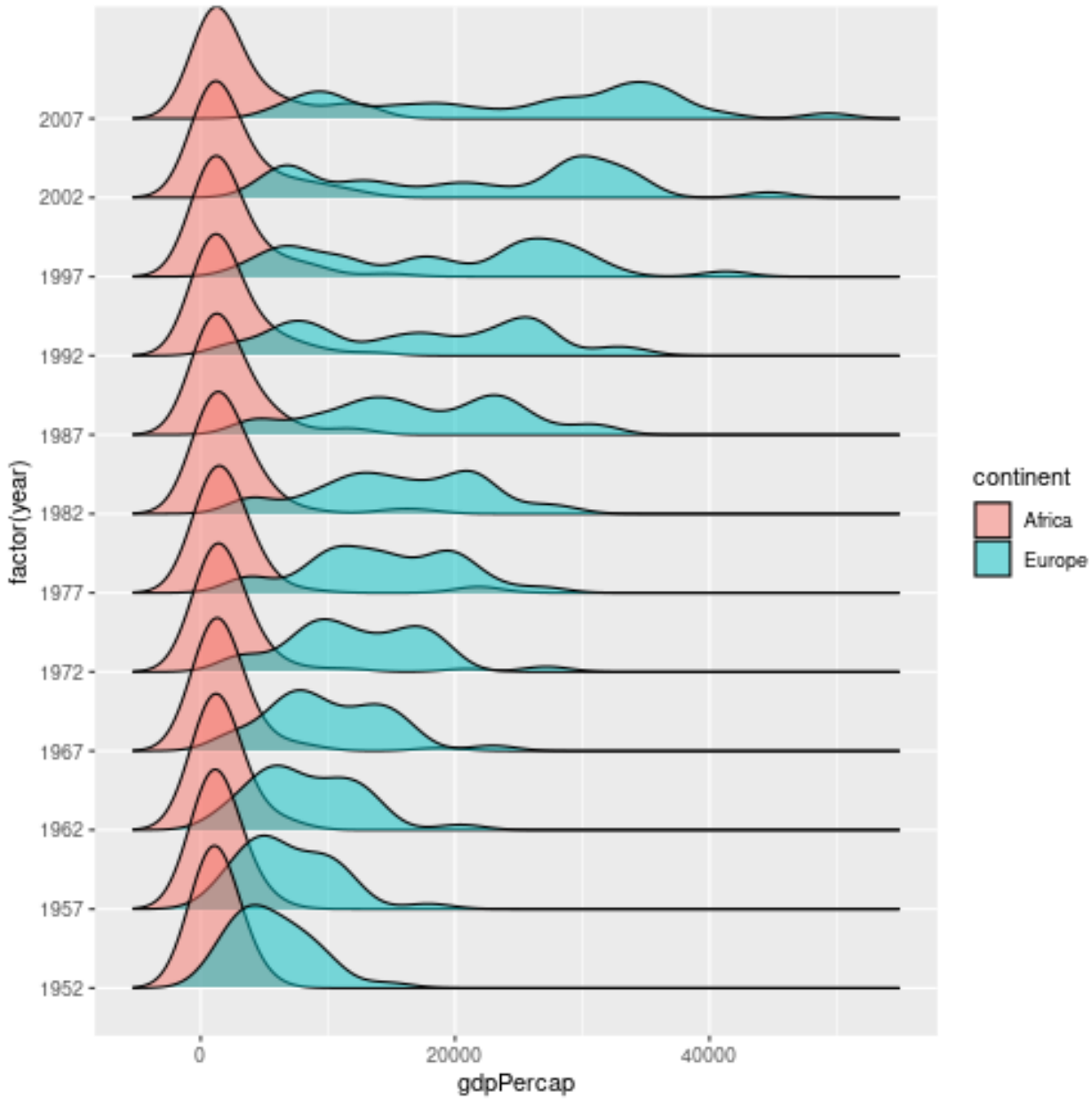

CUBOT S222
Unknown F808NM
Meizu 16th
Acer Iconia B1-721
Huawei Honor Pad 2
Archos 70c Neon
Xiaomi Redmi Note
CHUWI Hi10
eSTAR GRAND HD Quad Core
Orange Neva 80
LG Stylo 5
any iPod
Cube iPlay10
Teclast X98 Pro
Samsung Galaxy Tab 5
TechPad 1032
ASK Computer Technology Limit...
InnJoo Note
DoCoMo Galaxy Feel SC-04J
Polaroid MID3147

Jane said, "Here is a ball.
See this blue ball, Sally.
Do you want this ball?"

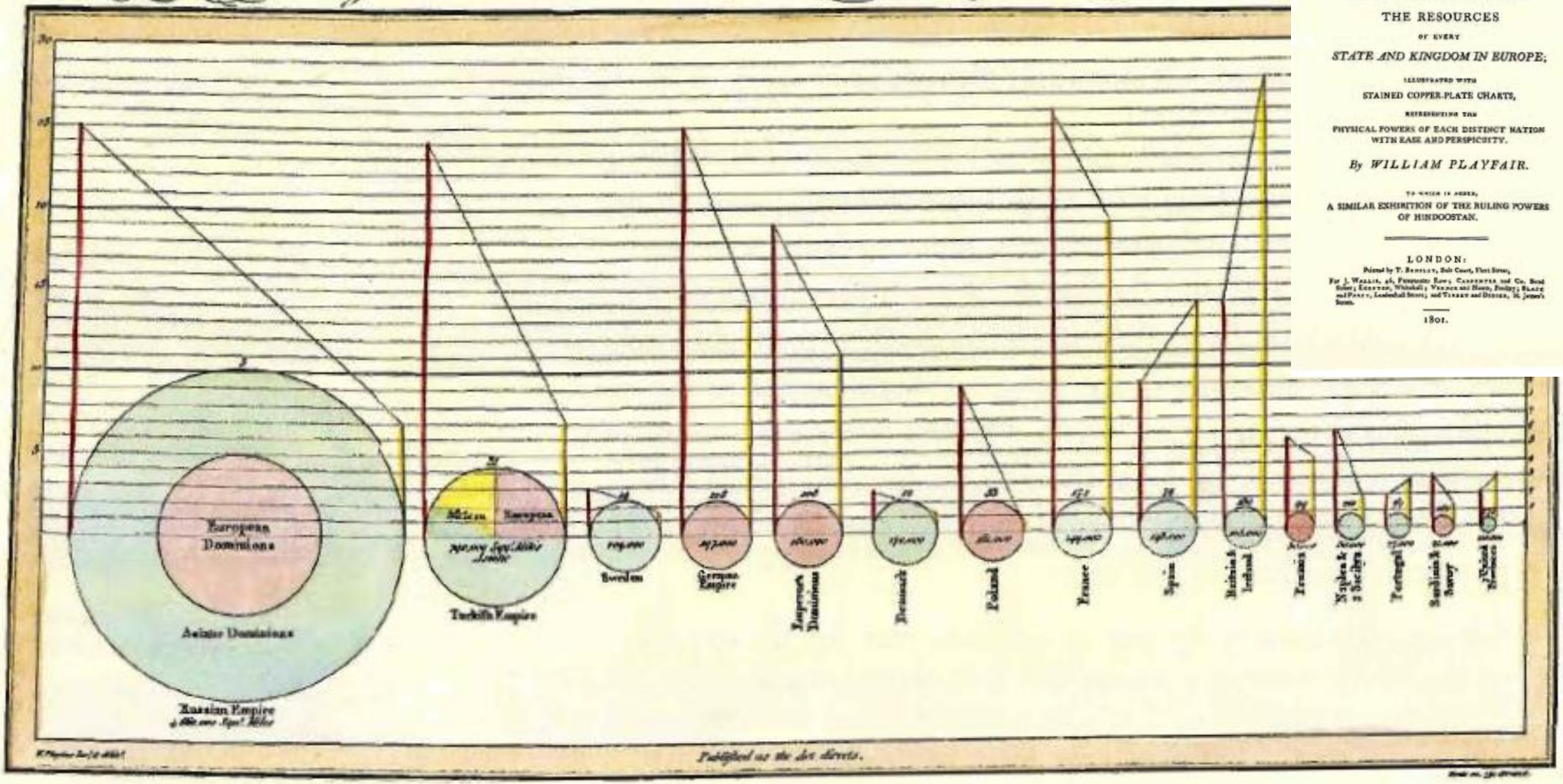
Sally said, "I want my ball.
My ball is yellow.
It is a big, pretty ball."



This map drawn by Charles Joseph Minard portrays the losses suffered by Napoleon's army in the Russian campaign of 1812. Beginning at the left on the Polish-Russian border near the Niemen, the thick band shows the size of the army (422,000 men) as it invaded Russia. The width of the band indicates the size of the army at each position. In September, the army reached Moscow with 100,000 men. The path of Napoleon's retreat from Moscow in the bitterly cold winter is depicted by the dark lower band, which is tied to temperature and time scales. The remains of the Grande Armée struggled out of Russia with 10,000 men. Minard's graphic tells a rich, coherent story with its multivariate data, far more enlightening than just a single number bouncing along over time. Six variables are plotted: the size of the army, its location on a two-dimensional surface, direction of the army's movement, and temperature on various dates during the retreat from Moscow. It may well be the best statistical graphic ever drawn. Napoleon's March poster $14 postpaid; English/French version $18 postpaid.


factor(year)
2007
2002
1997
1992
1987
1982
1977
1972
1967
1962
1957
1952
0
20000
40000
gdpPercap
continent
Africa
Europe

Statistical Chart shewing the Extent the Population & Revenues of the PRINCIPAL NATIONS of EUROPE, in the order of



Published as the Act directs.

THE

STATISTICAL BREVIARY;

SHEWING,

ON A PRINCIPLE ENTIRELY NEW,

THE RESOURCES

OF EVERY

STATE AND KINGDOM IN EUROPE;

ILLUSTRATED WITH

STAINED COPPER-PLATE CHARTS,

REPRESENTING THE

PHYSICAL POWERS OF EACH DISTINCT NATION
WITH EASE AND PERSPICUITY.

By WILLIAM PLAYFAIR.

TO WHICH IS ADDED,

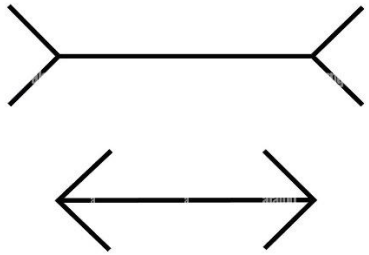
A SIMILAR EXHIBITION OF THE RULING POWERS
OF HINDOOSTAN.

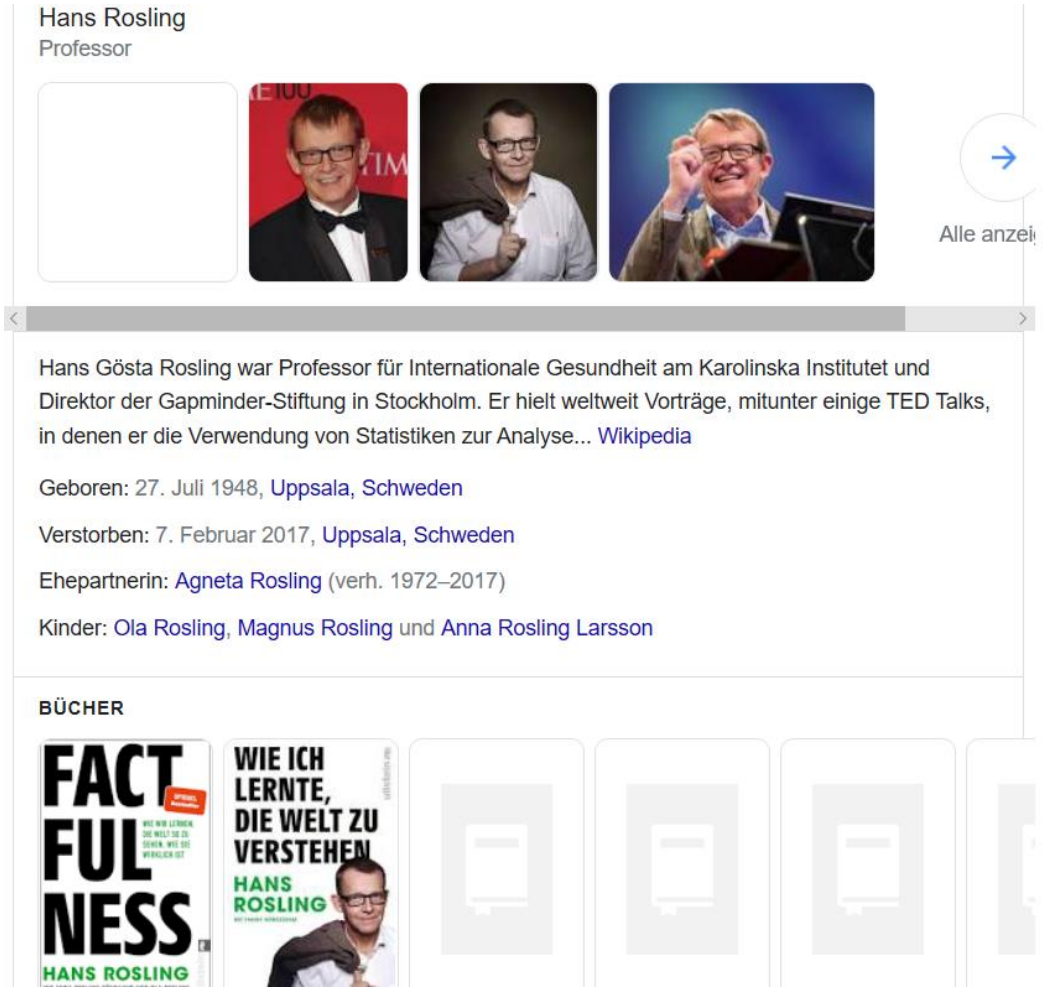
LONDON:
Printed by T. Bensley, Bolt Court, Fleet Street,
For J. Wallis, 46, Ponsonby Row; Carpenter and Co. Bond Street; Egerton, Whitehall; Vernor and Hood, Poultry; Black and Parry, Leadenhall Street; and Tebbett and Didier, St. James's Street.

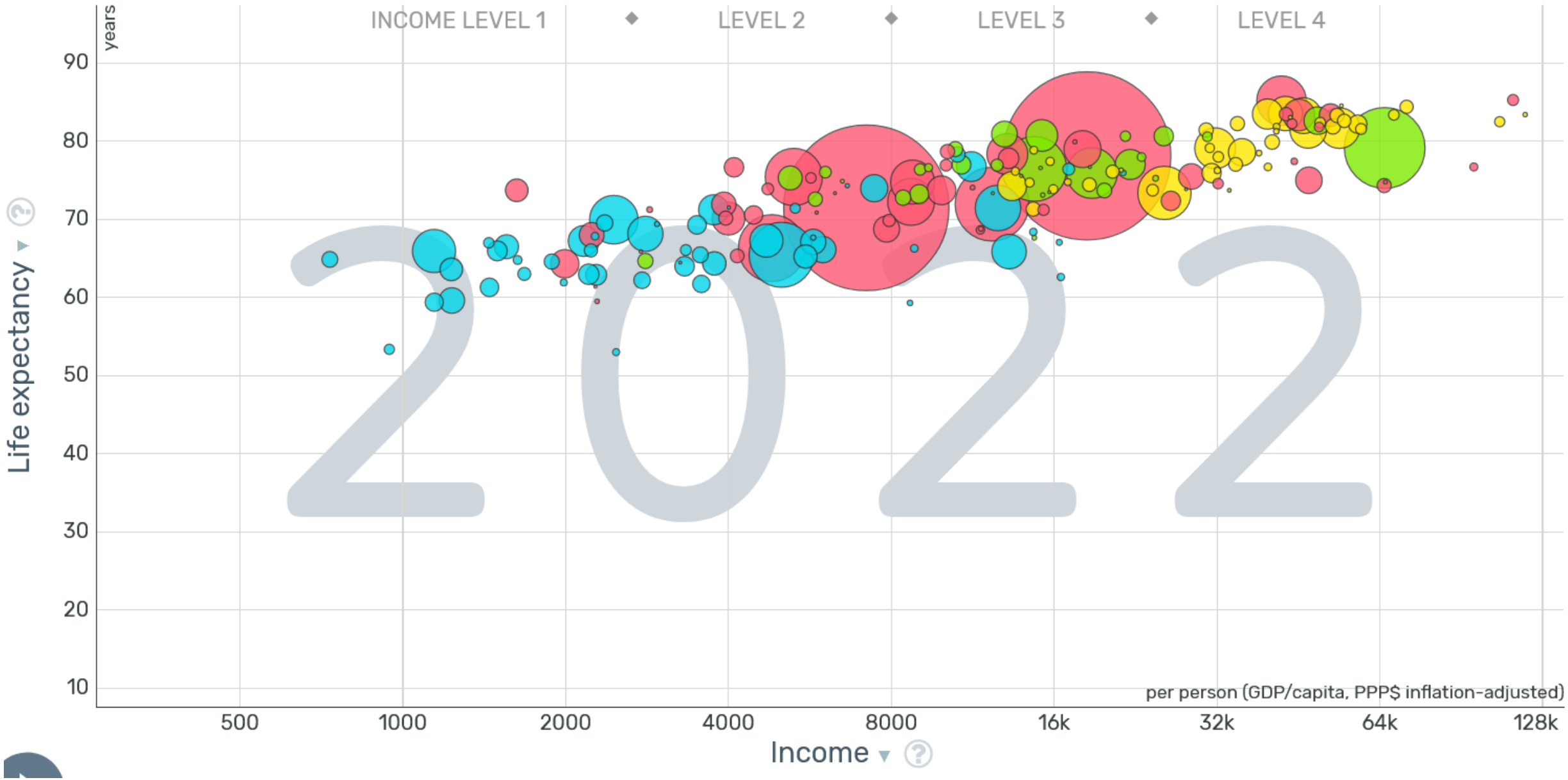
1801.

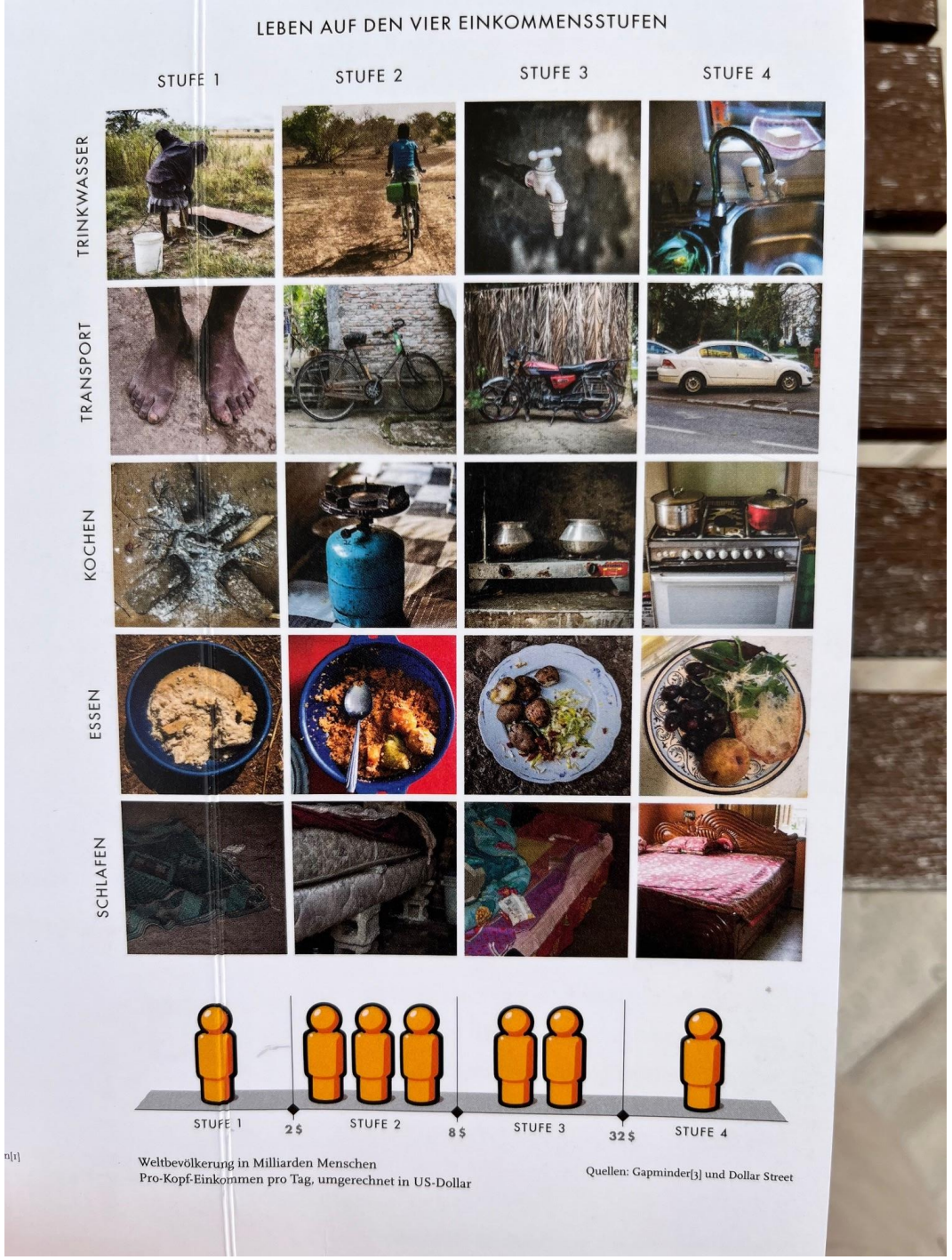
https://www.gapminder.org/

Illusionen entstehen nicht im Auge,
sondern im Gehirn…
z.B. Müller-Lyer Täuschung

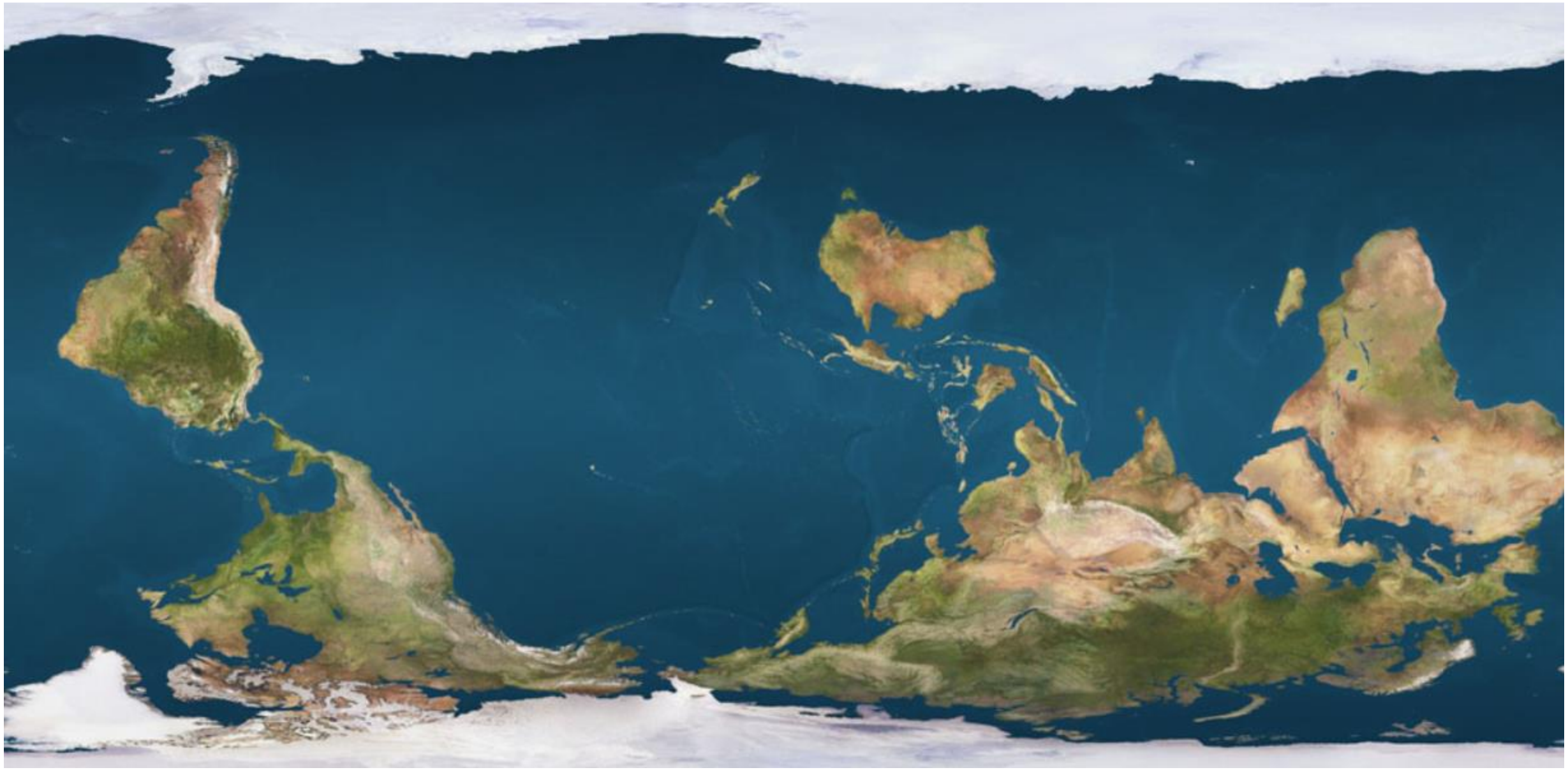




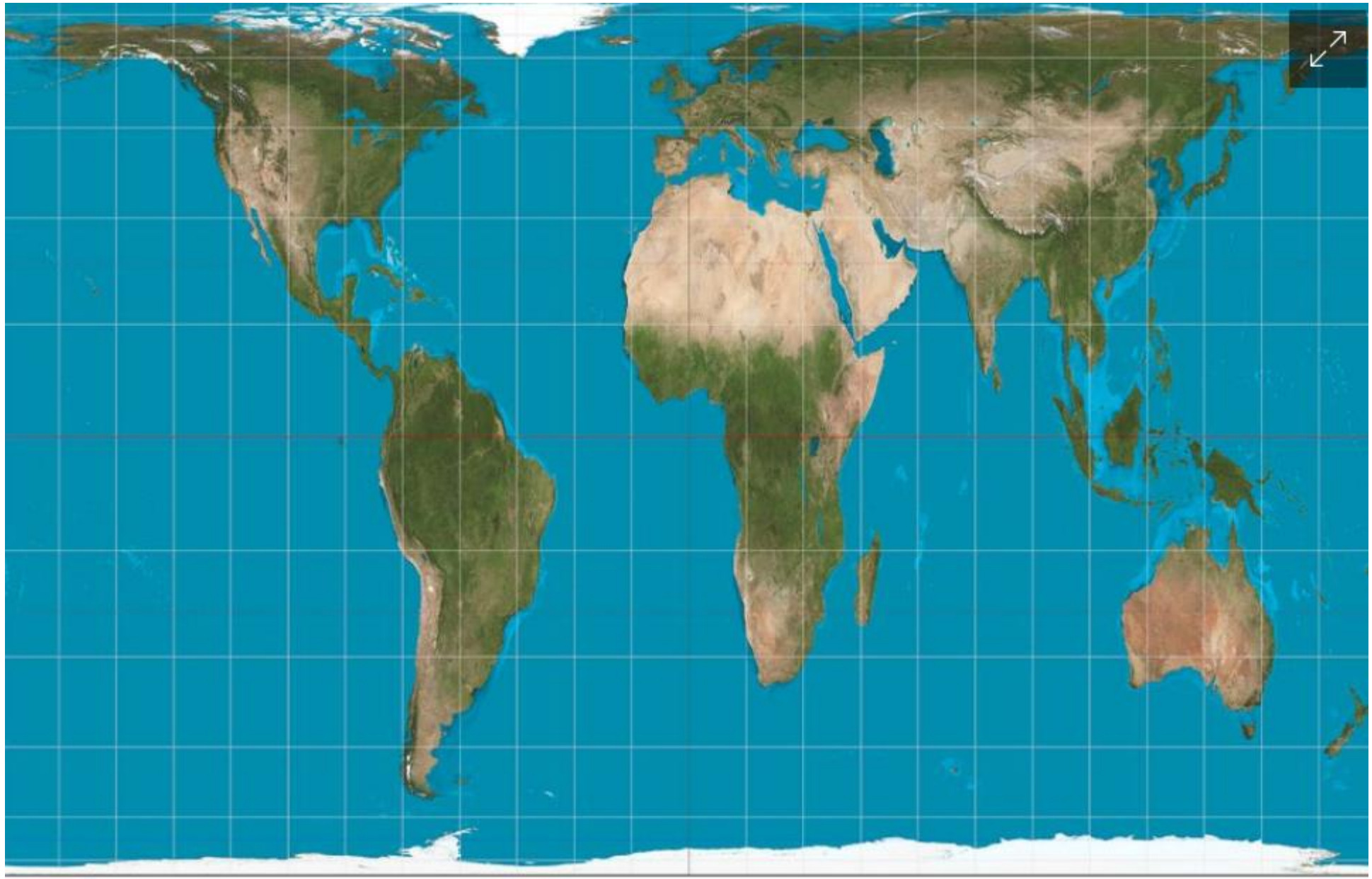

INCOME LEVEL 1
LEVEL 2
LEVEL 3
LEVEL 4
years
Life expectancy
90
80
70
60
50
40
30
20
10
2022
per person (GDP/capita, PPP$ inflation-adjusted)
500
1000
2000
4000
8000
16k
32k
64k
128k
Income



https://www.gapminder.org/dollar-street?



1659, Gerhard Mercator „ad usum navigantium“



https://ourworldindata.org/grapher/world-population-by-region-with-projections?time=1850..2100

We believe that a key reason why we fail to achieve the progress we are capable of is that we do not make enough use of this existing research and data: the important knowledge is often stored in inaccessible databases, locked away behind paywalls and buried under jargon in academic papers.
The goal of our work is to make the knowledge on the big problems accessible and understandable. As we say on our homepage,

Our World in Data's mission is to publish the ***"research and data to make progress against the world's largest problems".***

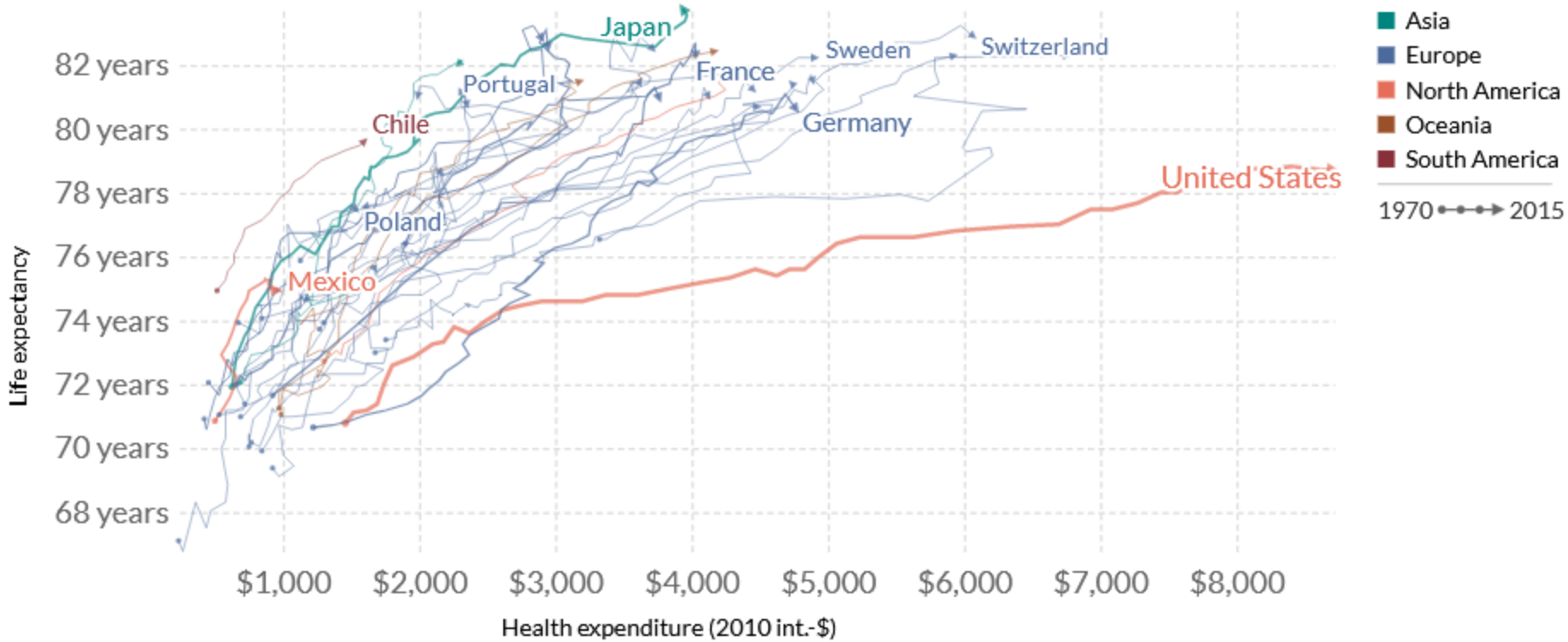
Max Roser, Founder of „Our World in Data"

Life expectancy vs. health expenditure, 1970 to 2015

Health financing is reported as the annual per capita health expenditure and is adjusted for inflation and price level differences between countries (measured in 2010 international dollars).

Our World in Data

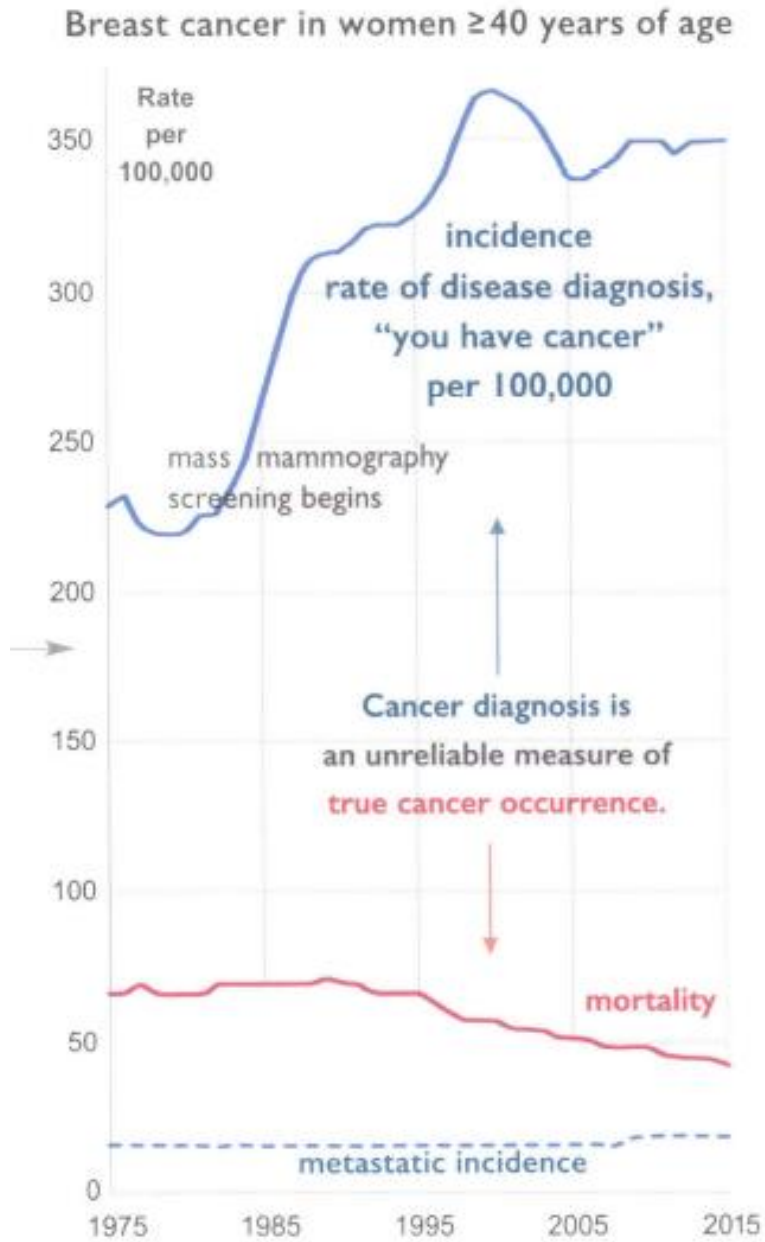
X: LINEAR | X: LOG | Select countries | Average annual change

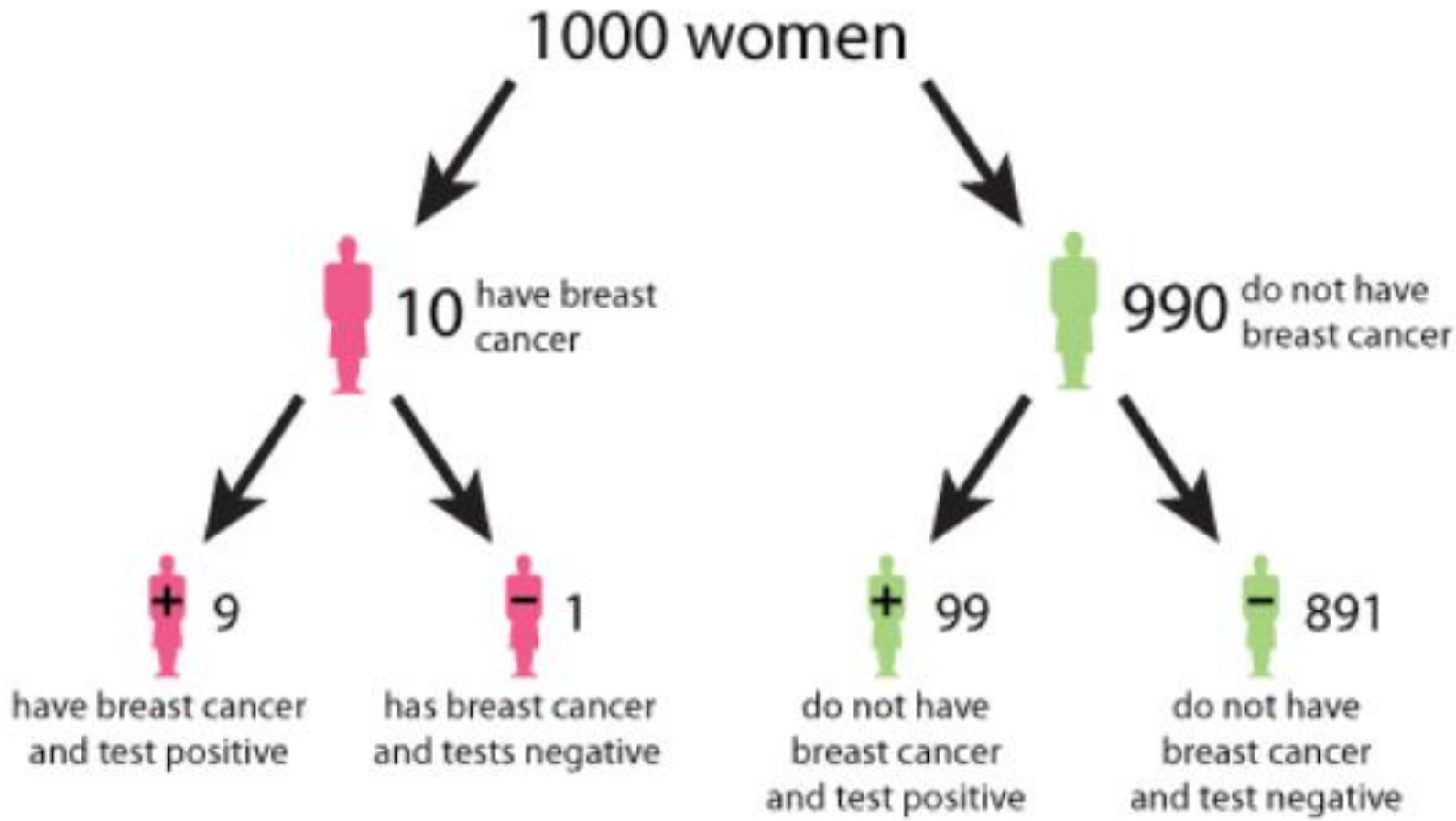


Source: Data compiled from multiple sources by World Bank; Health Expenditure and Financing - OECDstat (2017)
OurWorldInData.org/the-link-between-life-expectancy-and-health-spending-us-focus • CC BY

1970 2015

CHART | TABLE | SOURCES | DOWNLOAD


Breast cancer in women ≥40 years of age
Rate per 100,000
350
300
250
200
150
100
50
0
1975
1985
1995
2005
2015
incidence
rate of disease diagnosis, "you have cancer" per 100,000
mass mammography screening begins
Cancer diagnosis is an unreliable measure of true cancer occurrence.
mortality
metastatic incidence


1000 women
10 have breast cancer
990 do not have breast cancer
+ 9
have breast cancer and test positive
− 1
has breast cancer and tests negative
+ 99
do not have breast cancer and test positive
− 891
do not have breast cancer and test negative

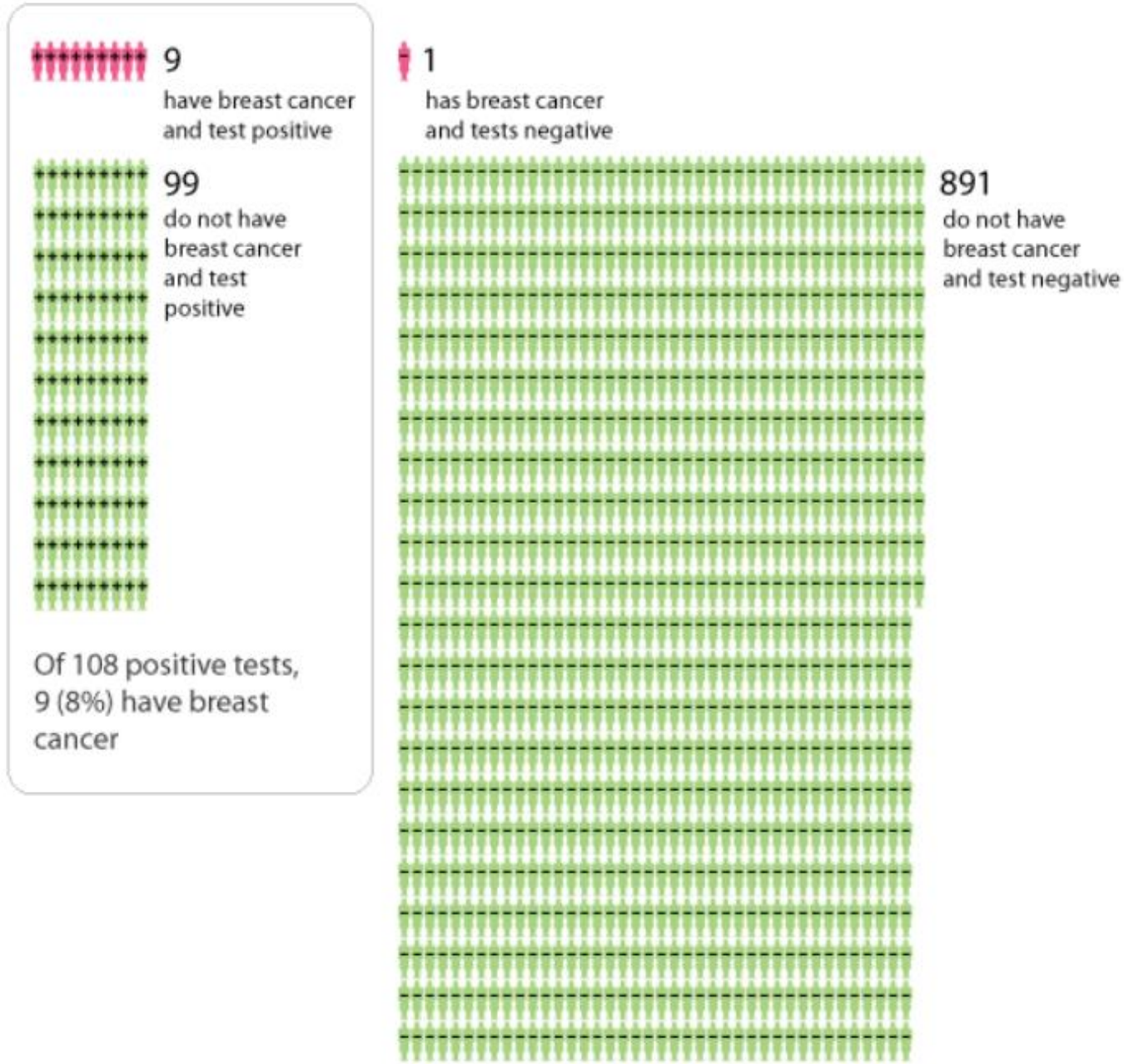
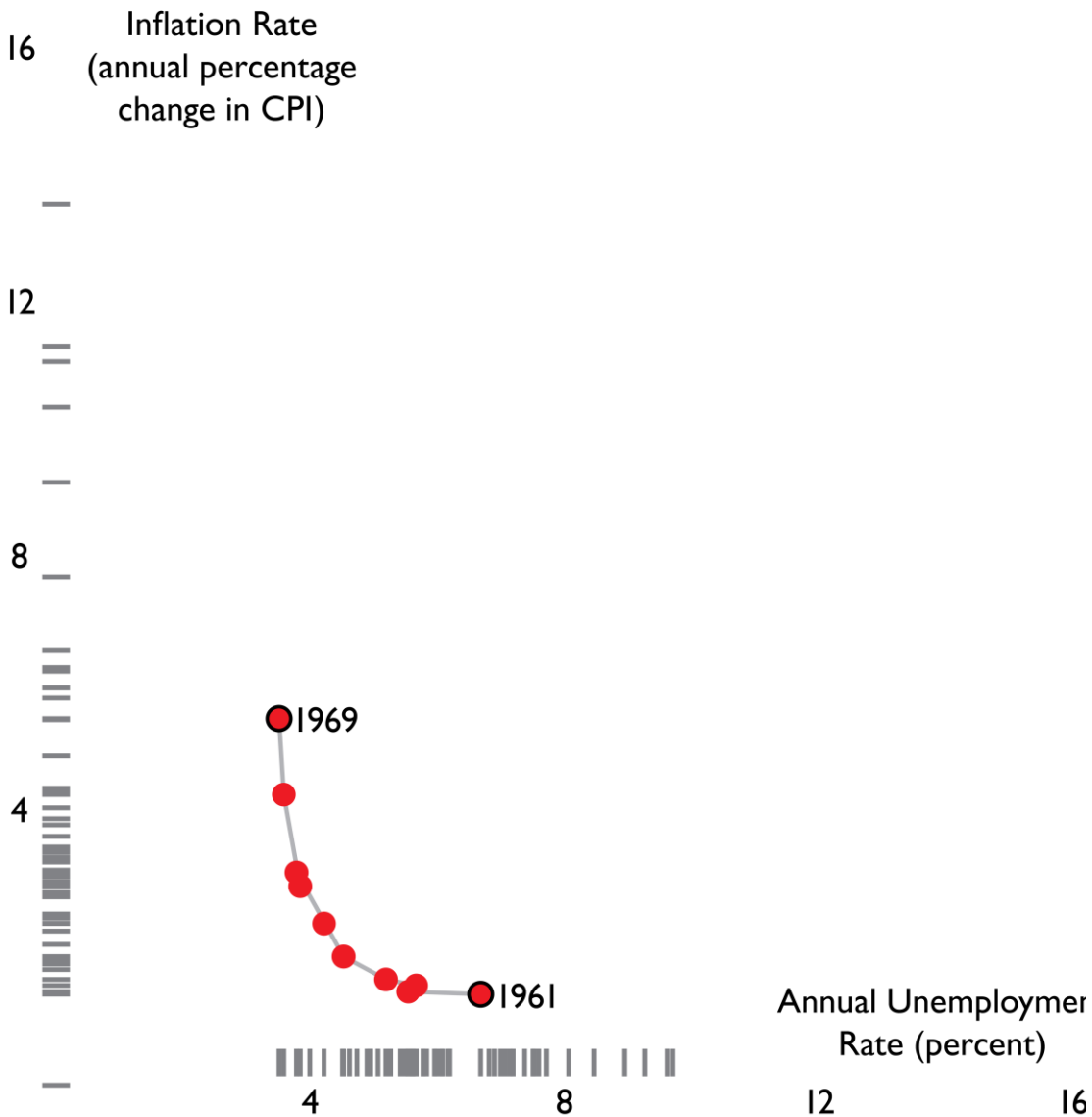
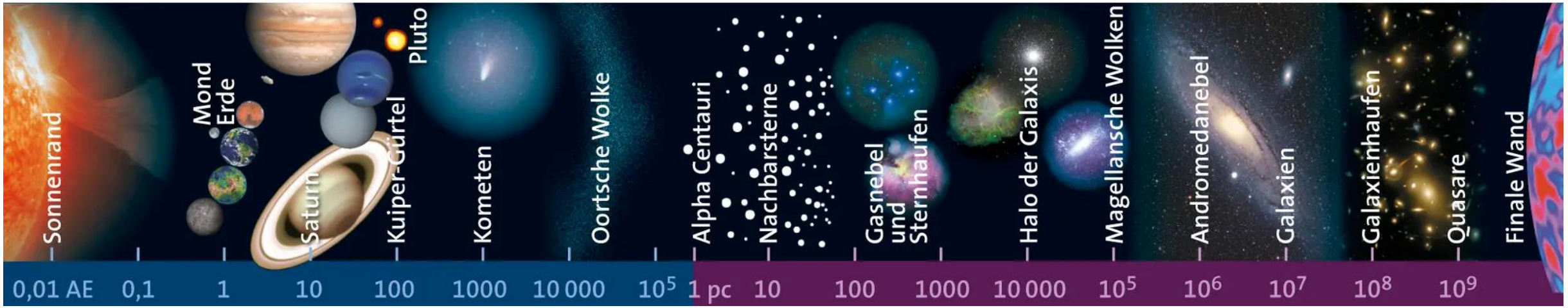


Figure 2: Icon display describing the outcomes of a mammography test.

Phillips curve,

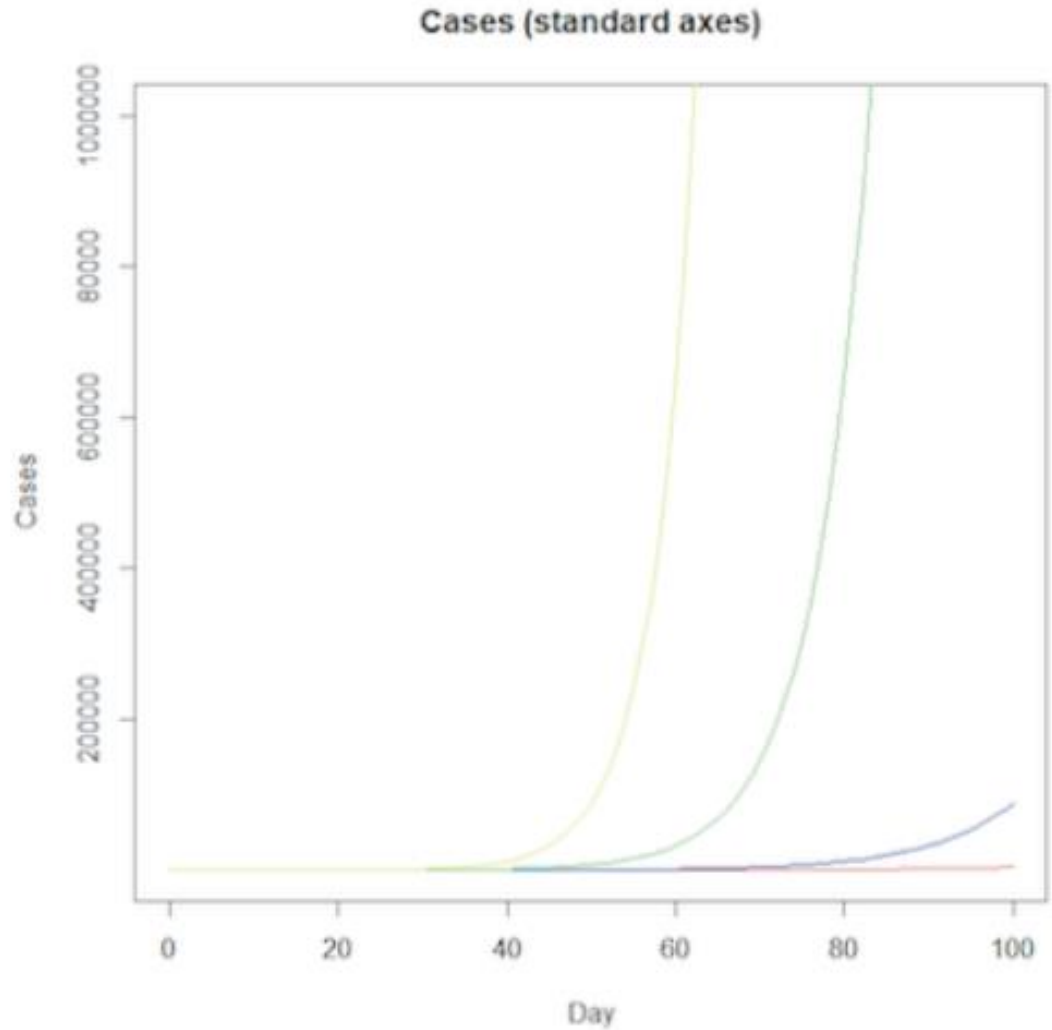


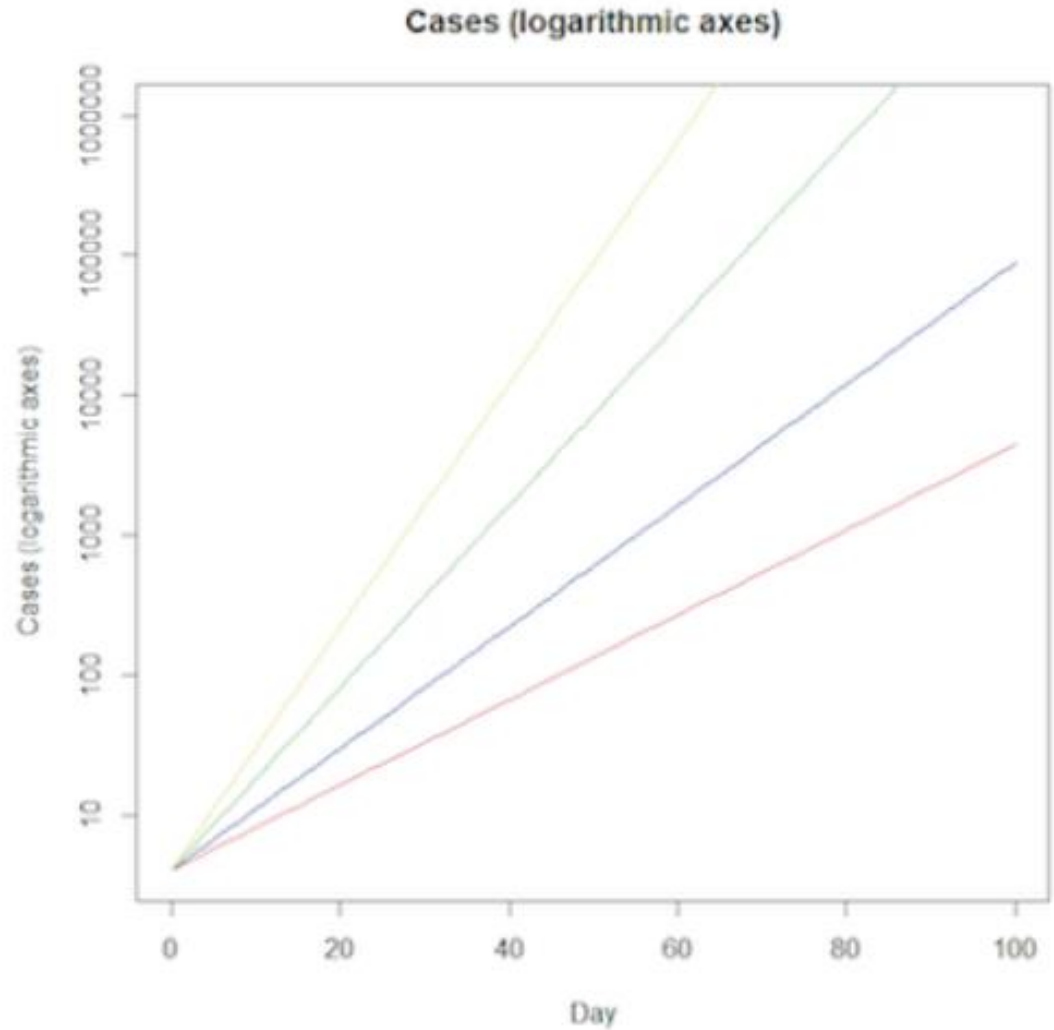


Galaxienhaufen

Quasare

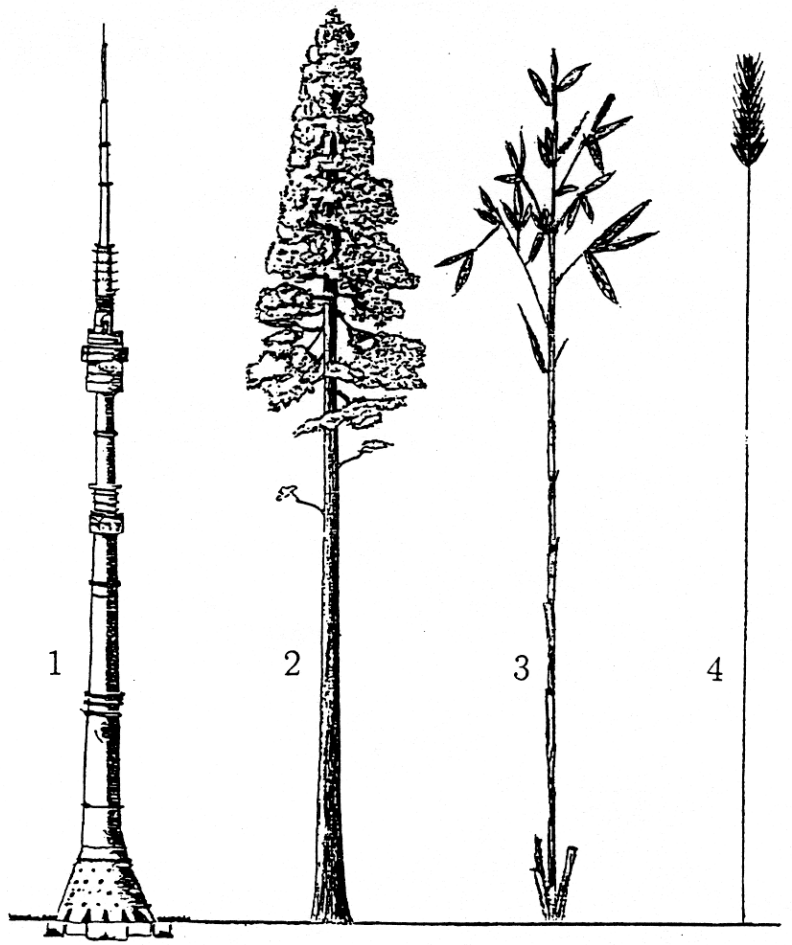
alles andere


Cases (standard axes)
Cases
1000000
800000
600000
400000
200000
0
20
40
60
80
100
Day

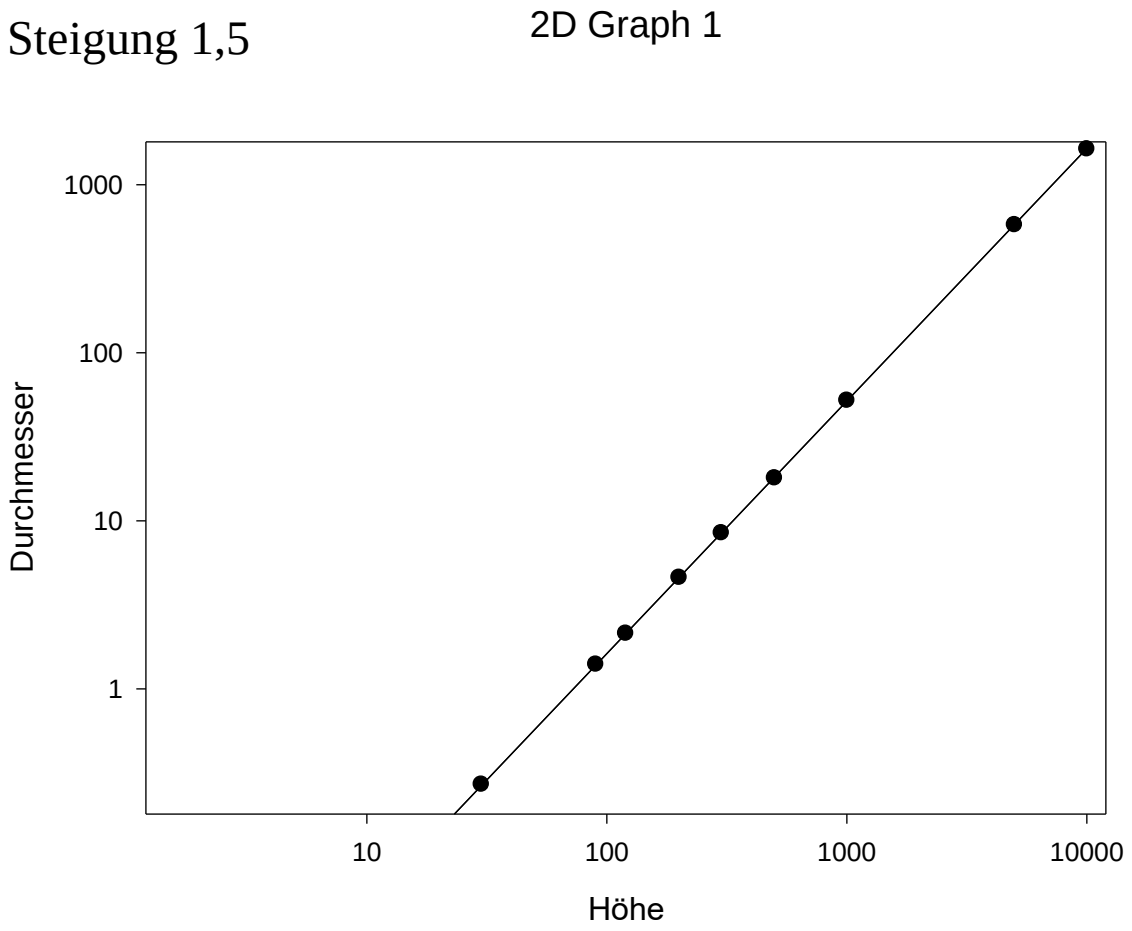

Cases (logarithmic axes)
Cases (logarithmic axes)
1000000
100000
10000
1000
100
10
0
20
40
60
80
100
Day

Wäre ein Roggenhalm so groß wie der Moskauer Fernsehturm, (533 m), so „müsste“ er nur 1,065 m dick sein.

1) Moskauer Fernsehturm (537/35)
2) Californian Redwood (112/9)
3) Riesenbambus (37/0,3)
4) Roggen (1,5/0,003)

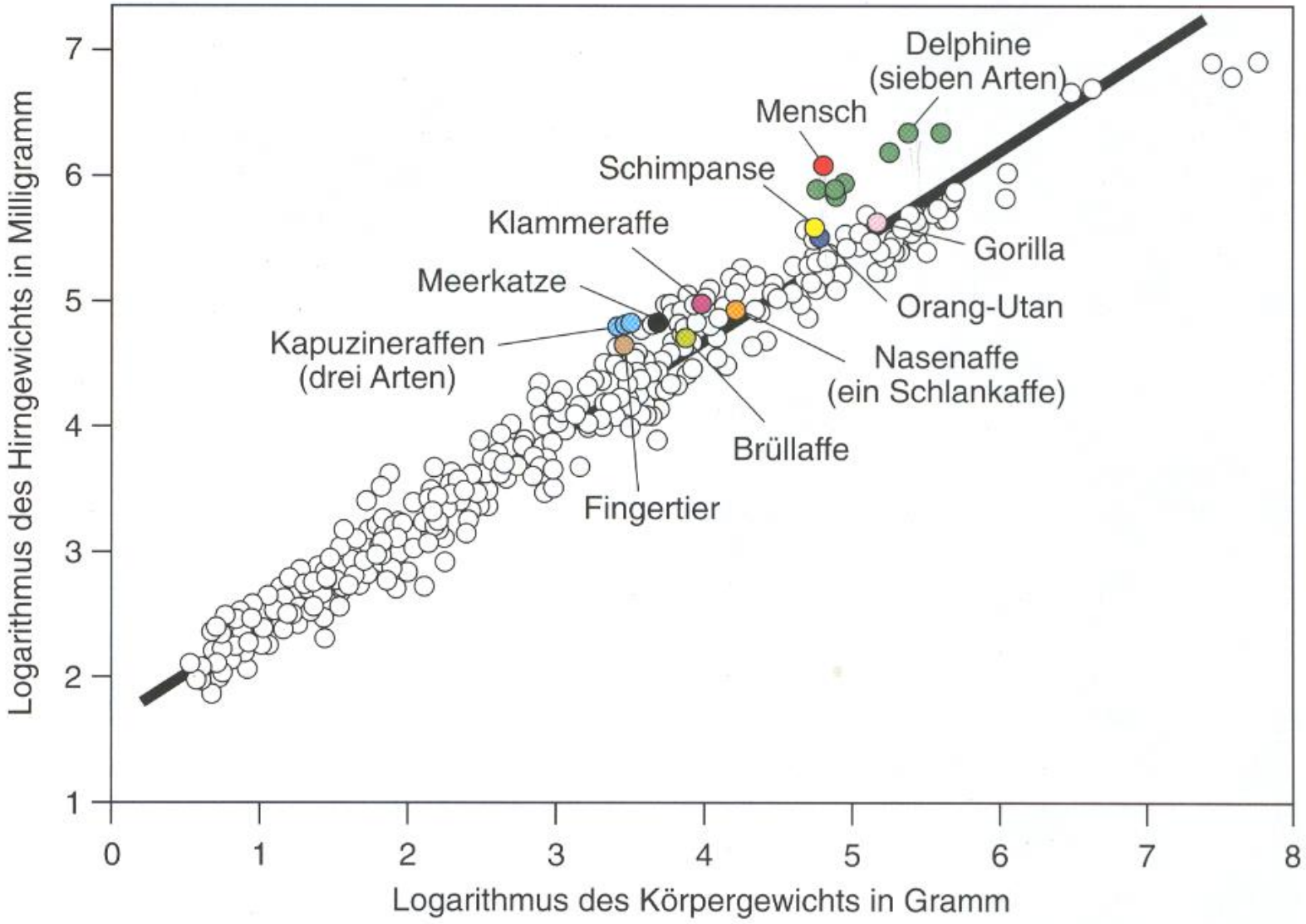


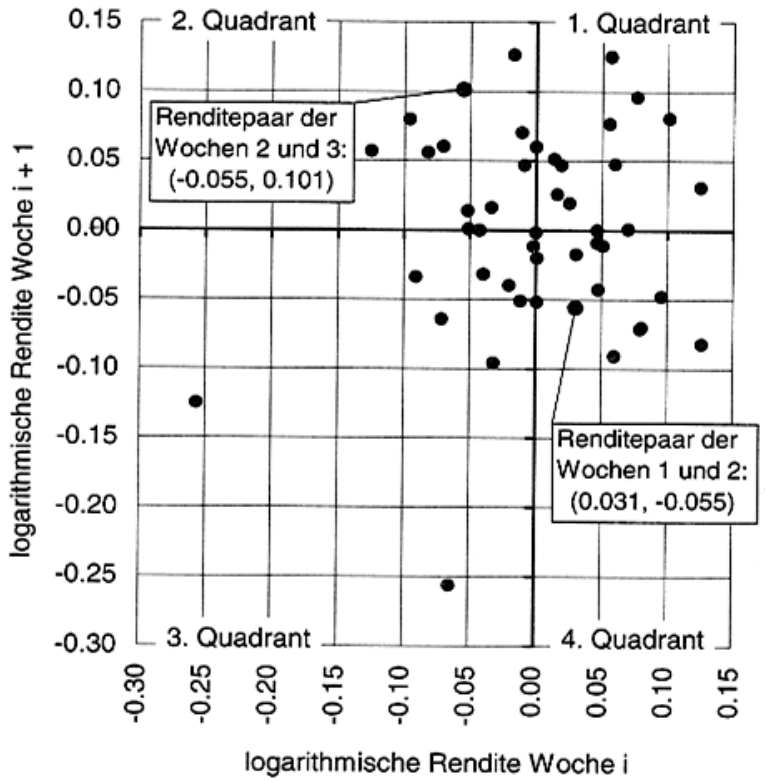
$r^2 = 0{,}99998$ Steigung 1,5

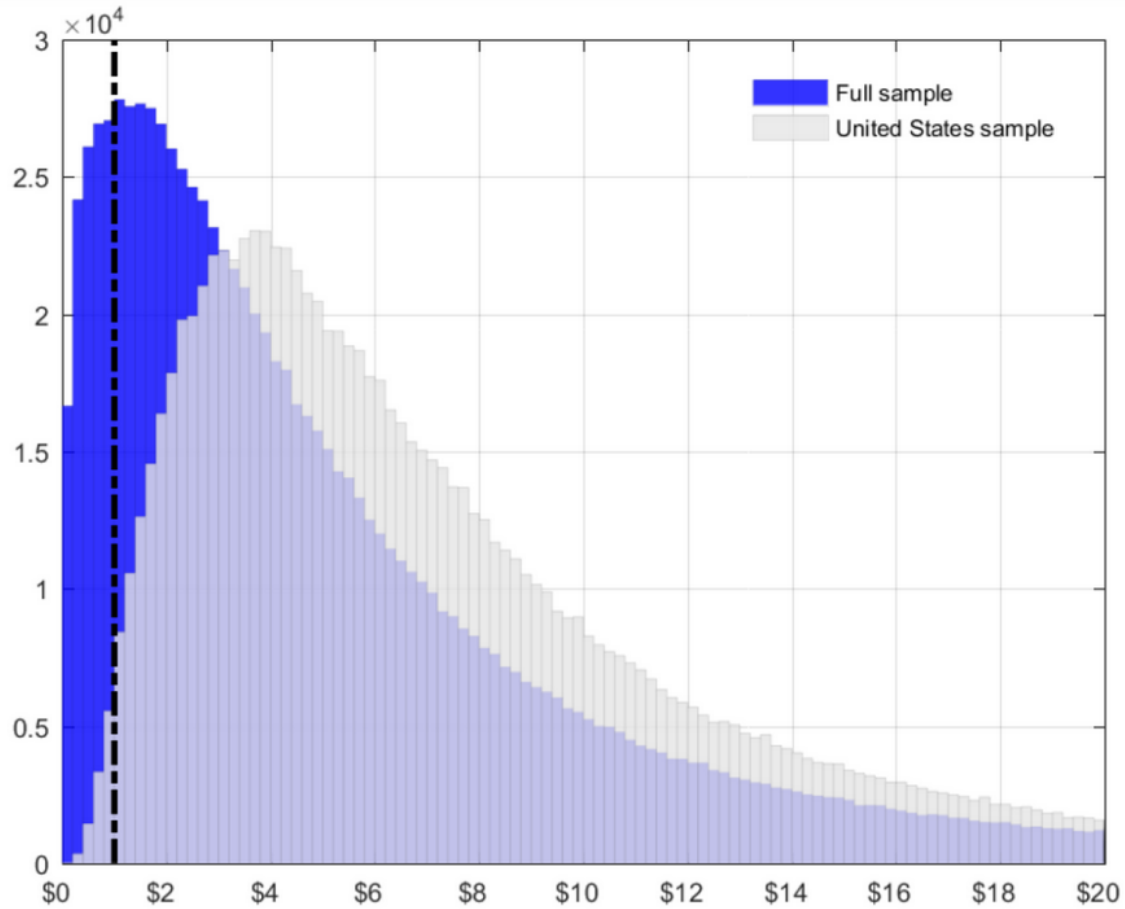


„straightening the curves“

Allometrische Analyse der Hirngröße




2. Quadrant
1. Quadrant
3. Quadrant
4. Quadrant
Renditepaar der Wochen 2 und 3: (-0.055, 0.101)
Renditepaar der Wochen 1 und 2: (0.031, -0.055)
logarithmische Rendite Woche i + 1
logarithmische Rendite Woche i
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
-0.30


×10^4
3
2.5
2
1.5
1
0.5
0
Full sample
United States sample
$0
$2
$4
$6
$8
$10
$12
$14
$16
$18
$20

Principles of Graphical Excellence

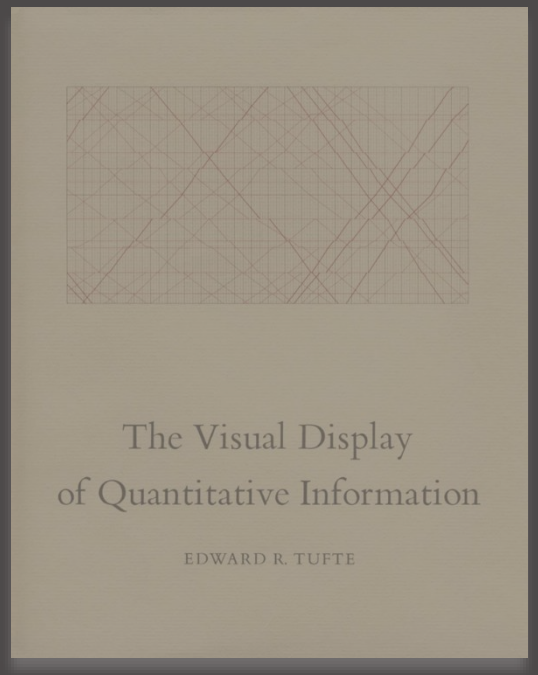
"Graphical excellence is the well-designed presentation of interesting data – a matter of substance, of statistics and of design."

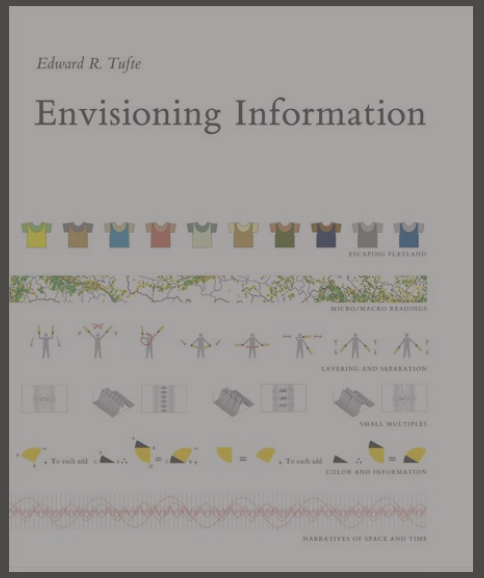
"Graphical excellence consists of complex ideas communicated with clarity, precision and efficiency."

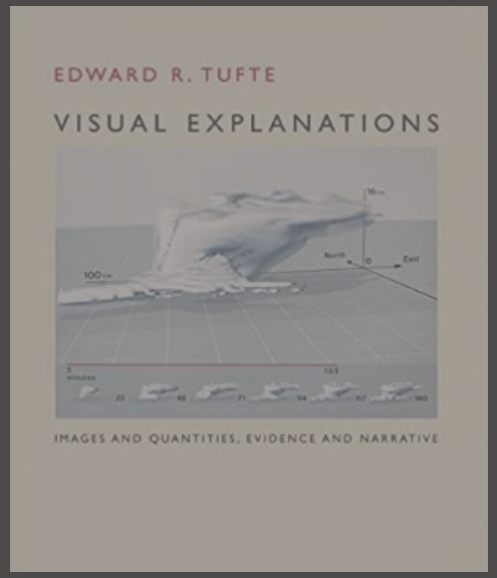
"Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest place."

"Graphical excellence is nearly always multivariate."

"Graphical excellence requires telling the truth about the data."







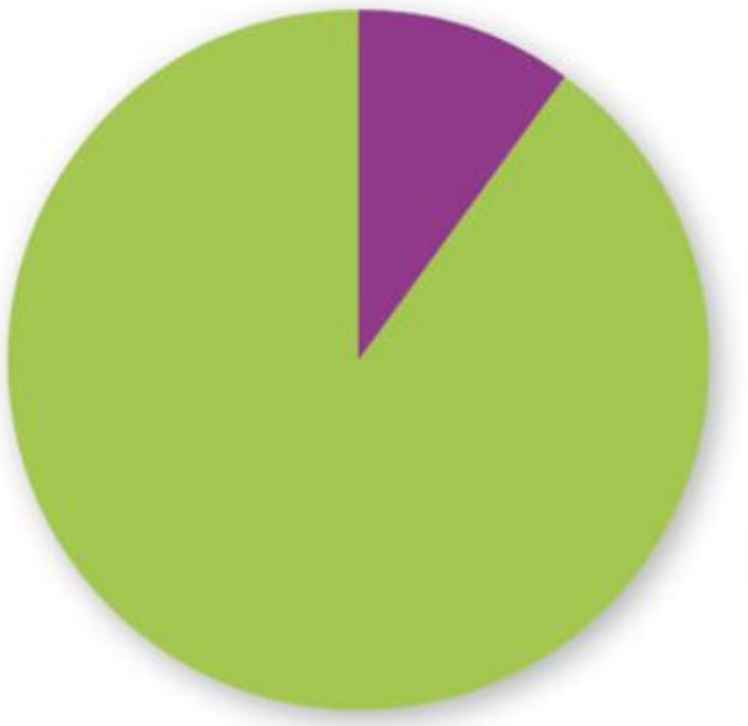
$$\text{Data-ink ratio} = \frac{\text{data-ink}}{\text{total ink used to print the graphic}}$$

$$= \text{proportion of a graphic's ink devoted to the non-redundant display of data-information}$$

$$= 1.0 - \text{proportion of a graphic that can be erased without loss of data-information.}$$

„Vollkommenheit entsteht offensichtlich nicht dann, wenn man nichts mehr hinzuzufügen hat, sondern wenn man nichts mehr wegnehmen kann."

Antoine de Saint-Exupéry



New York City, Central Park (KNYC)

Lat: 40.78°N **Lon:** 73.97°W **Elev:** 154ft.

Fair

43°F

6°C

Humidity	34%
Wind Speed	Calm
Barometer	29.99 in (1014.7 mb)
Dewpoint	16°F (-9°C)
Visibility	10.00 mi
Last update	27 Feb 12:51 pm EST

Extended Forecast for

New York NY

Click here for hazard details and duration

Winter Weather Advisory

This Afternoon	Tonight	Tuesday	Tuesday Night	Wednesday
	 100% 100%	 80% 60%		
Mostly Cloudy	Snow then Snow/Sleet	Wintry Mix then Rain Likely	Decreasing Clouds	Mostly Sunny
High: 42 °F	Low: 34 °F	High: 39 °F	Low: 31 °F	High: 47 °F

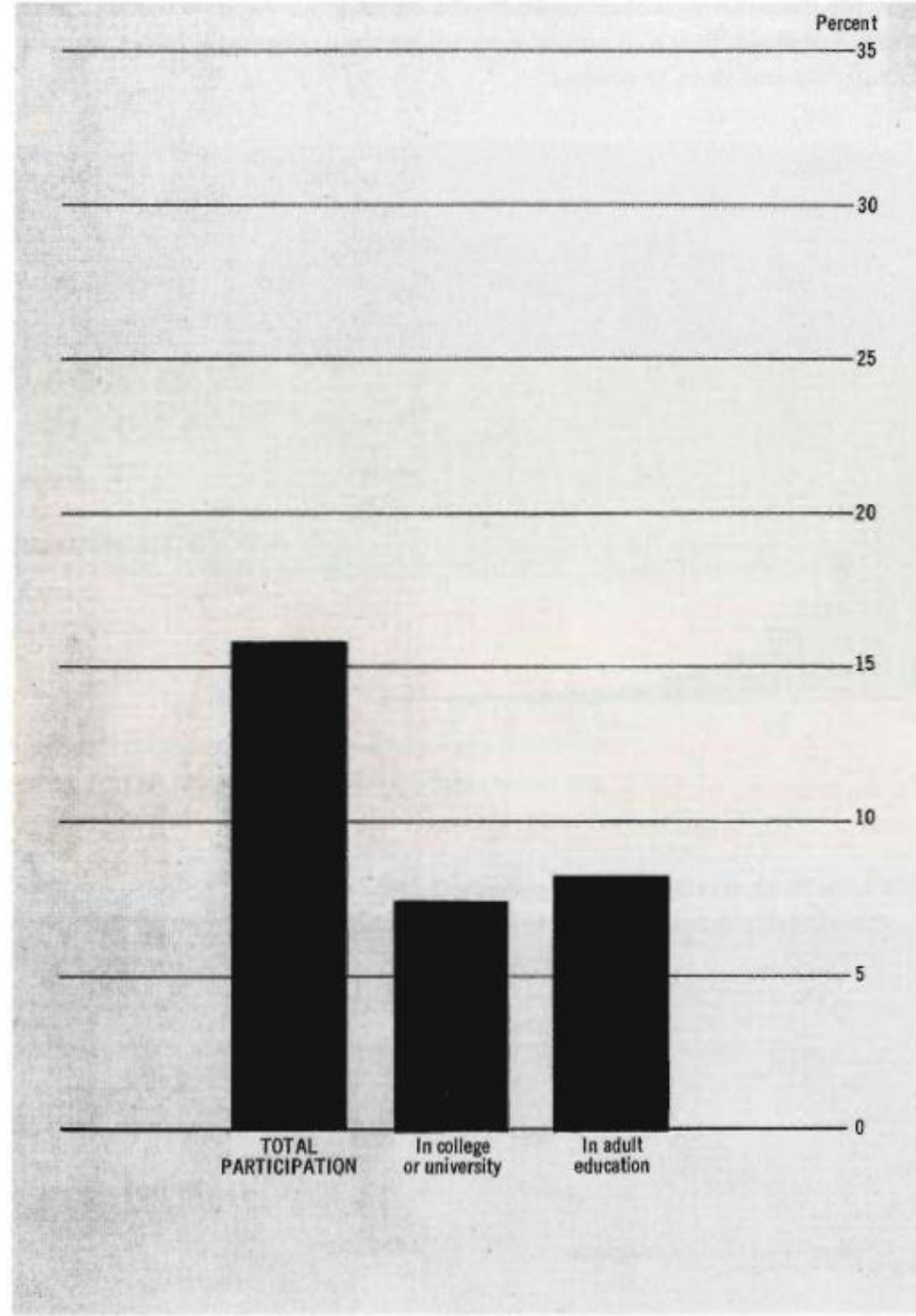
$$\text{data density of a graphic} = \frac{\text{number of entries in data matrix}}{\text{area of data graphic}}$$

No. 1450. Steel Products—Net Shipments, by Market Classes: 1960 to 1978

[**In thousands of short tons.** Comprises carbon, alloy, and stainless steel. "N.e.c." means not elsewhere classified]

MARKET CLASS	1960	1965	1970	1973	1974	1975	1976	1977	1978
Total [1]	**71,149**	**92,666**	**90,798**	**111,430**	**109,472**	**79,957**	**89,447**	**91,147**	**97,935**
Steel for converting and processing	2,928	3,932	3,443	4,714	4,486	3,255	4,036	3,679	4,612
Independent forgers, n.e.c.	841	1,250	1,048	1,213	1,339	1,098	952	998	1,192
Industrial fasteners [2]	1,071	1,234	1,005	1,278	1,331	675	912	848	870
Steel service centers, distributors	11,125	14,813	16,025	20,383	20,400	12,700	14,615	15,346	17,333
Construction, incl. maintenance	9,664	11,836	8,913	10,731	11,360	8,119	7,508	7,553	9,612
Contractors' products	3,602	5,018	4,440	6,459	6,249	3,927	4,502	4,500	3,480
Automotive	14,610	20,123	14,475	23,217	18,928	15,214	21,351	21,490	21,253
Rail transportation	2,525	3,805	3,098	3,228	3,417	3,152	3,056	3,238	3,549
Freight cars, passenger cars, locomotives	1,763	2,875	2,005	1,997	2,097	1,794	1,428	1,709	2,188
Rails and all other [3]	762	930	1,093	1,231	1,320	1,358	1,628	1,529	1,361
Shipbuilding and marine equip	622	1,051	859	1,019	1,339	1,413	969	869	845
Aircraft and aerospace	78	94	56	69	79	69	59	63	60
Oil and gas industries	1,759	1,936	3,550	3,405	4,210	4,171	2,653	3,650	4,140
Mining, quarrying, and lumbering	288	392	497	534	644	596	536	486	508
Agricultural, incl. machinery	1,003	1,483	1,126	1,772	1,859	1,429	1,784	1,743	1,805
Machinery, industrial equip., tools	3,958	5,873	5,169	6,351	6,440	5,173	5,180	5,566	5,992
Electrical equipment	2,078	2,985	2,694	3,348	3,242	2,173	2,671	2,639	2,811
Appliances, utensils, and cutlery	1,760	2,179	2,160	2,747	2,412	1,653	1,950	2,129	2,094
Other domestic commercial equip.	1,959	2,179	1,778	1,900	1,941	1,390	1,813	1,846	1,889
Containers, packaging, shipping	6,429	7,331	7,775	7,811	8,218	6,053	6,914	6,714	6,595
Cans and closures	4,976	5,867	6,239	6,070	6,349	4,859	5,290	5,173	4,950
Ordnance and other military	165	289	1,222	918	654	405	219	193	207
Exports (reporting companies only)	2,563	2,078	5,985	3,138	3,961	1,755	1,839	1,076	1,224

[1] Total includes nonclassified shipments, and, beginning 1970, data include estimates for a relatively small number of companies which report raw steel production but not shipments. [2] Bolts, nuts, rivets, and screws. [3] Includes railways, rapid transit systems, railroad rails, trackwork, and equipment.



KORRELATIONSMATRIX

1,00 ≥ ρ ≥ 0,75
0,74 ≥ ρ ≥ 0,50
0,49 ≥ ρ ≥ 0,25
0,24 ≥ ρ ≥ 0,00
–0,01 ≥ ρ ≥ –0,25
–0,26 ≥ ρ ≥ –1,00

		Aktien						Rohstoffe								Devisen			Zinsen		
		DAX®	EURO STOXX 50®	Nasdaq 100	S&P 500	Nikkei 225	DAXglobal® BRIC	S&P GSCI ER	S&P GSCI Energy ER	S&P GSCI Agriculture ER	S&P GSCI Industrial Metals ER	S&P GSCI Precious Metals ER	S&P GSCI Livestock ER	Brent-Rohöl	Gold	EUR/USD	EUR/JPY	EUR/GBP	6M Euribor*	10J EUR Swapsatz*	Rex Performance Index
Aktien	DAX®		0,90	0,75	0,79	0,63	0,48	0,29	0,30	0,03	0,41	–0,12	0,19	0,24	–0,23	0,17	0,20	0,16	0,41	0,43	–0,59
	EURO STOXX 50®	0,95		0,74	0,84	0,58	0,48	0,37	0,36	0,15	0,48	–0,04	0,12	0,32	–0,15	0,31	0,34	0,20	0,41	0,52	–0,70
	Nasdaq 100	0,82	0,81		0,95	0,70	0,63	0,47	0,43	0,32	0,51	0,07	0,10	0,38	–0,05	–0,06	0,02	–0,11	0,44	0,57	–0,60
	S&P 500	0,87	0,87	0,93		0,68	0,62	0,54	0,50	0,35	0,57	0,09	0,08	0,45	–0,04	0,10	0,15	–0,01	0,44	0,59	–0,64
	Nikkei 225	–0,10	0,72	0,68	0,72		0,67	0,35	0,30	0,30	0,39	0,14	0,22	0,27	0,04	–0,19	0,07	–0,23	0,43	0,49	–0,52
	DAXglobal® BRIC	0,77	0,75	0,72	0,75	0,73		0,54	0,51	0,35	0,61	0,20	0,12	0,45	0,10	–0,24	–0,09	–0,31	0,36	0,31	–0,32
Rohstoffe	S&P GSCI ER	0,47	0,47	0,39	0,45	0,41	0,48		0,97	0,68	0,72	0,60	–0,05	0,94	0,47	0,29	0,22	0,05	0,38	0,36	–0,34
	S&P GSCI Energy ER	0,43	0,43	0,36	0,42	0,37	0,44	0,98		0,50	0,65	0,51	–0,02	0,96	0,37	0,30	0,24	0,11	0,34	0,30	–0,31
	S&P GSCI Agriculture ER	0,32	0,34	0,28	0,30	0,29	0,33	0,58	0,44		0,52	0,58	–0,18	0,51	0,53	0,09	0,08	–0,17	0,37	0,41	–0,28
	S&P GSCI Industrial Metals ER	0,52	0,08	0,49	0,51	0,50	0,54	0,63	0,55	0,48		0,38	–0,07	0,61	0,28	0,27	0,15	–0,02	0,26	0,26	–0,29
	S&P GSCI Precious Metals ER	0,04	0,03	0,01	0,03	0,01	0,15	0,41	0,35	0,35	0,27		–0,14	0,52	0,96	0,16	–0,03	–0,20	0,14	0,05	0,07
	S&P GSCI Livestock ER	0,28	0,24	0,23	0,26	0,24	0,23	0,26	0,24	0,12	0,20	0,02		–0,03	–0,22	–0,14	–0,04	0,18	–0,03	0,12	–0,06
	Brent-Rohöl	0,42	0,43	0,37	0,42	0,38	0,44	0,95	0,96	0,06	0,56	0,38	0,27		0,40	0,26	0,24	0,08	0,34	0,32	–0,31
	Gold	0,00	–0,06	–0,03	–0,02	–0,02	0,11	0,36	0,30	–0,04	0,22	0,99	0,00	0,33		0,12	–0,09	–0,21	0,05	–0,06	0,18
Devisen	EUR/USD	0,27	0,02	0,29	0,31	0,25	0,18	0,46	0,40	0,07	0,39	0,44	0,10	0,43	0,41		0,73	0,74	0,02	–0,02	–0,12
	EUR/JPY	0,53	0,55	0,55	0,55	0,59	0,52	0,50	0,44	0,39	0,55	0,24	0,16	0,46	0,21	0,64		0,54	0,11	0,12	–0,29
	EUR/GBP	–0,07	–0,06	–0,03	–0,01	–0,15	–0,16	0,03	0,02	0,06	–0,05	0,12	0,00	0,02	0,11	0,43	0,09		–0,07	–0,03	–0,11
Zinsen	6M Euribor*	0,08	0,08	0,06	0,08	0,03	0,02	0,17	0,18	0,09	0,08	–0,03	0,02	0,11	–0,03	0,08	0,11	–0,10		0,59	–0,60
	10J EUR Swapsatz*	0,42	0,43	0,40	0,41	0,38	–0,07	0,32	0,30	0,25	0,03	0,06	0,13	0,30	0,04	0,27	0,44	0,01	0,21		–0,85
	Rex Performance Index	–0,46	–0,45	–0,42	–0,42	–0,44	–0,39	–0,32	–0,30	–0,23	–0,28	–0,02	–0,09	–0,29	0,01	–0,24	–0,49	0,08	–0,13	–0,74	

Stand: 06.12.2011; Quelle: Bloomberg, Goldman Sachs International. Im linken Dreieck finden Sie die 5-Jahres-Korrelationen, im rechten die 1-Jahres-Korrelationen (jeweils auf Basis wöchentlicher Renditen).

* Bei den angegebenen Korrelationen handelt es sich um Werte, die auf der Grundlage von in der Vergangenheit ermittelten Werten mit statistischen Methoden ermittelt wurden. Wir übernehmen keine Gewähr für die Richtigkeit. Es ist zu erwarten, dass künftige Korrelationen von diesen Werten möglicherweise auch erheblich abweichen werden.

Take another example, which portrays the key events in a couple of soccer matches showing completed passes (green lines), shots (blue triangles), and goals (red dots) as shown in the following image:

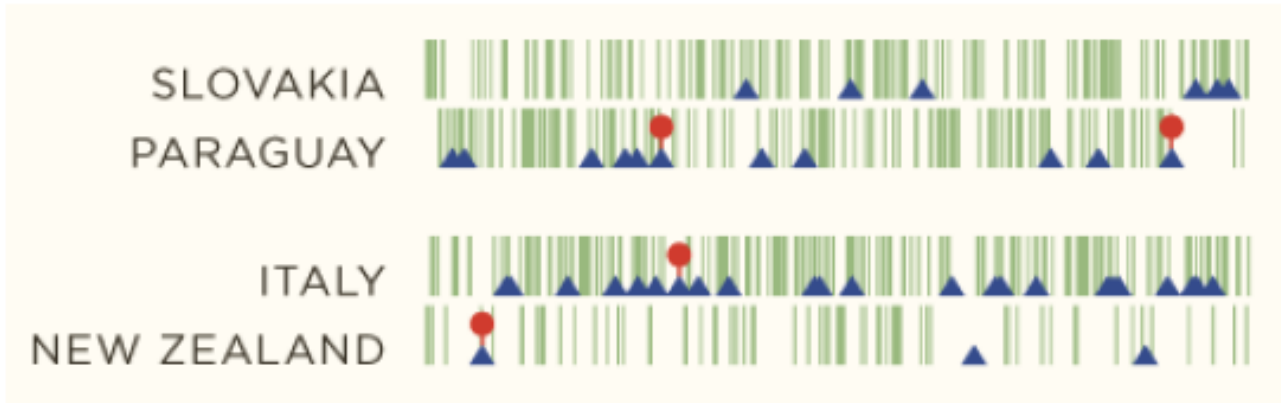
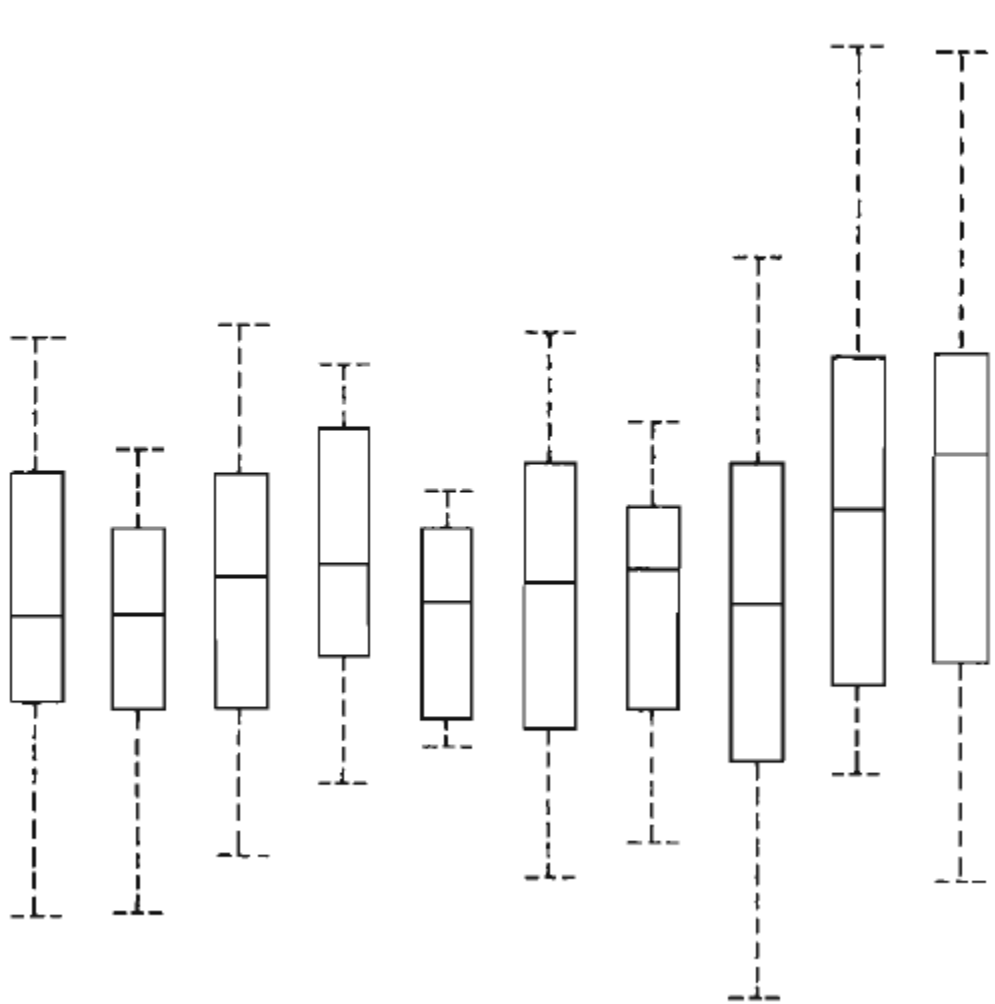
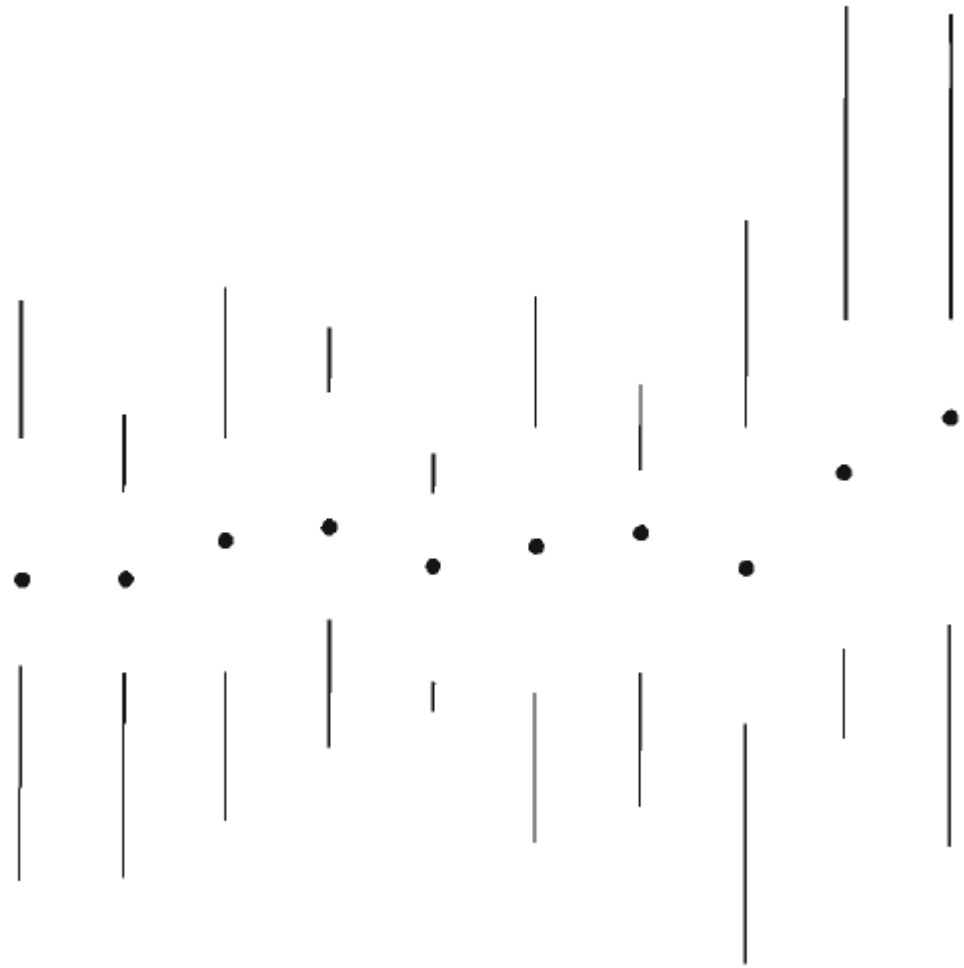
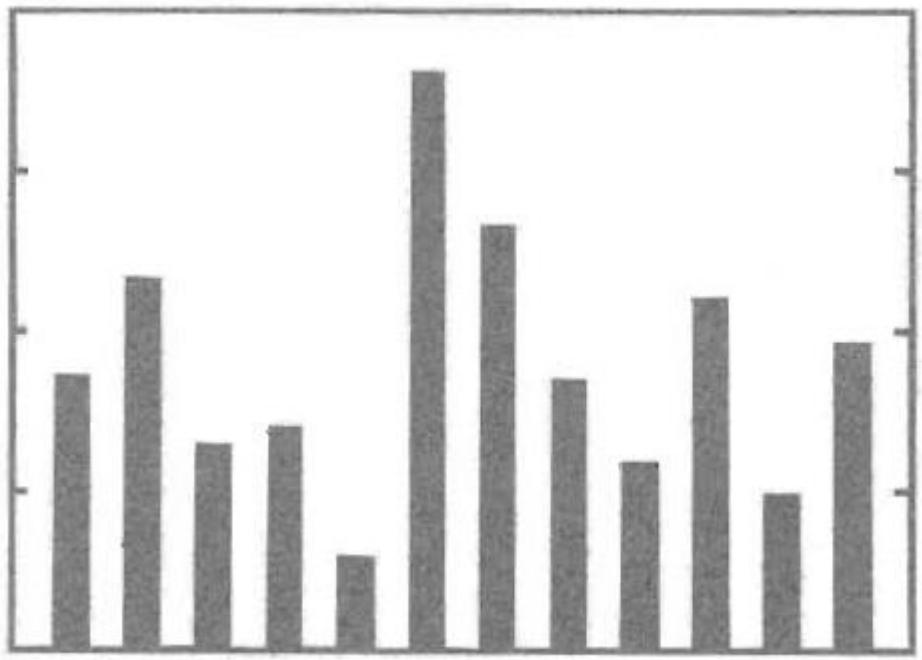


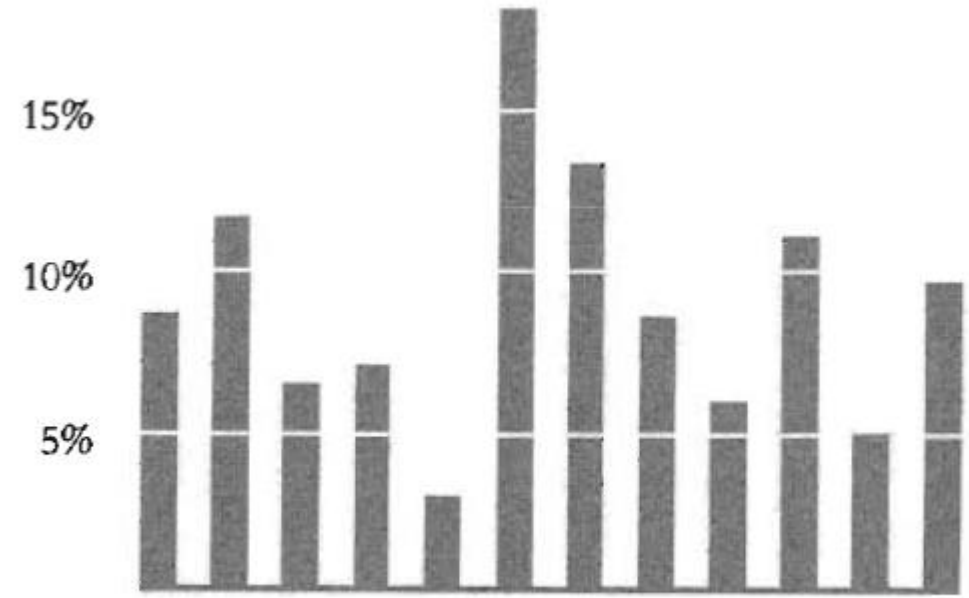
Image from "Umbro World Cup Poster" (`http://www.mikemake.com/Umbro-s-World-Cup-Poster`), created by Michael Deal

Redesigning (Tukey´s Box Plot)

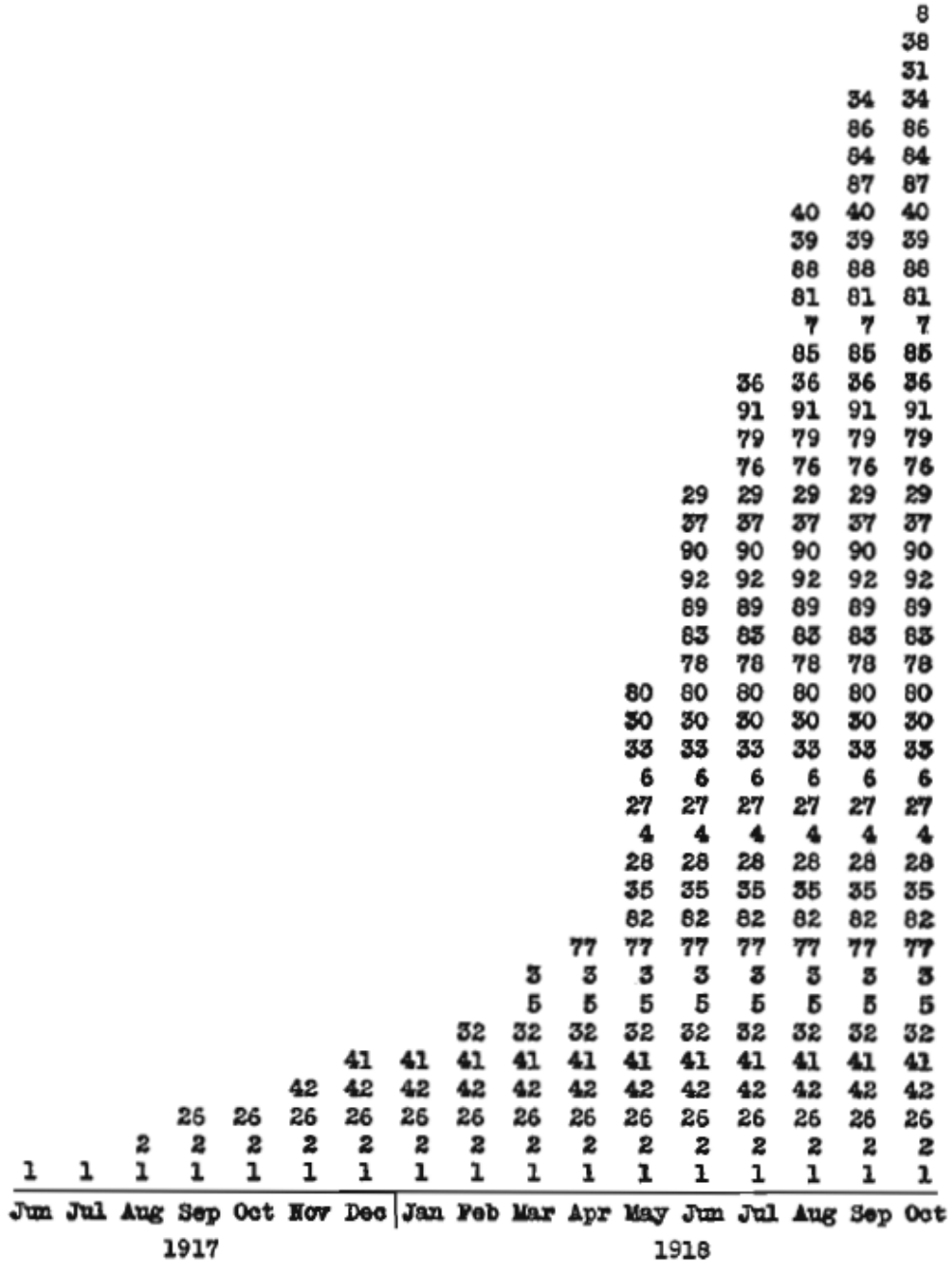


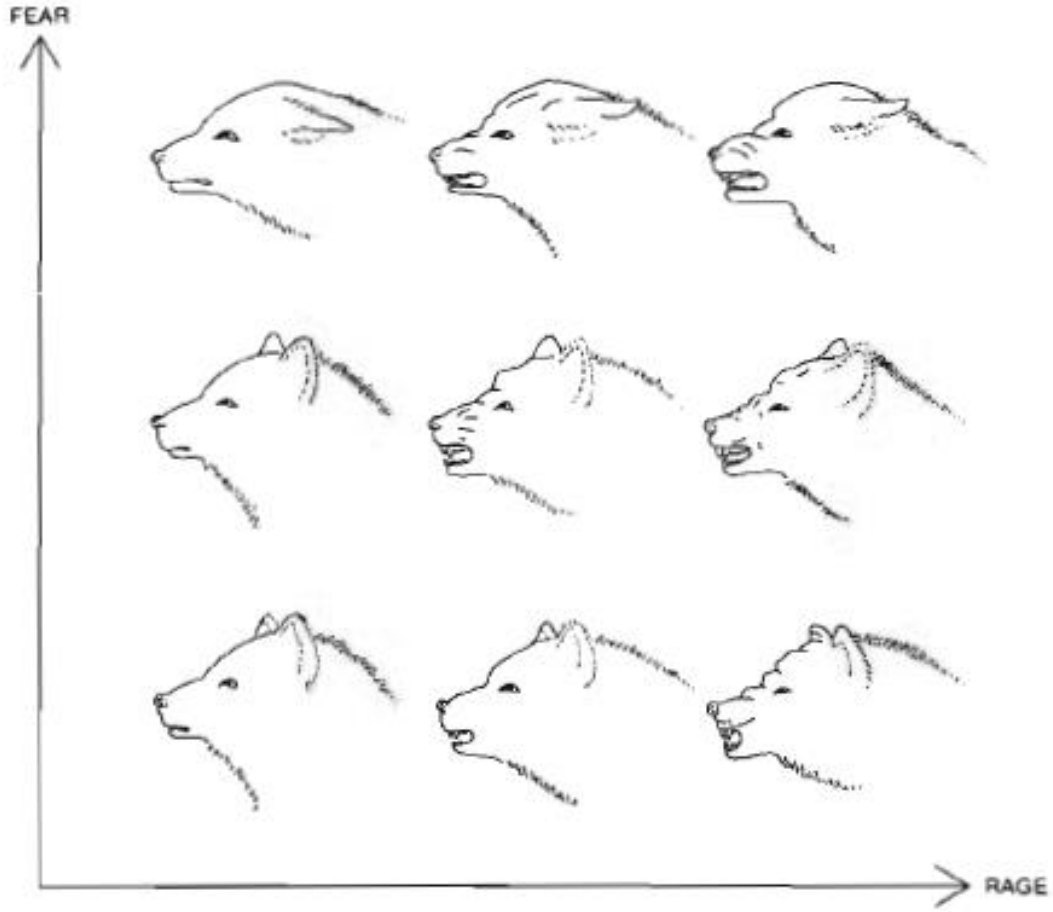




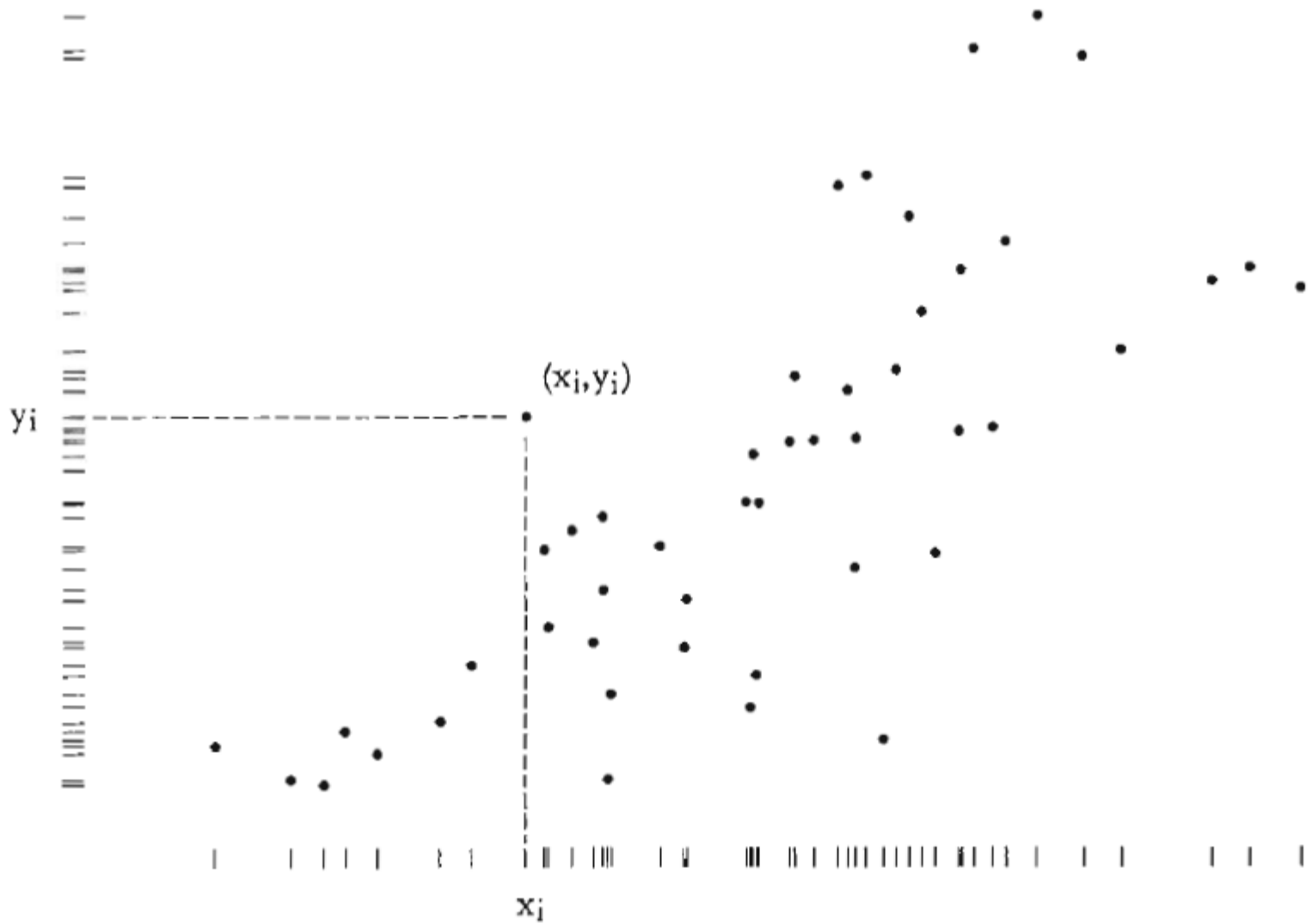

15%
10%
5%

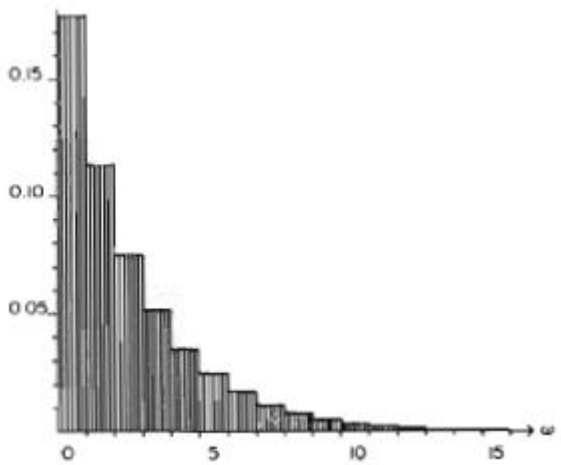
Stem and Leaf Plots

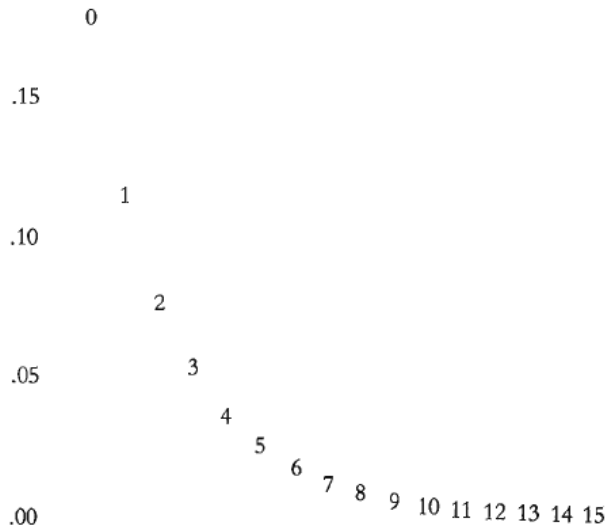


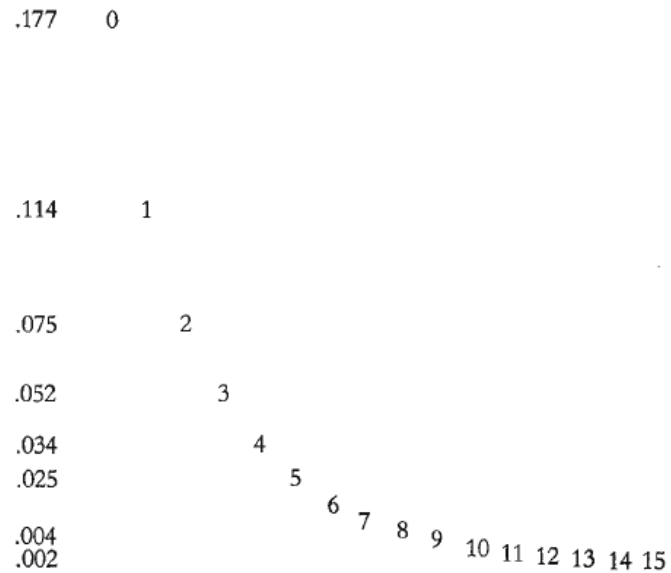


E. C. Zeeman, "Catastrophe Theory," *Scientific American*, 234 (April 1976), 67; based on Konrad Z. Lorenz, *King Solomon's Ring* (New York, 1952).


(x_i, y_i)
y_i
x_i

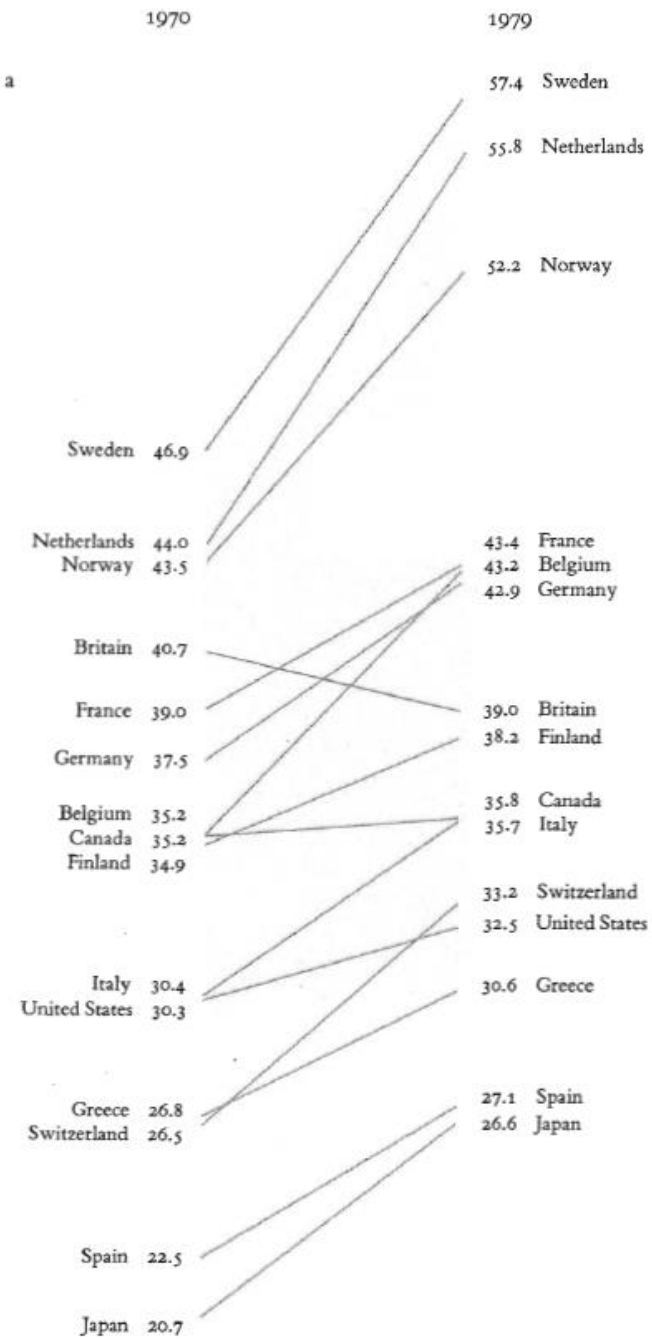






for good data analysis. But at least a few computer graphics only evoke the response "Isn't it remarkable that the computer can be programmed to draw like that?" instead of "My, what interesting data."

Current Receipts of Government as a Percentage of Gross Domestic Product, 1970 and 1979



Principles of Graphical Excellence

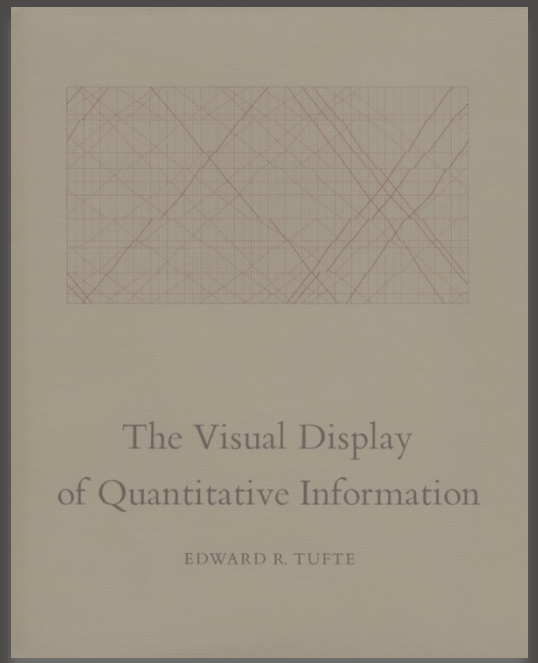
"Graphical excellence is the well-designed presentation of interesting data – a matter of substance, of statistics and of design."

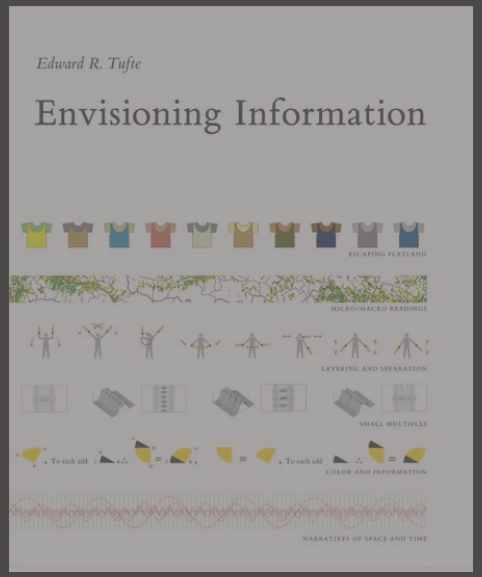
"Graphical excellence consists of complex ideas communicated with clarity, precision and efficiency."

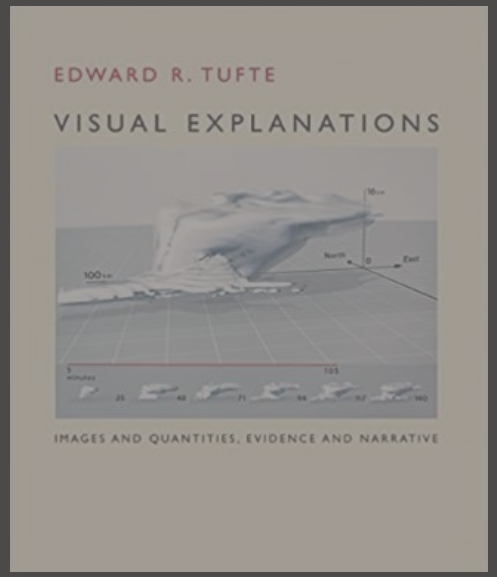
"Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest place."

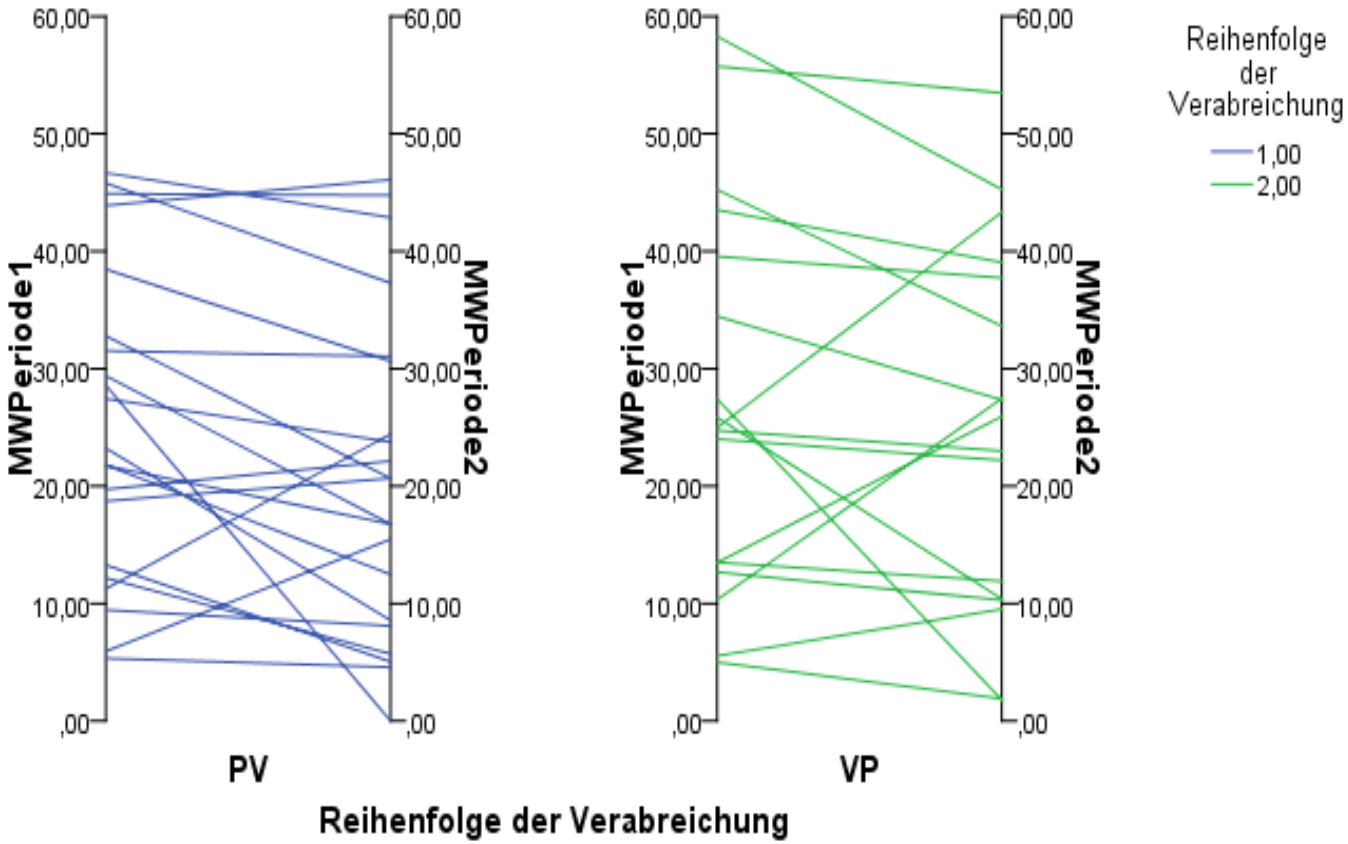
"Graphical excellence is nearly always multivariate."

"Graphical excellence requires telling the truth about the data."





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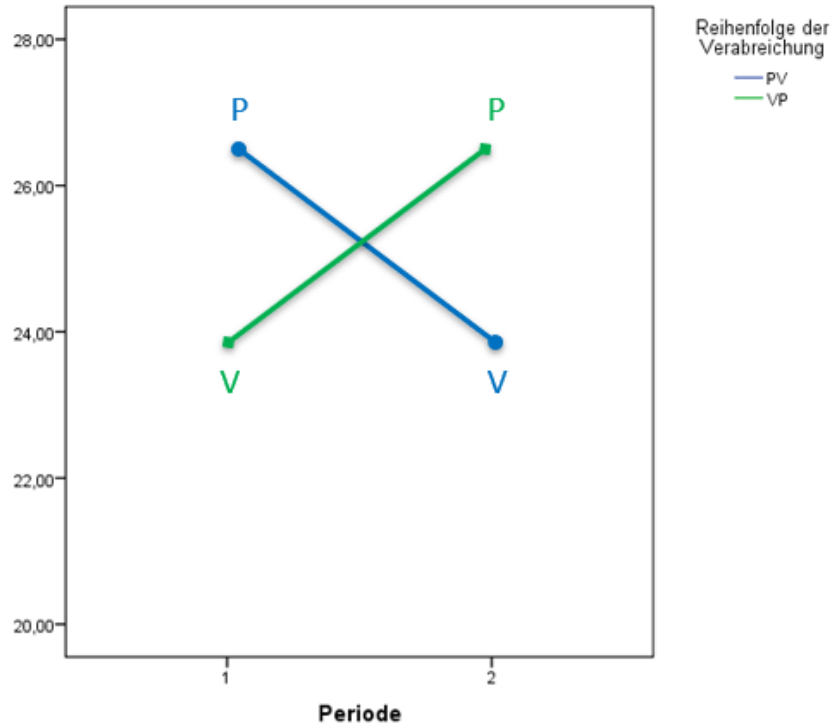
50,00
40,00
30,00
20,00
10,00
,00
MWPeriode1
MWPeriode2
PV
VP
Reihenfolge der Verabreichung
Reihenfolge der Verabreichung
1,00
2,00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26,00
24,00
22,00
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P
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V
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1
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Periode
Reihenfolge der Verabreichung
PV
VP

III	I	II			
	I	III	I		I
	II	II	I		I
II	II	I		I	II
I	II	I		III	I

Graphical elegance is often found in simplicity of design and complexity of data.

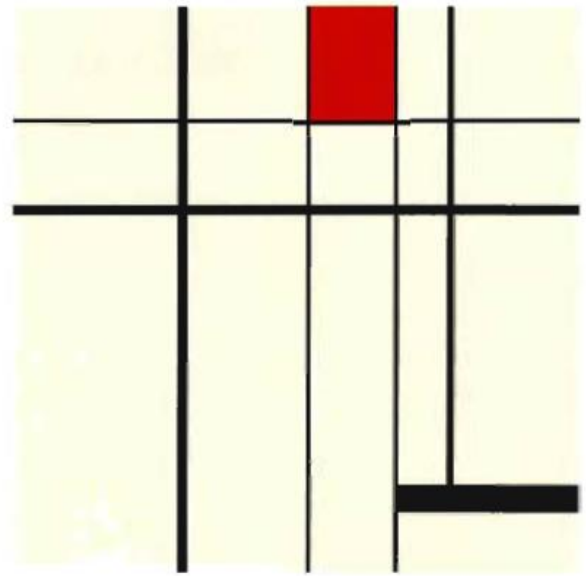
some labels

instead of

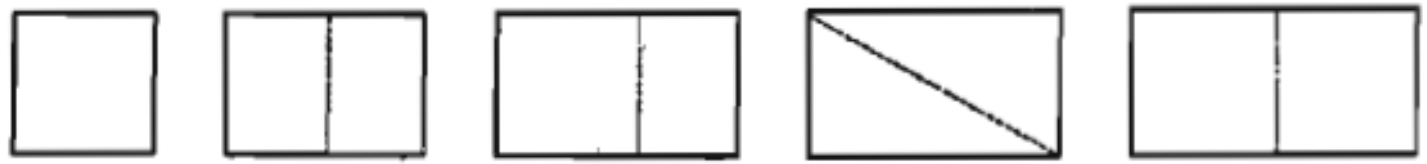
some other labels

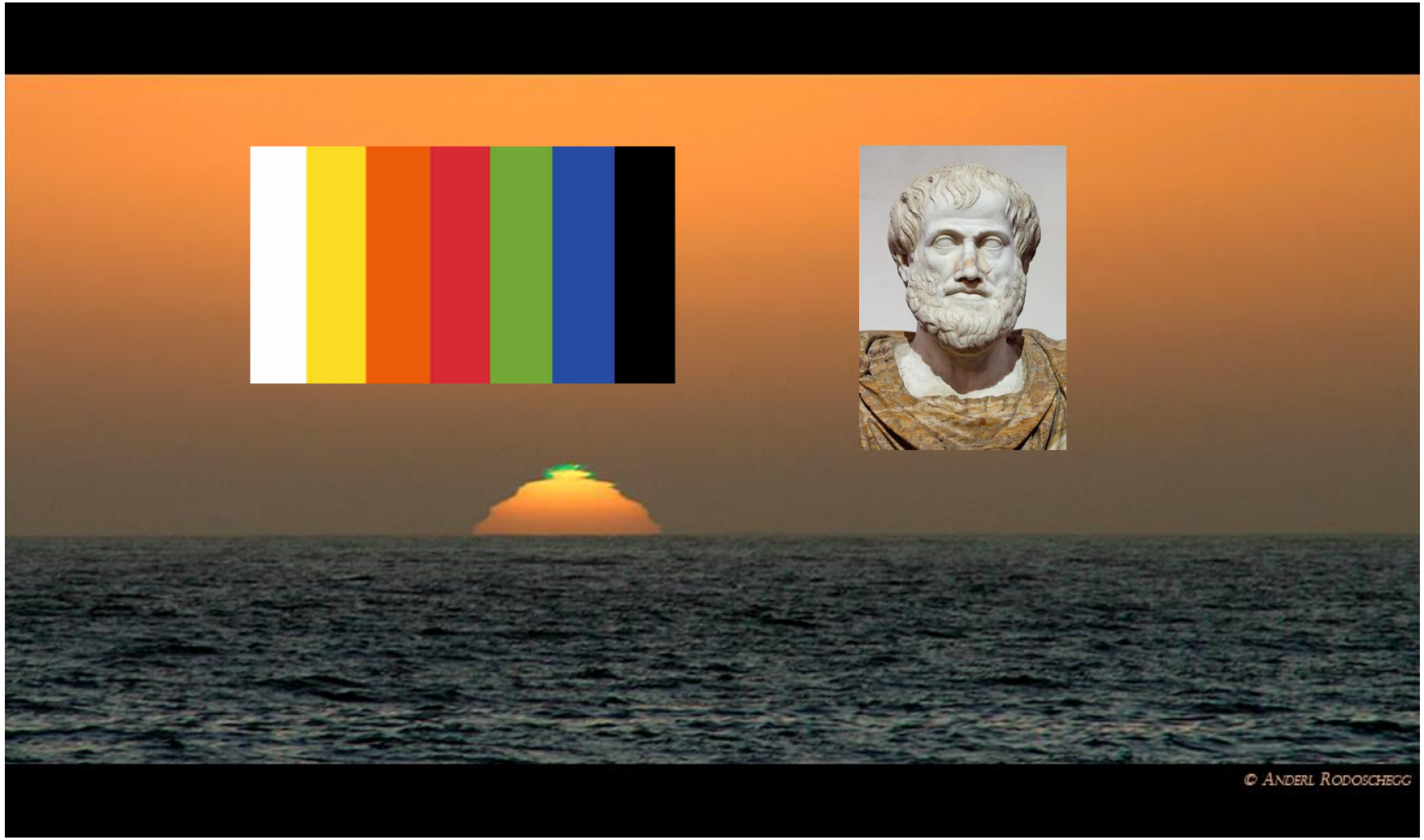
some labels

some other labels



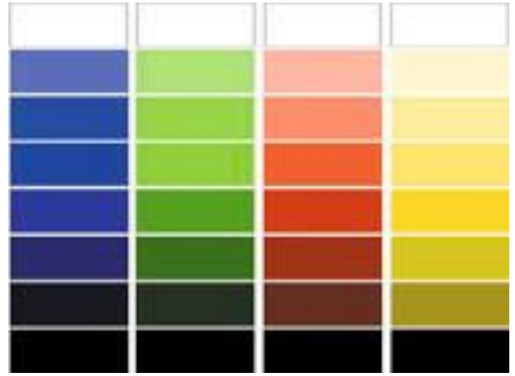
Poster for the exhibition "Mondrian and Neo-Plasticism in America," Yale University Art Gallery, October 18 to December 2, 1979. The original painting was done in 1941 by Diller; see Nancy J. Troy, *Mondrian and Neo-Plasticism in America* (New Haven, 1979), p. 28.




© Anderl Rodoschegg

Le Blon 1730

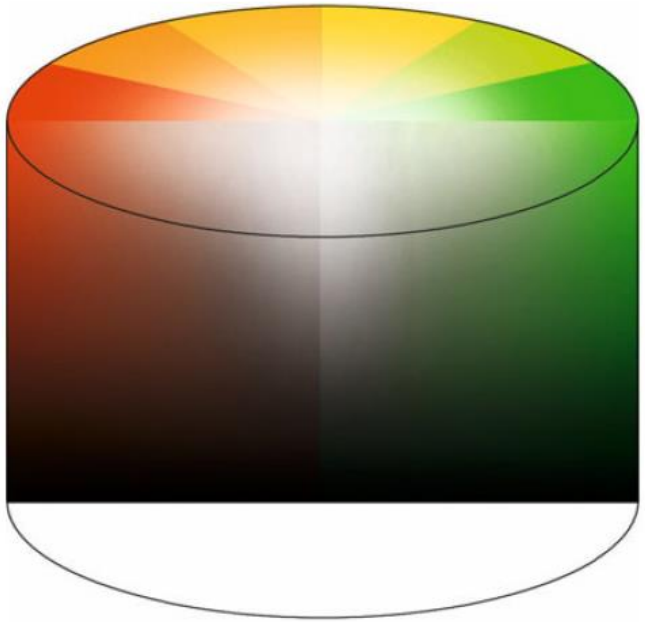
Newton 1704



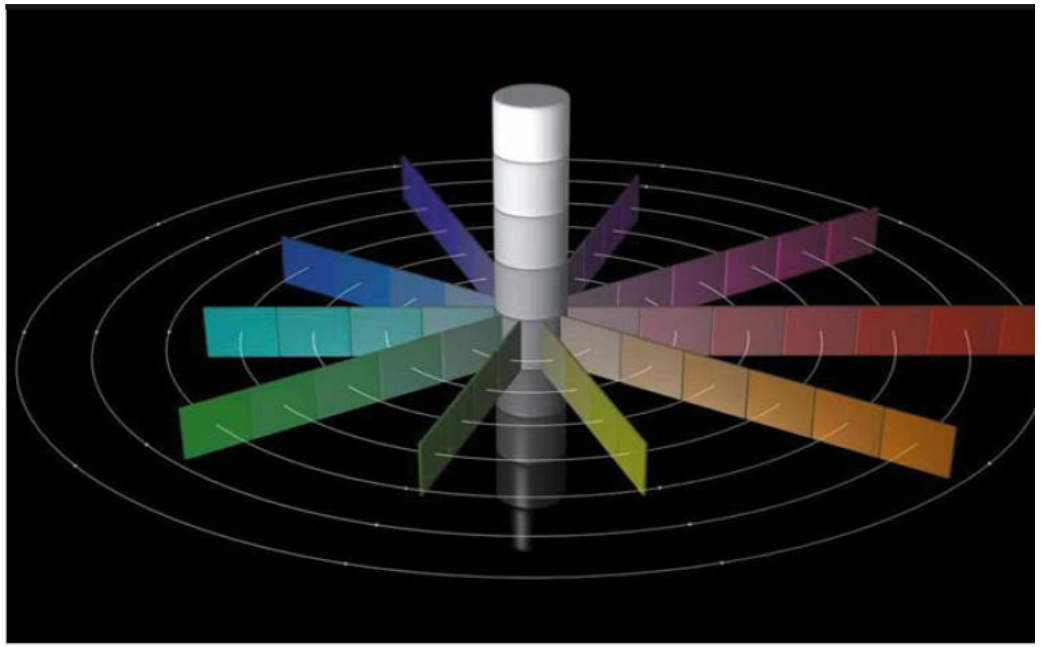
Forsius 1611

Tizian: „Assunta“ 1516-1518

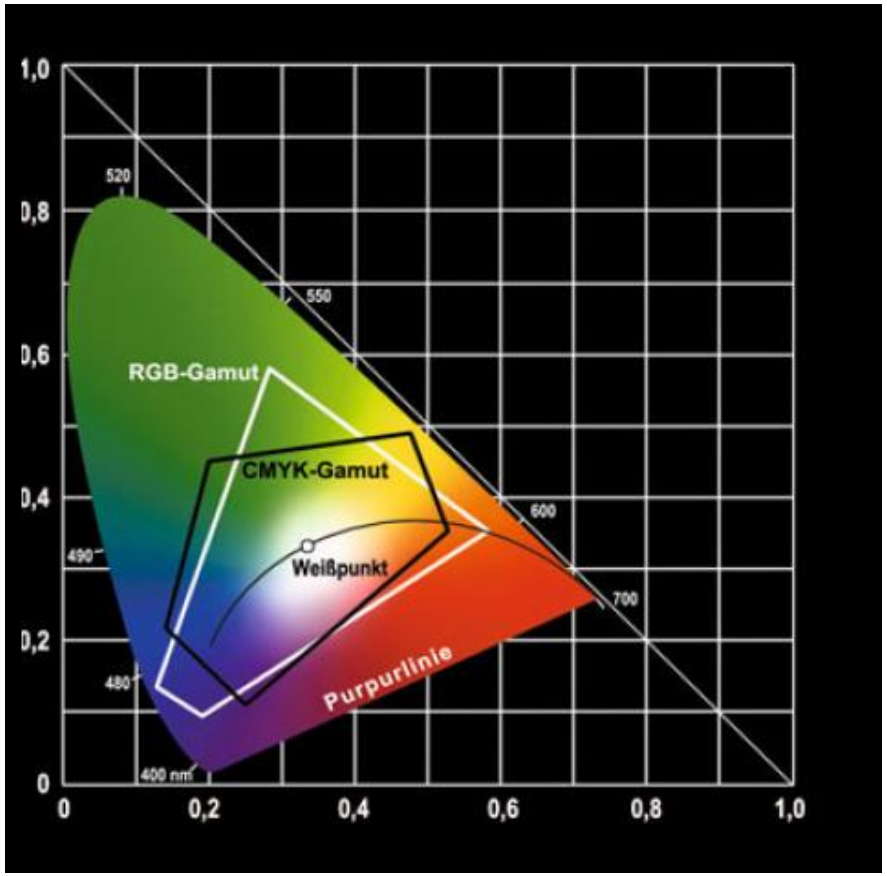
Maxwell



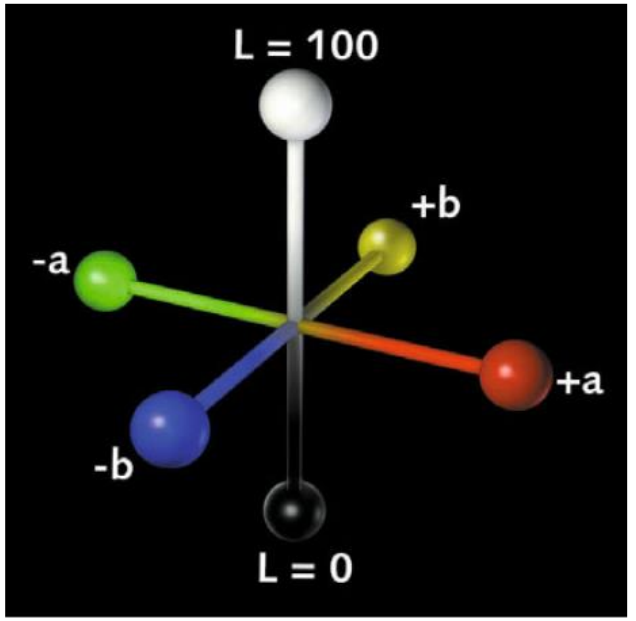
Rood-Farbzylinder



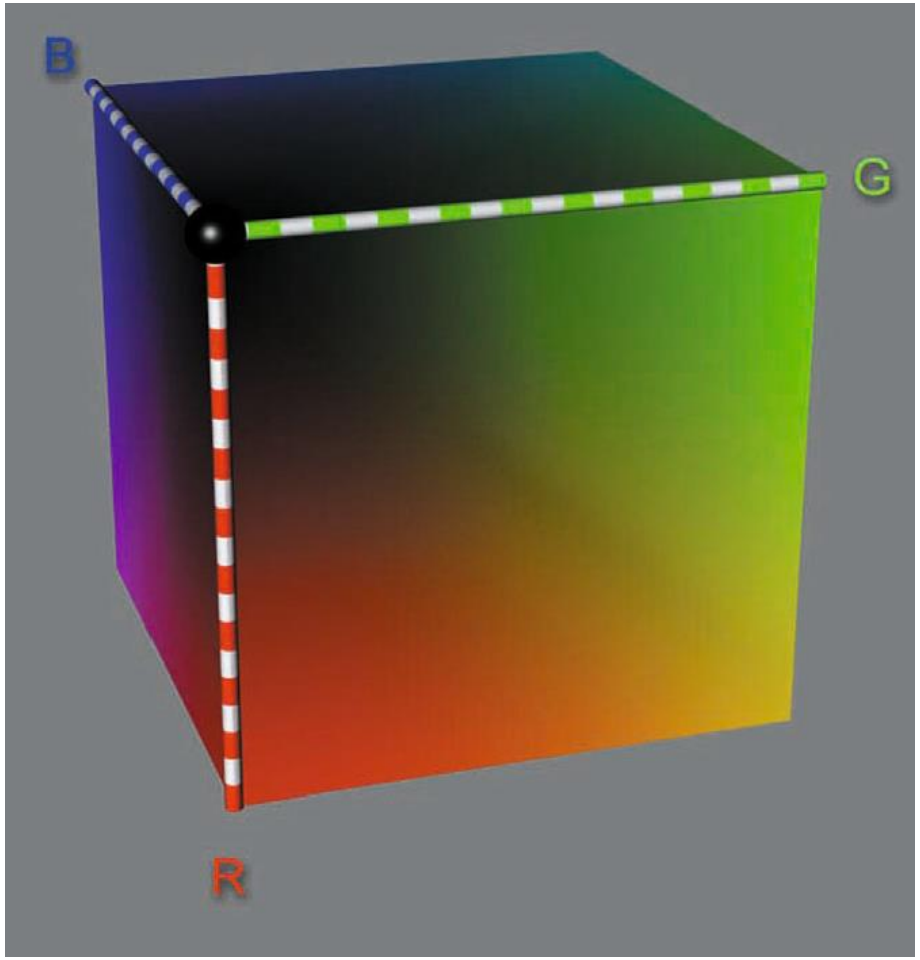
Munsell- Farbsystem

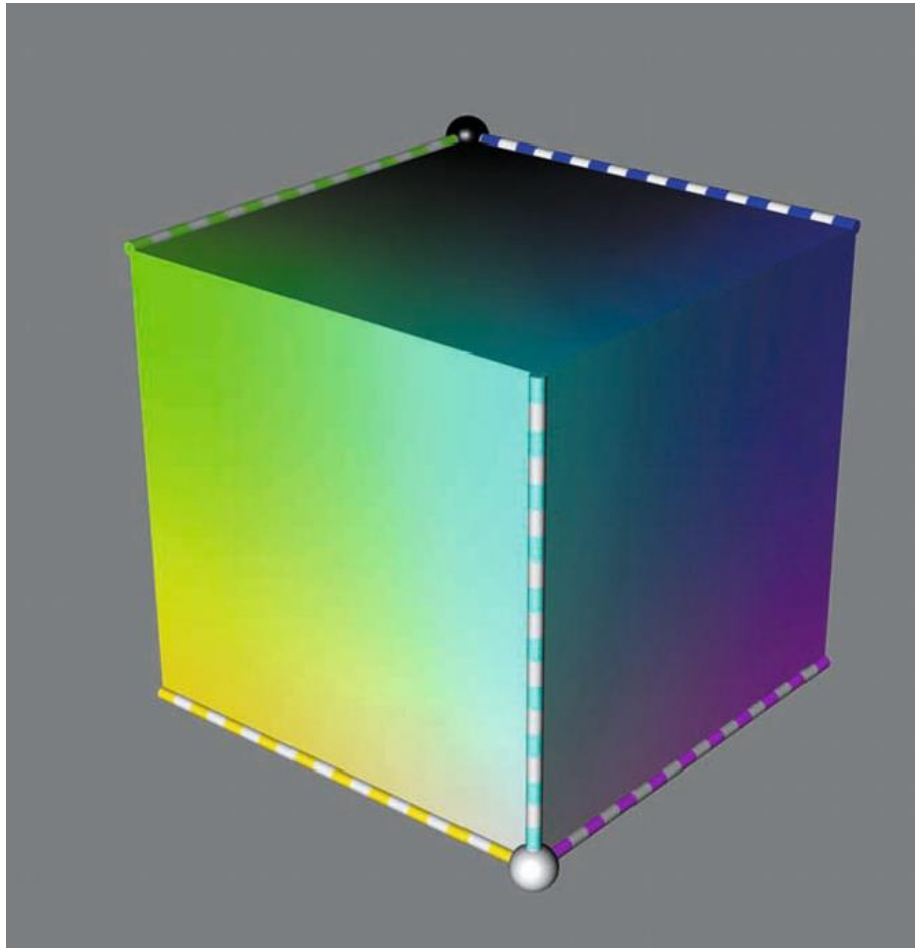


CIE Farbsohle



CIE - Lab System


B
G
R



Design is choice. The theory of the visual display of quantitative information consists of principles that generate design options and that guide choices among options. The principles should not be applied rigidly or in a peevish spirit; they are not logically or mathematically certain; and it is better to violate any principle than to place graceless or inelegant marks on paper. Most principles of design should be greeted with some skepticism, for word authority can dominate our vision, and we may come to see only through the lenses of word authority rather than with our own eyes.

What is to be sought in designs for the display of information is the clear portrayal of complexity. Not the complication of the simple; rather the task of the designer is to give visual access to the subtle and the difficult—that is,

the revelation of the complex.