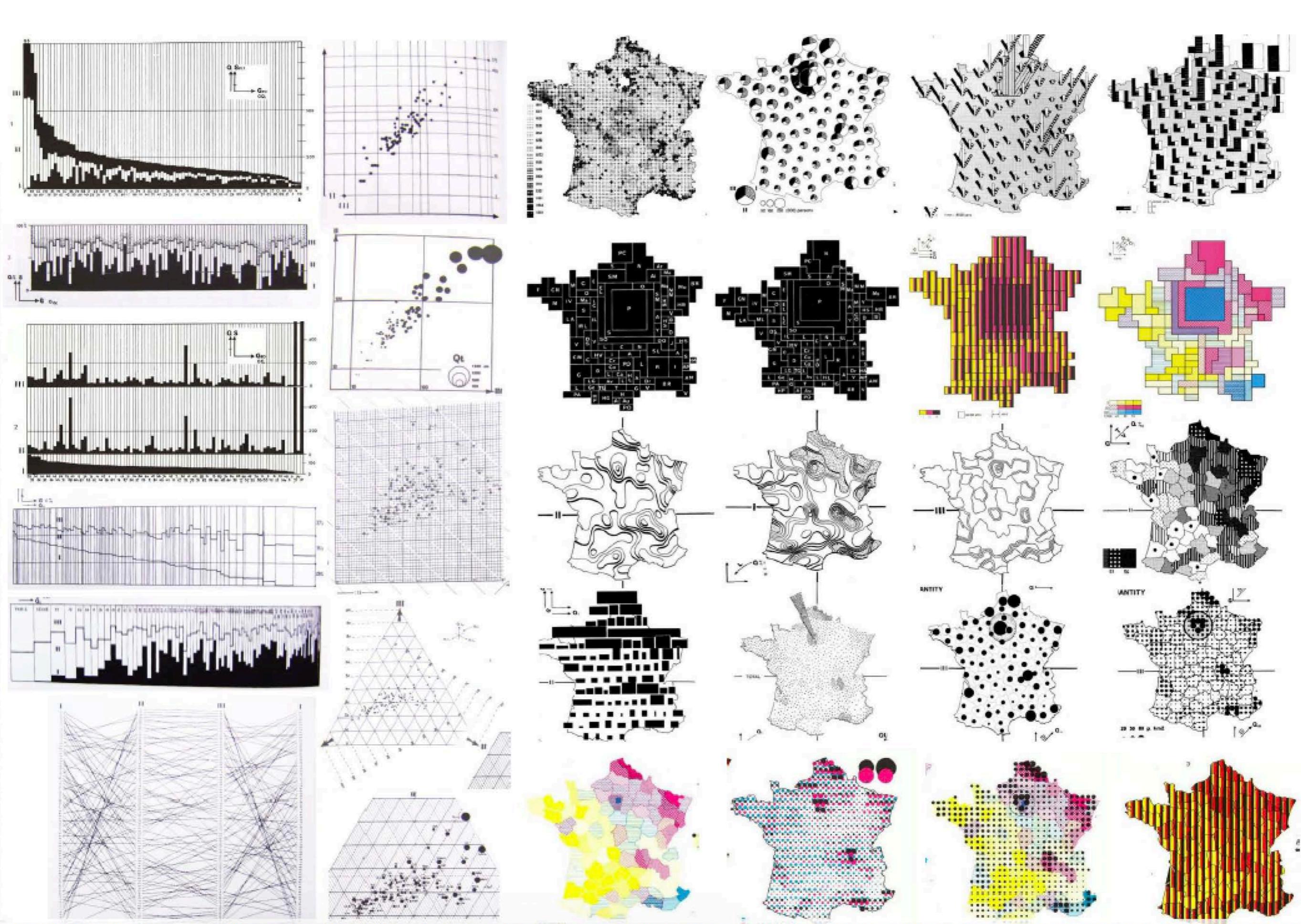


CSC2537 / STA2555

INFORMATION VISUALISATION

Fanny CHEVALIER

Département	Nombre (1999)			Proportion %			1	II	III	Total	I	II	III	
	I	II	III	I	II	III								
1 AIN	67	72	69	158	45	29	27							
2 ALPES	66	74	68	198	29	37	34							
3 ALLIER	63	45	57	165	39	37	34							
4 Hautes ALPES	15	8	13	36	43	24	23							
5 Basses ALPES	14	8	13	37	44	21	25							
6 ALPES Maritimes	33	61	122	216	19	29	27							
7 ARDECHE	46	30	25	101	45	21	26							
8 Ardèches	25	53	31	119	22	47	31							
9 ARIEGE	33	17	14	64	52	29	23							
10 Aude	28	48	36	112	25	43	32							
11 Aude	50	20	32	102	40	18	33							
12 Aveyron	79	92	29	193	54	29	22							
13 Bouches du Rhône	43	143	326	492	10	35	55							
14 Calvados	79	35	69	184	26	28	36							
15 Cantal	45	13	23	78	38	18	26							
16 Charente	65	20	38	140	47	24	27							
17 Charente Maritime	79	39	62	182	43	21	36							
18 Chér	43	43	36	129	26	34	39							
19 Corrèze	64	22	39	176	23	20	25							
20 Côte d'Or	43	41	30	143	30	29	41							
21 Côte d'Or Nord	131	35	62	228	38	25	37							
22 Creuse	59	13	17	88	50	19	19							
23 Dordogne	104	24	41	179	38	19	22							
25 Drôme	75	67	39	182	25	47	39							
26 Drôme	45	38	35	129	28	28	39							
27 Eure	49	12	45	145	33	26	31							
28 Eure & Loir	44	27	38	119	41	23	34							
29 Finistère	154	26	89	329	50	22	27							
30 Gard	40	31	32	144	20	26	36							
31 Haute Garonne	64	67	64	216	36	33	33							
32 Gers	43	10	16	69	71	11	18							
33 Gironde	123	107	179	302	30	27	33							
34 Hérault	49	69	71	172	38	29	41							
35 Ille & Vil.	137	68	82	279	49	29	39							
36 Indre	54	38	32	116	40	26	28							
37 Indre & Lo.	61	41	55	157	30	28	35							
38 Isère	68	199	76	362	24	48	28							
39 Jura	38	74	27	109	39	24	37							
40 Landes	79	25	29	123	52	20	23							
41 Lot & Chir	51	27	30	108	47	23	28							
42 Lot	38	100	82	218	48	24	27							
43 Lot & Lot	78	29	23	97	54	24	27							
44 Lot & Lot	101	109	105	314	30	24	24							
45 Louhans	54	51	34	136	32	23	26							
46 Lot	41	10	16	67	61	19	24							
47 Lot & Garonne	79	24	30	124	37	19	24							
48 Lot-et-Garonne	22	5	7	34	64	17	21							
49 Maine	43	10	16	67	61	19	24							
50 Maine & Loire	104	65	63	234	44	29	26							
51 Manche	115	43	56	214	34	20	26							
52 Maine	44	57	67	198	39	24	36							
53 Marne	35	28	28	91	31	22	24							
54 Mayenne	74	23	28	125	39	19	23							
55 Meurtres & M.	73	127	93	241	9	53	36							
56 Meuse	24	31	27	92	39	18	29							
57 Morbihan	132	47	59	238	55	20	25							
58 Morbihan	36	123	94	383	32	57	31							
59 Moselle	34	21	23	94	36	29	35							
60 Moselle	81	483	298	800	7	56	35							
61 Moselle	44	22	24	74	34	17	23							
62 Morbihan	132	47	59	238	55	20	25							
63 Morbihan	36	123	94	383	32	57	31							
64 Morbihan	34	21	23	94	36	29	35							
65 Morbihan	81	483	298	800	7	56	35							
66 Morbihan	44	22	24	74	34	17	23							
67 Morbihan	132	47	59	238	55	20	25							
68 Morbihan	36	123	94	383	32	57	31							
69 Morbihan	34	21	23	94	36	29	35							
70 Morbihan	81	483	298	800	7	56	35							
71 Morbihan	44	22	24	74	34	17	23							
72 Morbihan	132	47	59	238	55	20	25							
73 Morbihan	36	123	94	383	32	57	31							
74 Morbihan	34	21	23	94	36	29	35							
75 Morbihan	81	483	298	800	7	56	35							
76 Morbihan	44	22	24	74	34	17	23							
77 Morbihan	132	47	59	238	55	20	25							
78 Morbihan	36	123	94	383	32	57	31							
79 Morbihan	34	21	23	94	36	29	35							
80 Morbihan	81	483	298	800	7	56	35							
81 Morbihan	44	22	24	74	34	17	23							
82 Morbihan	132	47	59	238	55	20	25							
83 Morbihan	36	123	94	383	32	57	31							
84 Morbihan	34	21	23	94	36	29	35							
85 Morbihan	81	483	298	800	7	56	35							
86 Morbihan	44	22	24	74	34	17	23							
87 Morbihan	132	47	59	238	55	20	25				</			



Bertin defined the design space then showed how it could be used to generate many different types of visualizations; using a simple dataset as an example. (Semiology of Graphics, pg 100 ~ 138). Side note French edition appendix on text, not translated into English.

MARKS

Geometric primitives

→ Points



→ Lines

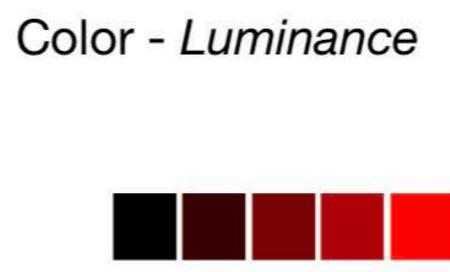
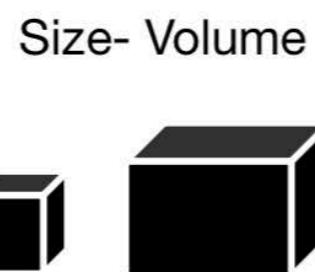
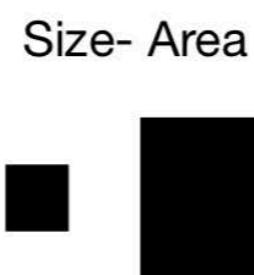
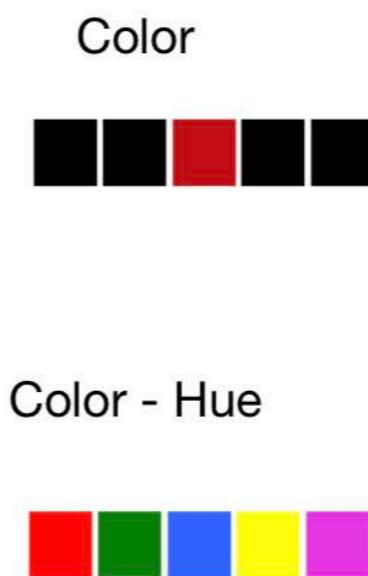
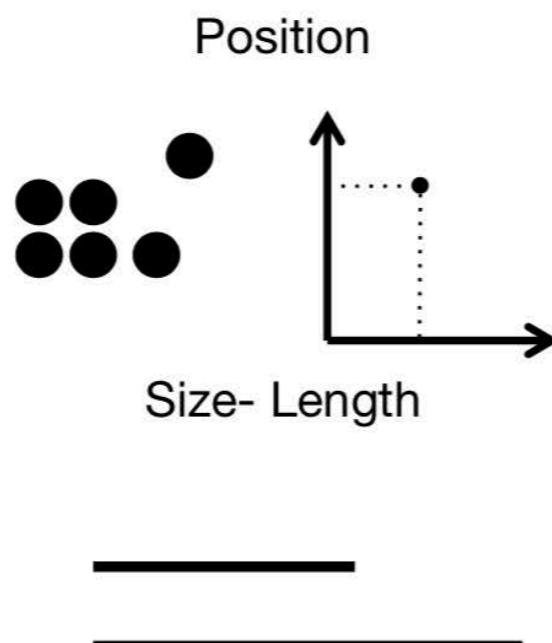


→ Areas



CHANNELS (VISUAL VARIABLES)

Control appearance of marks



DATA MARKS

Département	Quantités (1000)			Proportion %			
	I	II	III	Total	I	II	
1 AIN	67	13	40	118	45	38	27
2 ALÈZE	66	74	66	193	29	37	34
3 ALLIER	65	45	51	161	39	27	34
4 Bass ALPES	35	8	13	56	43	14	33
5 Hautes ALPES	16	2	13	31	44	21	35
6 ALPES MARIT.	31	61	122	213	14	39	37
7 ARDÈCHE	46	32	35	113	45	21	24
8 Ardèche	25	53	31	113	22	47	31
9 ARIège	33	17	74	64	52	26	32
10 Aude	28	48	36	112	26	43	32
11 Aude	50	20	32	102	40	18	32
12 Aveyron	52	32	39	123	34	24	32
13 BOCAGE DU RHÔNE	42	143	126	413	10	35	55
14 CALVADOS	70	15	69	154	36	28	36
15 CANTAL	45	13	20	78	38	16	26
16 CHARENTE	65	20	38	143	47	26	27
17 CHARENTE MARIT.	73	39	63	182	43	21	36
18 Charente	43	41	36	120	26	34	30
19 Corrèze	64	59	39	162	35	20	25
20 CÔTE D'OR	43	41	59	142	36	20	41
21 CÔTE D'OR NORD	121	35	42	228	56	15	27
22 CRÉTINEAU	50	18	17	86	60	18	19
23 DORDOGNE	164	34	41	219	48	19	23
24 Doubs	35	67	39	142	25	47	28
25 Drôme	48	38	35	121	39	31	39
27 Eure	49	53	45	143	33	26	31
28 EURE & LOIR	44	27	38	119	41	25	34
29 FINISTERE	164	26	89	229	50	23	27
30 GARD	40	51	52	144	20	26	36
31 HAUTE-GARONNE	64	67	64	215	39	31	39
32 Gers	43	19	16	69	71	11	18
33 Gironde	123	107	170	302	30	27	43
34 Hérault	42	48	71	173	36	23	41
35 Ille & Vilaine	137	68	82	279	49	23	39
36 Indre	54	38	92	186	40	26	38
37 Indre & Loire	61	41	55	157	39	26	35
38 Isère	68	136	78	222	34	48	28
39 Jura	38	34	27	109	39	34	37
40 Landes	79	25	28	123	52	20	23
41 Lot & Garonne	51	27	39	118	41	23	28
42 Lot-et-Gar.	56	150	82	288	49	54	27
43 Marnes	52	23	23	91	34	24	27
44 Loire Atlantique	101	108	105	316	32	34	34
45 Loiret	51	51	58	166	32	33	33
46 Lot	41	10	16	67	61	10	24
47 Lot & Garon.	59	24	30	124	39	19	24
48 Luxembourg	23	5	7	34	64	13	21
49 Maine & Loire	104	65	65	234	44	28	26
50 Manche	115	42	36	214	34	20	26
51 Marne	44	57	67	180	20	34	49
52 Haute Marne	25	26	26	91	31	33	34
53 Mayenne	74	23	26	123	39	19	24
54 Meurthe & Moselle	73	127	91	241	8	53	38
55 Meuse	26	31	27	82	30	36	33
56 Moselle	132	47	50	288	55	20	25
57 Moselle	36	173	94	303	12	57	31
58 Pyrénées	34	21	33	94	36	23	35
59 Pyrénées	81	483	298	809	9	56	35
60 Var	111	22	22	223	42	24	24

→ Points



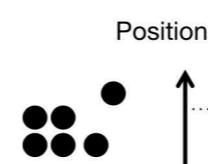
→ Lines



→ Areas



CHANNELS



Position



Size- Length



Format



Color



Color - Hue



Color - Saturation



Size- Area



Orientation/Direction



Size- Volume



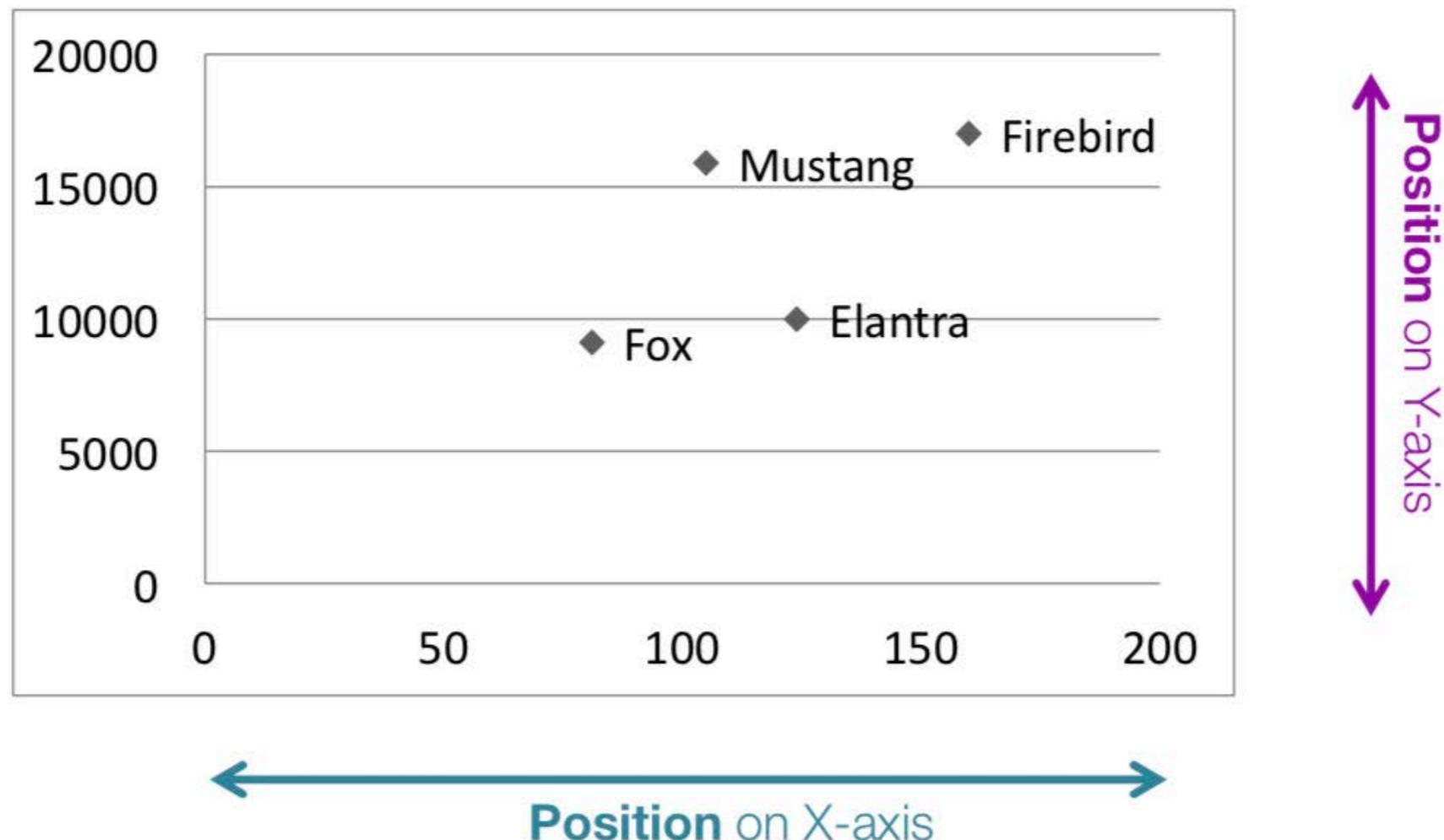
Angle



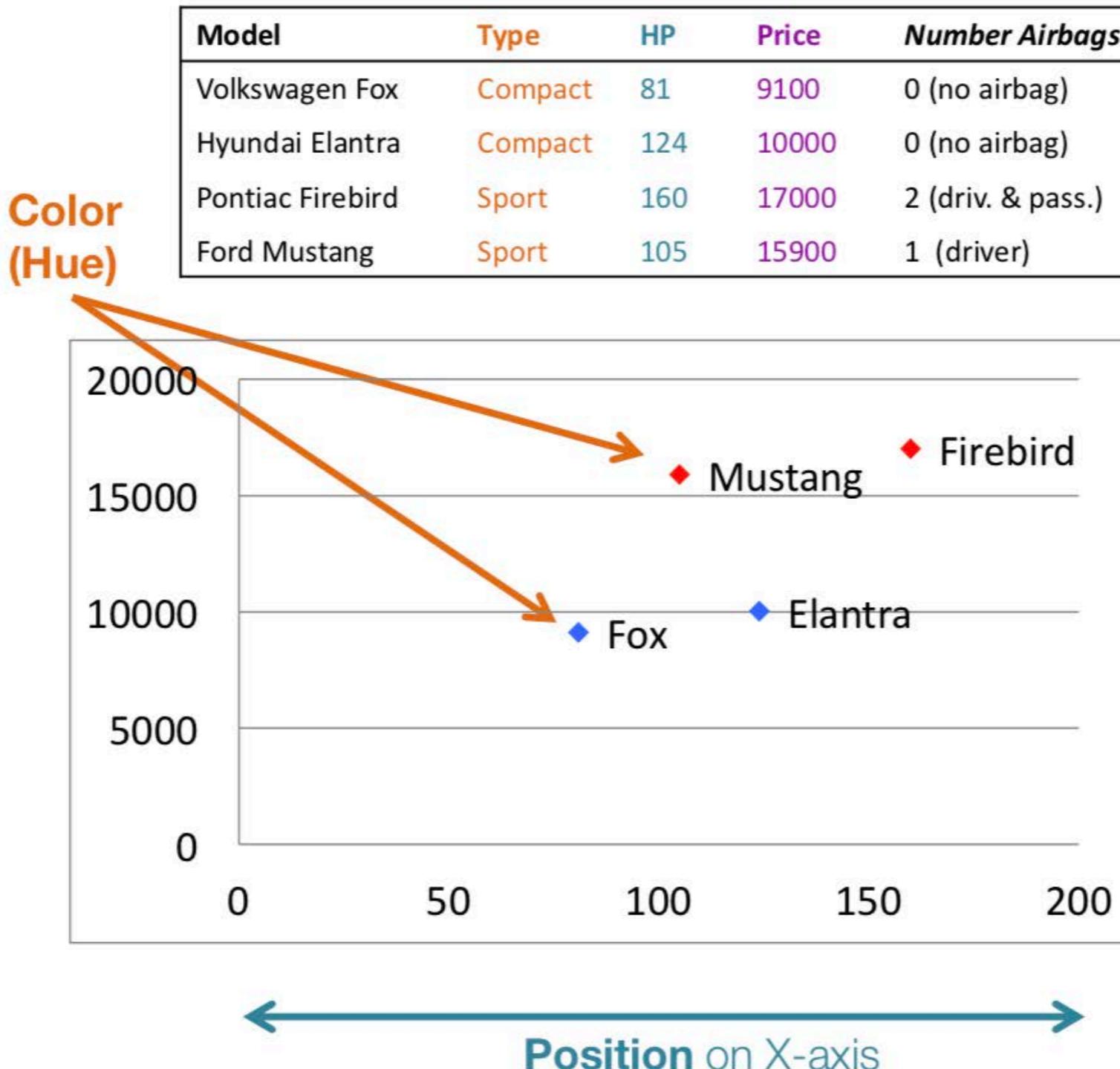
Color - Luminance

MAPPING DATA TO VISUAL VARIABLES

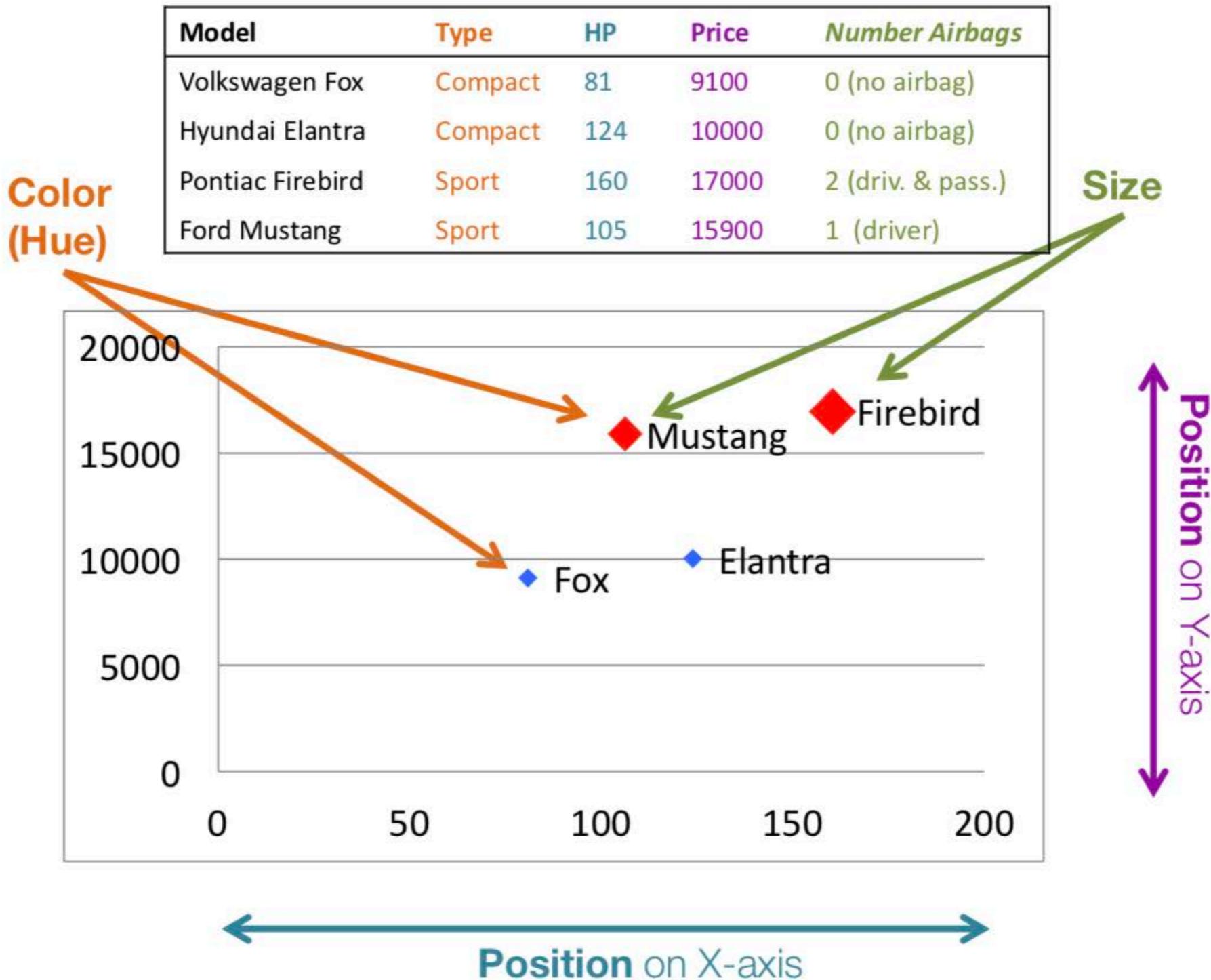
Model	Type	HP	Price	Number Airbags
Volkswagen Fox	Compact	81	9100	0 (no airbag)
Hyundai Elantra	Compact	124	10000	0 (no airbag)
Pontiac Firebird	Sport	160	17000	2 (driv. & pass.)
Ford Mustang	Sport	105	15900	1 (driver)



MAPPING DATA TO VISUAL VARIABLES



MAPPING DATA TO VISUAL VARIABLES



TAKE AWAY MESSAGE....

It takes **experience!**

But despite of that, we all have the “necessary prerequisites” to be a good visualization designer....

.... we just need to learn how to **see** things a bit differently!



Anascombe's Quartet

I		II		III		IV	
x	y	x	y	x	y	x	y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

Source: Anascombe's Quartet, Wikipedia

STATISTICAL ANALYSIS

suggests that all datasets are equivalent w.r.t. some metrics

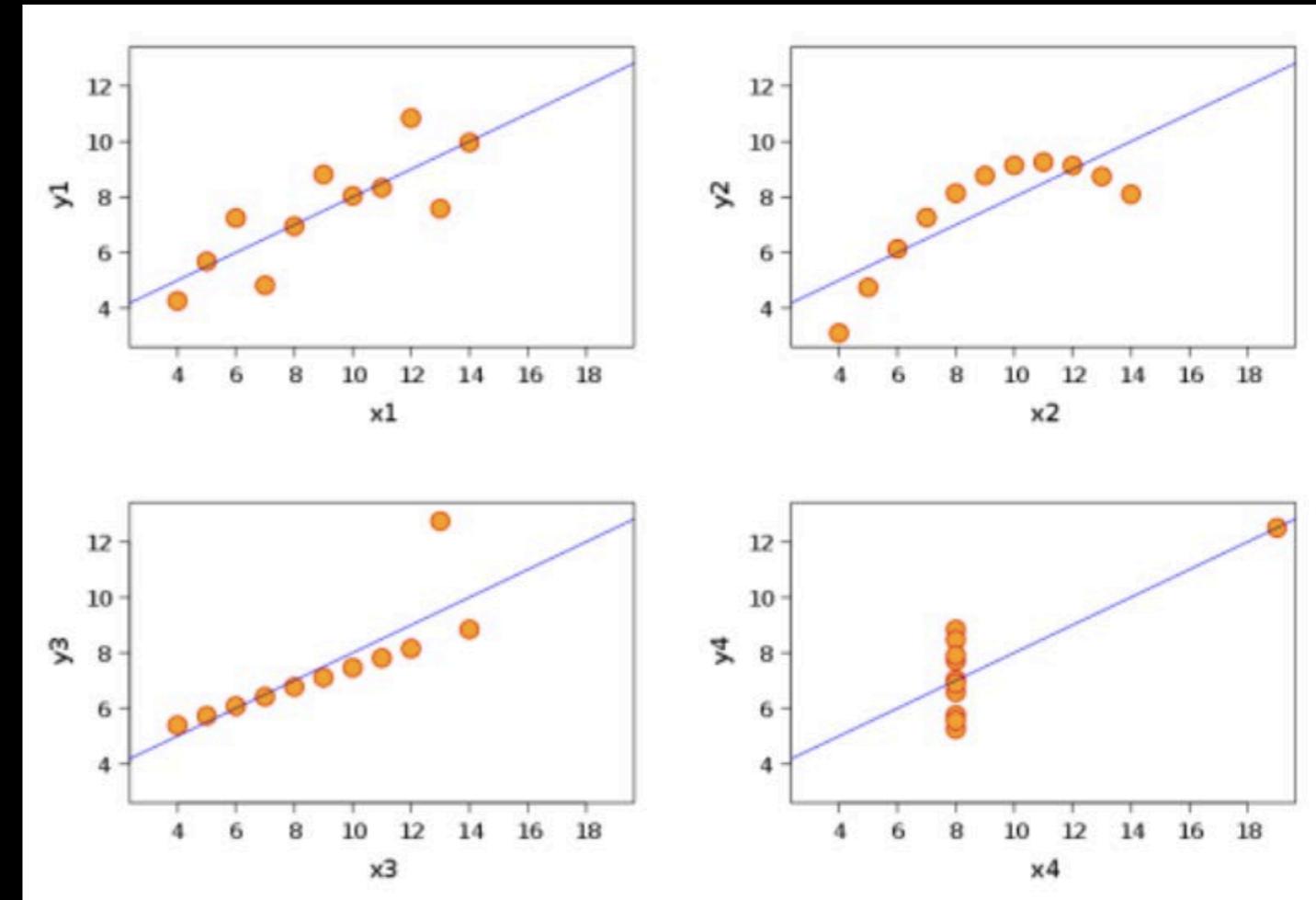
I		II		III		IV	
x	y	x	y	x	y	x	y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

Mean of x	9
Sample variance of x	11
Mean of y	7.50
Sample variance of y	4.12
Correlation between x and y	0.816
Linear regression line	$y = 3.00 + 0.500x$

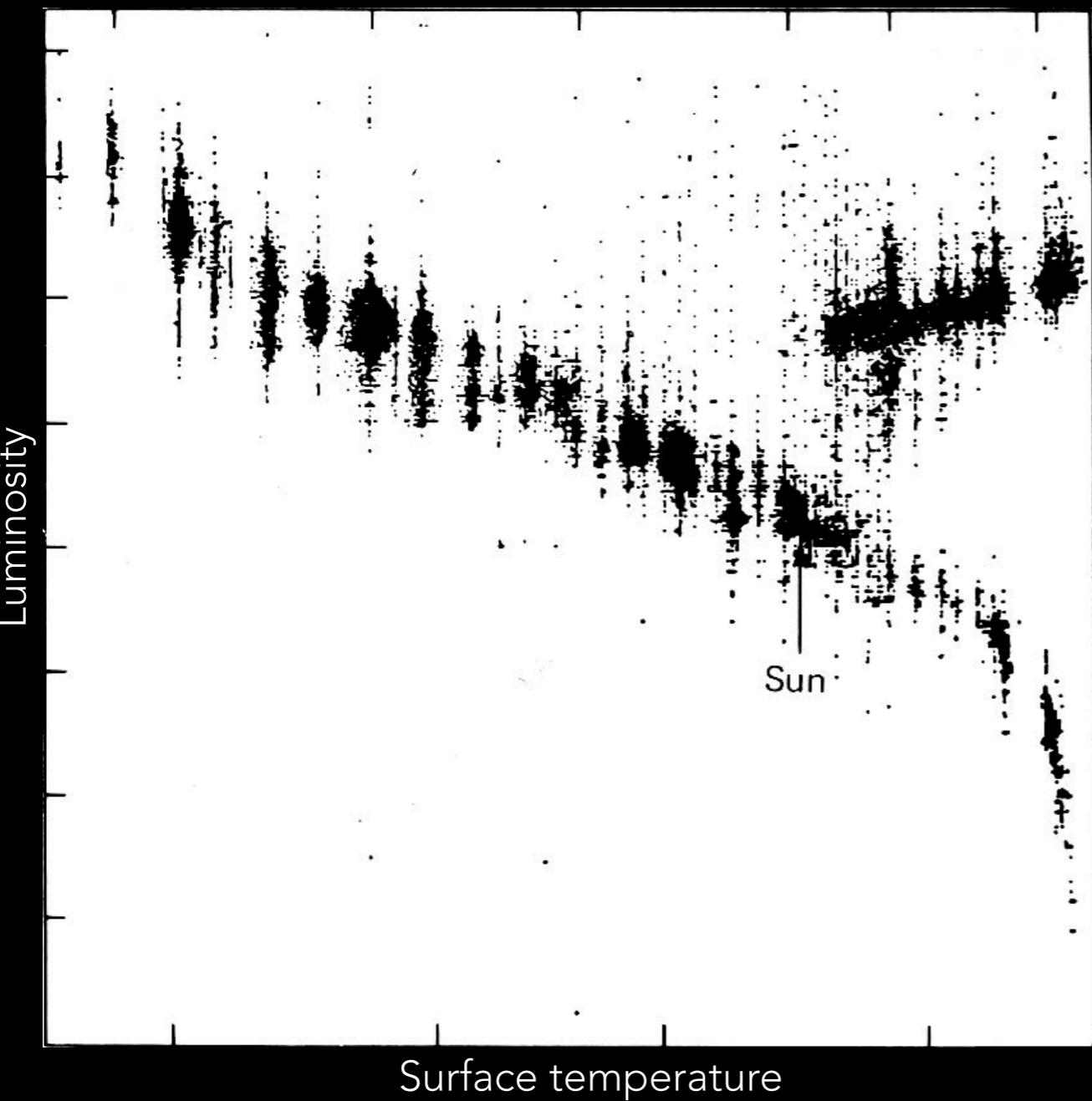
VISUALIZATION

the visual representations tell a complete different story...

I		II		III		IV	
x	y	x	y	x	y	x	y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

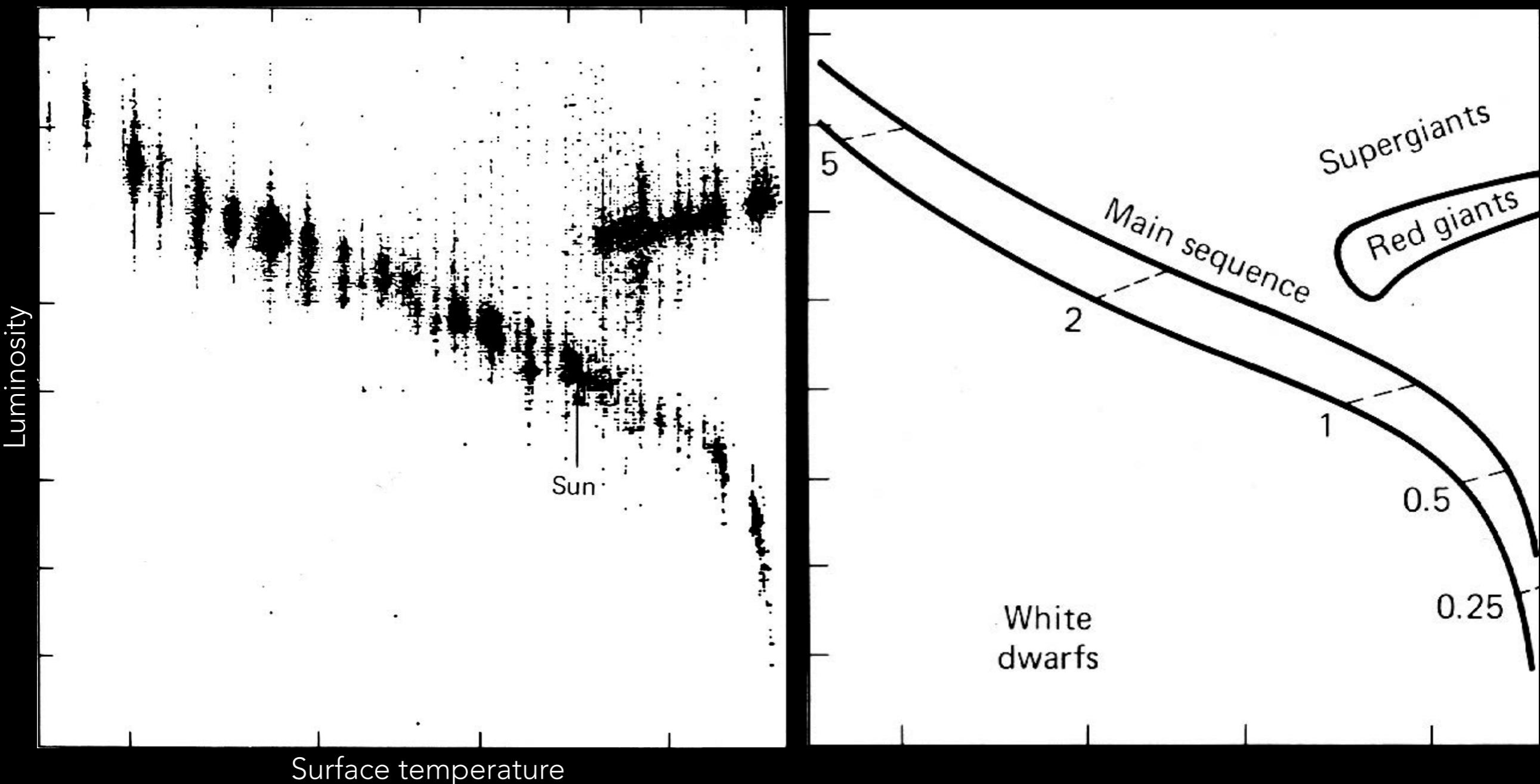


AUTOMATIC ABSTRACTION CAPABILITY

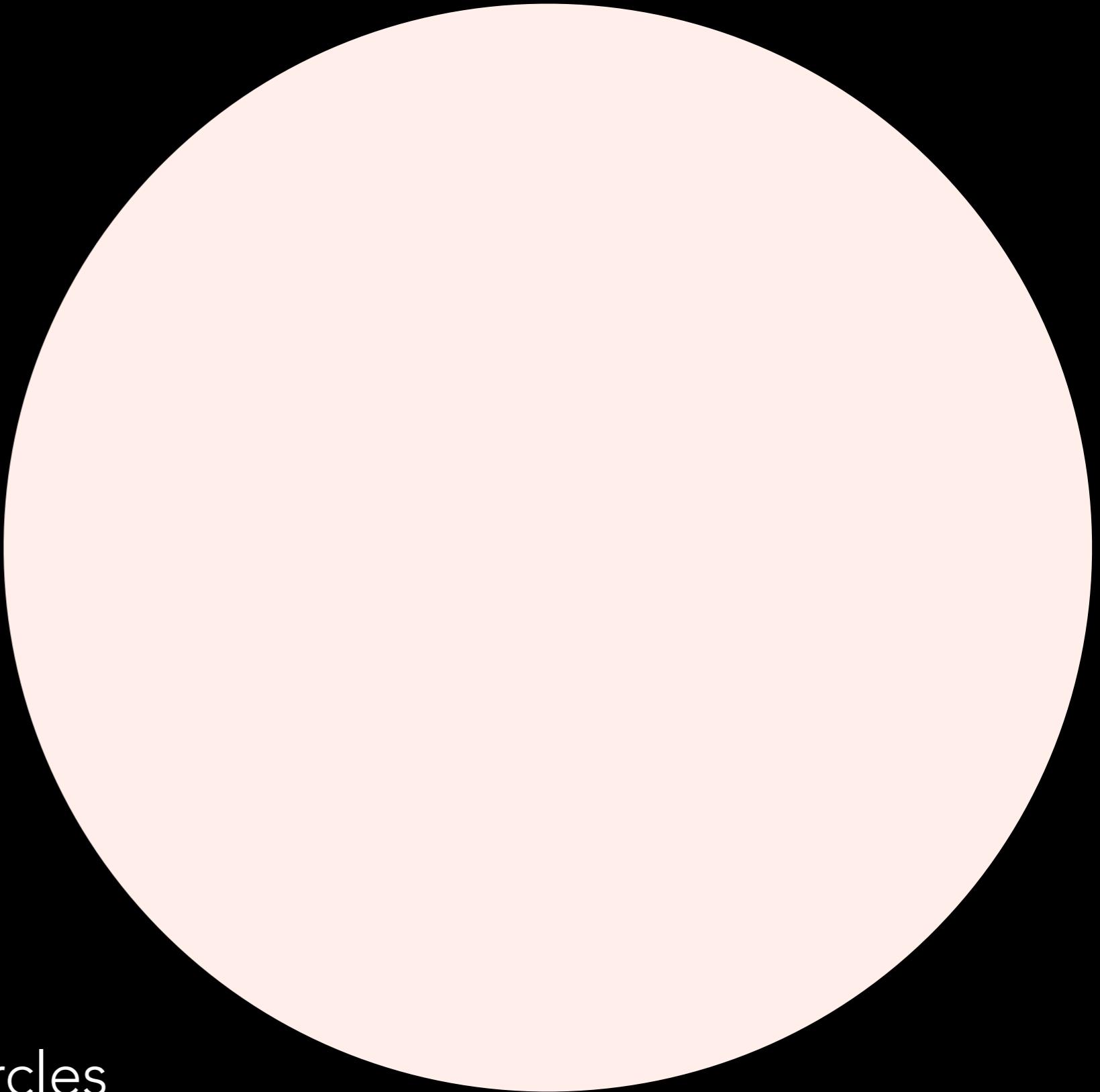
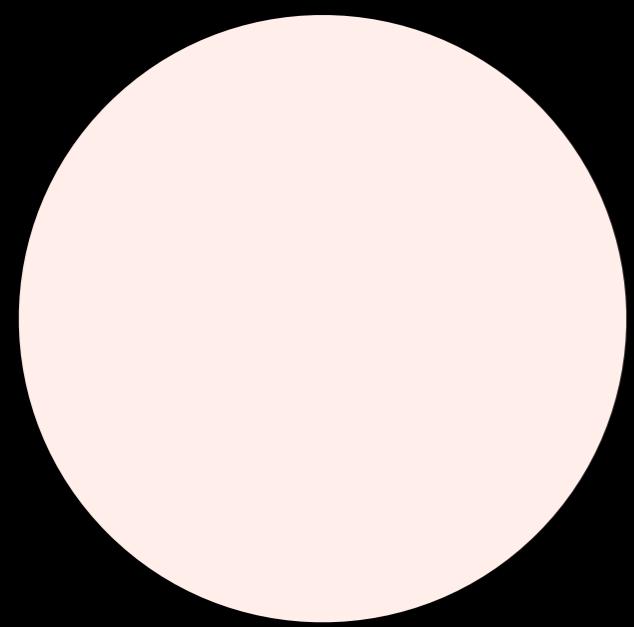


Hertzsprung Russell Diagram and its interpretation

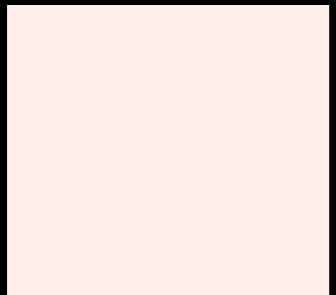
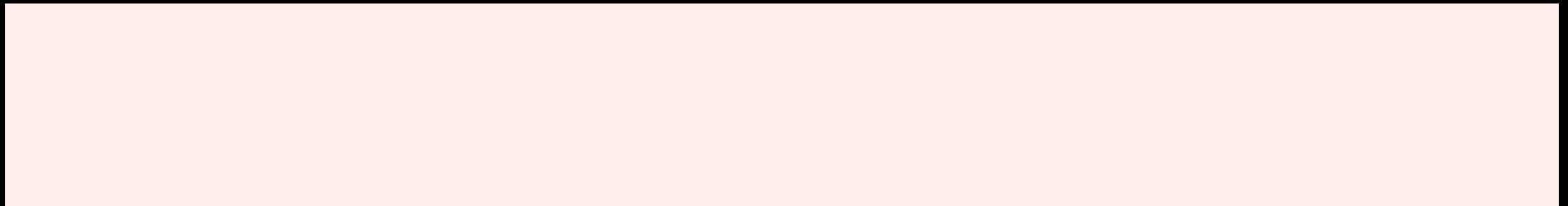
AUTOMATIC ABSTRACTION CAPABILITY



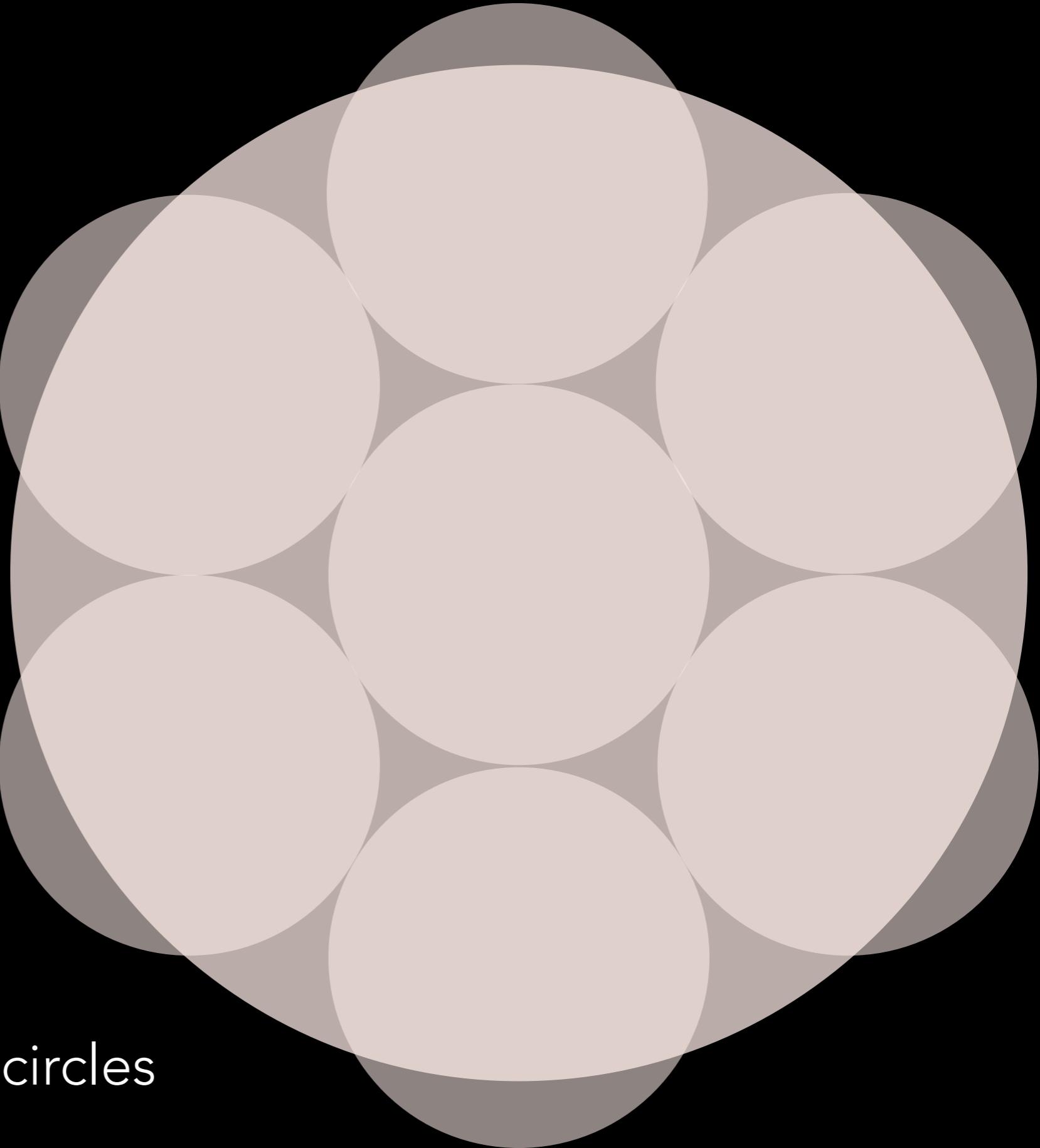
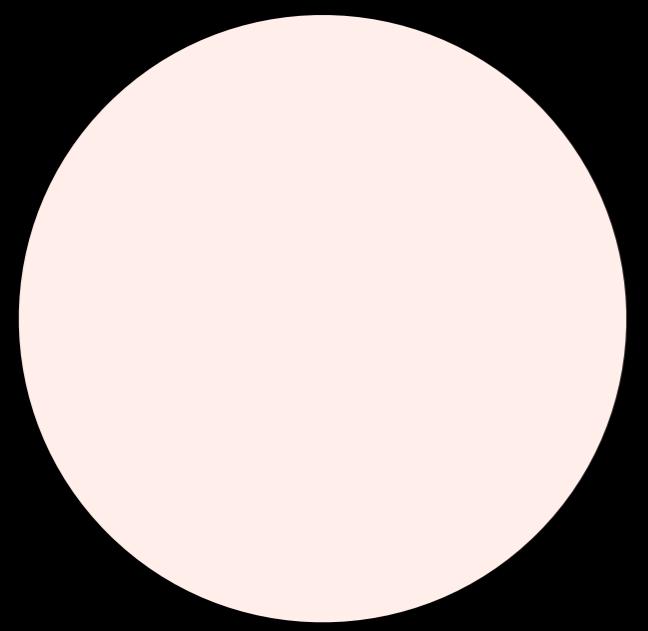
Hertzsprung Russell Diagram and its interpretation



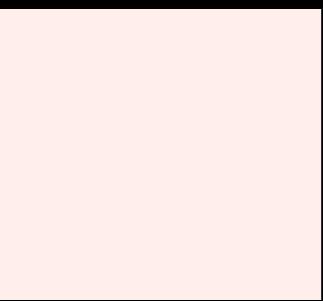
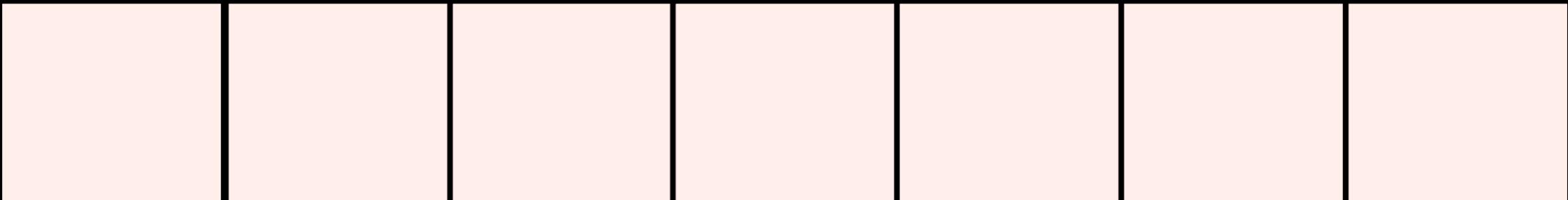
Compare **area** of circles



Compare **length** of bars

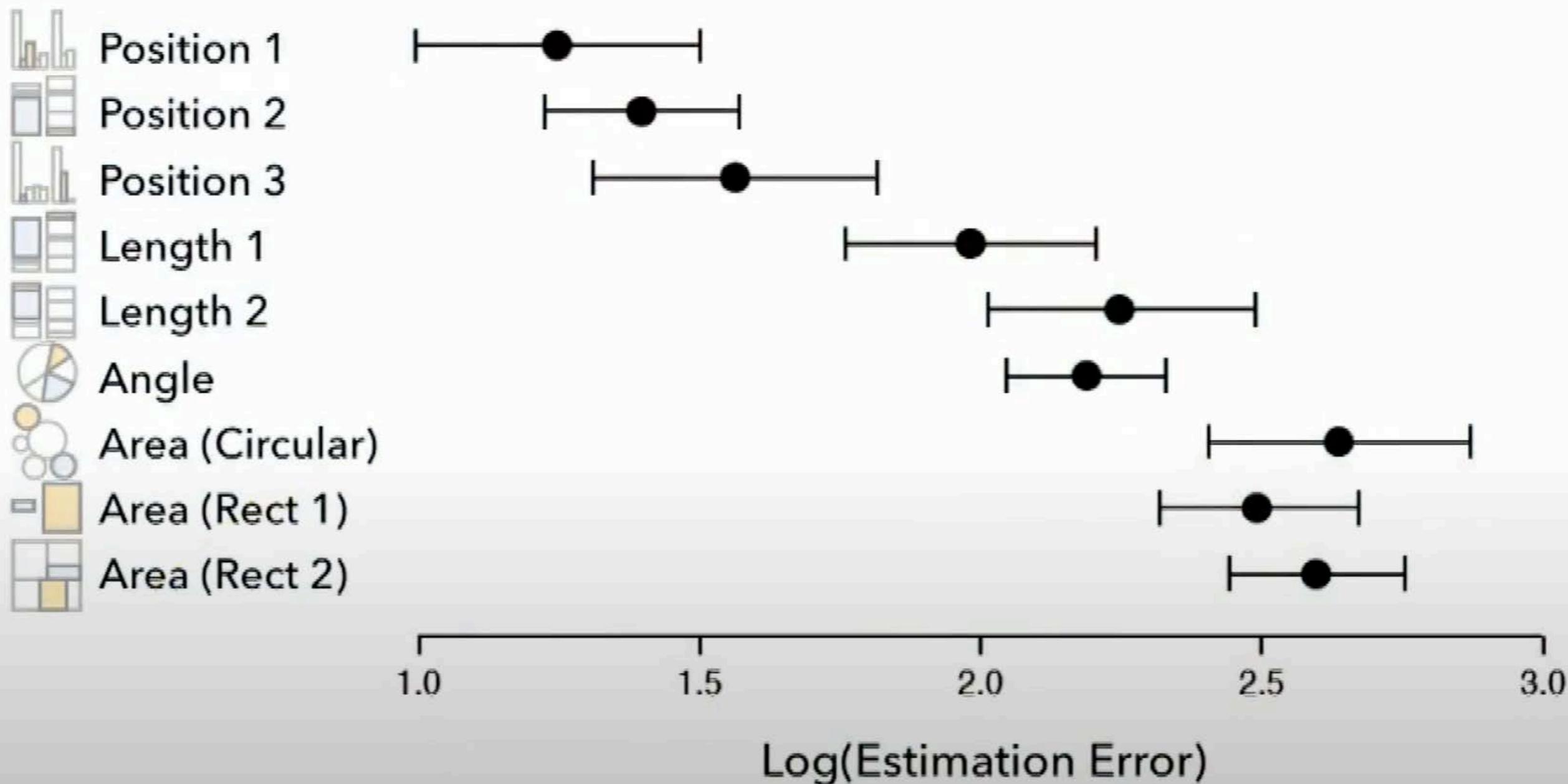


Compare the **area** of circles

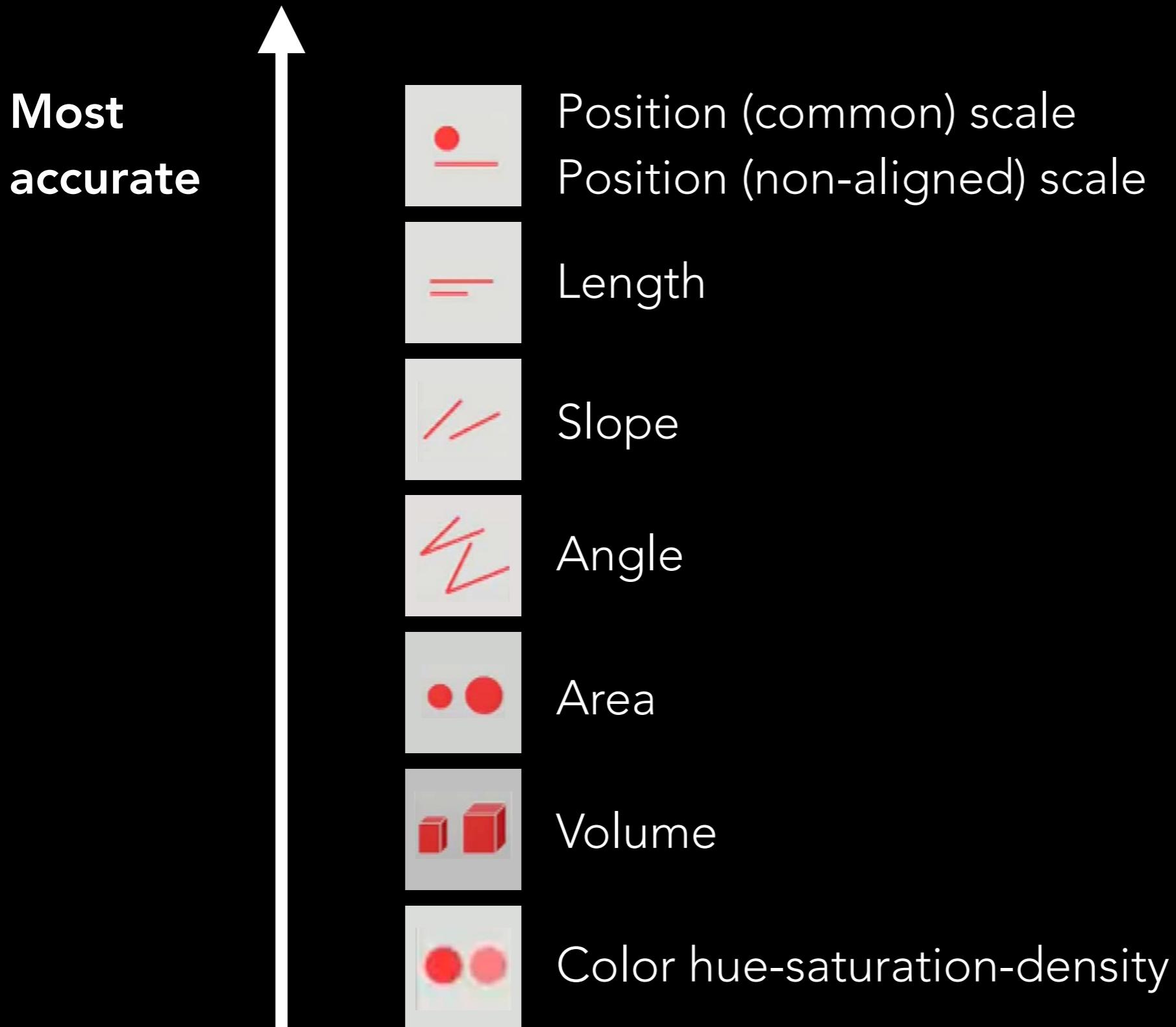


Compare **length** of bars

Accuracy of Visual Decoding



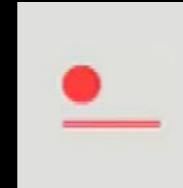
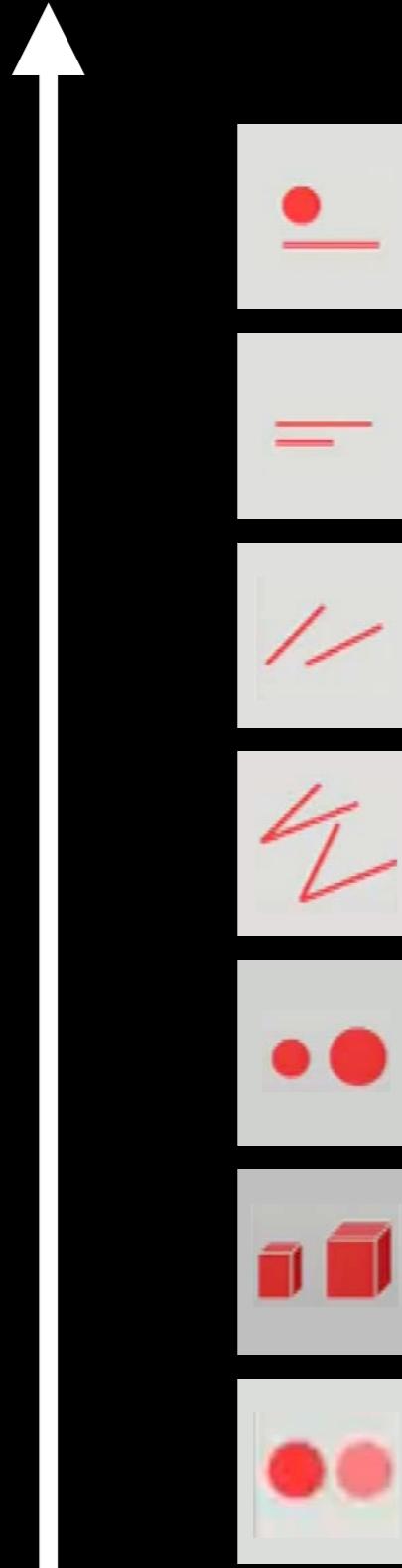
RANKING VISUAL ENCODINGS



RANKING VISUAL ENCODINGS

Most
accurate

for
comparing
proportions



Position (common) scale
Position (non-aligned) scale



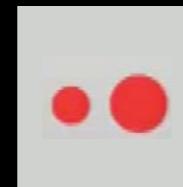
Length



Slope



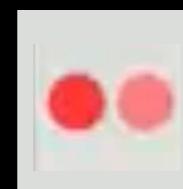
Angle



Area



Volume



Color hue-saturation-density

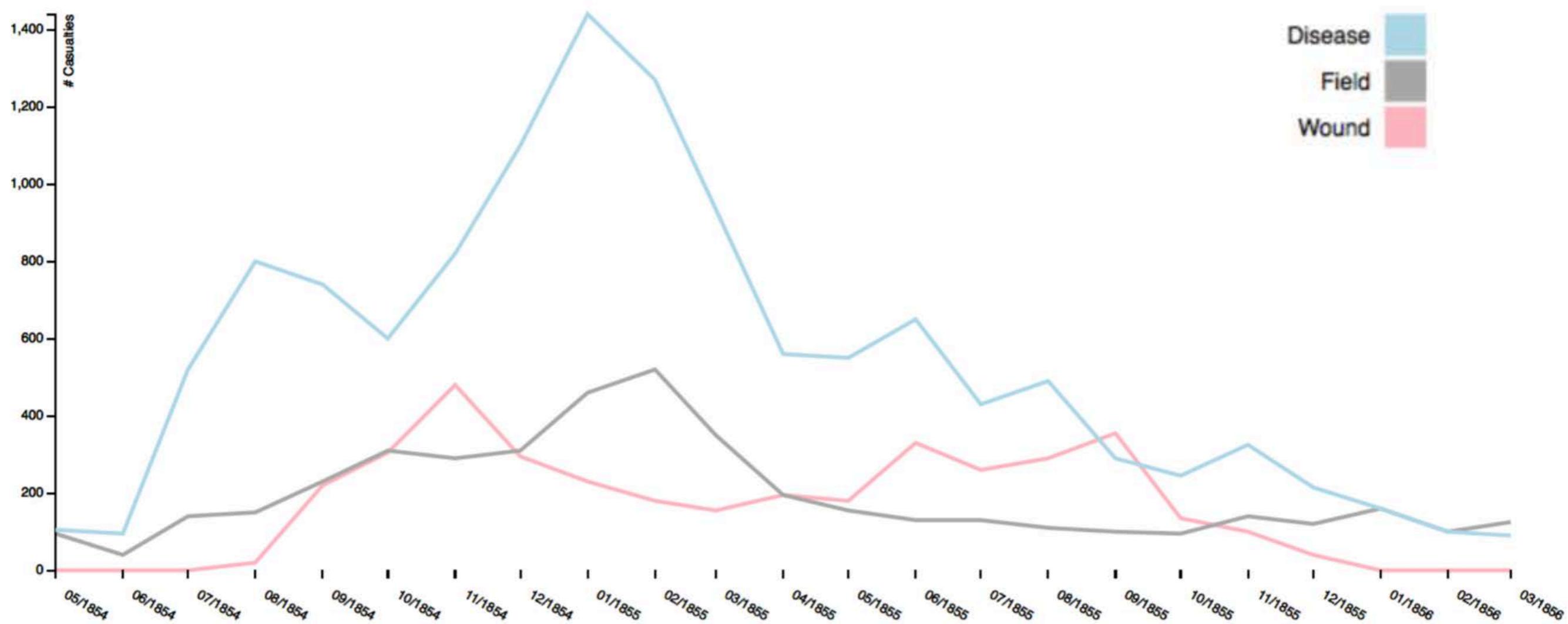
TASKS

British Casualties in the Crimean War

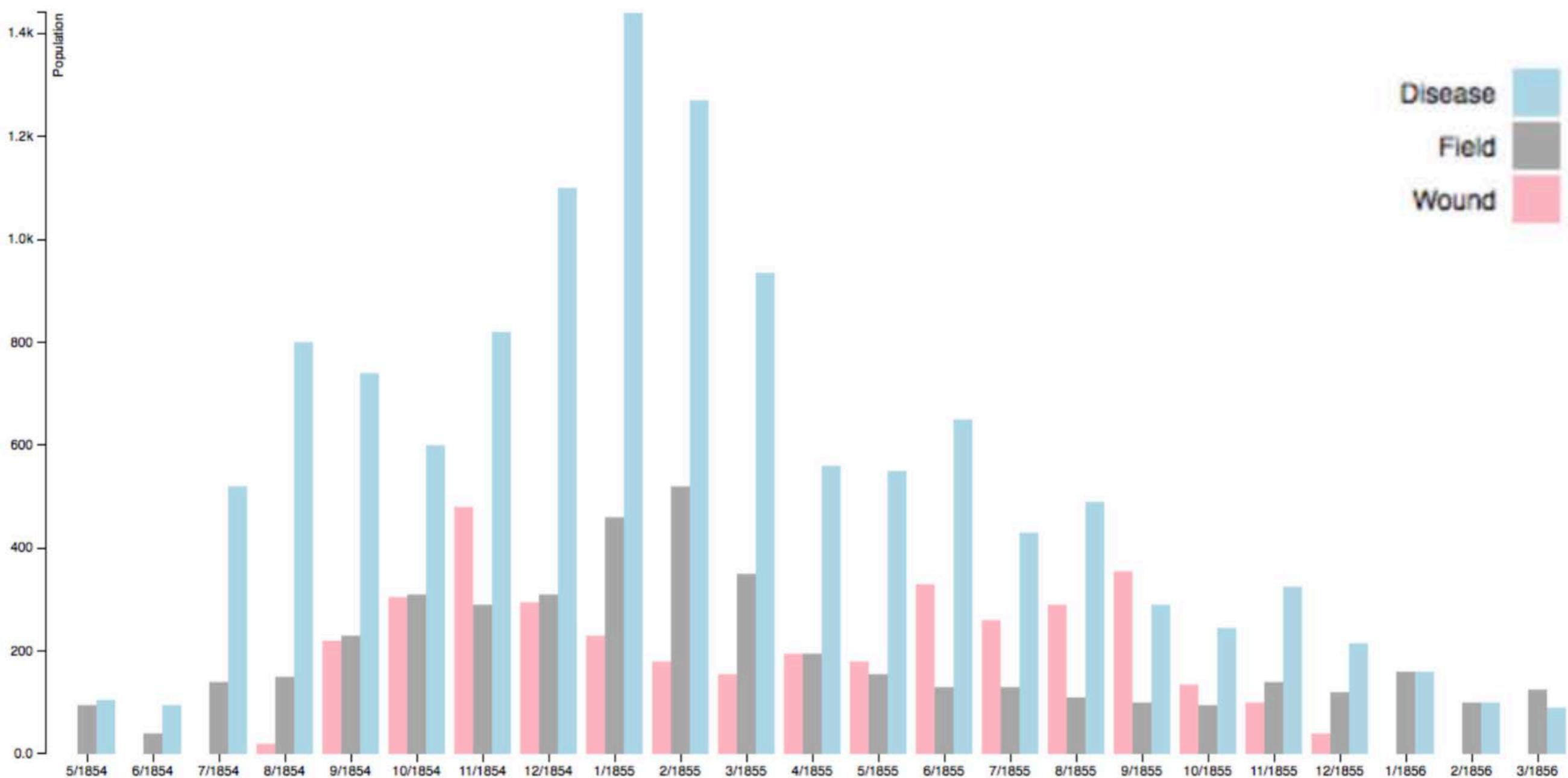
Data	Wound	Field	Disease
05/1854	0	95	105
06/1854	0	40	95
07/1854	0	140	520
08/1854	20	150	800
09/1854	220	230	740
10/1854	305	310	600
11/1854	480	290	820
12/1854	295	310	1100
01/1855	230	460	1440
02/1855	180	520	1270
03/1855	155	350	935
04/1855	195	195	560
05/1855	180	155	550
06/1855	330	130	650
07/1855	260	130	430
08/1855	290	110	490
09/1855	355	100	290
10/1855	135	95	245
11/1855	100	140	325
12/1855	40	120	215
01/1856	0	160	160
02/1856	0	100	100
03/1856	0	125	90

- ▶ Month with highest casualty rates in the field?
- ▶ Months in which deaths by wound exceeds deaths in the field?
- ▶ Month with highest total casualty rate?
- ▶ Months in which % of deaths by disease was below 50%?

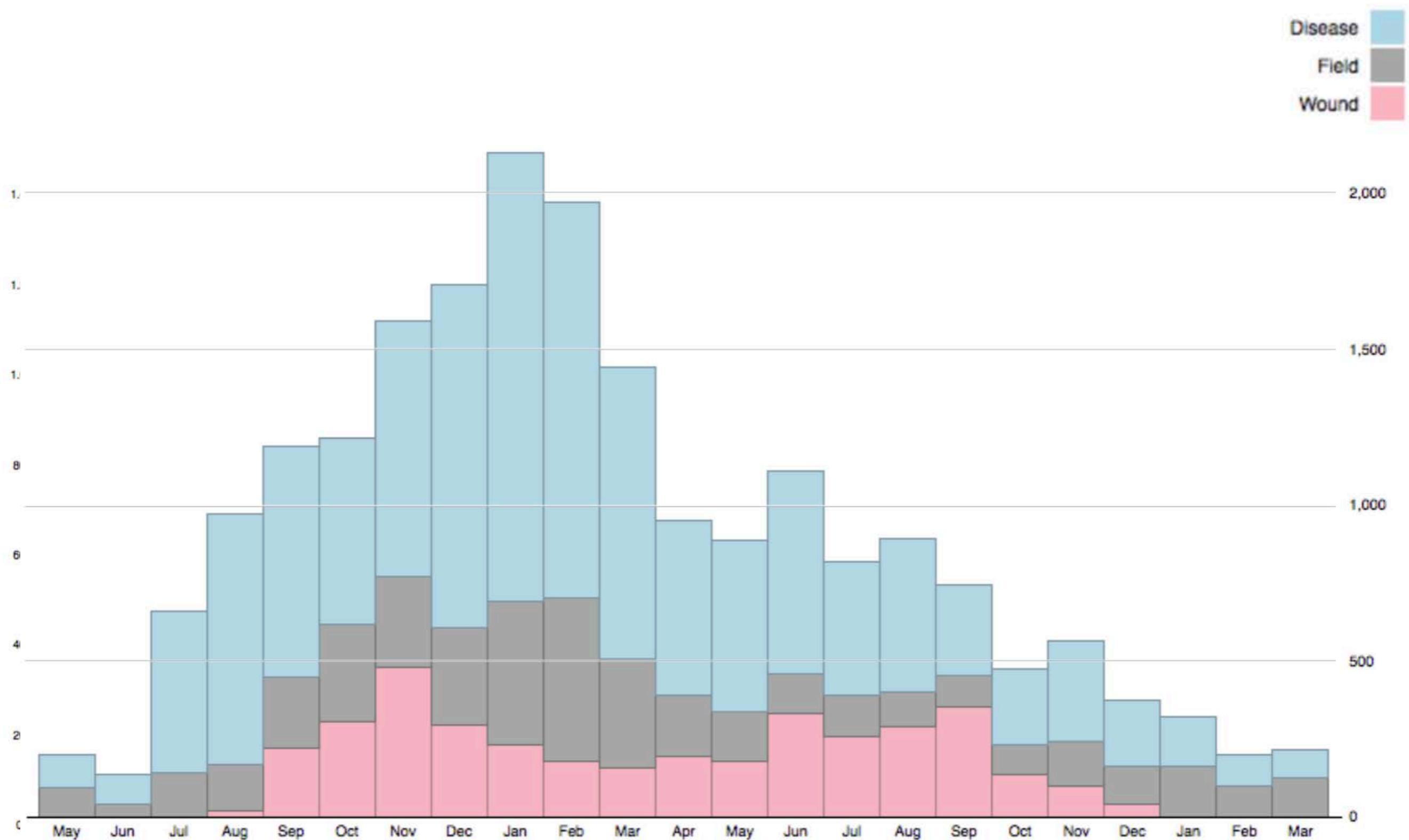
Month with highest casualty rates in the field?



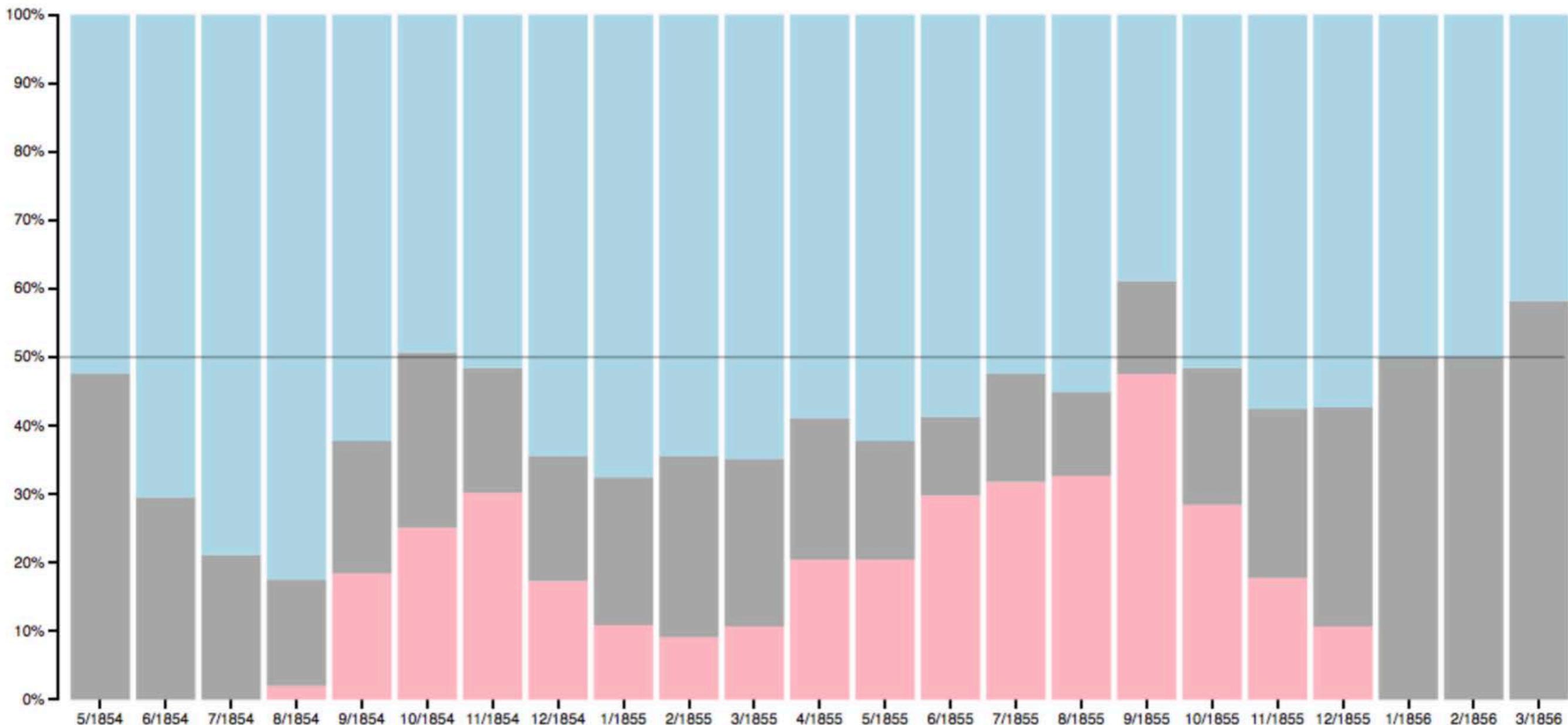
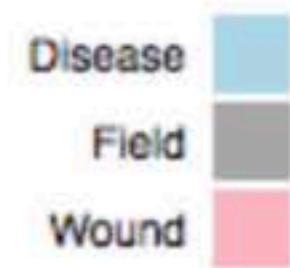
Months in which deaths by wound exceeds deaths in the field?



Month with highest total casualty rate?



Months in which % of deaths by disease was below 50%?



British Casualties in the Crimean War

Data	Wound	Field	Disease
05/1854	0	95	105
06/1854	0	40	95
07/1854	0	140	520
08/1854	20	150	800
09/1854	220	230	740
10/1854	305	310	600
11/1854	480	290	820
12/1854	295	310	1100
01/1855	230	460	1440
02/1855	180	520	1270
03/1855	155	350	935
04/1855	195	195	560
05/1855	180	155	550
06/1855	330	130	650
07/1855	260	130	430
08/1855	290	110	490
09/1855	355	100	290
10/1855	135	95	245
11/1855	100	140	325
12/1855	40	120	215
01/1856	0	160	160
02/1856	0	100	100
03/1856	0	125	90

- ▶ Month with highest casualty rates in the field?
- ▶ Months in which deaths by wound exceeds deaths in the field?
- ▶ Month with highest total casualty rate?
- ▶ Months in which % of deaths by disease was below 50%?

<https://open.toronto.ca/dataset/covid-19-cases-in-toronto/>

COVID19 cases																
Outbreak Associated	Age Group	Neighbourhood Name	FSA	Source of Infection	Classification	Episode Date	Reported Date	Client Gender	Outcome	Currently Hospitalized	Currently in ICU	Currently Intubated	Ever Hospitalized	Ever in ICU	Ever Intubated	
Sporadic	50 to 59 Years	Willowdale East	M2N	Travel	CONFIRMED	2020-01-22	2020-01-23	FEMALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	50 to 59 Years	Willowdale East	M2N	Travel	CONFIRMED	2020-01-21	2020-01-23	MALE	RESOLVED	No	No	No	Yes	No	No	No
Sporadic	20 to 29 Years	Parkwoods-Donaldda	M3A	Healthcare	CONFIRMED	2020-02-05	2020-02-21	FEMALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	60 to 69 Years	Church-Yonge Corridor	M4W	Travel	CONFIRMED	2020-02-16	2020-02-25	FEMALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	60 to 69 Years	Church-Yonge Corridor	M4W	Travel	CONFIRMED	2020-02-20	2020-02-26	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	50 to 59 Years	Newtonbrook West	M2R	Travel	CONFIRMED	2020-02-24	2020-02-27	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	80 to 89 Years	Milliken	M1V	Travel	CONFIRMED	2020-02-20	2020-02-28	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	60 to 69 Years	Willowdale West	M2N	Travel	CONFIRMED	2020-02-21	2020-03-04	MALE	RESOLVED	No	No	No	Yes	No	No	No
Sporadic	50 to 59 Years	Willowdale East	M2N	Travel	CONFIRMED	2020-02-29	2020-02-29	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	60 to 69 Years	Henry Farm	M2J	Travel	CONFIRMED	2020-02-26	2020-03-01	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	70 to 79 Years	Don Valley Village	M2J	Community	CONFIRMED	2020-02-14	2020-03-01	FEMALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	50 to 59 Years	Lawrence Park South	M4R	Travel	PROBABLE	2020-03-01	2020-03-02	MALE	FATAL	No	No	No	No	No	No	No
Sporadic	60 to 69 Years	Bridle Path-Sunnybrook-York Mills	M2L	Travel	CONFIRMED	2020-03-02	2020-03-03	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	30 to 39 Years	Moss Park	M5A	Institutional	PROBABLE	2020-03-03	2020-03-04	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	40 to 49 Years	Annex	M6G	Travel	CONFIRMED	2020-03-02	2020-03-05	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	50 to 59 Years	Willowdale East	M2N	Travel	CONFIRMED	2020-03-03	2020-03-05	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	20 to 29 Years	Westminster-Branson	M2R	Travel	CONFIRMED	2020-03-02	2020-03-06	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	40 to 49 Years	Leaside-Bennington	M4G	Travel	CONFIRMED	2020-03-04	2020-03-07	FEMALE	RESOLVED	No	No	No	No	No	No	No
Outbreak Associated	40 to 49 Years		N/A - Outbreak associated	CONFIRMED	2020-03-06	2020-03-06	MALE	RESOLVED	No	No	No	Yes	No	No	No	
Sporadic	60 to 69 Years	St. Andrew-Windfields	M2P	Travel	CONFIRMED	2020-03-05	2020-03-07	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	80 to 89 Years	Willowdale East	M2N	Travel	CONFIRMED	2020-03-03	2020-03-08	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	70 to 79 Years	Willowdale East	M2N	Travel	CONFIRMED	2020-03-03	2020-03-08	FEMALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	60 to 69 Years	Malvern	M1B	Travel	CONFIRMED	2020-03-04	2020-03-08	FEMALE	RESOLVED	No	No	No	Yes	Yes	Yes	Yes
Sporadic	40 to 49 Years	Bedford Park-Nortown	M5N	Travel	CONFIRMED	2020-03-09	2020-03-09	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	40 to 49 Years	High Park North	M6P	Travel	CONFIRMED	2020-03-02	2020-03-09	MALE	FATAL	No	No	No	No	No	No	No
Sporadic	30 to 39 Years	Waterfront Communities-The Island	M5V	Travel	CONFIRMED	2020-03-03	2020-03-10	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	20 to 29 Years	Leaside-Bennington	M4G	Close contact	CONFIRMED	2020-03-09	2020-03-10	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	20 to 29 Years			Travel	PROBABLE	2020-03-02	2020-03-10	MALE	ACTIVE	No	No	No	No	No	No	No
Sporadic	40 to 49 Years	Mimico (includes Humber Bay Shores)	M8Y	Travel	CONFIRMED	2020-03-07	2020-03-11	FEMALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	40 to 49 Years	Danforth-East York	M4J	Travel	CONFIRMED	2020-03-09	2020-03-11	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	70 to 79 Years	Princess-Rosethorn	M9B	Travel	CONFIRMED	2020-02-28	2020-03-11	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	19 and younger	Willowdale East	M2N	Close contact	CONFIRMED	2020-03-09	2020-03-10	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	30 to 39 Years	Willowdale East	M2N	Close contact	CONFIRMED	2020-03-07	2020-03-10	FEMALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	40 to 49 Years	Roncesvalles	M6R	Travel	PROBABLE	2020-03-09	2020-03-10	MALE	ACTIVE	Yes	Yes	Yes	No	No	No	No
Sporadic	30 to 39 Years	Willowdale East	M2N	Close contact	CONFIRMED	2020-03-10	2020-03-11	MALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	20 to 29 Years	Long Branch	M8W	Travel	CONFIRMED	2020-03-07	2020-03-11	FEMALE	ACTIVE	No	No	No	No	No	No	No
Sporadic	30 to 39 Years	Dovercourt-Wallace Emerson-Junction	M6H	Travel	PROBABLE	2020-03-04	2020-03-09	FEMALE	RESOLVED	No	No	No	No	No	No	No
Sporadic	19 and younger	Dovercourt-Wallace Emerson-Junction	M6H	Travel	CONFIRMED	2020-03-09	2020-03-11	FEMALE	ACTIVE	No	No	No	Yes	No	No	No
Sporadic	60 to 69 Years	Mount Pleasant West	M4S	Travel	CONFIRMED	2020-03-08	2020-03-12	MALE	RESOLVED	No	No	No	Yes	No	No	No

DATA TYPES

DATA TYPES

Taxonomies of **data types** stem from Steven's scale of measurement

- **Nominal** (identity)
- **Ordinal** (comparison)
- **Quantitative** (differences, ratios)

S.S. Stevens, On the theory of scales of measurements, 1946

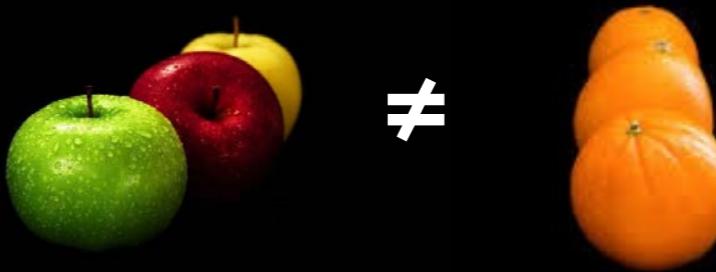
See also:

S. Card and J. Mackinlay. The Structure of the Information Visualization Design Space. In proc. InfoVis'97, 92–99, 1997.

DATA TYPES AND TASKS

- **Nominal** (labels)

- Operations: $=, \neq$



- **Ordinal**

- Operations: $=, \neq, <, >$



- **Quantitative** : Interval

- Operations: $=, \neq, <, >, -, +$

$[1989 - 1999] + [2002 - 2012]$

- Distance measure possible

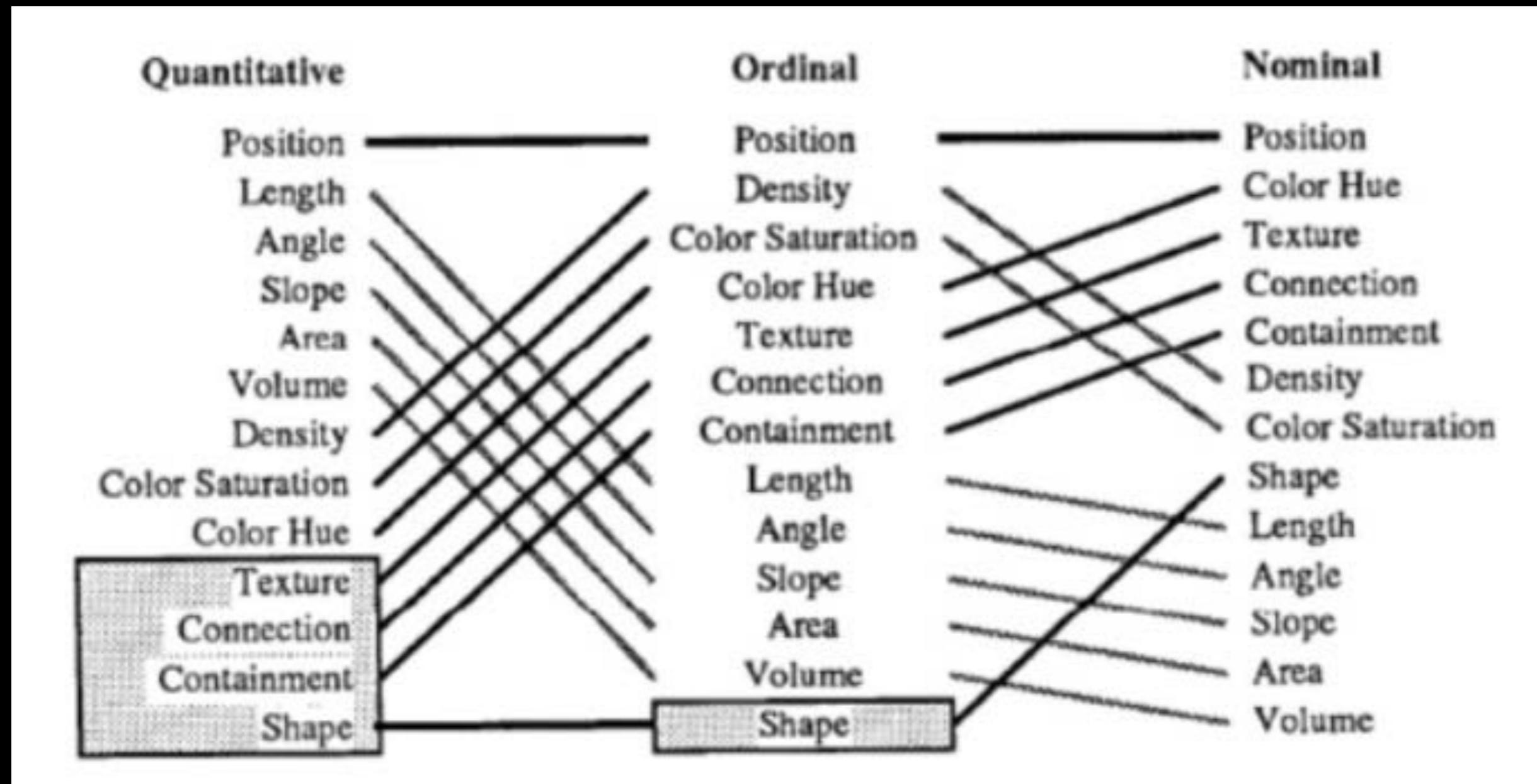
- **Quantitative** : Ratio

- Operations : $=, \neq, <, >, -, +, \times, /$

$10\text{kg} / 5\text{kg}$

- Ratio or proportion measure possible

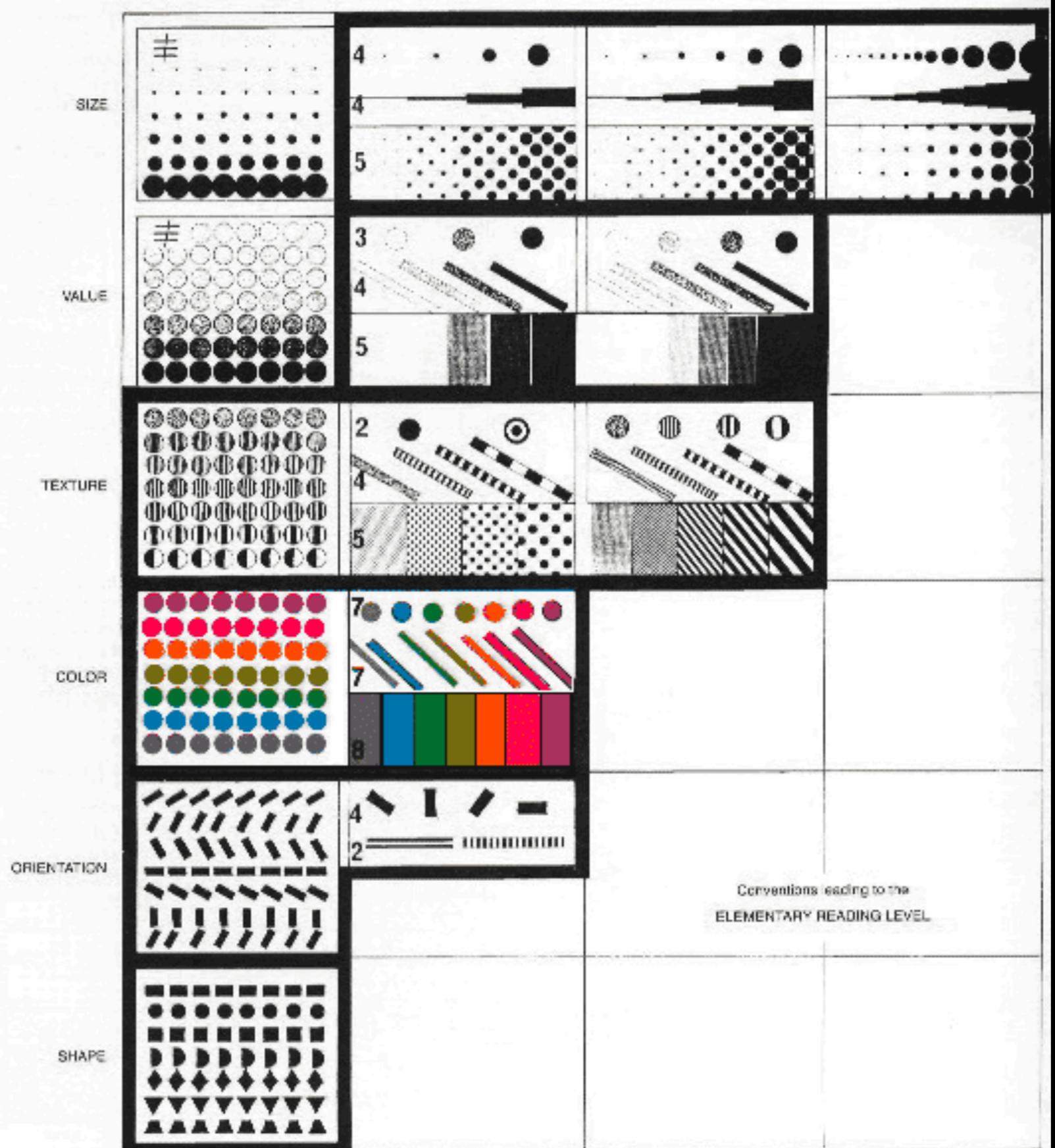
GUIDELINES FOR MAPPING



W. S. Cleveland and R. McGill. Graphical Perception: Theory, Experimentation, and Application
to the Development of Graphical Methods. Journal of the American Statistical Association. 79(387). 1984
J. Mackinlay. Automating the Design of Graphical Presentations of Relational Information. ACM Trans. Graph. 5(2): 110–141, 1986.

LEVEL OF THE RETINAL VARIABLES

ASSOCIATION	SELECTION	ORDER	QUANTITY
≡ PLANAR DIMENSIONS The marks can be perceived as SIMILAR	≠ The marks are perceived as DIFFERENT, forming families	○ The marks are perceived as ORDERED	Q The marks are perceived as PROPORTIONAL to each other

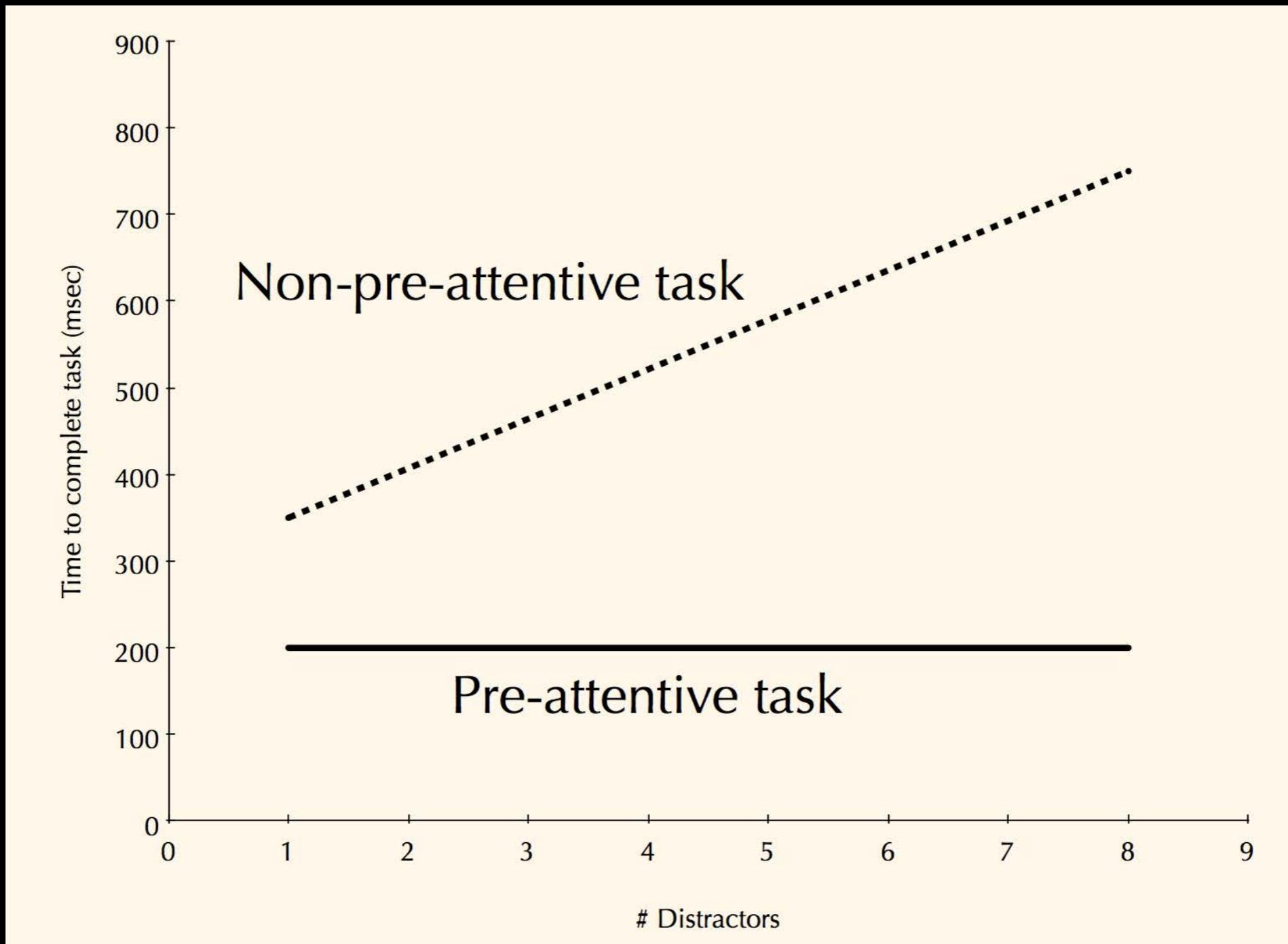


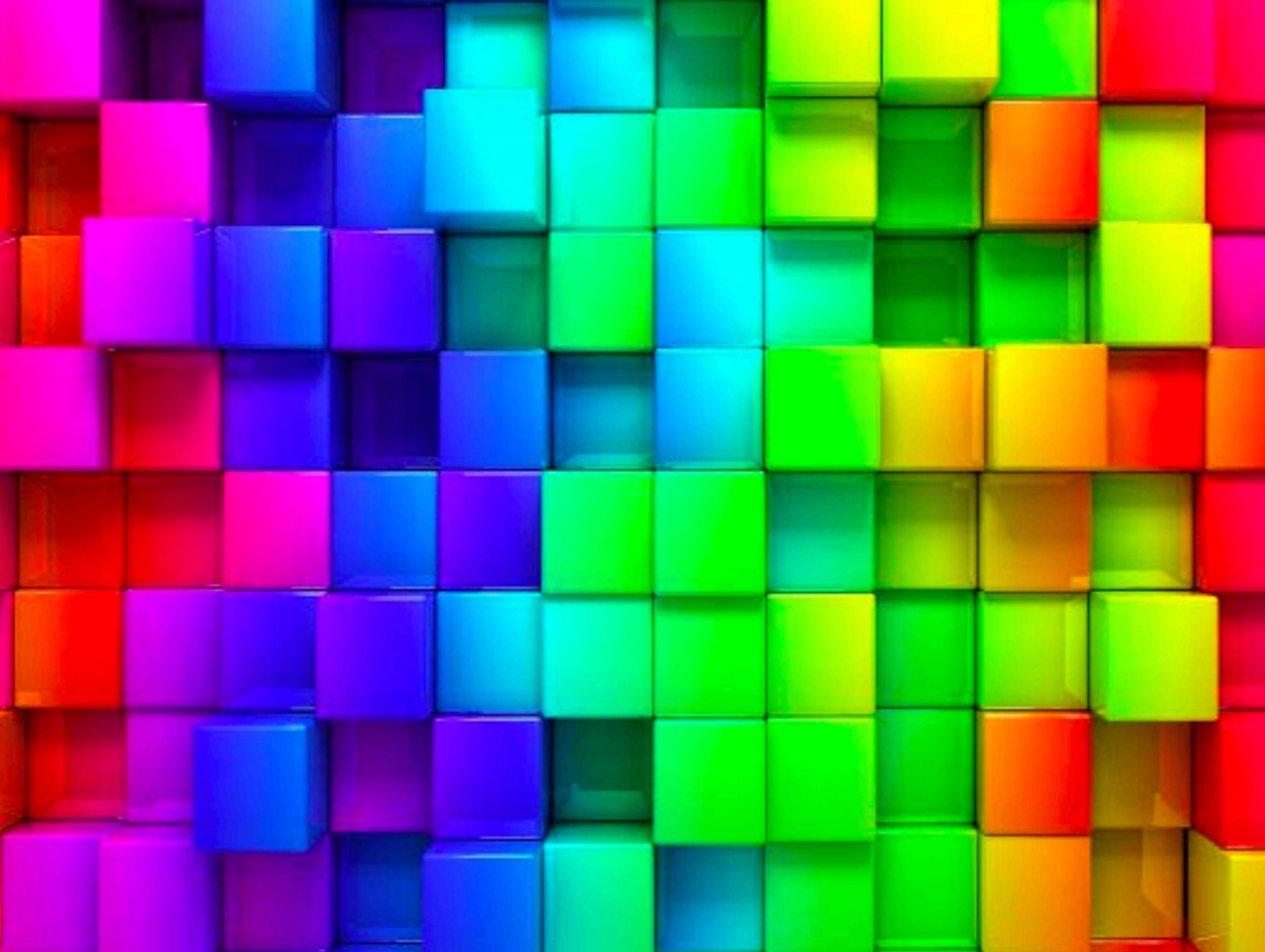
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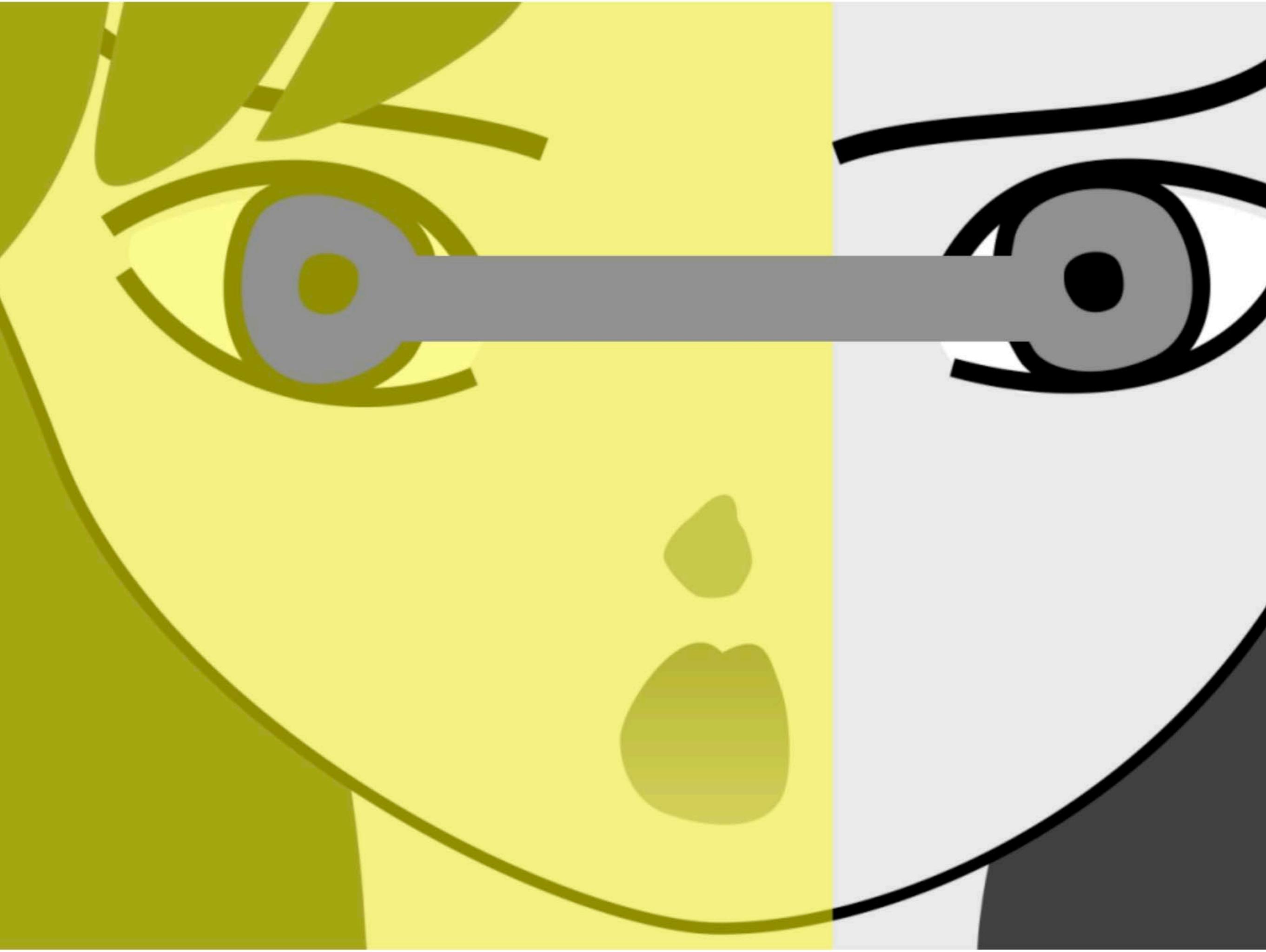
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285960799918712845268101495969124567781
874241649645757659608149596912456701285
960799164964575127879918712845298496912
223591649645759588198250963576596080596

PRE-ATTENTIVE PERCEPTION

Takes the same amount of time, regardless of the number of distractors



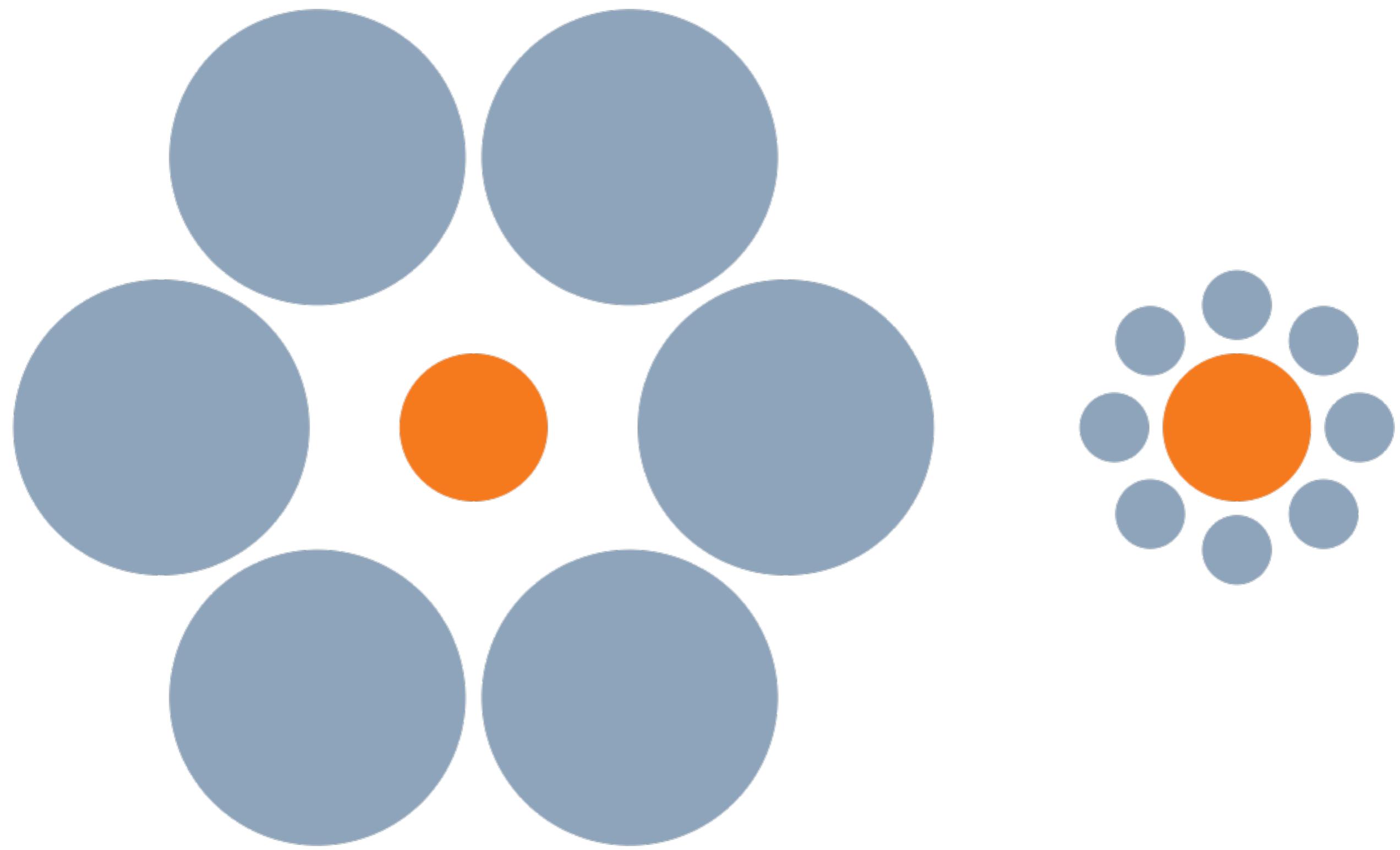


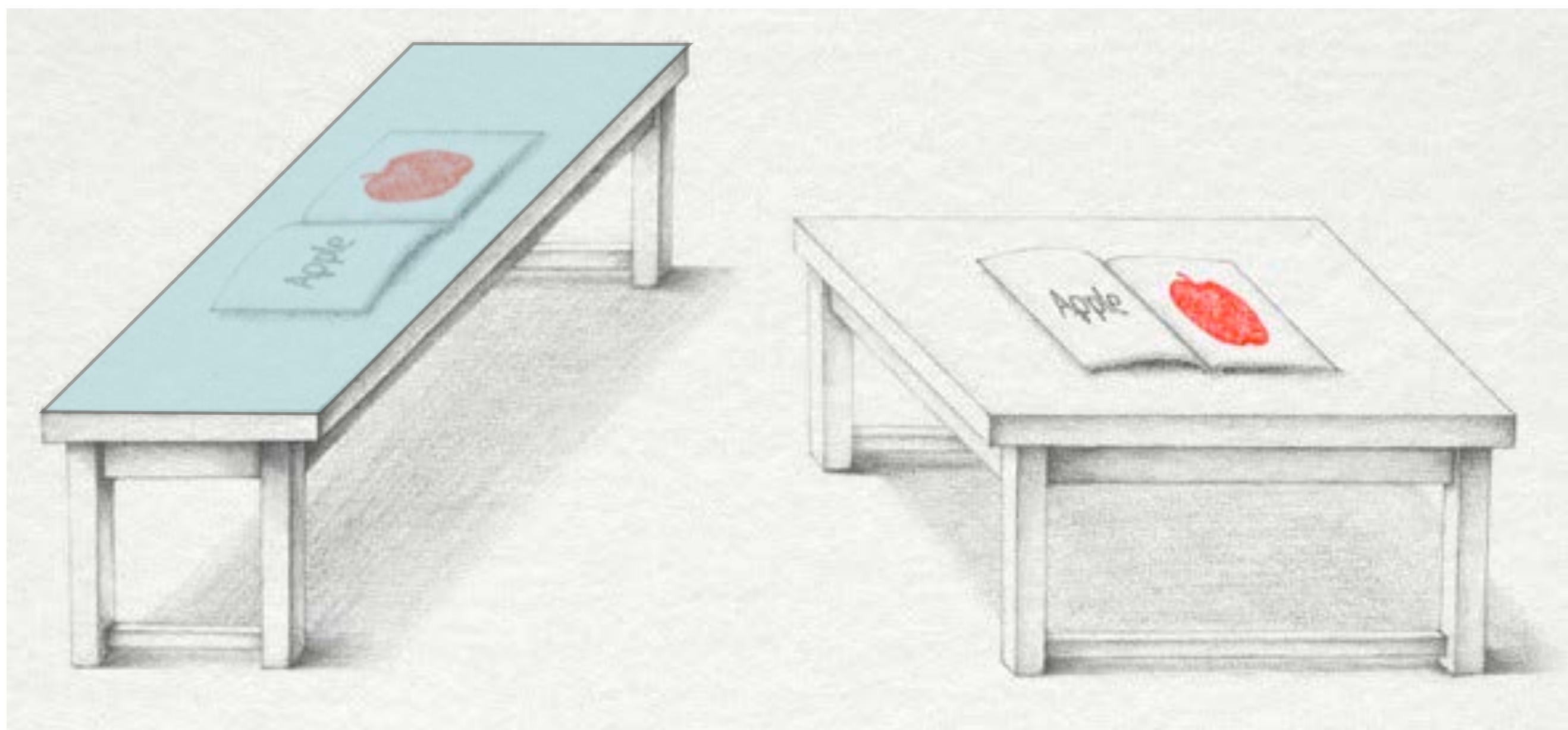




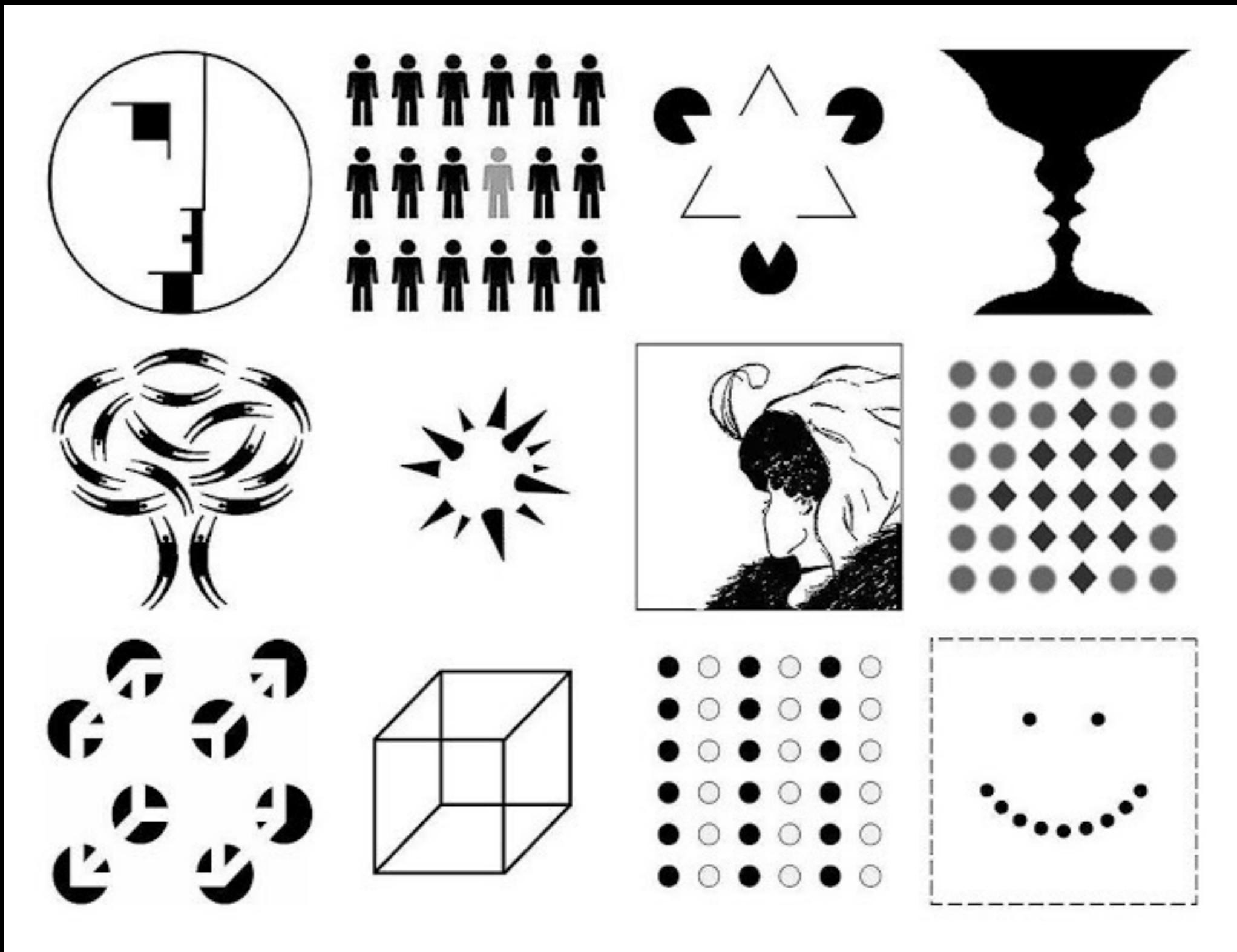
length?

SIZE?

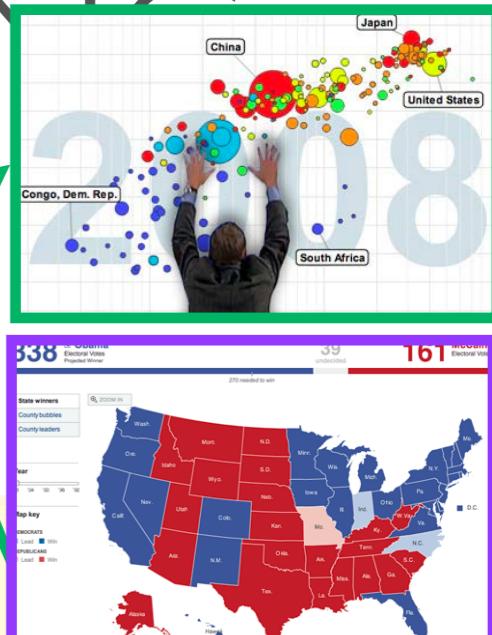




GESTALT PSYCHOLOGY



VISUALIZATION ENCODING



Visualization Encoding Pipeline

Structured Data map to Visual Attributes draw as Marks plot on a Layout

Nominal

Apple, Banana, Pear

Ordered

Mint, Good, Fair, Poor

Quantitative

0, 3, 4.2, -31.2, 6.6×10^6

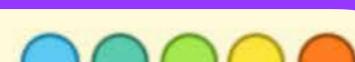
Position



Size



Hue



Shape



Brightness



Etc



Point



Line



Area



Scatter



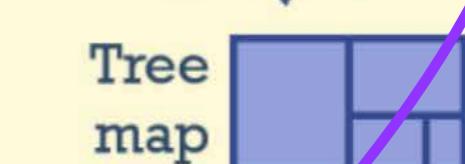
Graph



Line



Tree map



Etc



Which representations can I use to encode data?

Expressiveness principle: use adequate/suitable data representations

Encodings should convey all, and only, the information of associated attributes.

e.g. Ordinal data representation should convey “order”; similarly, “categorical data” should not be shown in a way that implies order.

**Which representations are more suitable to ensure
I'm conveying the right message?**

**Effectiveness principle:
choosing the best representation to your data**

Importance of attributes should match the “saliency” of the channel;

Most important attributes should be encoded using the most effective and noticeable channels.

KNOW YOUR USER'S TASK

“Every [designed] thing is best at something, and worst at something else”

— Bill Buxton

"A tool that serves well for one task can be poorly suited for another, for exactly the same dataset. The task of the users is an equally important constraint for a vis designer as the kind of data that the users have"

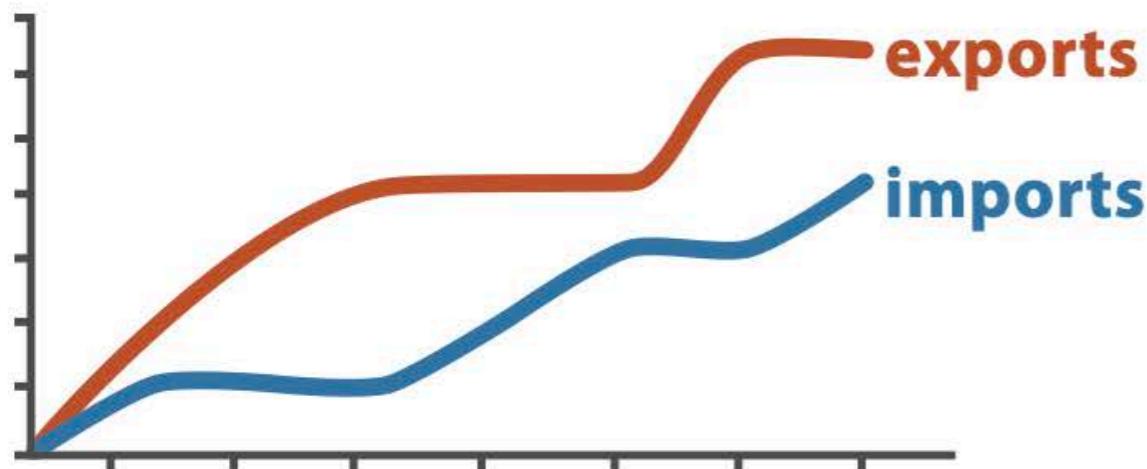
— Tamara Munzner

DON'T JUST DRAW WHAT YOU'RE GIVEN!

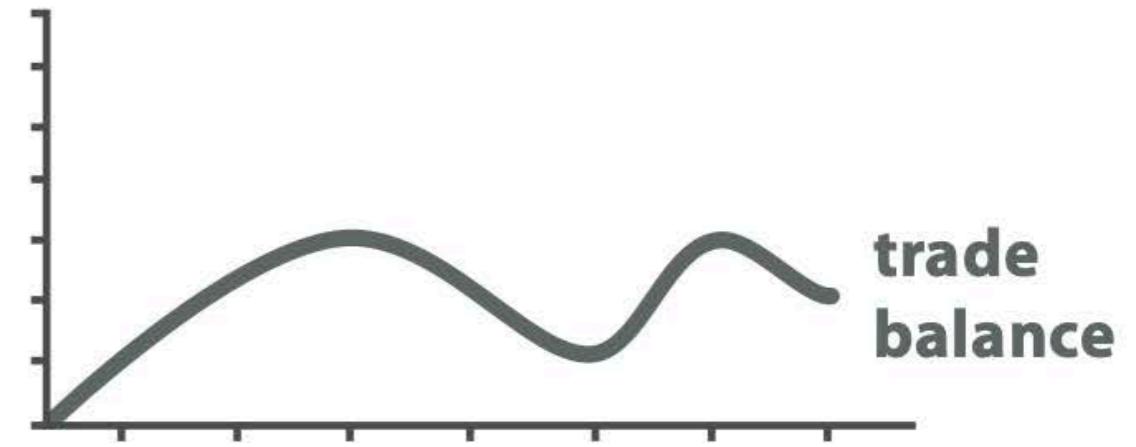
Decide what the right thing to show is

Create it with a series of transformations from the original dataset

Draw that



Original Data



$$\text{trade balance} = \text{exports} - \text{imports}$$

Derived Data



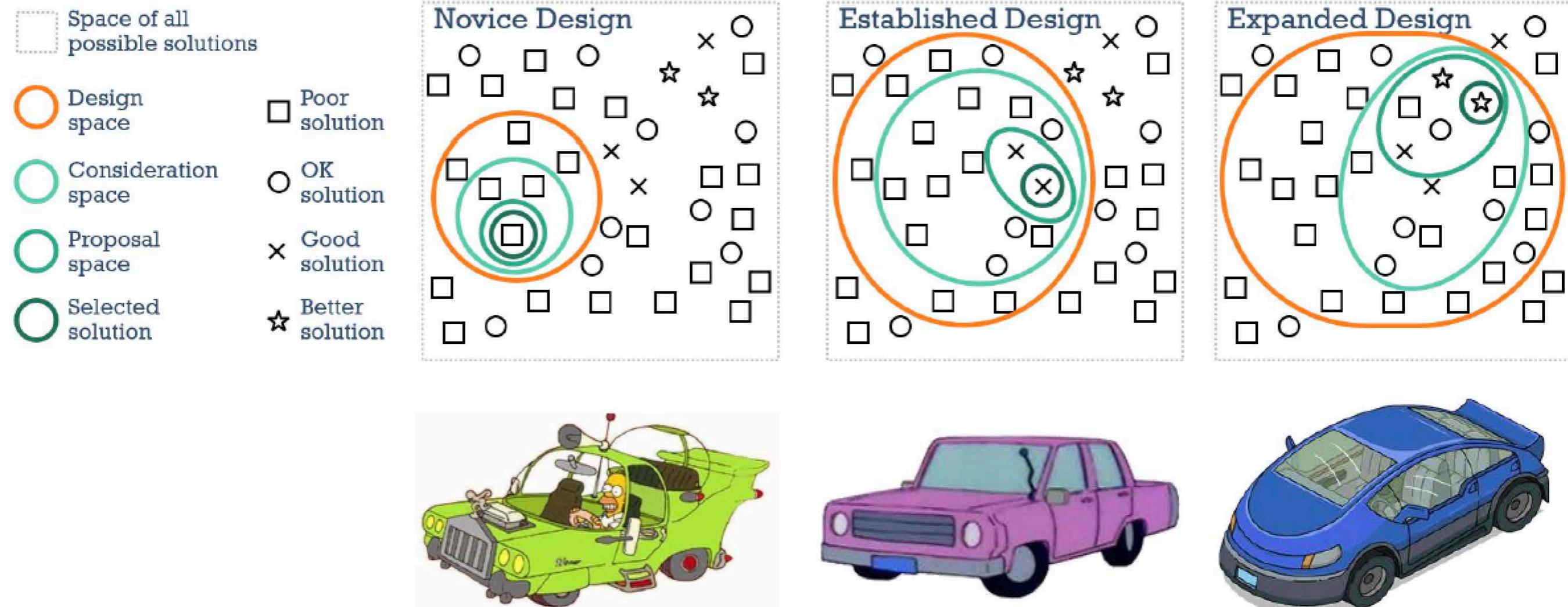
Examples, lots of
examples!

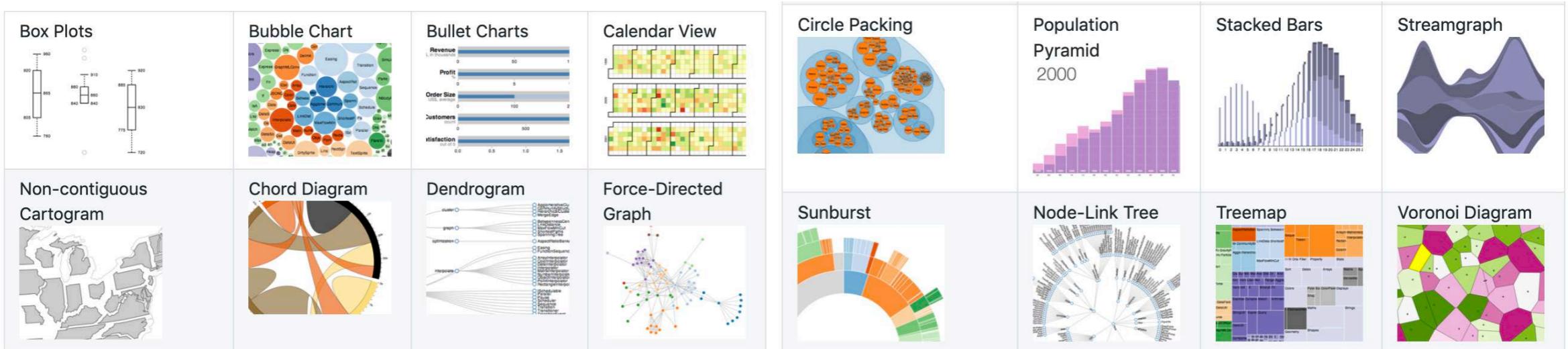
Fundamentals

DESIGN SPACE?

The set of possible design elements, parameters, and configurations that meet the specific application objectives.

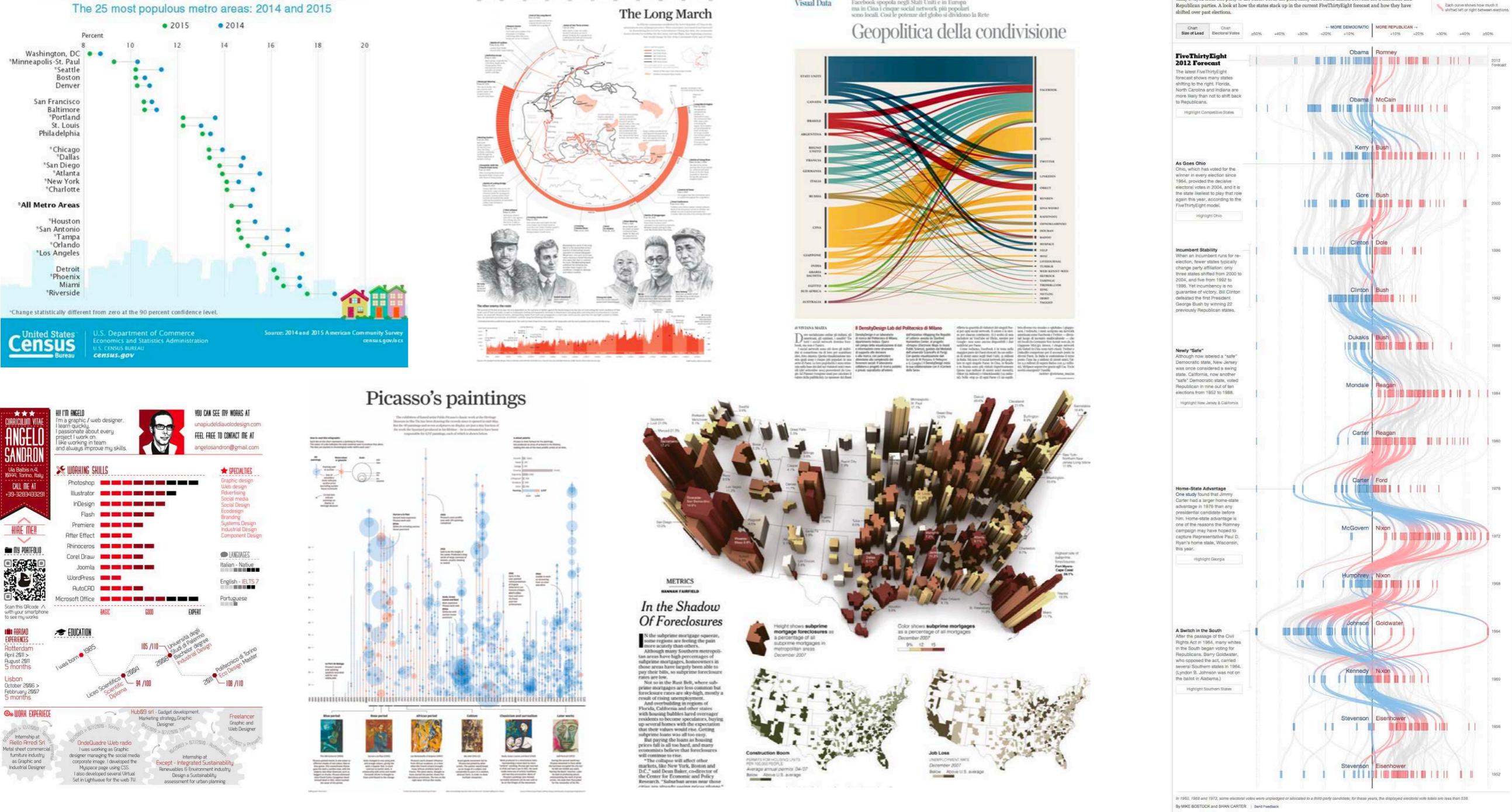
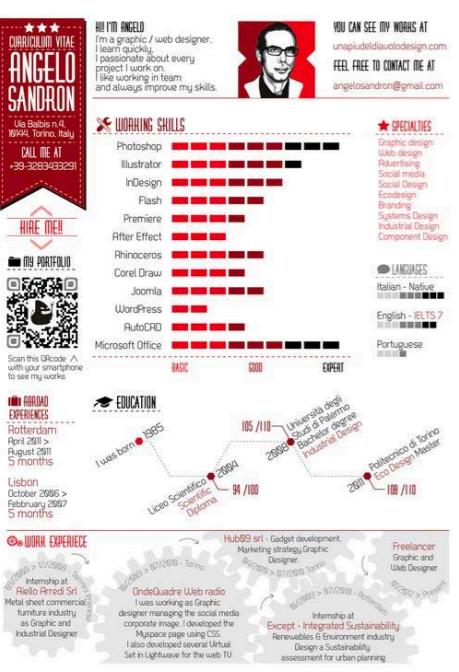
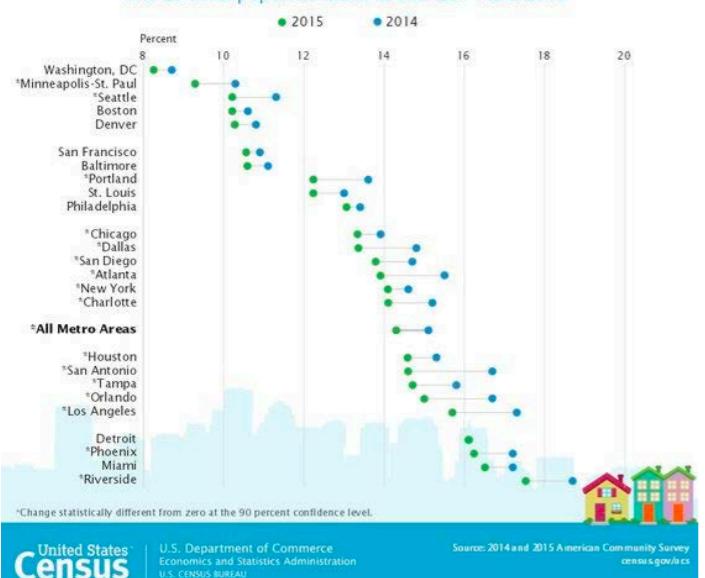
WHY DOES THE DESIGN SPACE MATTER?





Poverty in the United States

The 25 most populous metro areas: 2014 and 2015

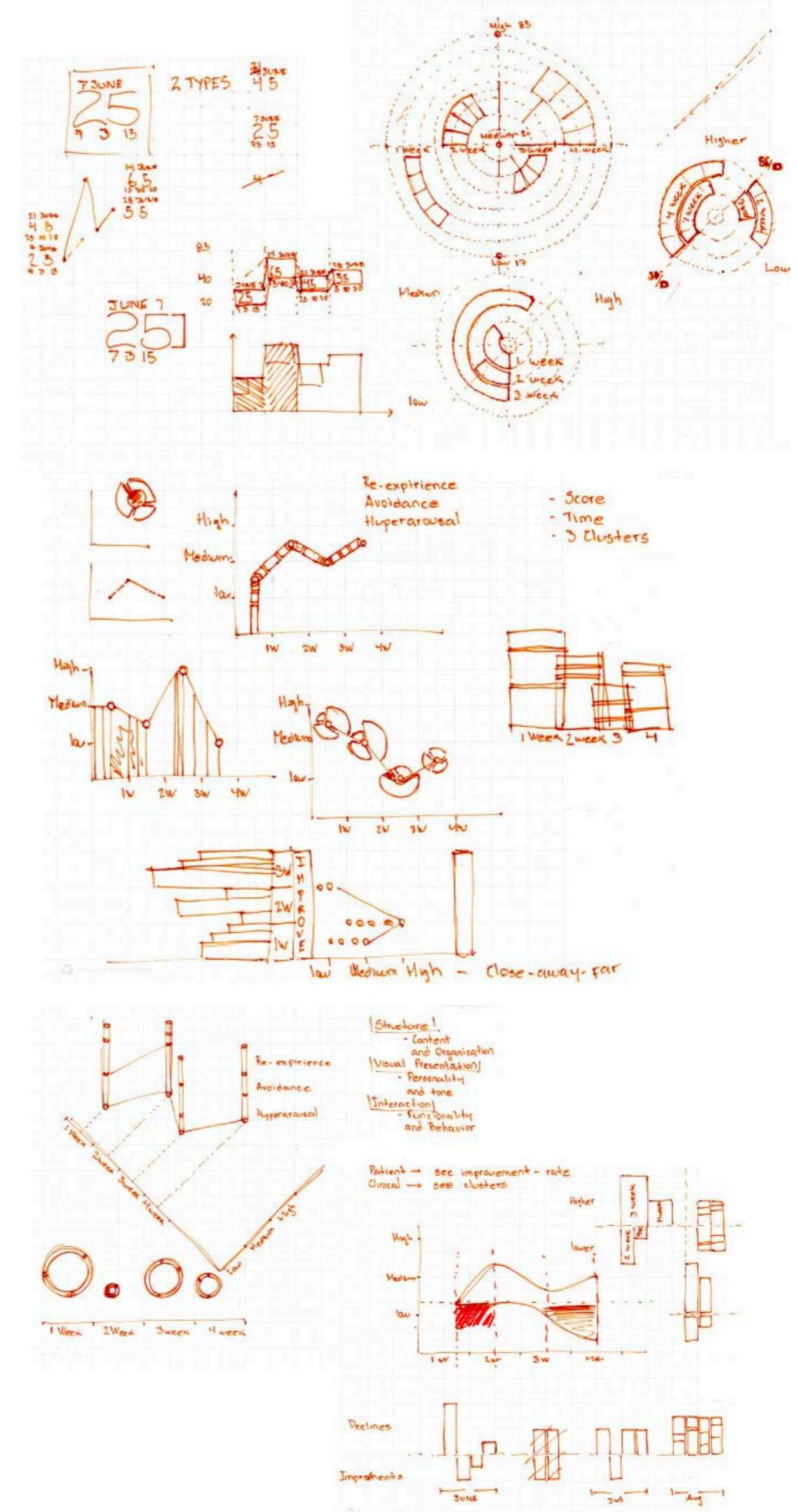


SKETCH!

Don't commit to a solution immediately; (easy to make, easy to discard)

Prototype ideas in early stages

Share and discuss your designs with other people



LET'S DECODE VISUALIZATIONS

MARKS

CHANNELS

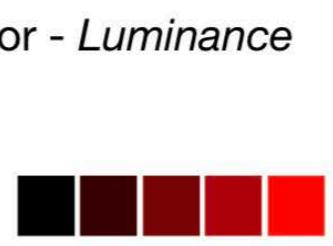
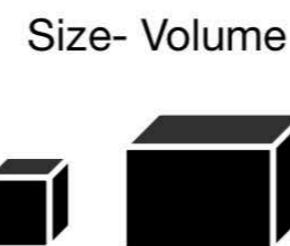
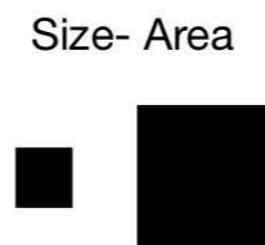
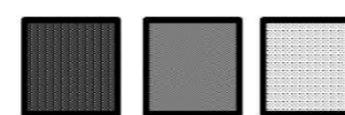
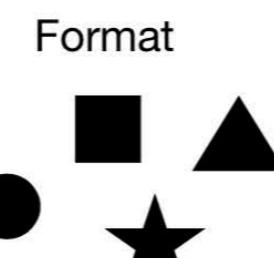
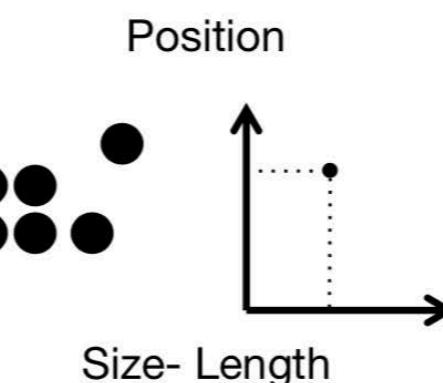
→ Points



→ Lines



→ Areas



DECODING EXERCISE

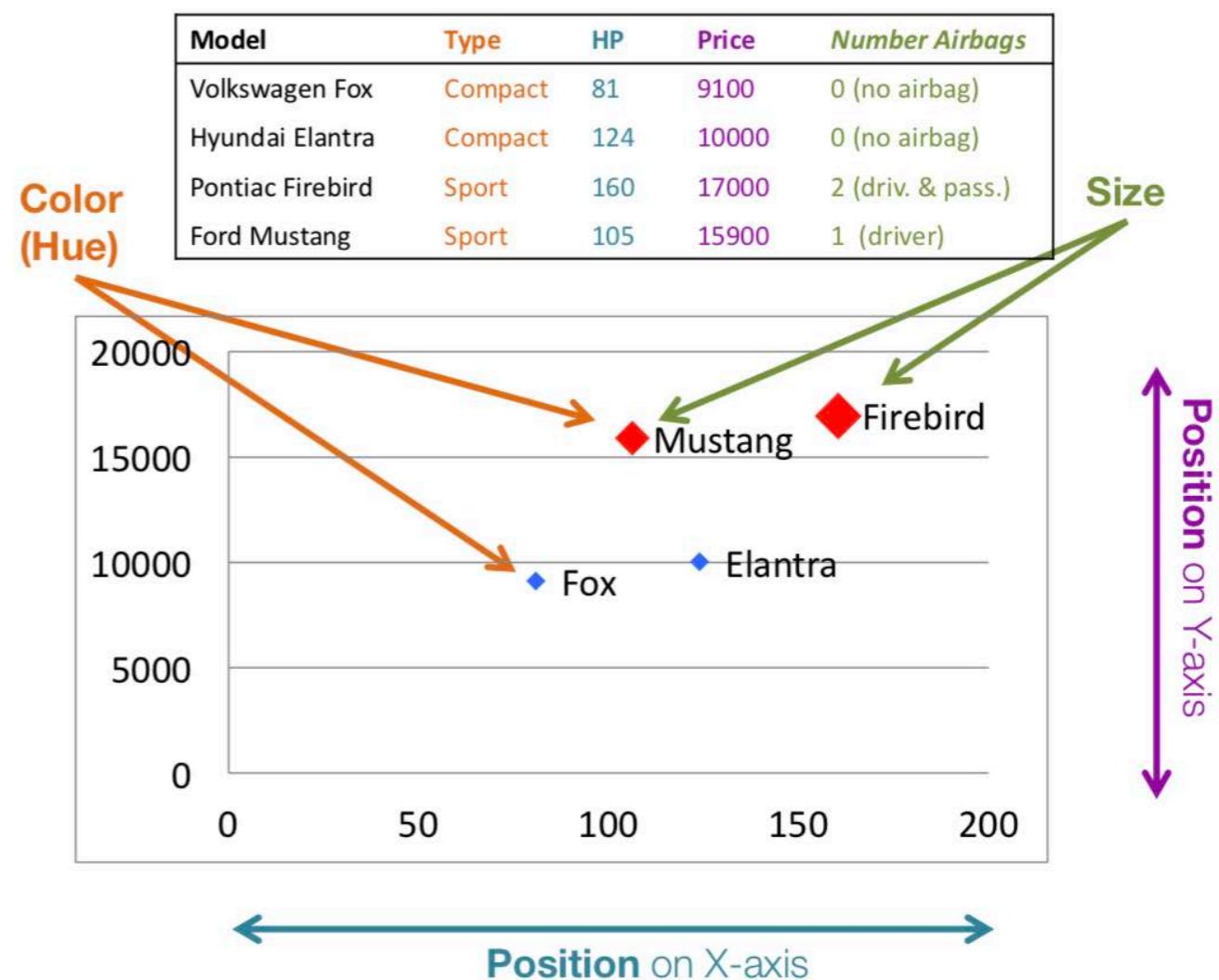
Marks used?

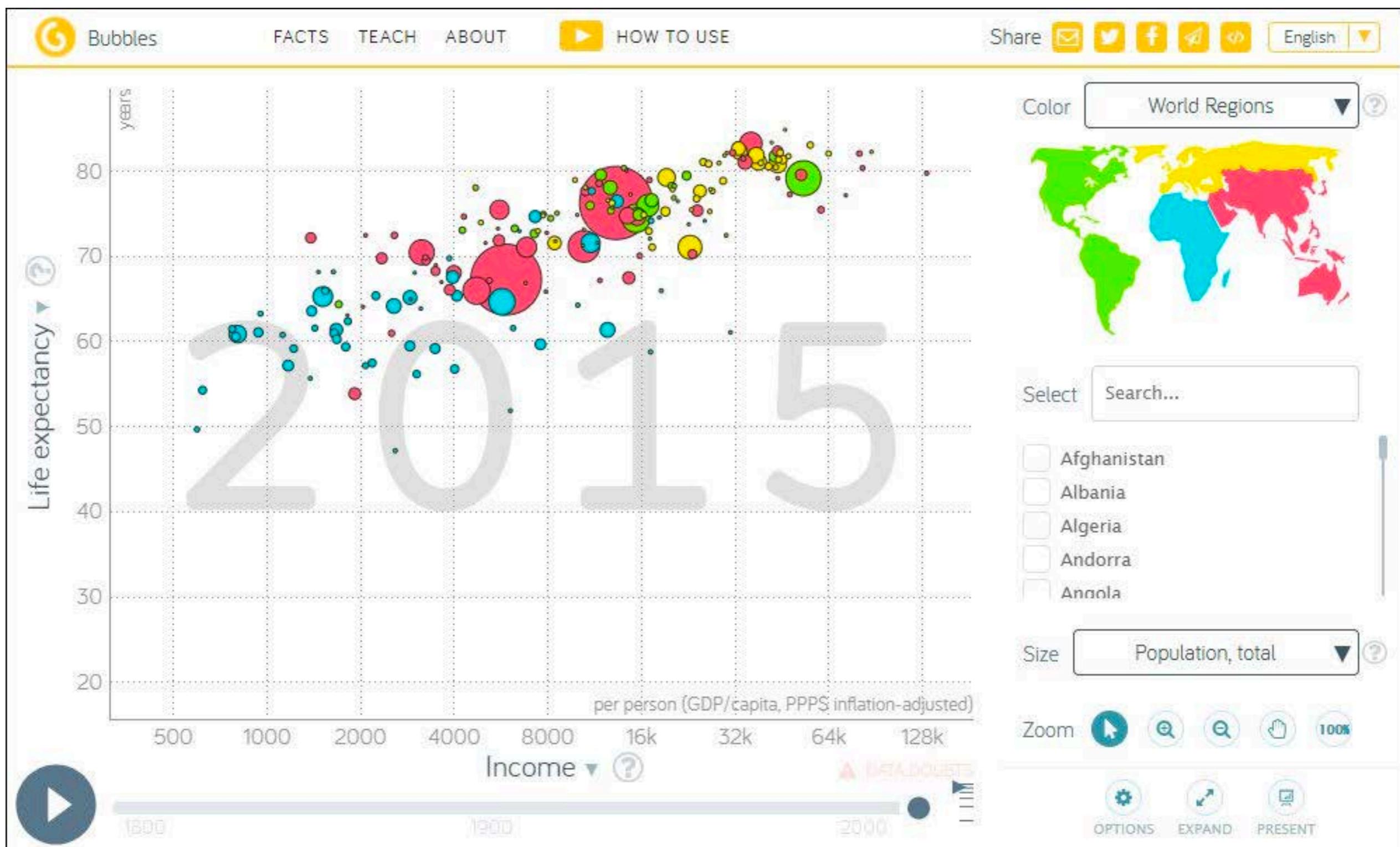
Mark of type encodes

Visual channels used?

Channel ... encodes ...

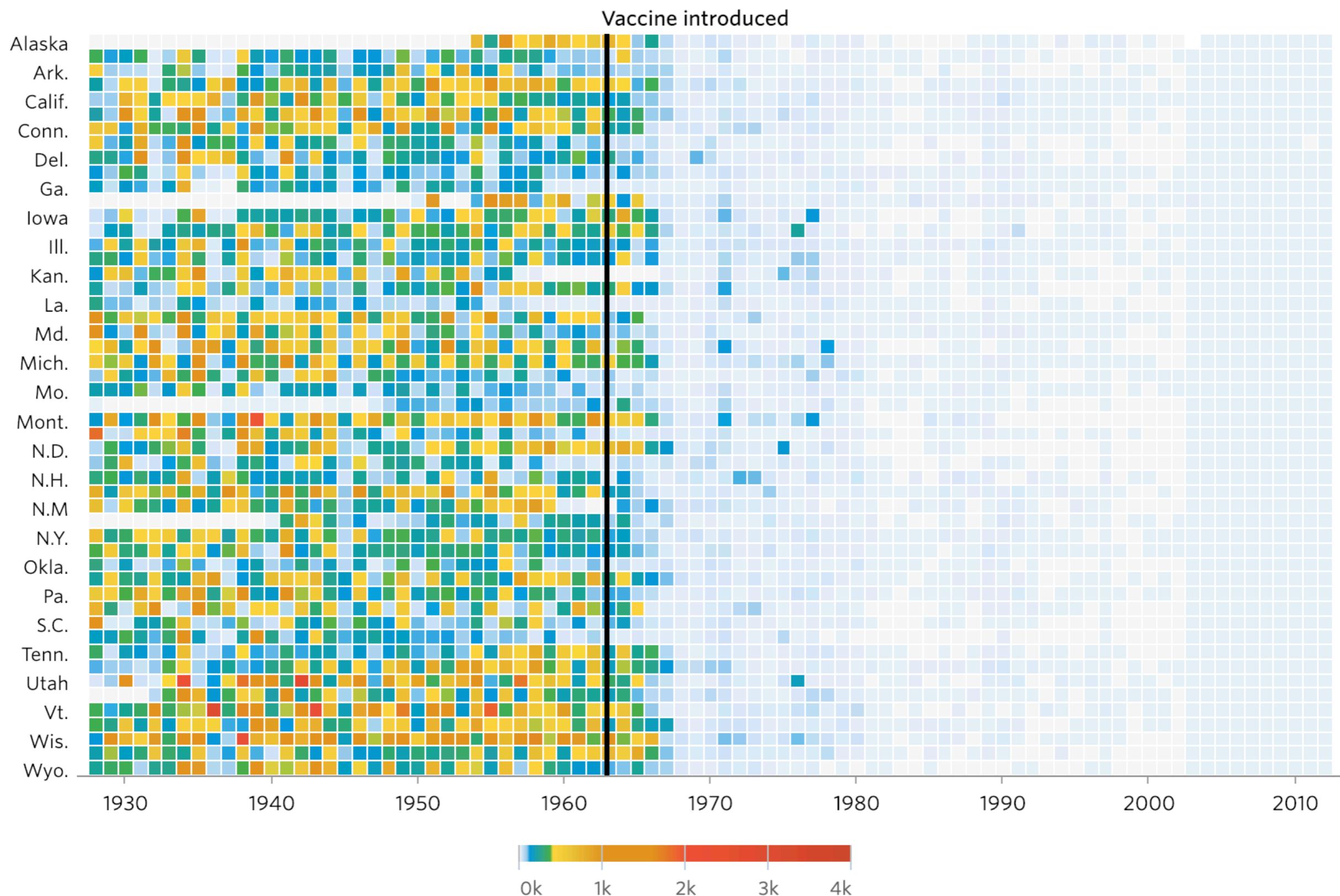
Channel ... encodes ...





<https://www.gapminder.org/tools/>

Measles



SPENDING PER STUDENT, BY SCHOOL DISTRICT

Adjusted for regional differences, for primary and unified school districts

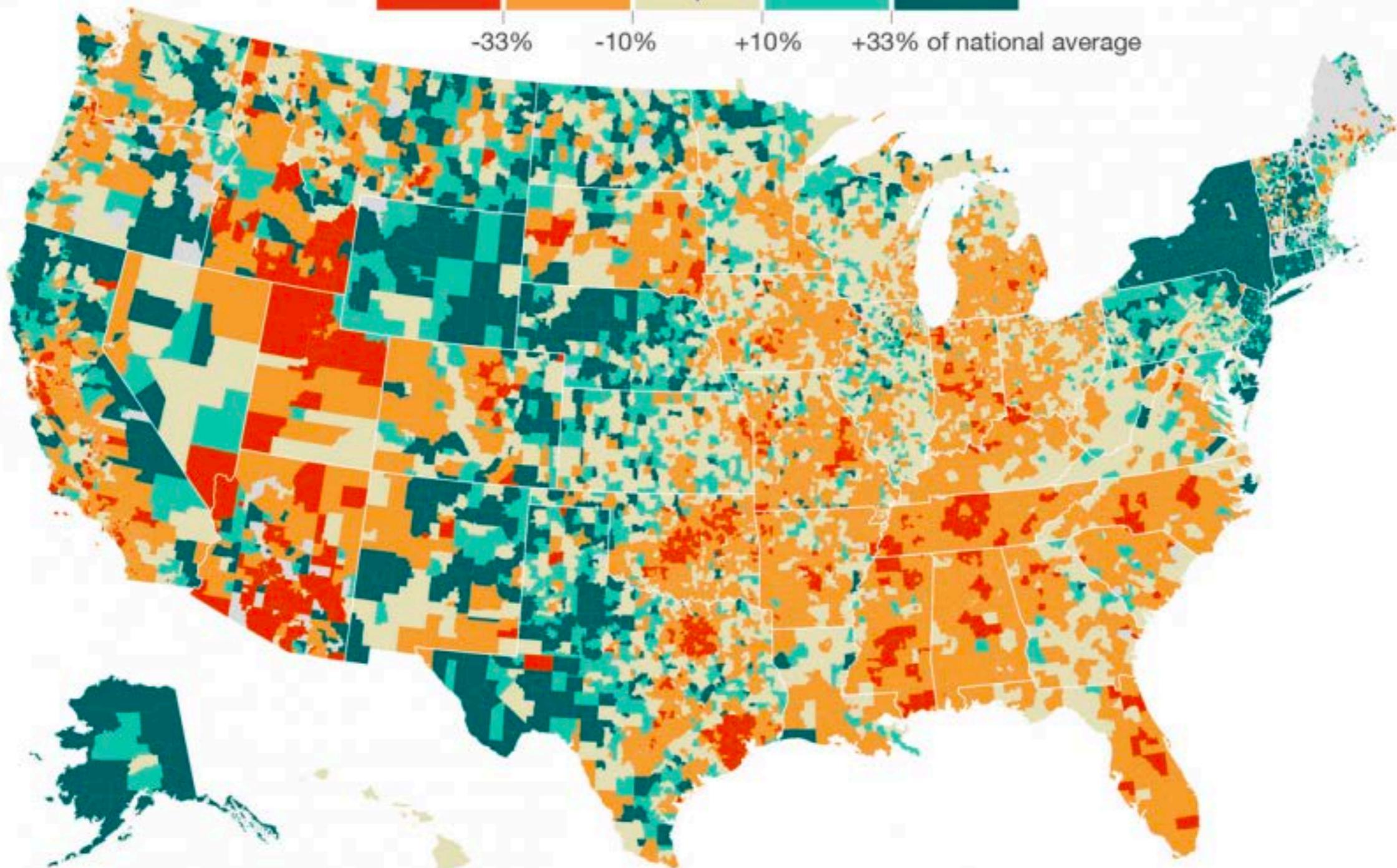
National average: \$11,841

-33%

-10%

+10%

+33% of national average



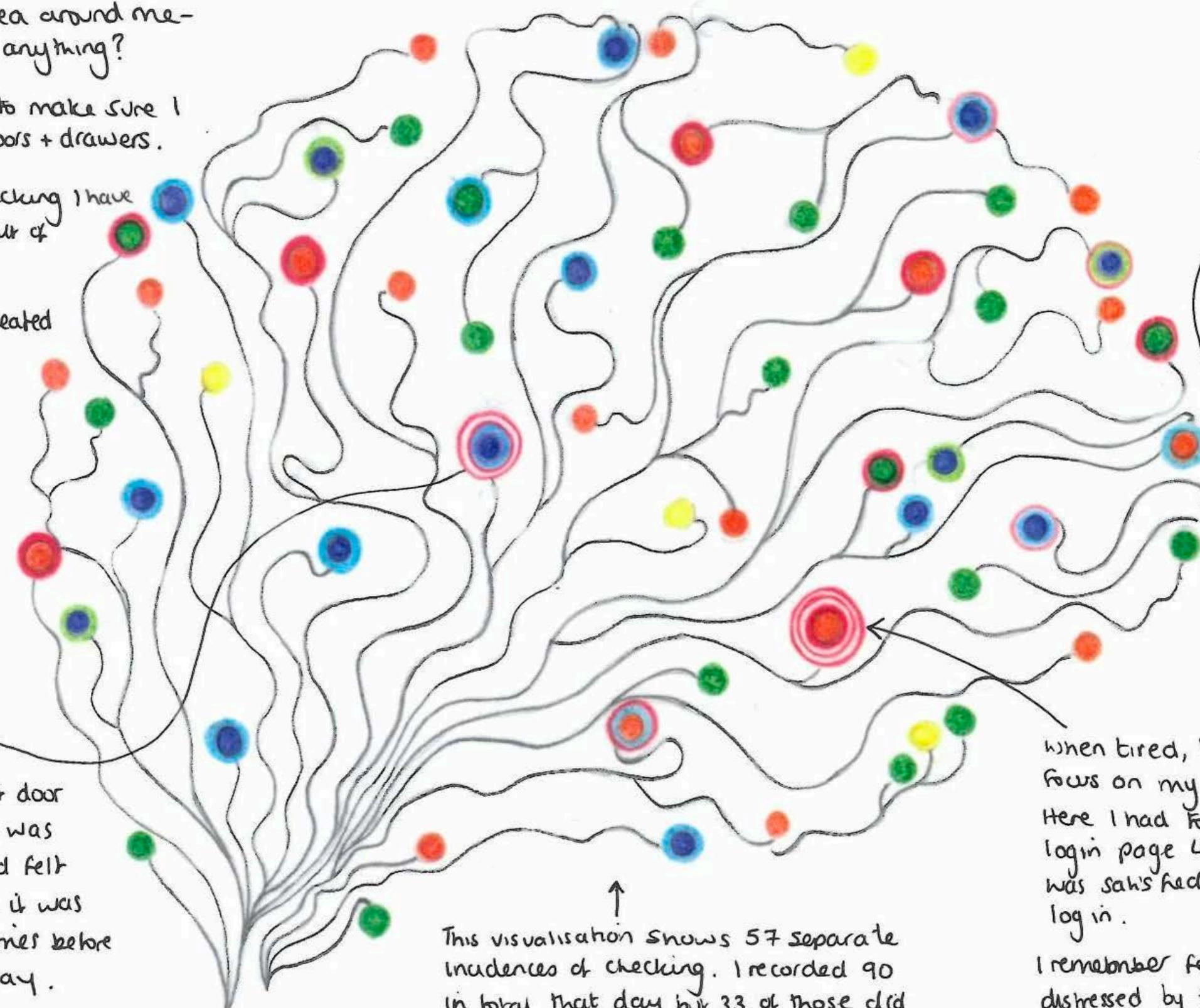
Key:

- Check clothes inside + out
- check floor area around me - have I dropped anything?
- try the handle to make sure I have locked doors + drawers.
- IT systems - checking I have logged in and out of secure systems.
- Action ritually repeated 4 times
- Action ritually repeated 2 times.
- Action repeated as I do not trust myself that I checked properly first time round!

A Day of OCD - Conscious acts of checking

I am afraid of losing material and digital information.

Each circle represents one act of checking to ensure I don't lose information.



People with OCD often ritually repeat actions.

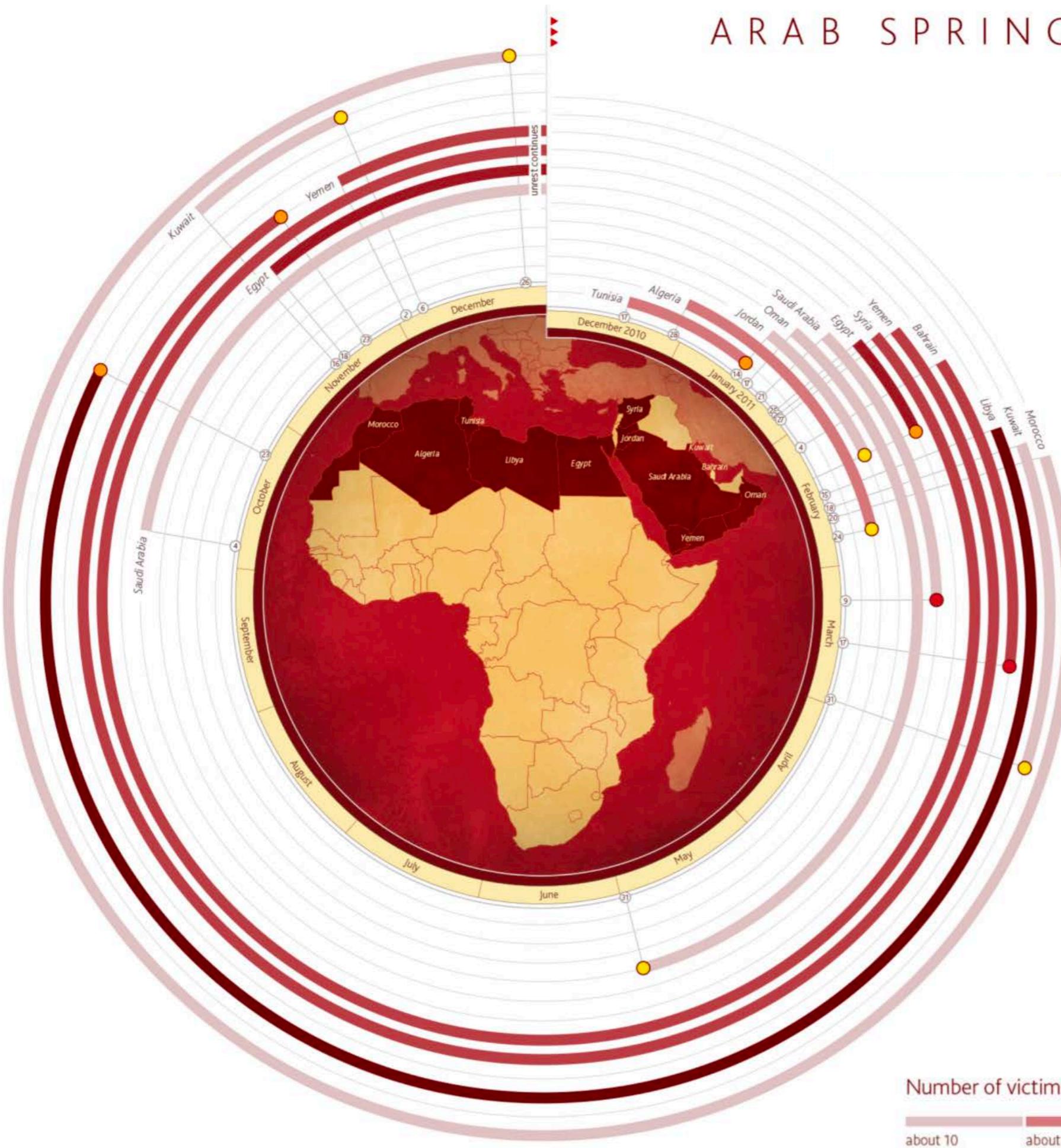
Here I am checking my computer is turned off, 4 times.

When tired, I find it hard to focus on my checks.

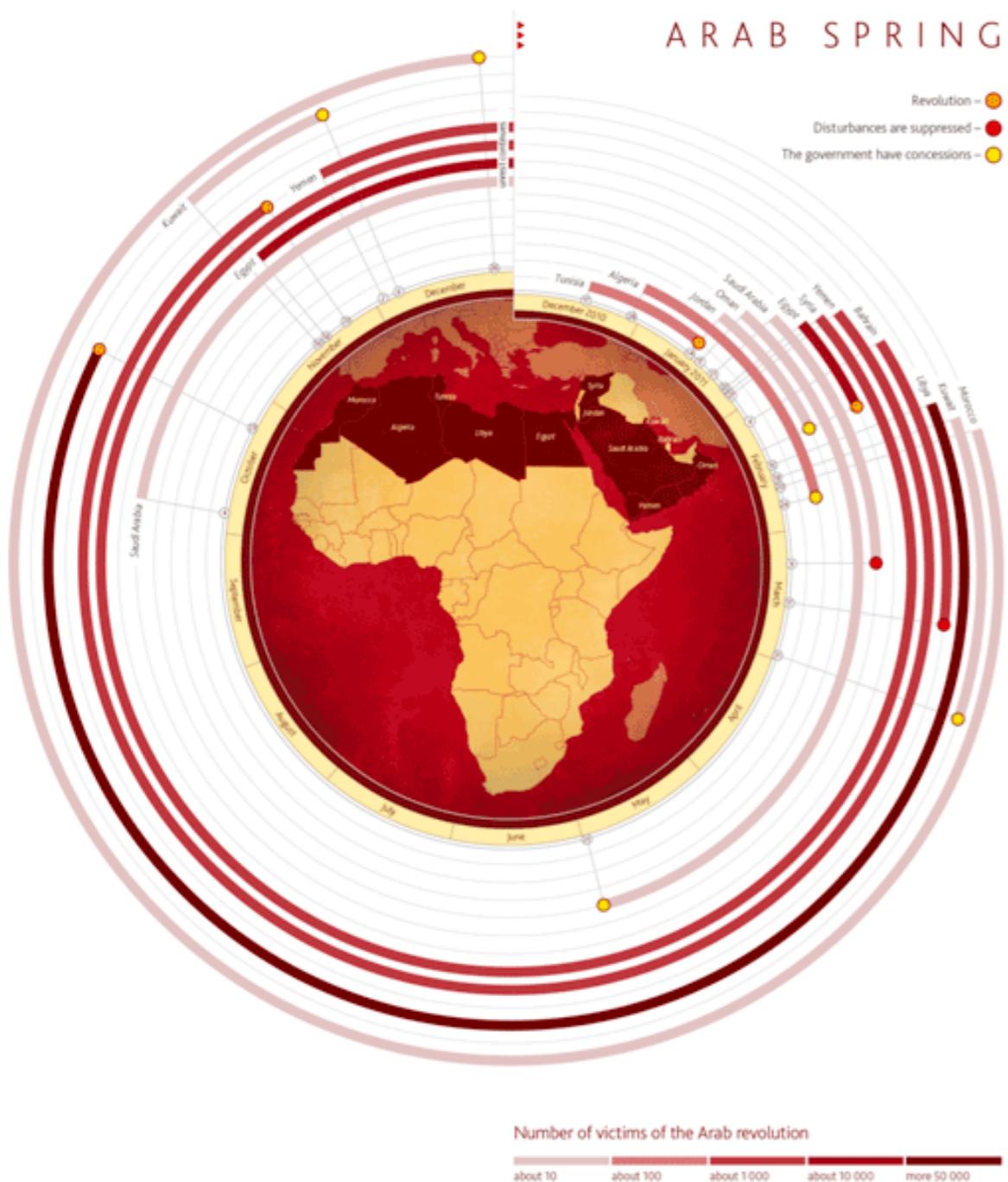
Here I had to open my email login page 4 times before I was satisfied it was secure to log in.

I remember feeling frustrated and distressed by this.

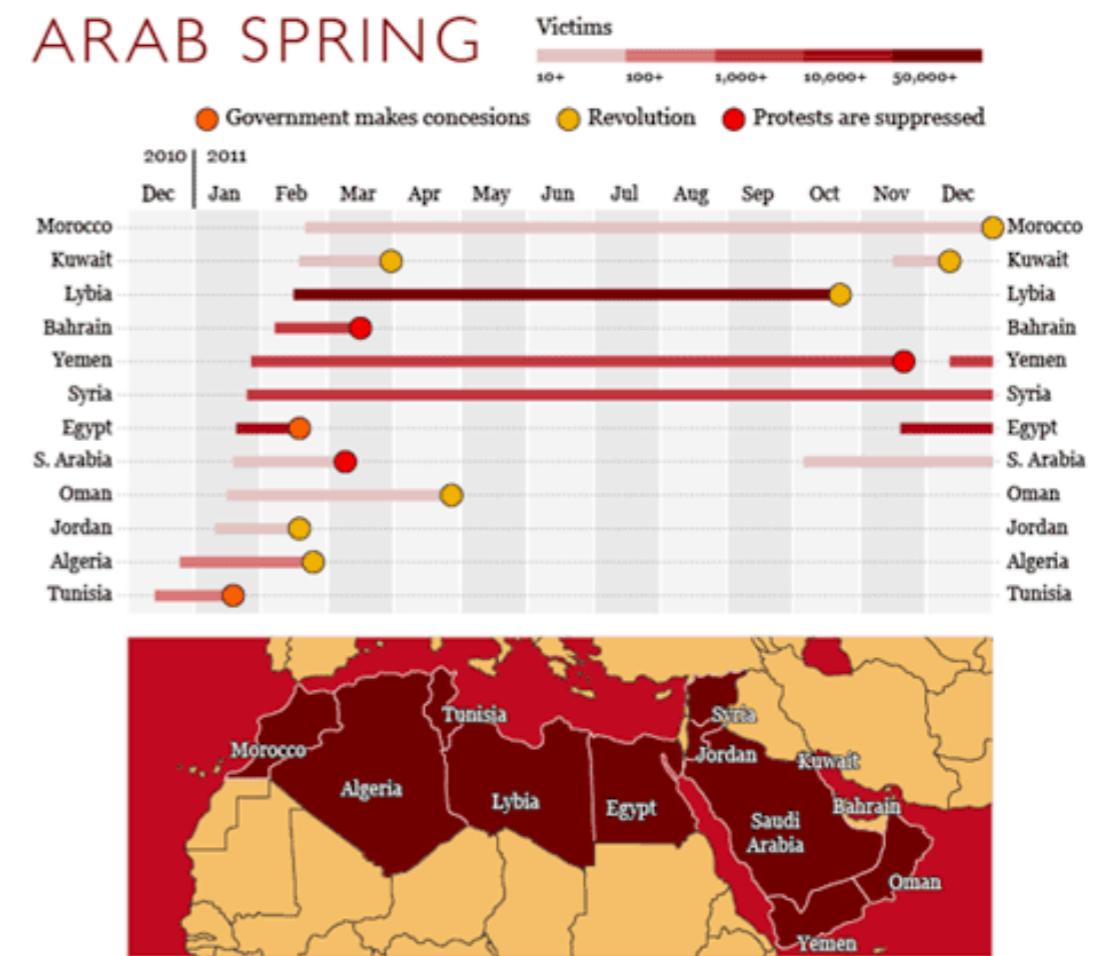
ARAB SPRING



EXERCISE: DECODE



Timeline of Arab Spring events in North Africa, by Alexander Katin and Kir Khachaturov.



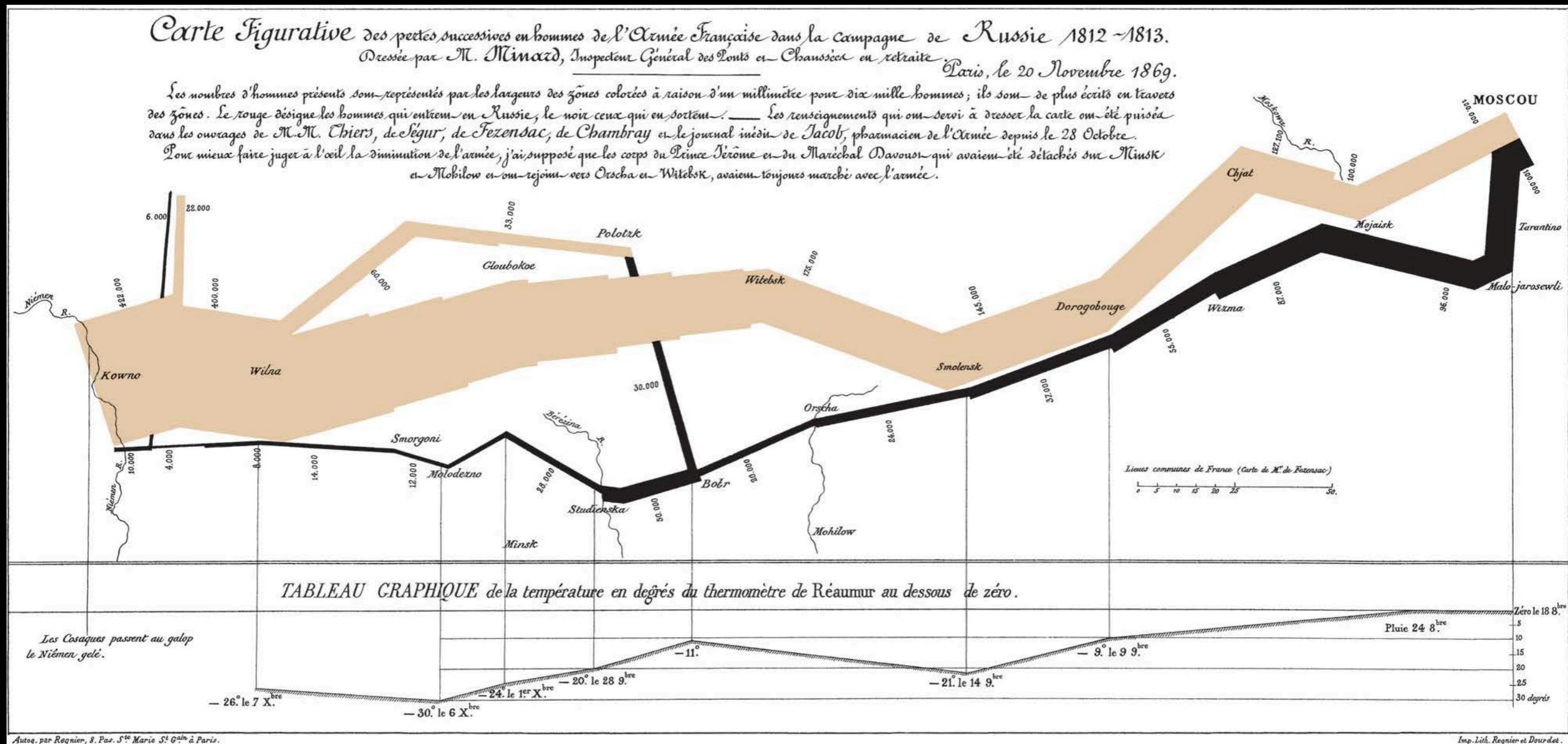
Alberto Cairo's redesign of the same circular timeline. Posted on "The Functional Art" blog.

VISUAL THINKING: NAPOLEON'S MOSCOW MARCH

Qualified by Edward Tufte as the best statistical representation ever.



Charles Minard, 1869



More about this: The Visual Display of Quantitative Information (Tufte)

"WE HYPOTHESIZE THAT..."

VISUALIZATION RESEARCH



HEMATOLOGY

Leukocytes	5.500 /mmc	(4.000.00)
Red Cells.....	4.930.000 /mmc	(4.000.00)
Hematocrit.....	43,80 %	(40.00-52)
Hemoglobin.....	15,20 g/dl	(13.00-18.6)
M.C.V.....	89,00 fl	(80.00-100.0)
M.C.H.....	30,80 pg	(27.00-32.00)
M.C.H.C.....	34,70 g/dl	(31.00-36.00)
Platelets.....	1.000 /mmc	(100.000-400.000)
M.V.P.....	90 fl	(7.30-13.00)
Neutrophils.....	37 %	(40.00-75.00)
Lym.....	20 %	(10.00-50.00)
Monocytes.....	2	(0-2)
Eosinophils.....	2	(0-2)
Basophils.....	2	(0-2)

Nutrition Facts

Serving size 1 potato (148g/5.2oz)

Amount per serving

Calories

110

% Daily Value*

Total Fat 0g **0%**

Saturated Fat 0g **0%**

Trans Fat 0g

Cholesterol 0mg **0%**

Sodium 0mg **0%**

Total Carbohydrate 26g **9%**

Dietary Fiber 2g **7%**

Total Sugars 1g

Includes 0g Added Sugars **0%**

Protein 3g

Vitamin D 0mcg **0%**

Calcium 20mg **2%**

Iron 1.1mg **6%**

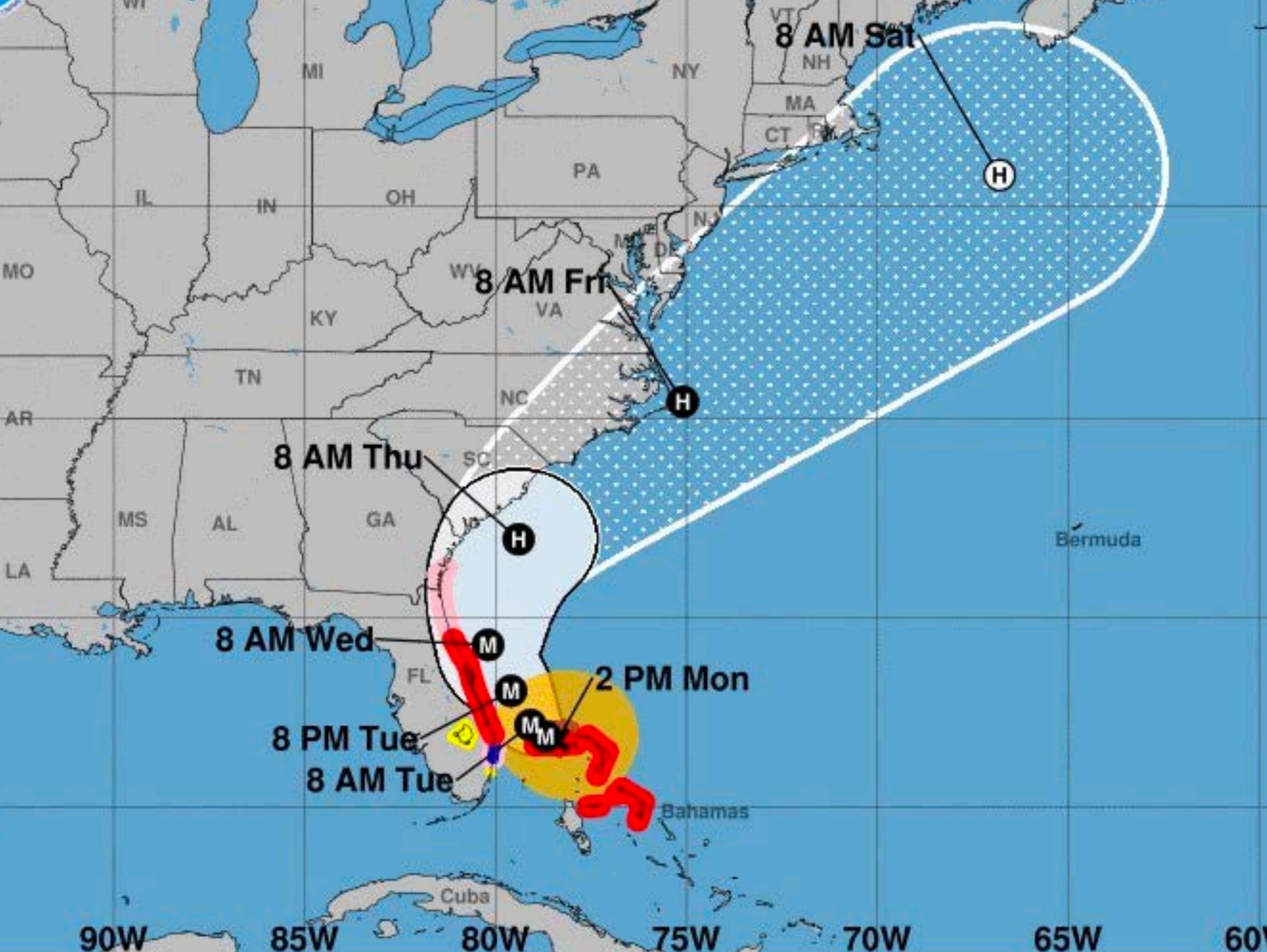
Potassium 620mg **15%**

Vitamin C 27mg **30%**

Vitamin B₆ 0.2mg **10%**

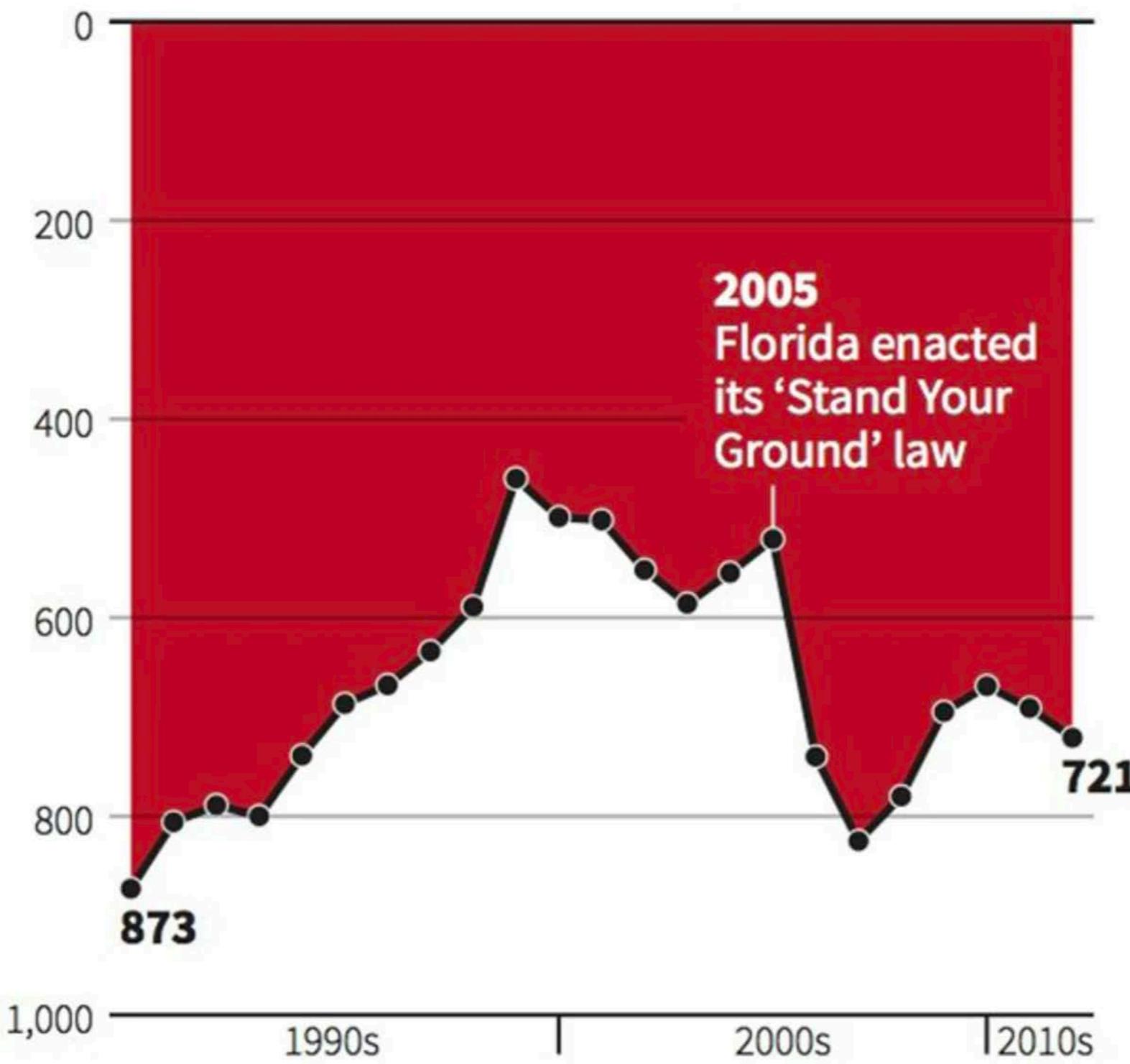
* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.



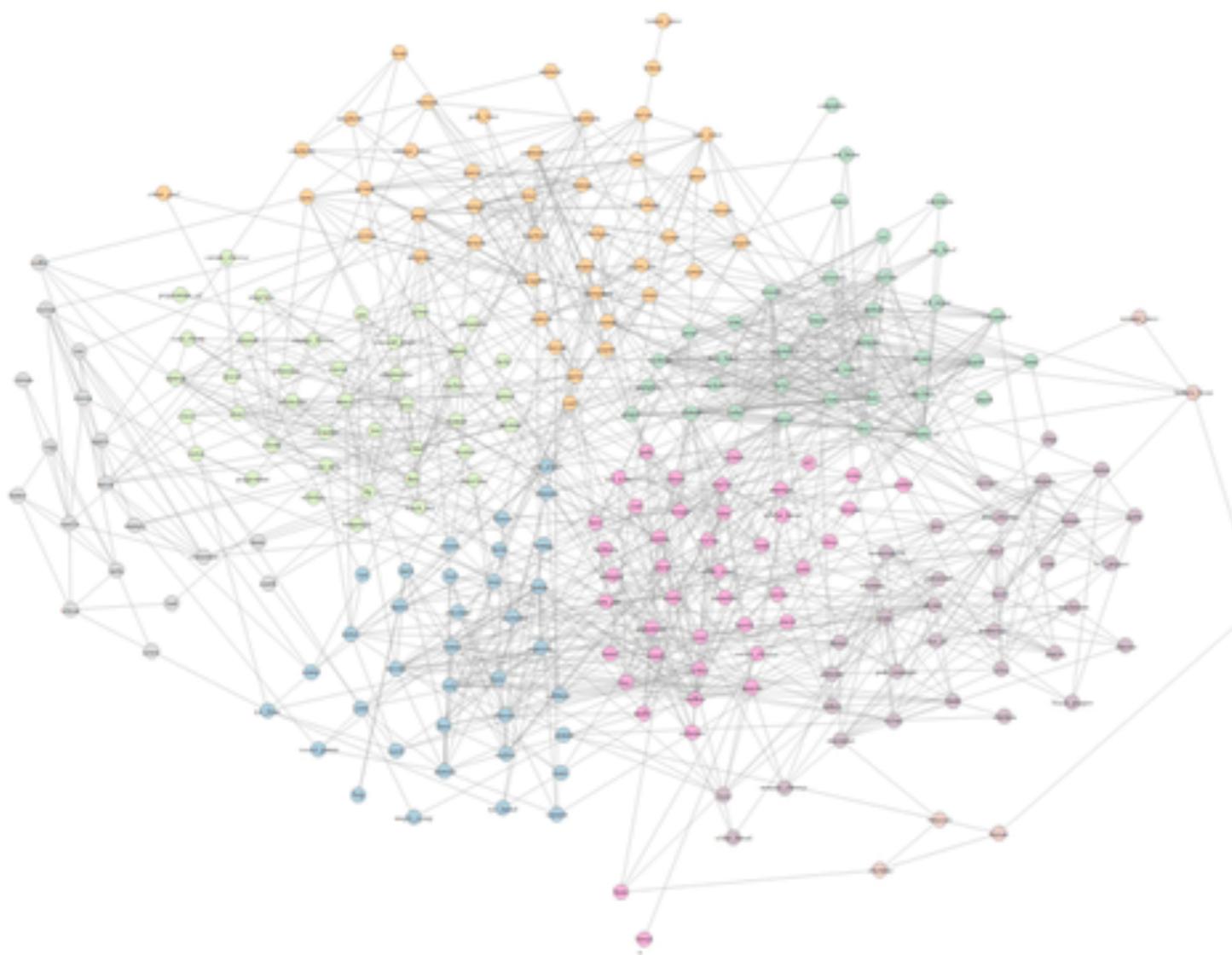


Gun deaths in Florida

Number of murders committed using firearms

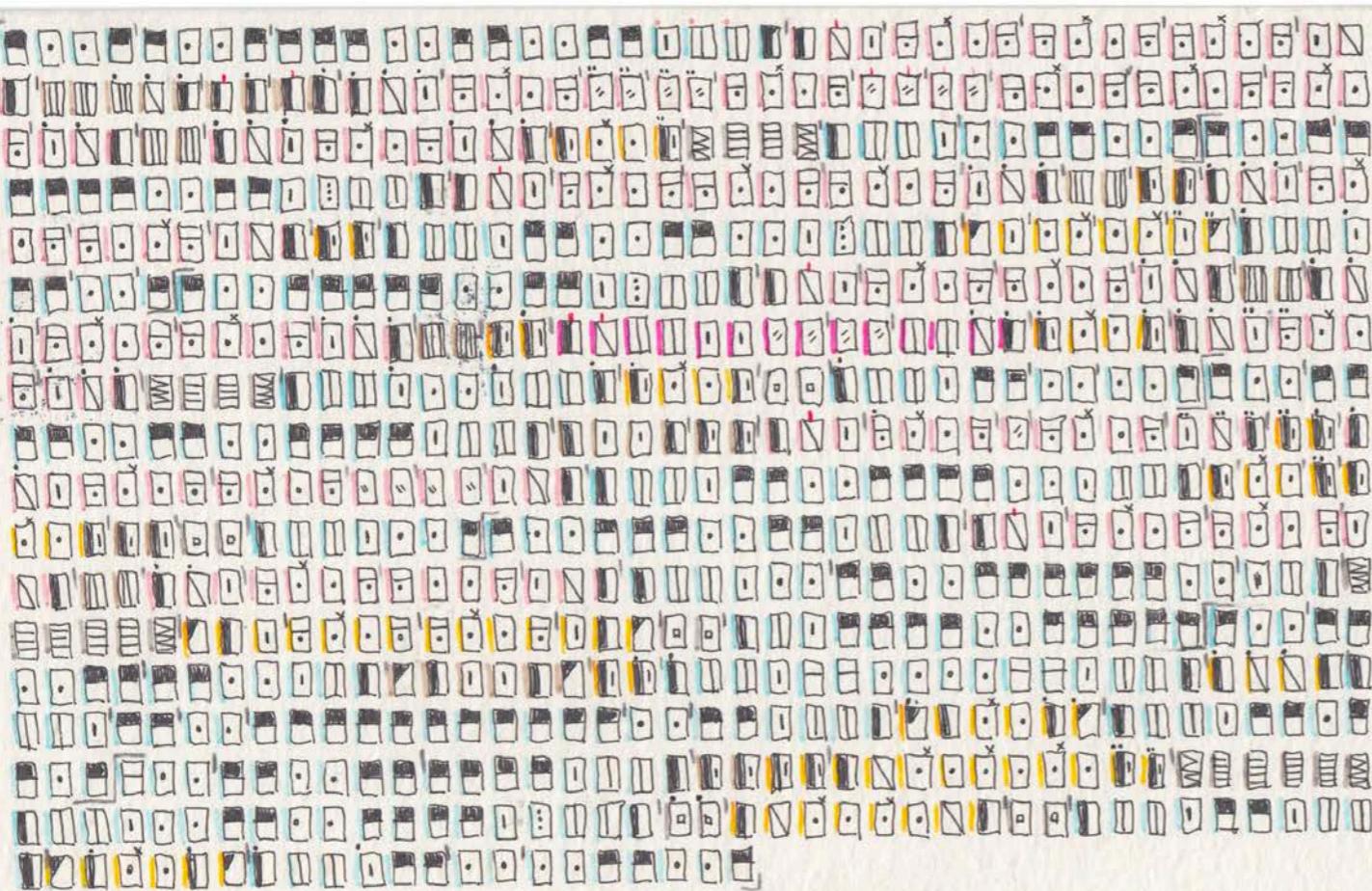


Source: Florida Department of Law Enforcement



“A natural extension of these techniques is the ability to measure or control aesthetic improvement. It might be possible, for example, to vary perceived aesthetics based on a data attribute’s values, to draw attention to important regions in a visualization.”

— Healey and Enns



“DEAR DATA
WEEK 24: DOORS' PATTERNS

HOW TO READ IT:

Every little rectangle represents a door I opened and/or passed through, in chronological order, to enter a space. (P.S. closet doors and furniture doors are not included)

MAIN LOCATION:

my Building
Work (NEW INC)
SHOP/STORE
CAFÉ/PUB RESTAURANT
CLIENT PLACE

TRANSPORTATION

TIME OF DOOR:

- extra external door (IT'S cold here Ha!)
- external door - entering the building
- eventual MID DOOR
- main space access (e.g. my apt)
- when external door coincides to main space entrance
- external sliding door
- elevator automatic door
- train doors
- cab doors

24 FEB 2015

FROM:
NEW YORK G. LUPI



11249 BROOKLYN
NY - USA

SEND TO:

STEFANIE POSAVEC

- UK -

ENGLAND

