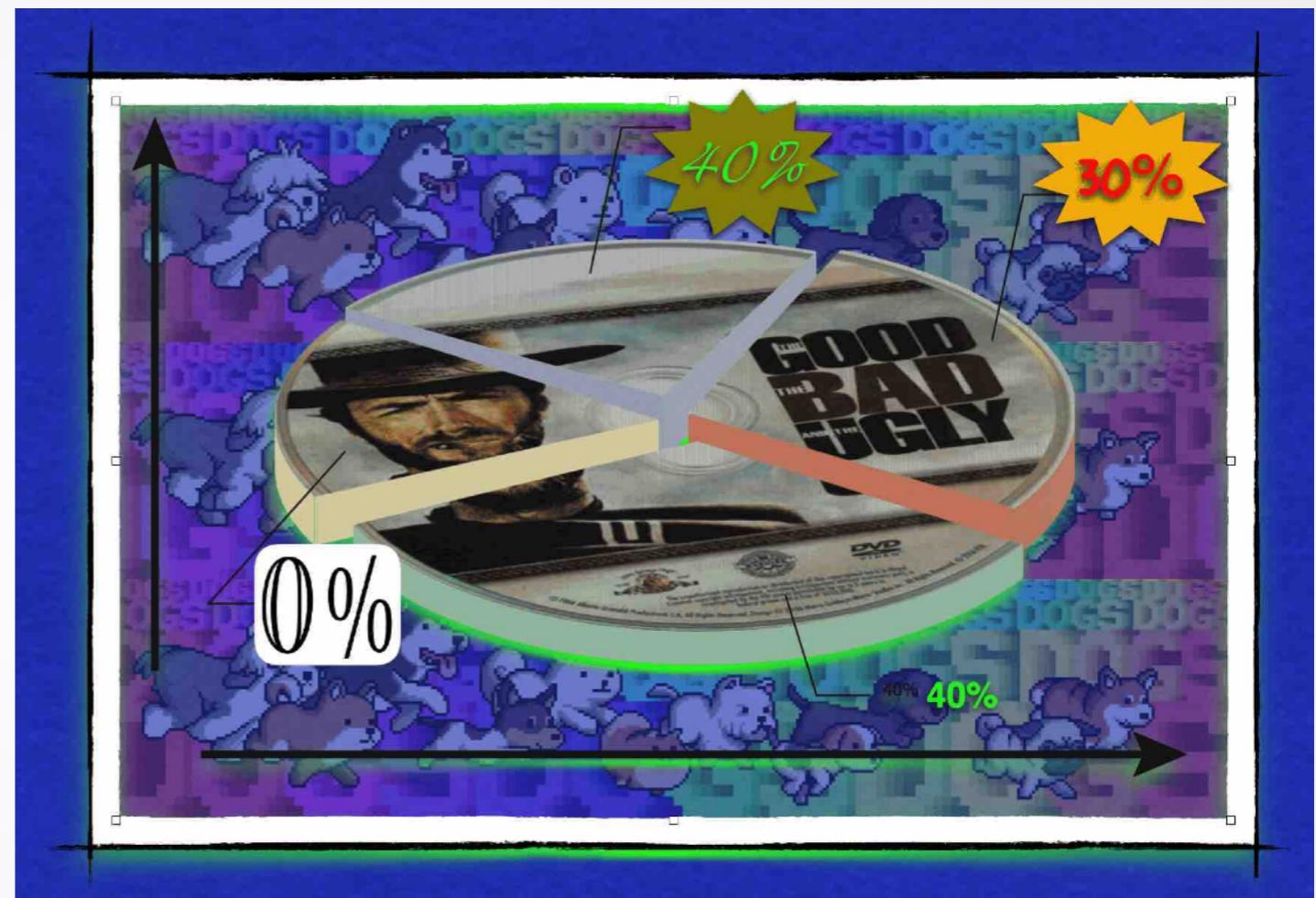


MESA WORKSHOP

PART 1

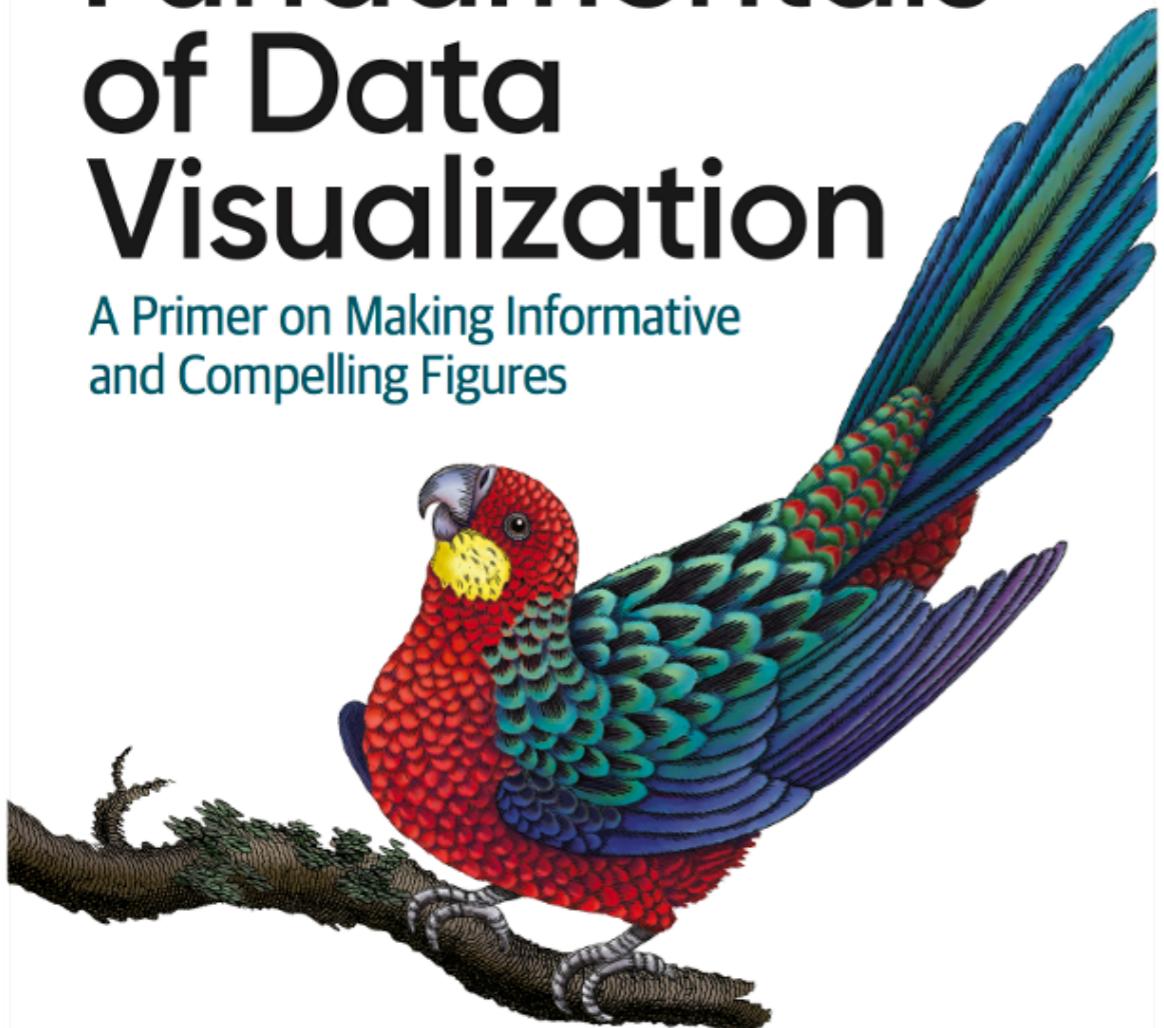
THINKING ABOUT GRAPHICS



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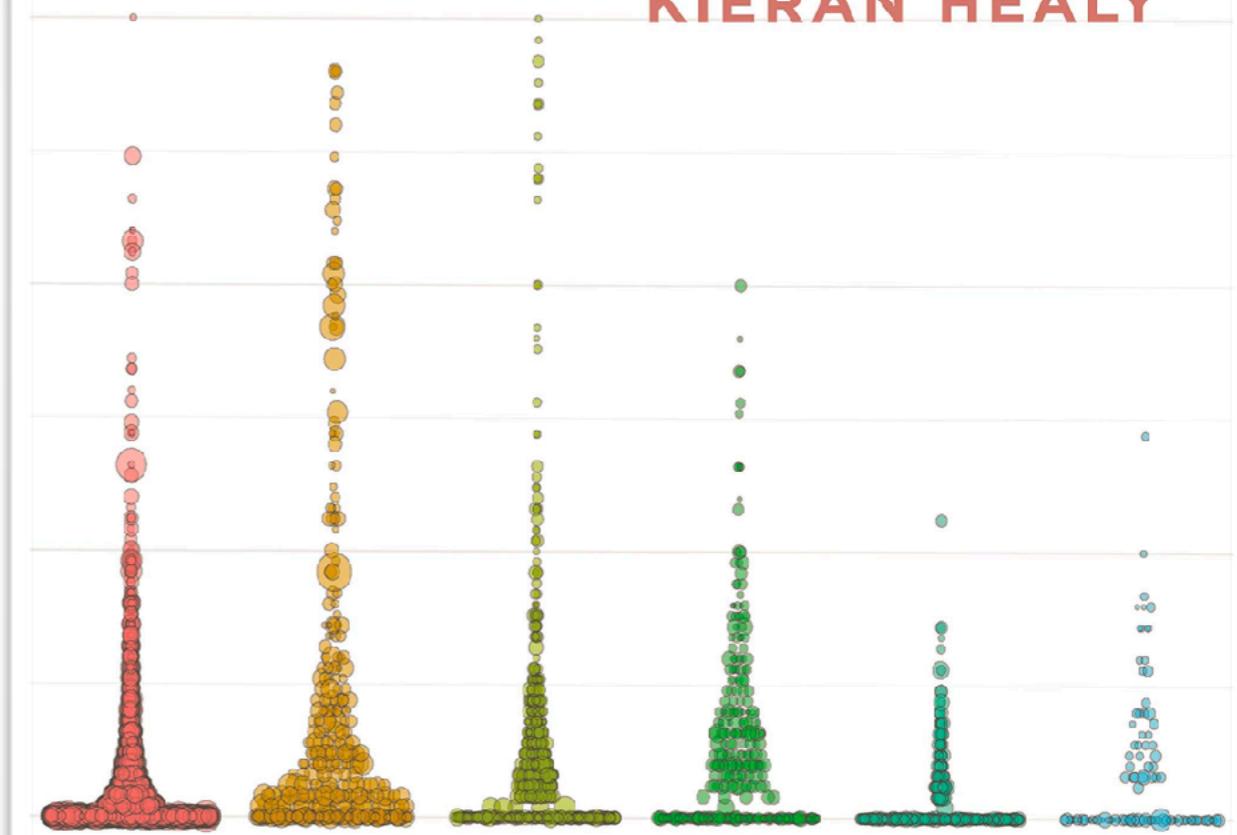
Claus O. Wilke

serialmentor.com/dataviz

DATA VISUALIZATION

A PRACTICAL INTRODUCTION

KIERAN HEALY



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GRAPHICS 101

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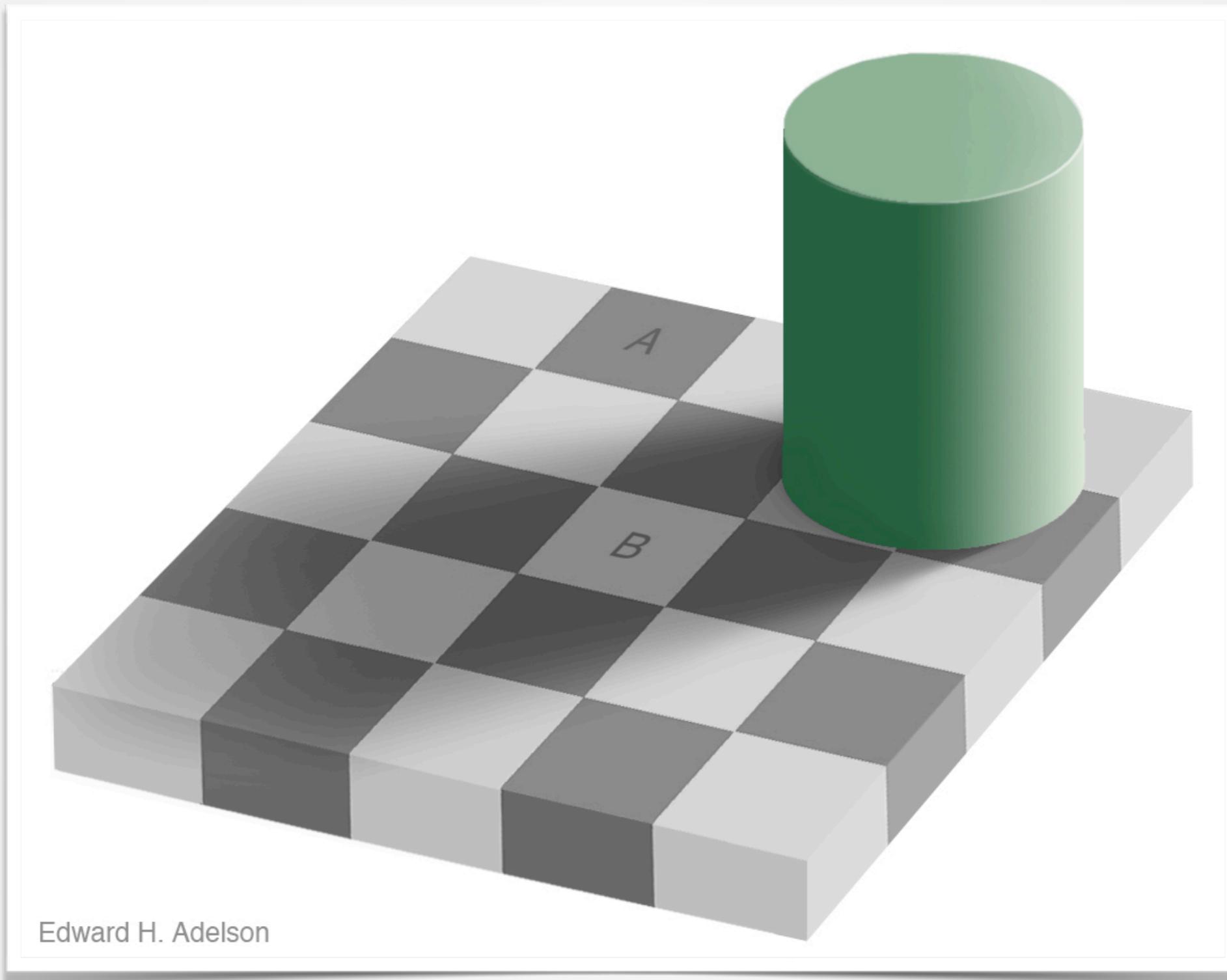
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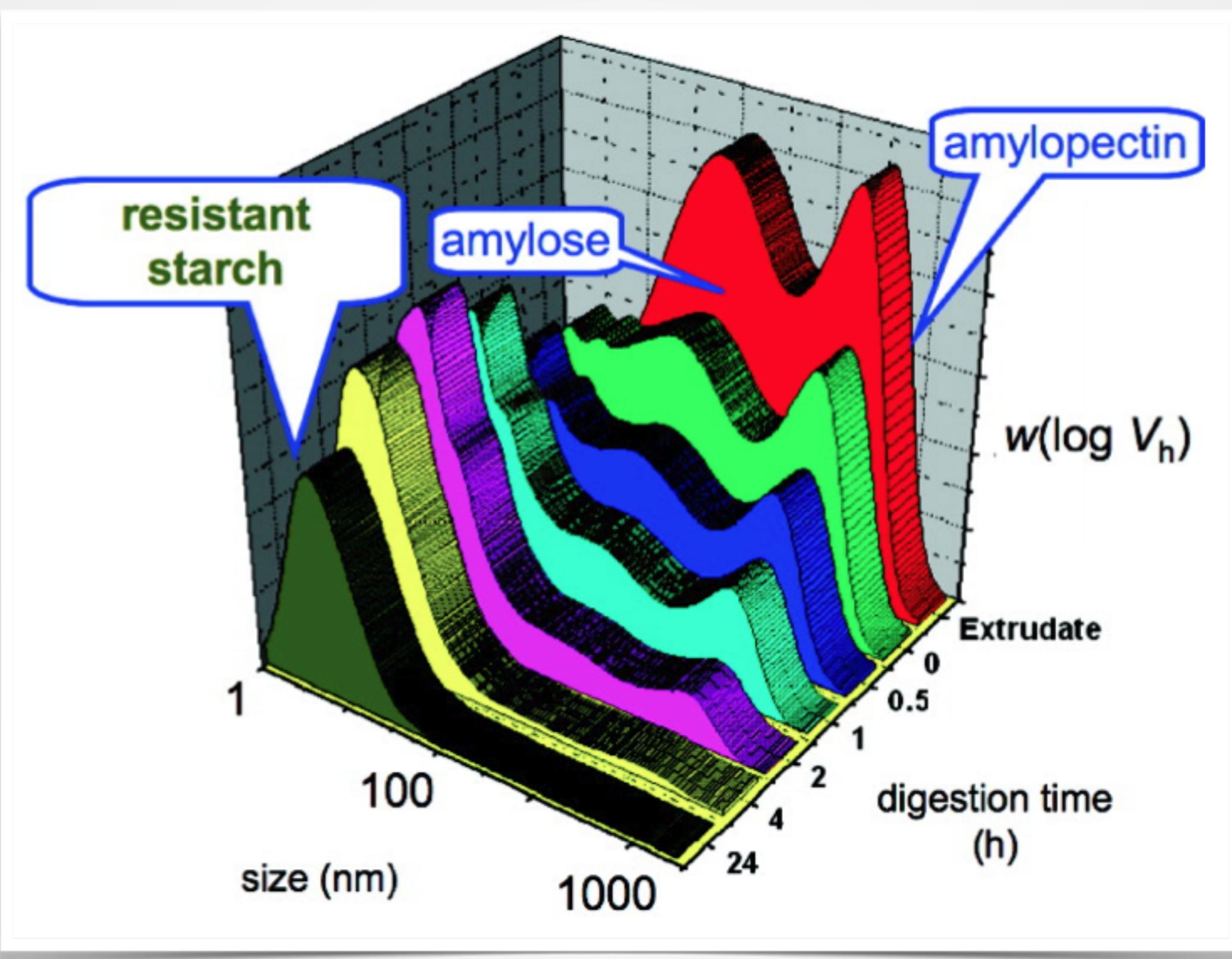
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“WHO CARES HOW PLOTS LOOK, ONLY THE DATA MATTERS”



Edward H. Adelson





Tatsuo Horiuchi
Excel artist

TOOLS DON'T MATTER

but they kind of do...

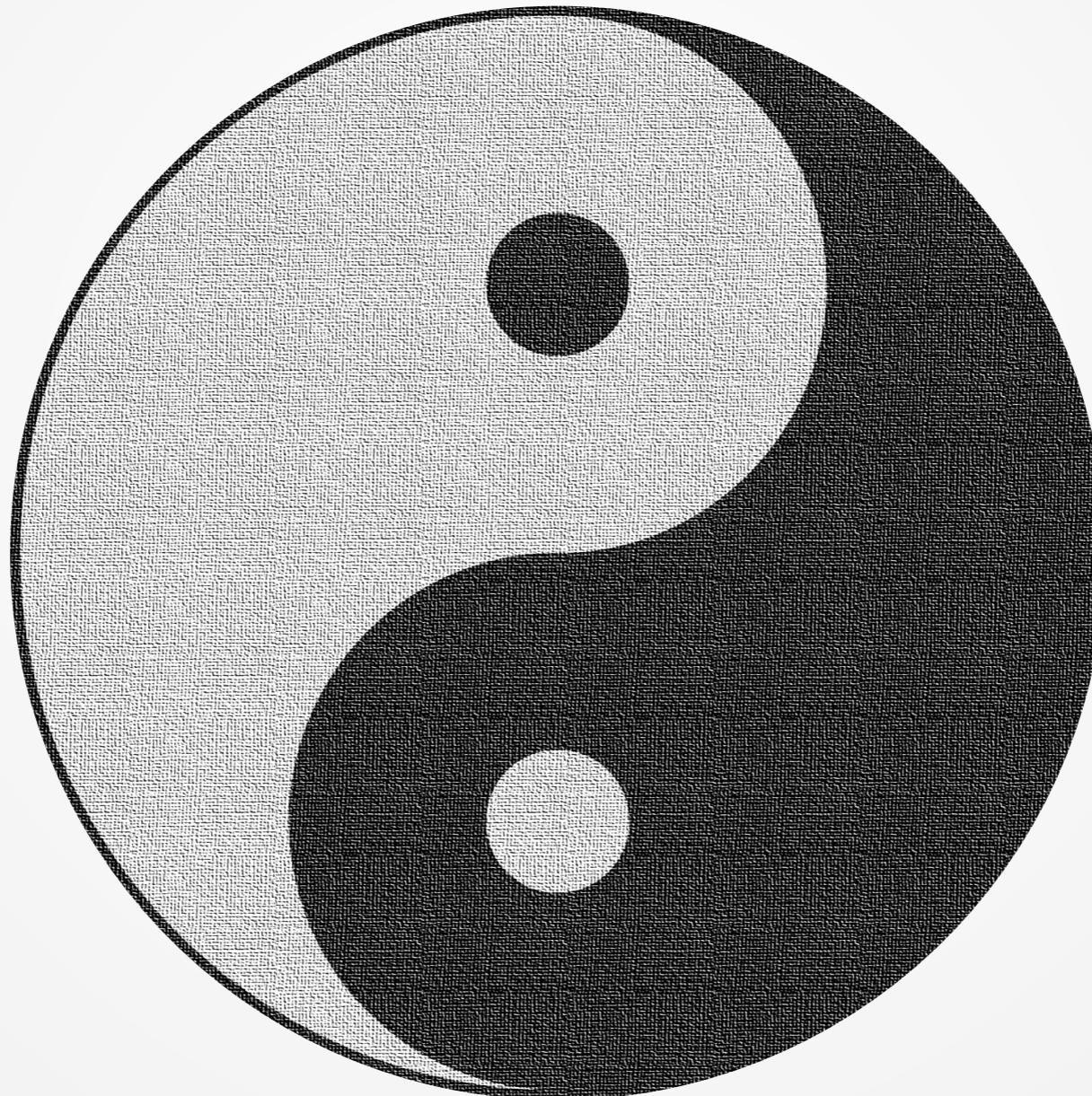
MOTIVATION

(SOME ILLUSTRATIONS)

worrydream.com/TenBrighterIdeas/
jasondavies.com/maps/transition/
mbostock.github.io/d3/talk/20111116/#17
<https://www.visualcinnamon.com>
<https://ourworldindata.org/coronavirus>
<https://www.roguepenguin.co.nz/data-viz>

MY PHILOSOPHY OF GRAPHICS

ANALYTIC



Aesthetic

key message

DATA-TO-INK RATIO

be deliberate with
your pixels

SOMETIMES A TABLE IS BEST

$h:$	$x_{\max}:$	0.01	0.1	1	2	3	4	5	6	7	8	10	12	15	20	25	30	40	50	60	70	80
1.1	N	5	5	7	9	11	11	13	15	17	17	21	23	27	35	41	47	63	77	95	127	111
	N_θ	6	6	6	7	7	8	8	9	9	10	15	15	15	20	25	35	40	40	80	80	1200
	error	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10^{-12}	10^{-11}	10^{-9}	10^{-7}	10^{-4}
1.3	N	5	5	9	11	11	13	15	15	19	19	23	27	31	37	45	53	69	93	115		
	N_θ	9	9	9	9	9	10	15	15	15	15	15	20	20	25	45	30	50	45	500		
	error	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10^{-12}	10^{-9}	10^{-7}	10^{-3}		
2	N	5	7	11	13	15	15	19	19	21	23	25	27	33	41	49	61	75	103			
	N_θ	20	20	20	20	20	20	20	20	25	25	25	25	30	35	45	35	50	45			
	error	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10^{-12}	10^{-11}	10^{-7}	10^{-4}		
4	N	5	7	11	15	17	19	21	23	23	25	29	31	35	45	51	57	59				
	N_θ	40	40	40	40	40	7	40	45	45	45	50	50	60	70	70	90	90				
	error	—	—	—	—	—	10^{-3}	—	—	—	—	—	—	—	10^{-13}	10^{-11}	10^{-9}	10^{-4}				
7	N	5	7	11	15	19	19	19	23	25	27	31	35	37	41	47	47					
	N_θ	70	70	70	70	70	70	80	80	80	80	90	90	100	200	130	130					
	error	—	—	—	—	—	—	—	—	—	—	—	—	—	10^{-11}	10^{-10}	10^{-6}					
10	N	5	7	13	15	19	19	21	25	27	27	31	33	41	45	43	47					
	N_θ	100	100	90	100	100	100	110	110	110	120	120	130	140	180	180	200					
	error	—	—	—	—	—	—	—	—	—	—	—	—	—	10^{-11}	10^{-8}	10^{-6}					
20	N	5	7	13	15	19	21	23	23	27	29	33	37	43	43	49	41					
	N_θ	200	200	200	200	200	200	220	220	240	260	260	280	300	550	400						
	error	—	—	—	—	—	—	—	—	—	—	—	—	—	10^{-12}	10^{-8}	10^{-4}					
50	N	5	7	13	17	19	21	23	25	27	29	33	35	39	45	47	45					
	N_θ	500	500	500	500	500	500	550	550	550	600	650	800	700	1100	900	1200					
	error	—	—	—	—	—	—	—	—	—	—	—	—	10^{-13}	10^{-12}	10^{-9}	10^{-6}					
100	N	5	7	13	17	19	21	23	25	27	27	33	35	47	53	47						
	N_θ	1000	1100	1000	1100	1000	1100	1100	1100	1100	1100	1300	1500	1400	1600	2000						
	error	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10^{-9}						

MOTIVATION

LETTERS

NATURE PHOTONICS DOI: 10.1038/NPHOTON.2012.300

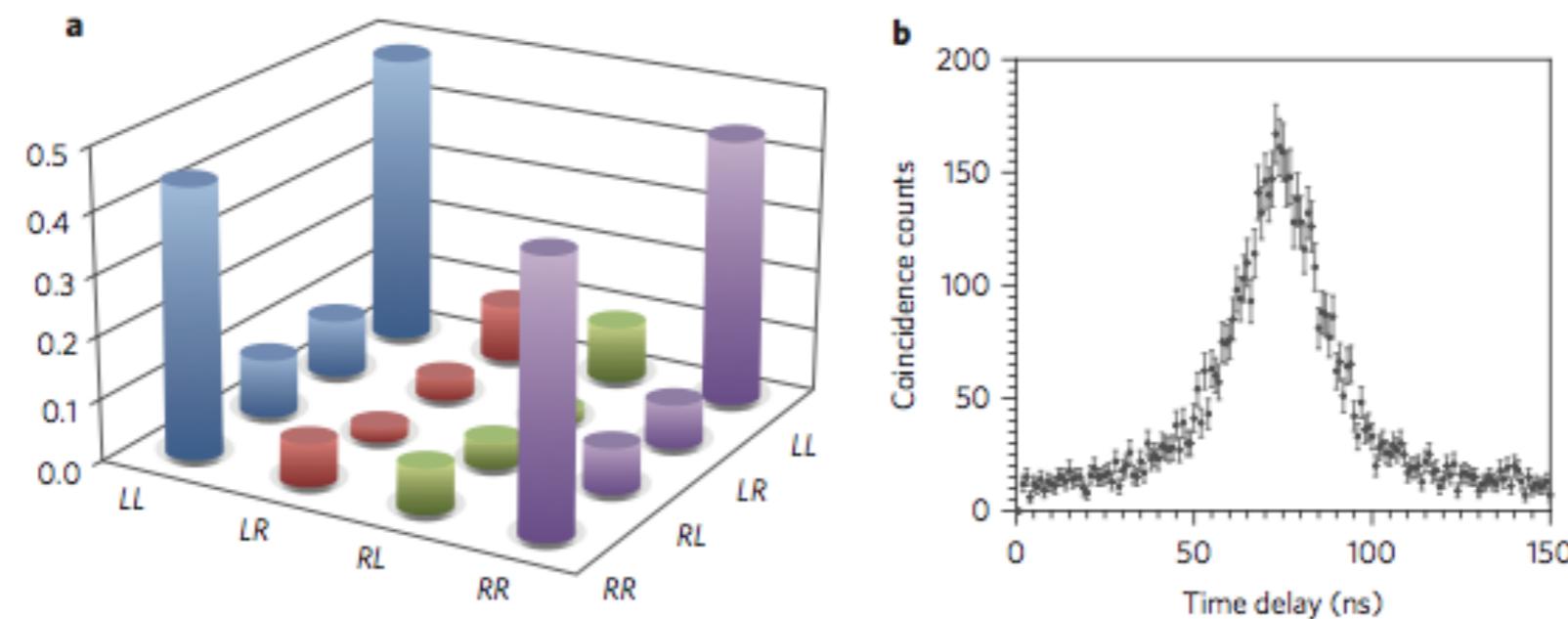
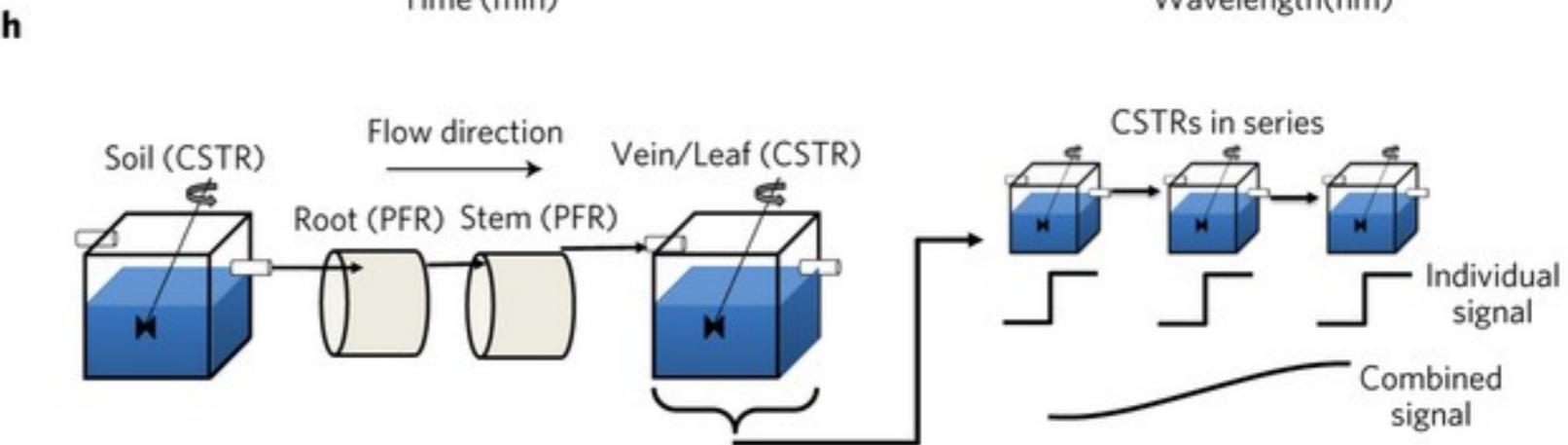
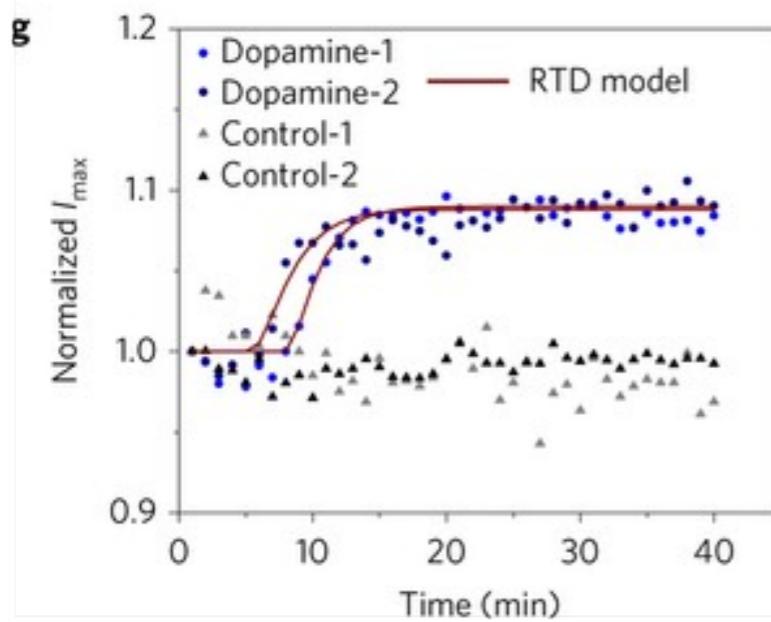
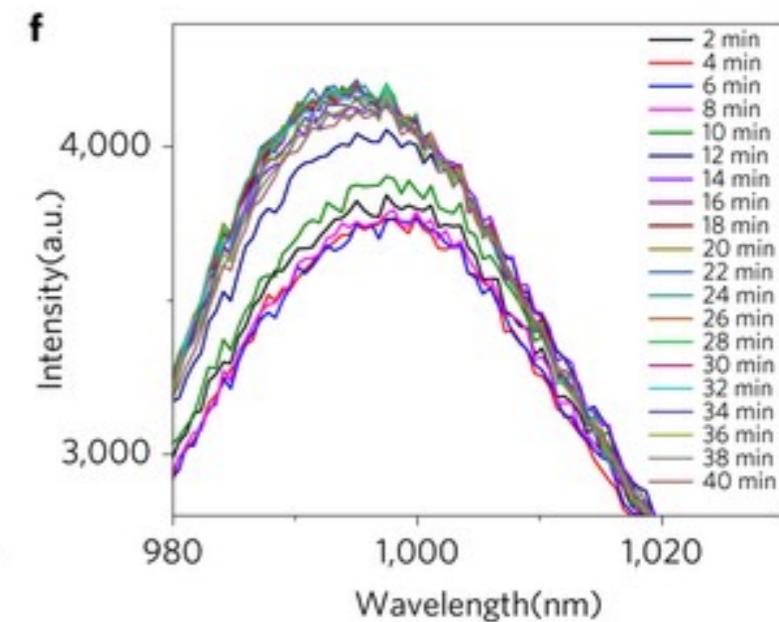
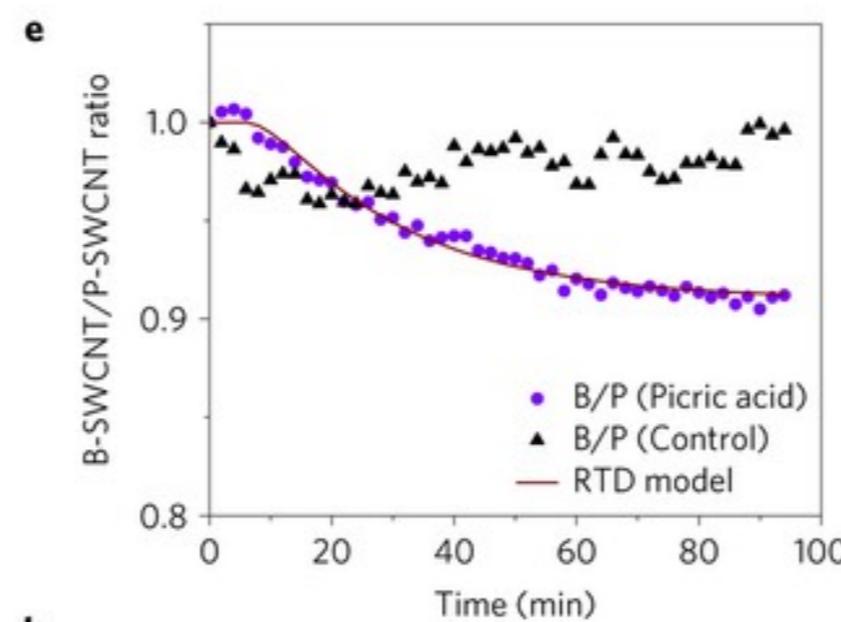
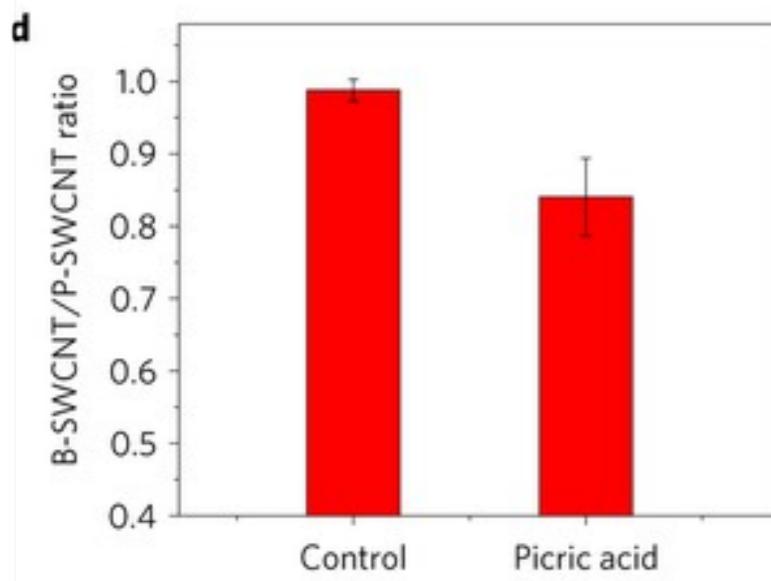
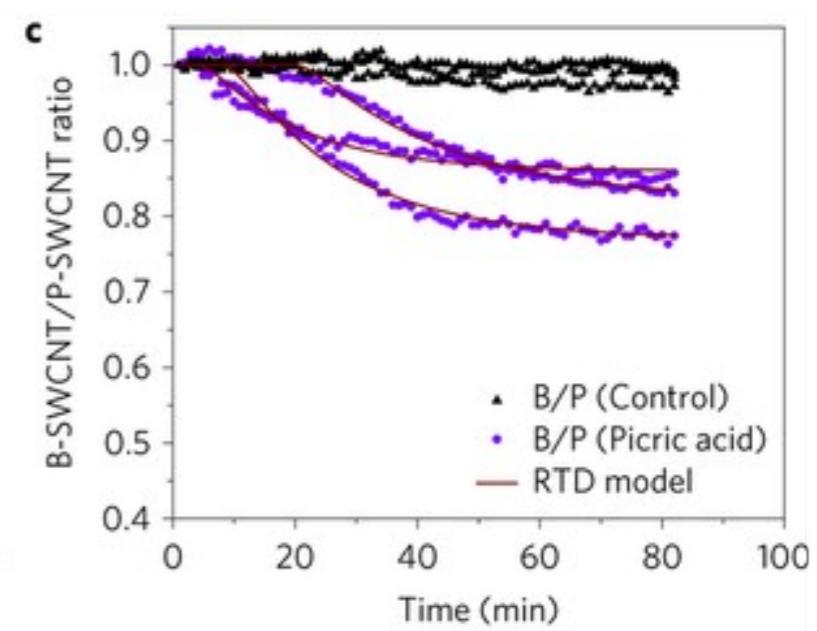
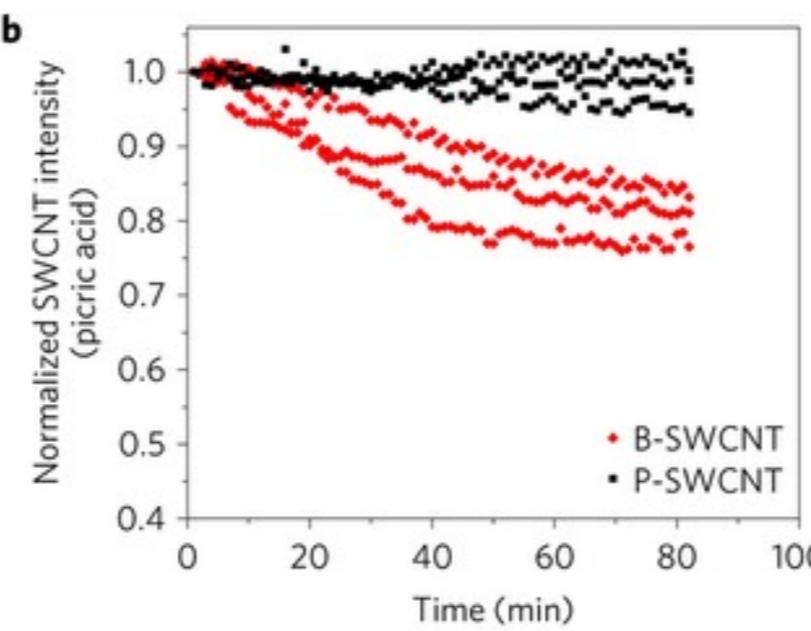
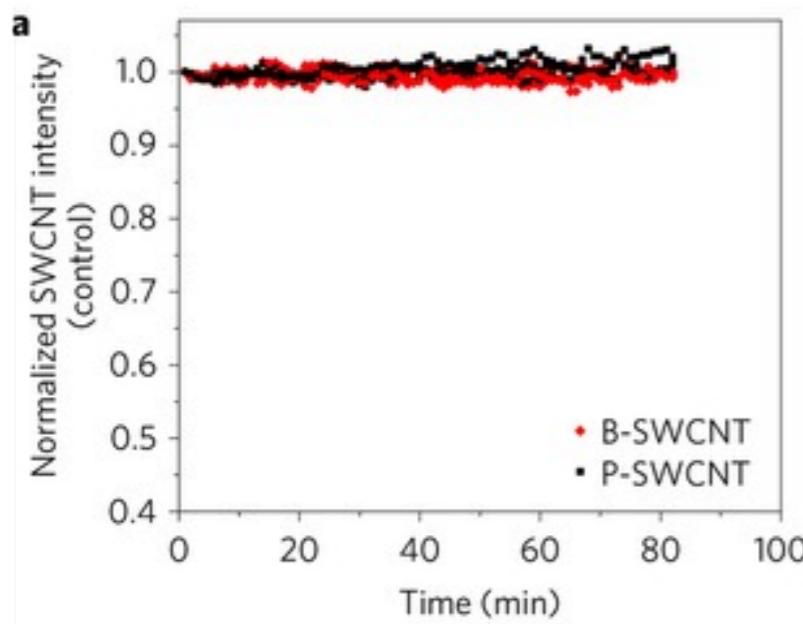
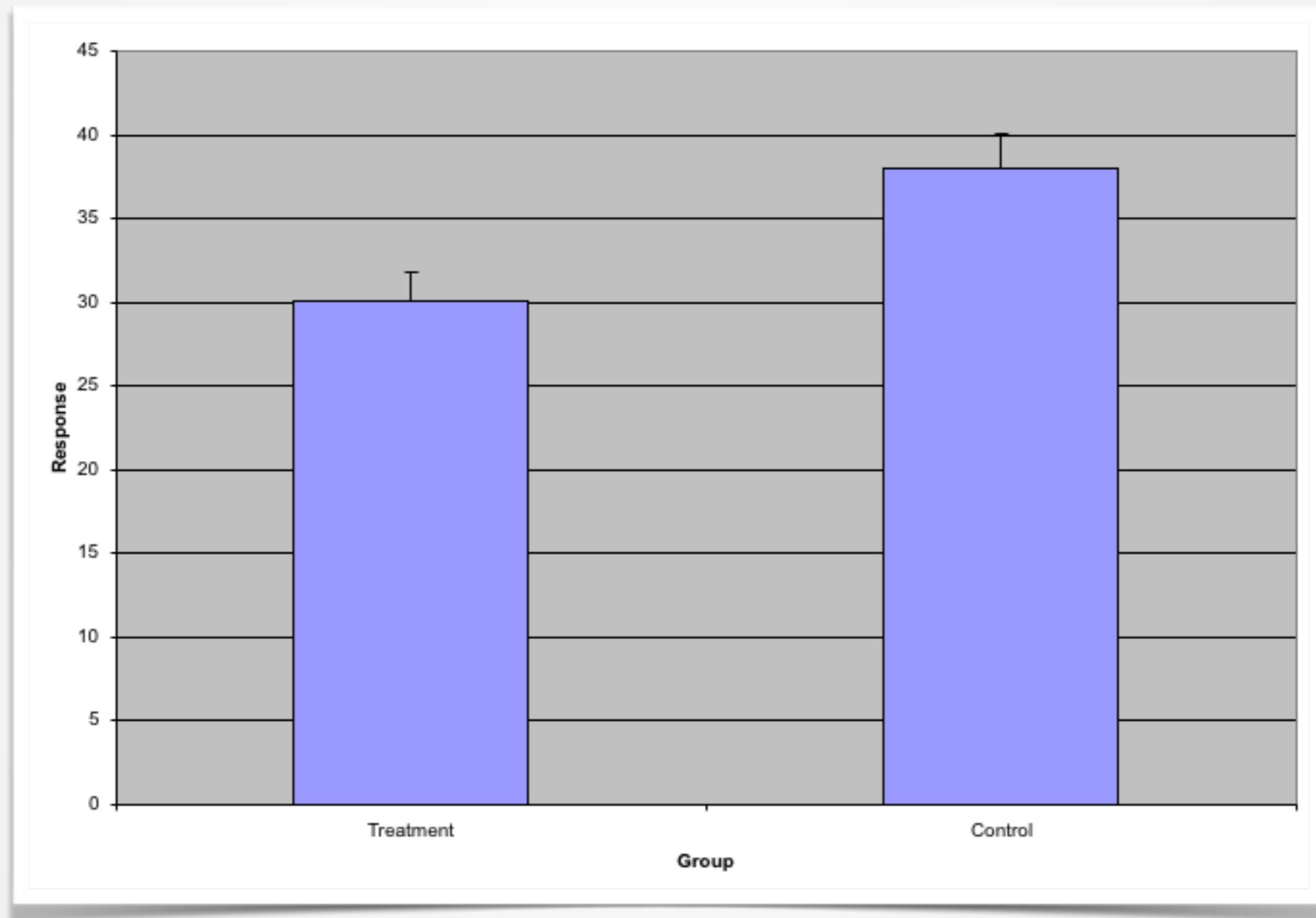
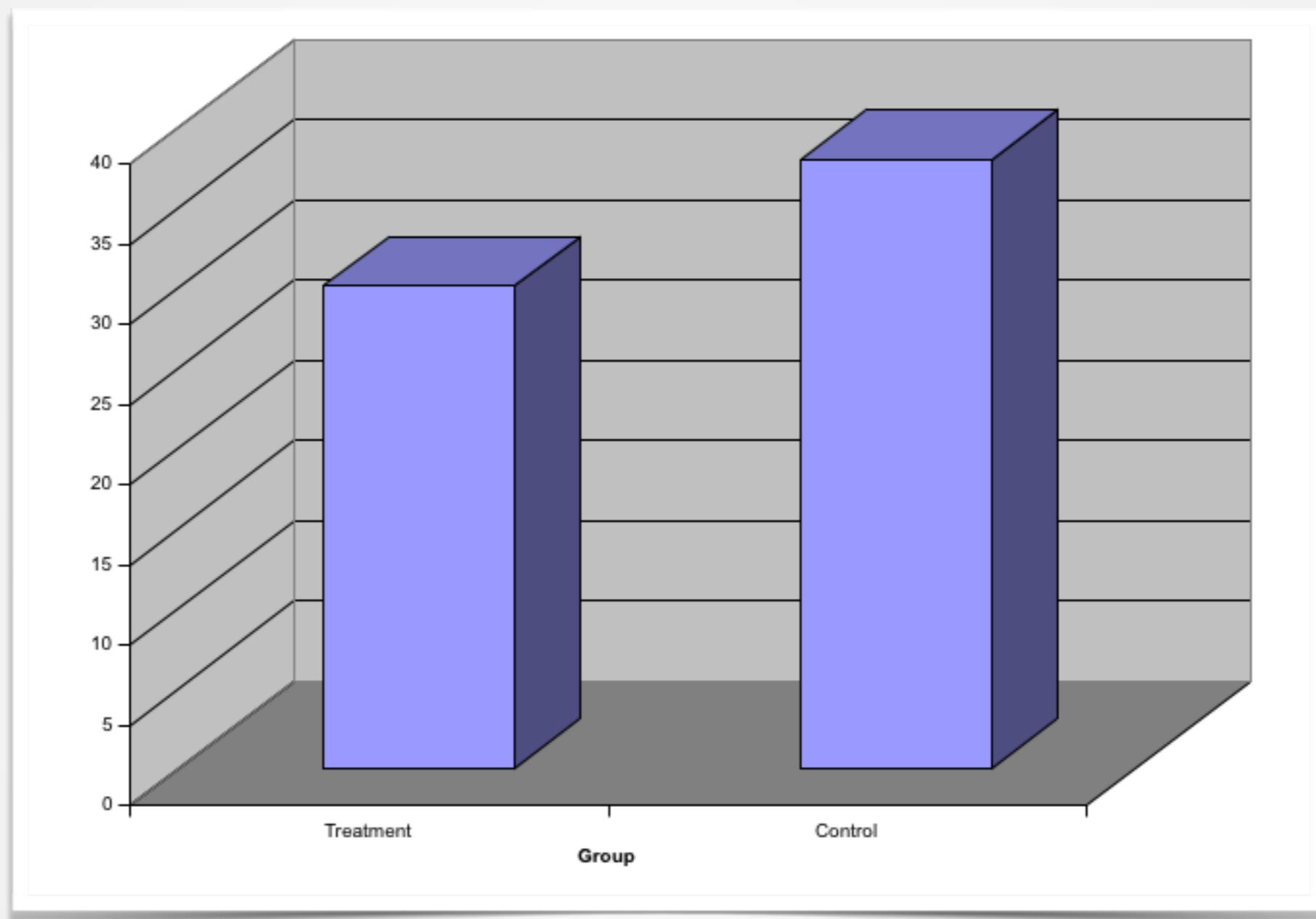


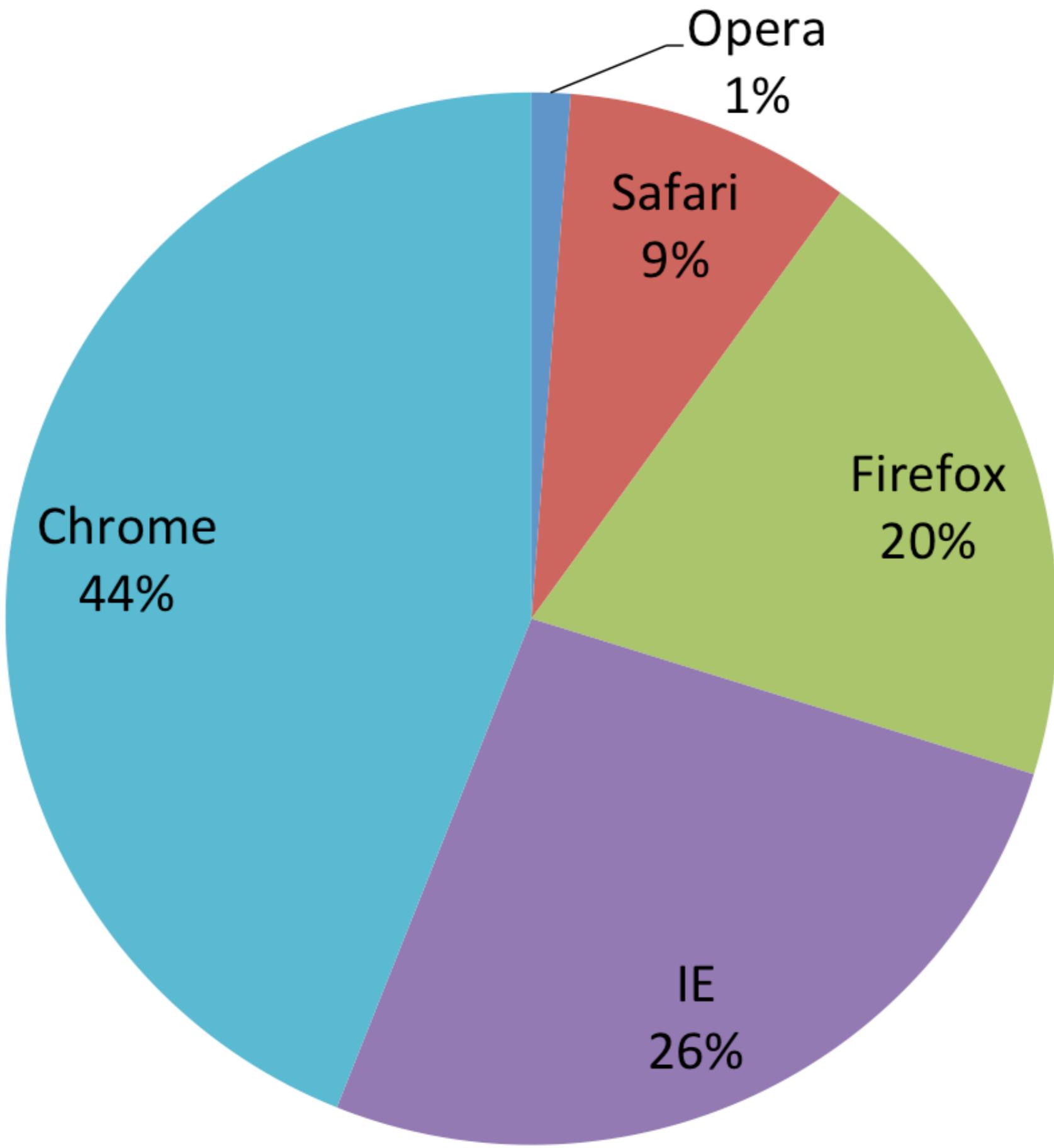
Figure 3 | NOON state characterization. **a**, Density matrix ρ (magnitudes only) from quantum state tomography, showing large coherence between $|LL\rangle$ and $|RR\rangle$ components. **b**, Measured correlation of the filtered CESPDC pairs (no background subtracted). The absence of modulation at the 2 ns cavity roundtrip time indicates the presence of a single cavity mode.



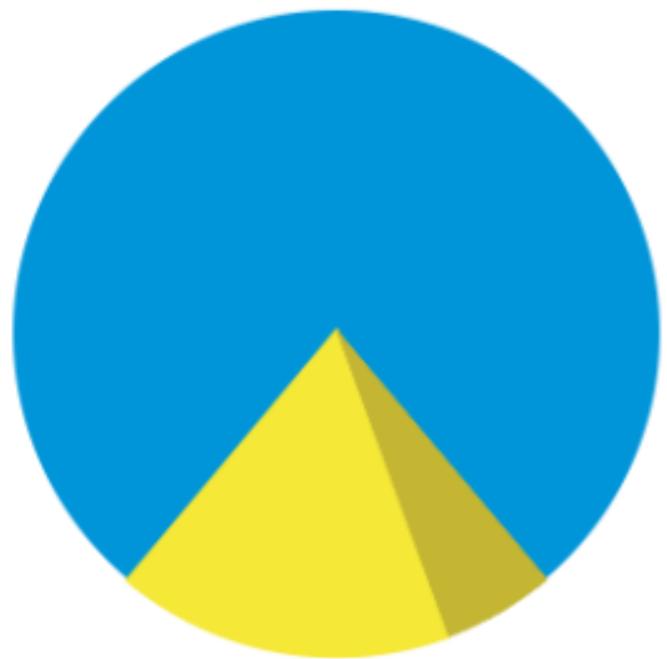
DYNAMITE PLOT



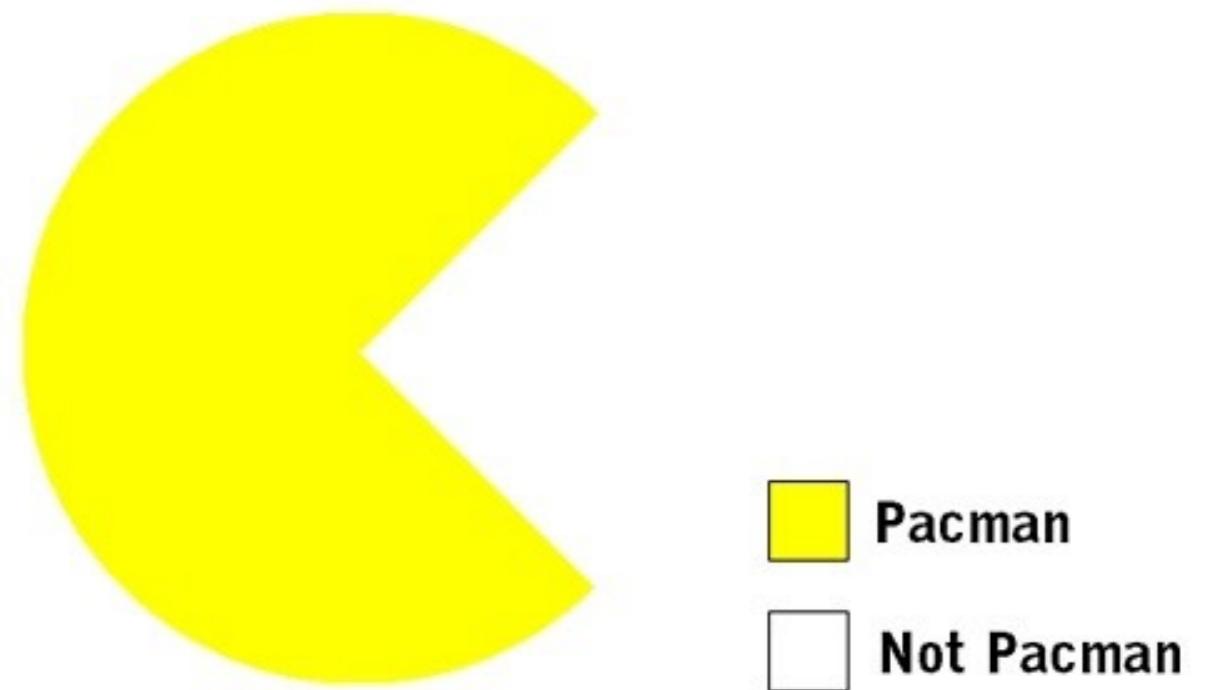
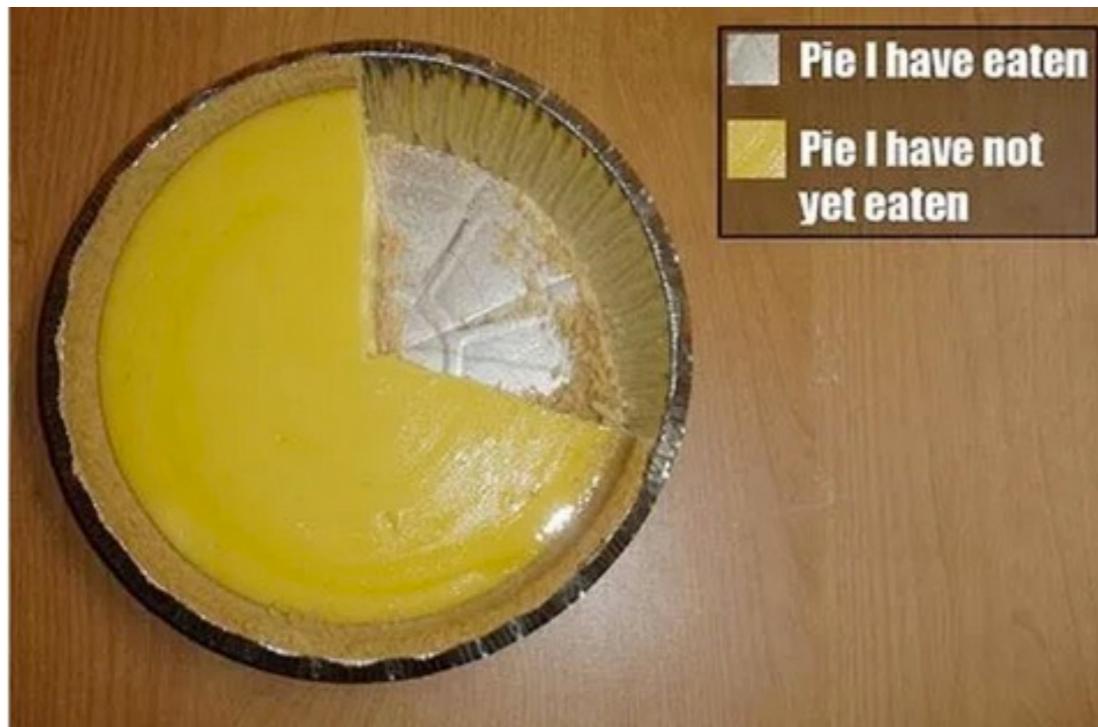
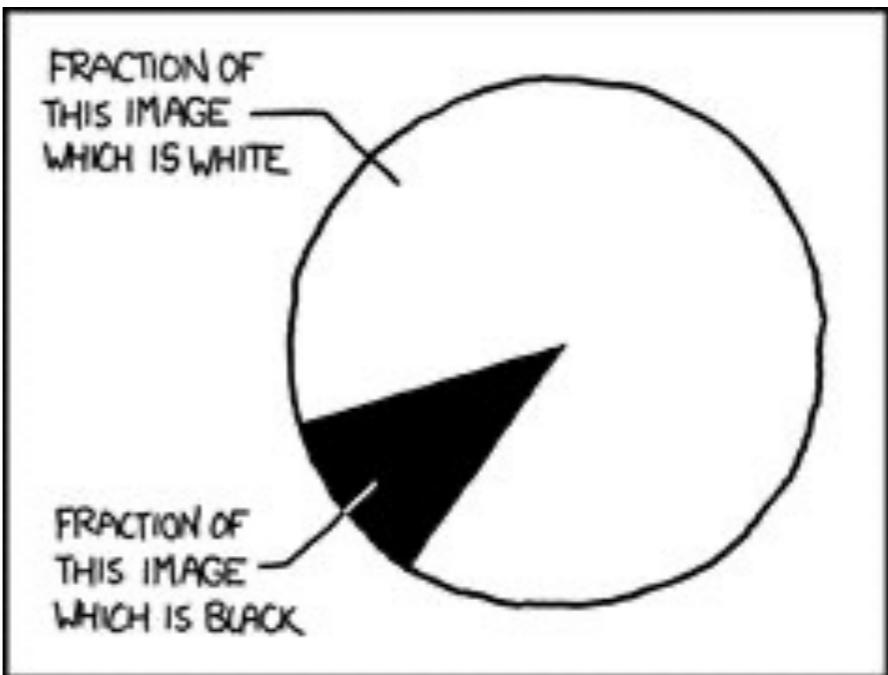




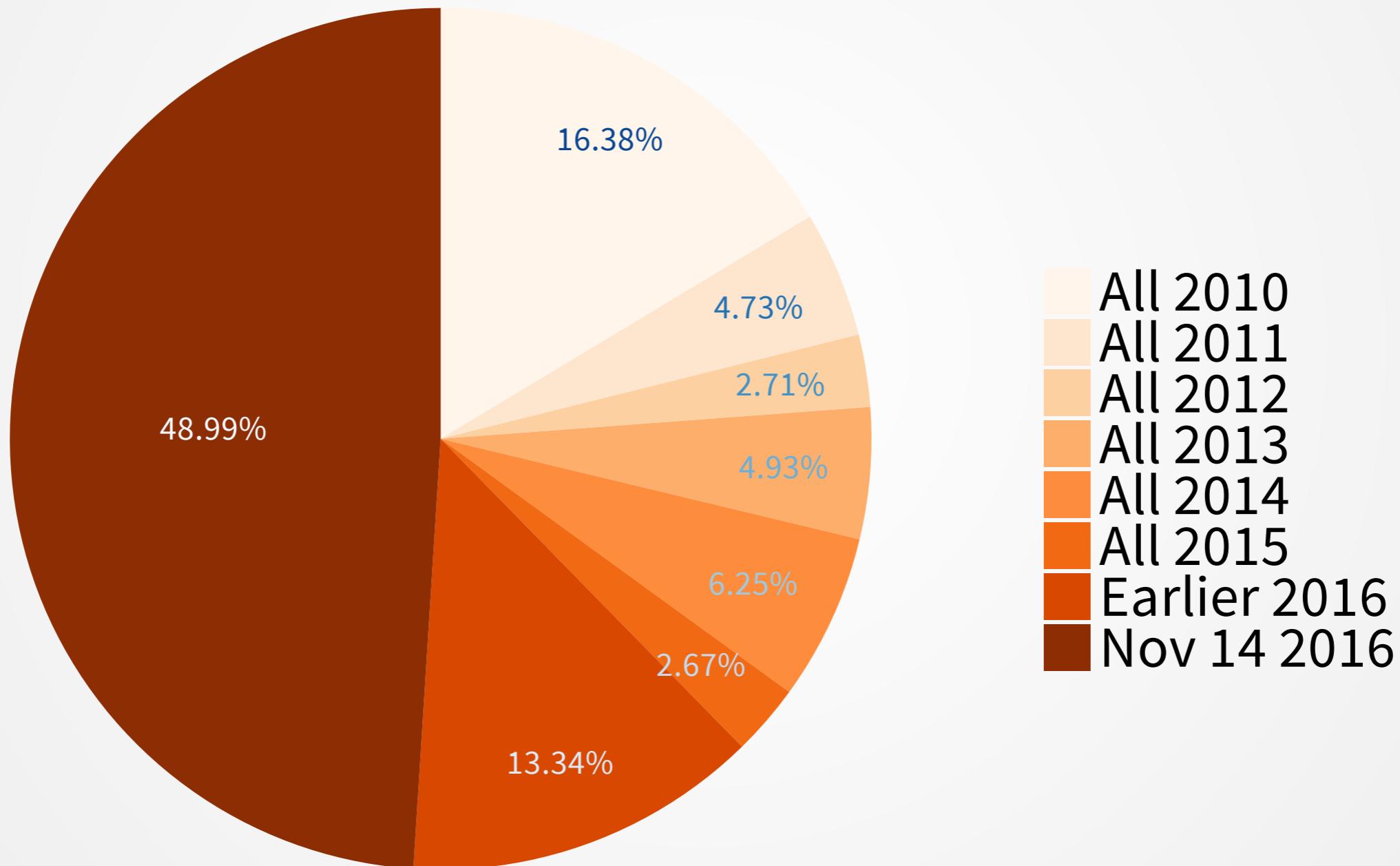
PIE CHARTS – LIMITED USE

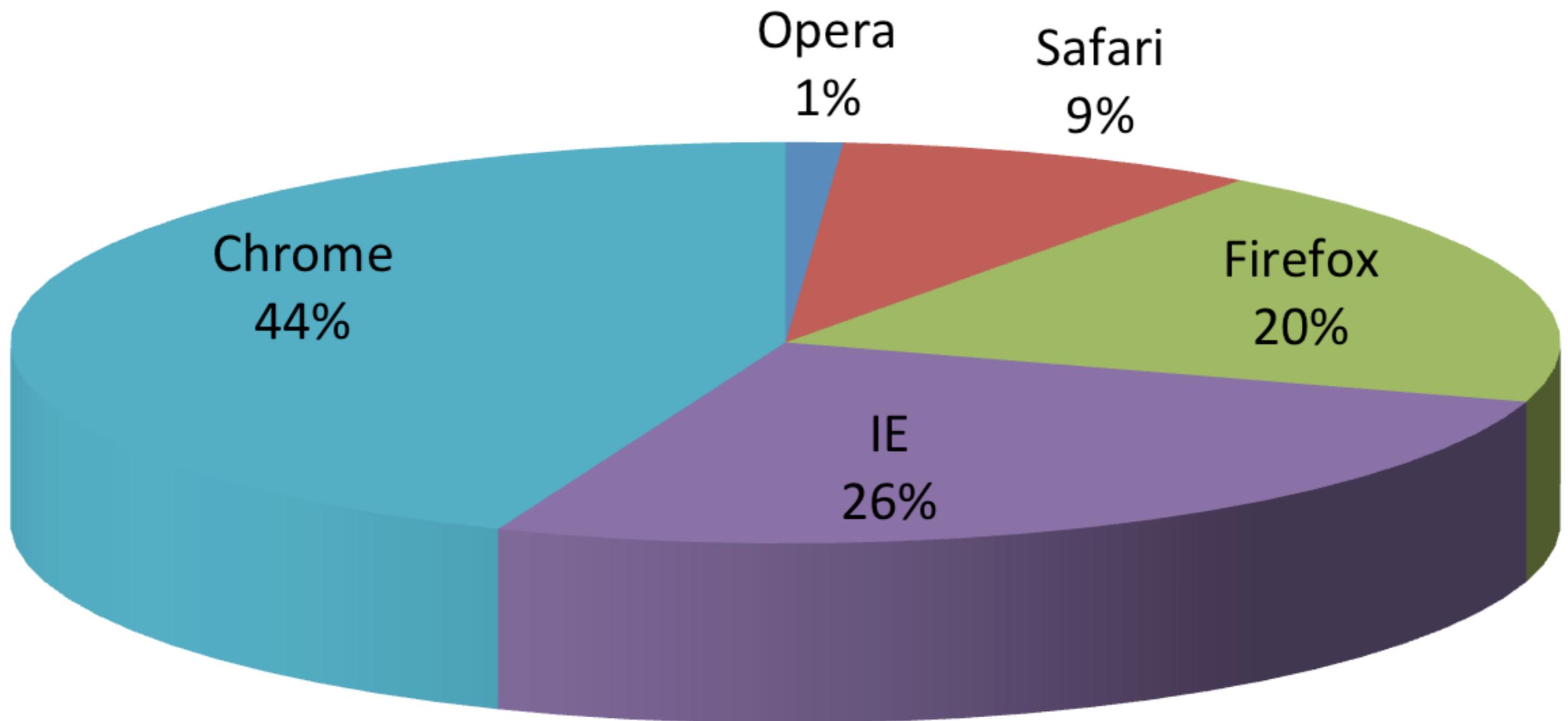


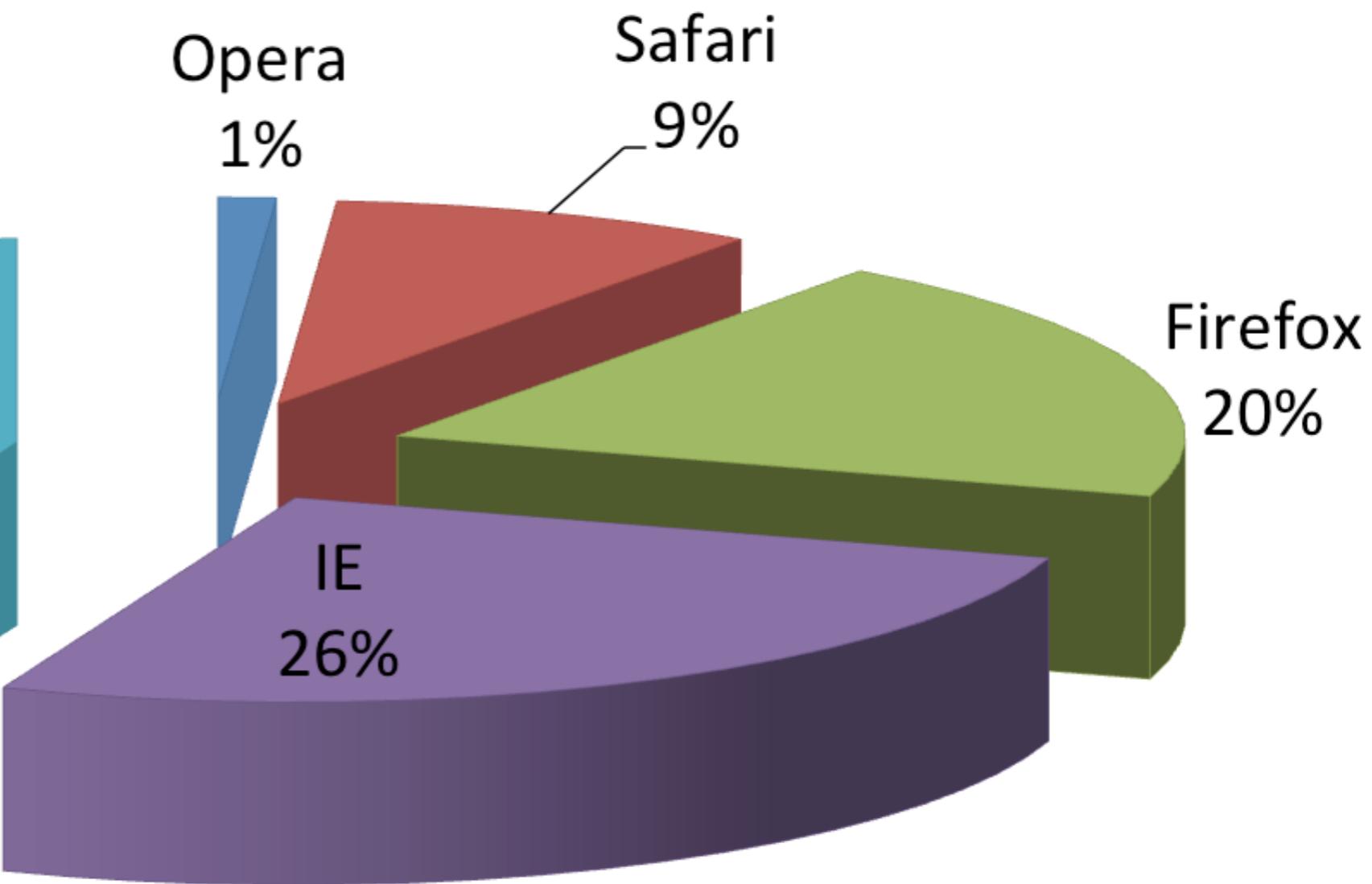
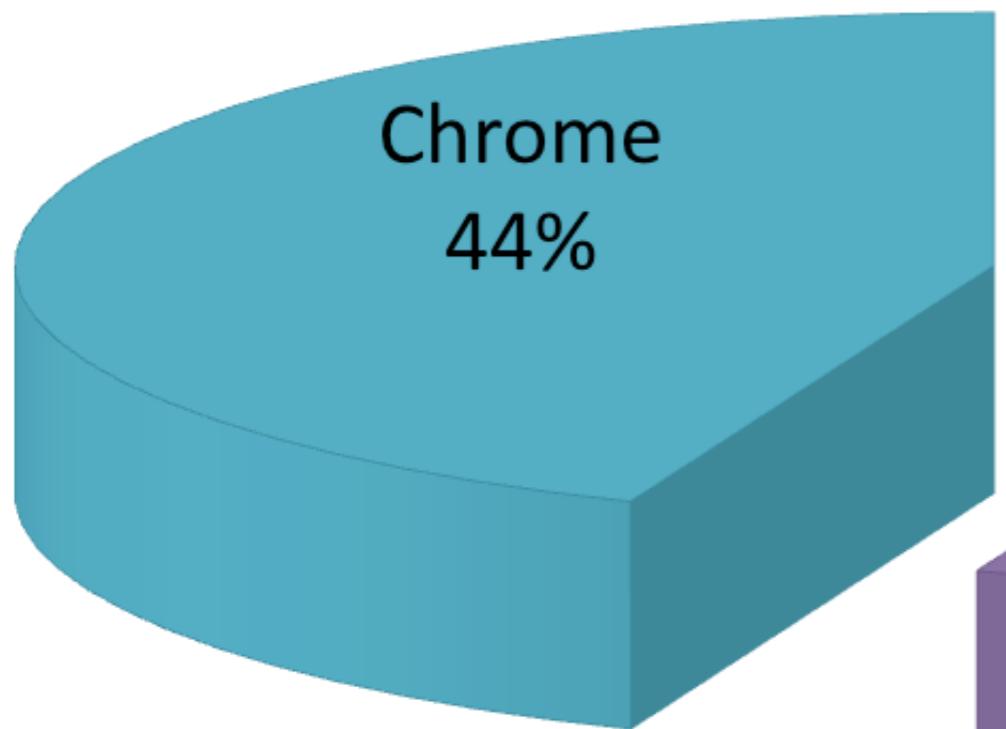
- Sky
- Sunny side of pyramid
- Shady side of pyramid



ENERGY RELEASED IN EARTHQUAKES 2010–2016







SOFTWARE

▶ **PLOTS**

- Python, R, Julia...
- d3.js, Vega-lite, plot.ly (interactive)
- Tableau (expensive)

▶ **SCHEMATICS & LAYOUT**

- Inkscape (open-source)
- Figma
- Adobe Illustrator, etc.

BENEFITS OF SCRIPTING GRAPHICS

- ▶ **EXPLORING MORE POSSIBILITIES**

- Save time
- Try multiple variations

- ▶ **CONSISTENCY**

- Reproducible code & aesthetics
- Self-documenting analysis

If progress is to be made in graphics,
we must be prepared to set aside
old procedures when better ones are
developed, just as is done in other
areas of science.

—W.S. Cleveland

FURTHER READING

- ▶ J.L. Doumont • *Trees, maps, and theorems*
- ▶ William Cleveland • *The Elements of Graphing Data*
- ▶ Jan White • *Graphic design for the electronic age*
- ▶ H. Wainer • *How to Display Data Badly*
- ▶ Edward Tufte • *The visual display of quantitative information*
- ▶ serialmentor.com/dataviz
- ▶ socviz.co
- ▶ ft.com/vocabulary
- ▶ data-to-viz.com

ADDITIONAL LINKS

- ▶ https://github.com/kbroman/Talk_Graphs
- ▶ <http://www.perceptualedge.com/examples.php>
- ▶ <http://colinpurrington.com/2012/example-of-bad-scientific-poster>
- ▶ <https://medialab.github.io/iwanthue/>
- ▶ <http://vis.berkeley.edu/papers/banking/>
- ▶ <http://earthobservatory.nasa.gov/blogs/elegantfigures/2013/08/06/subtleties-of-color-part-2-of-6/>
- ▶ “*Show the data, don't conceal them*”
<https://doi.org/10.1111/j.1476-5381.2011.01251.x>
- ▶ “*Everything we know about how humans interpret graphics*” <https://www.youtube.com/watch?v=s0J6EDvlN30>
- ▶ “*The Science of Visual Data Communication: What Works*”
<https://doi.org/10.1177/15291006211051956>