

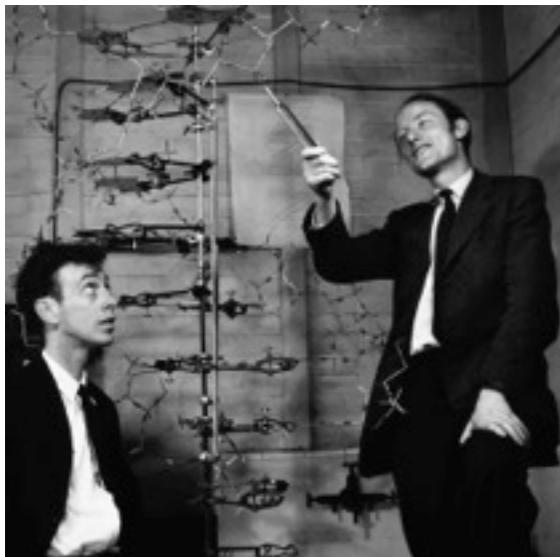
CS 109: Data Science

Visual Attributes, Color, Design Principles

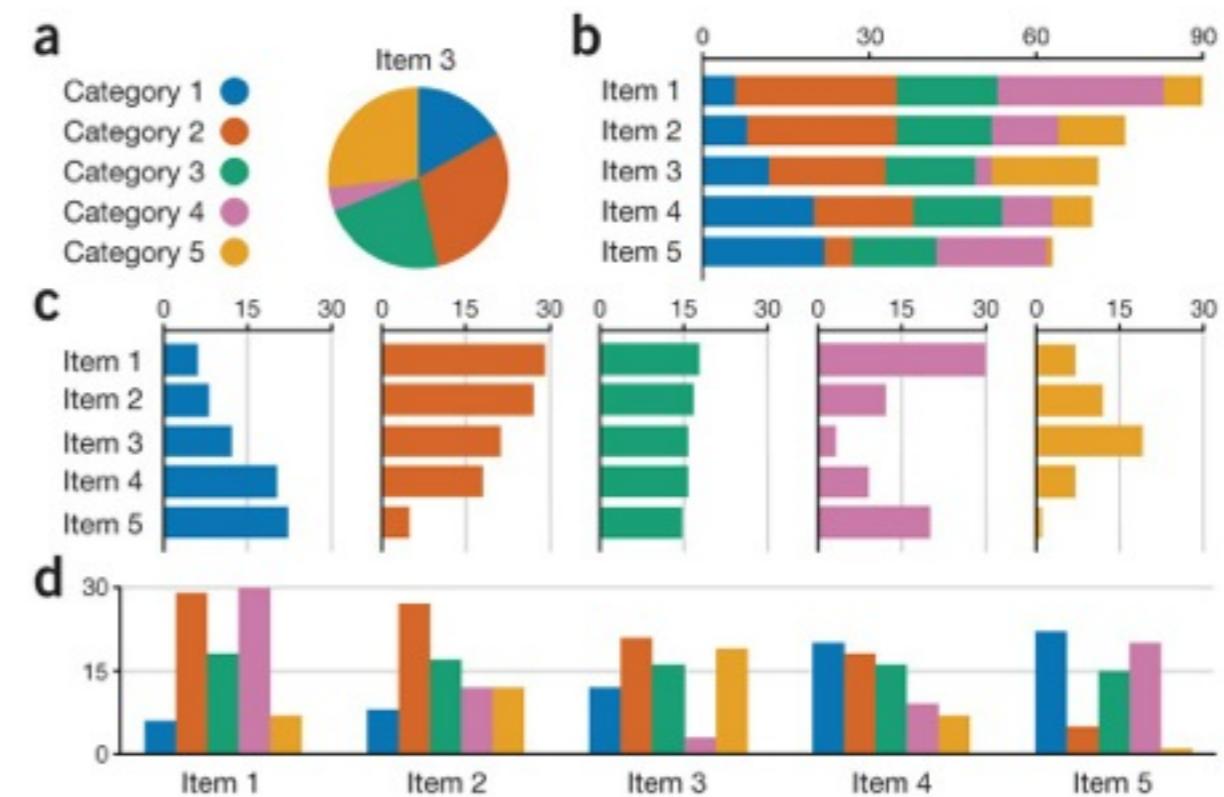
Marc Streit

mstreit@seas.harvard.edu

On Tuesday...



| parch | fare | embarked | class | who |
|-------|---------|----------|--------|-------|
| 0 | 7.25 | S | Third | man |
| 0 | 71.2833 | C | First | woman |
| 0 | 7.925 | S | Third | woman |
| 0 | 53.1 | S | First | woman |
| 0 | 8.05 | S | Third | man |
| 0 | 8.4583 | Q | Third | man |
| 0 | 51.8625 | S | First | man |
| 1 | 21.075 | S | Third | child |
| 2 | 11.1333 | S | Third | woman |
| 0 | 30.0708 | C | Second | child |
| 1 | 16.7 | S | Third | child |
| 0 | 26.55 | S | First | woman |
| 0 | 8.05 | S | Third | man |
| 5 | 31.275 | S | Third | man |
| 0 | 7.8542 | S | Third | child |
| 0 | 16.0 | S | Second | woman |
| 1 | 29.125 | Q | Third | child |
| 0 | 13.0 | S | Second | man |
| 0 | 18.0 | S | Third | woman |
| 0 | 7.225 | C | Third | woman |
| 0 | 26.0 | S | Second | man |
| 0 | 13.0 | S | Second | man |
| 0 | 8.0292 | Q | Third | child |

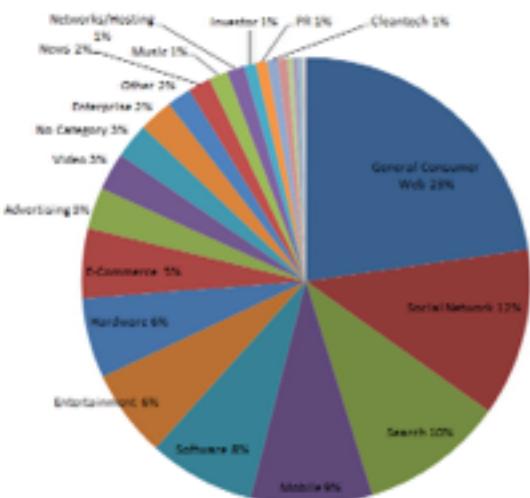


Vis Goals

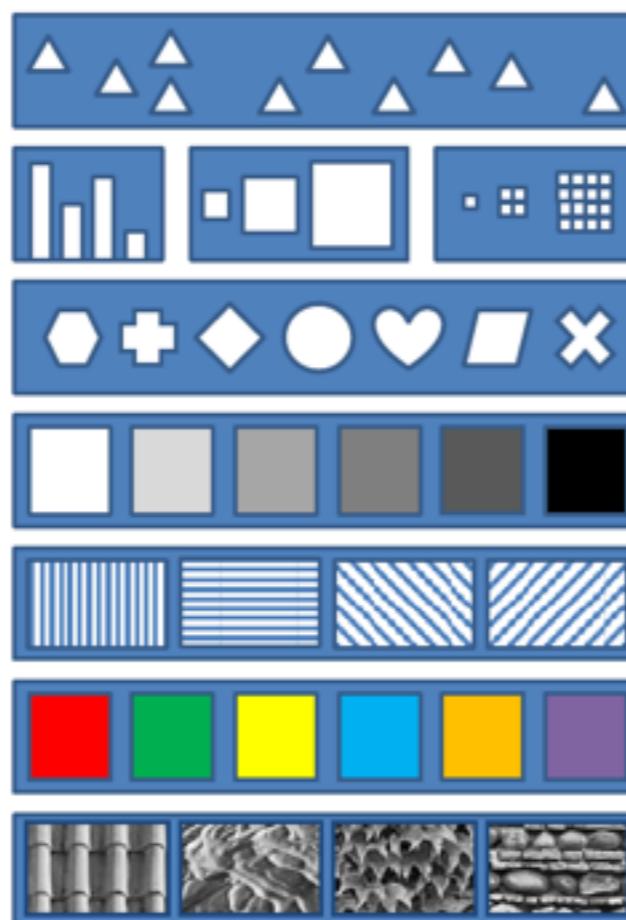
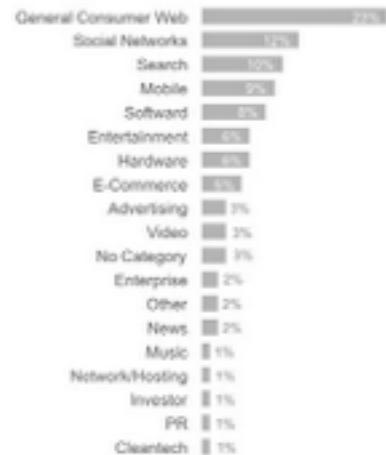
Data Types
Dimensionality

Graph Types

Outline



TechCrunch Coverage: 2005 - 2011
Bars are best!

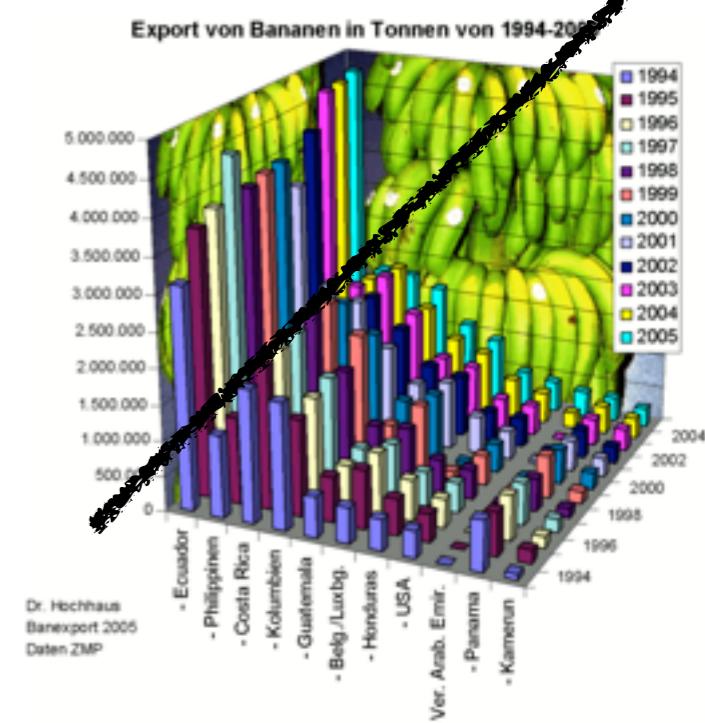
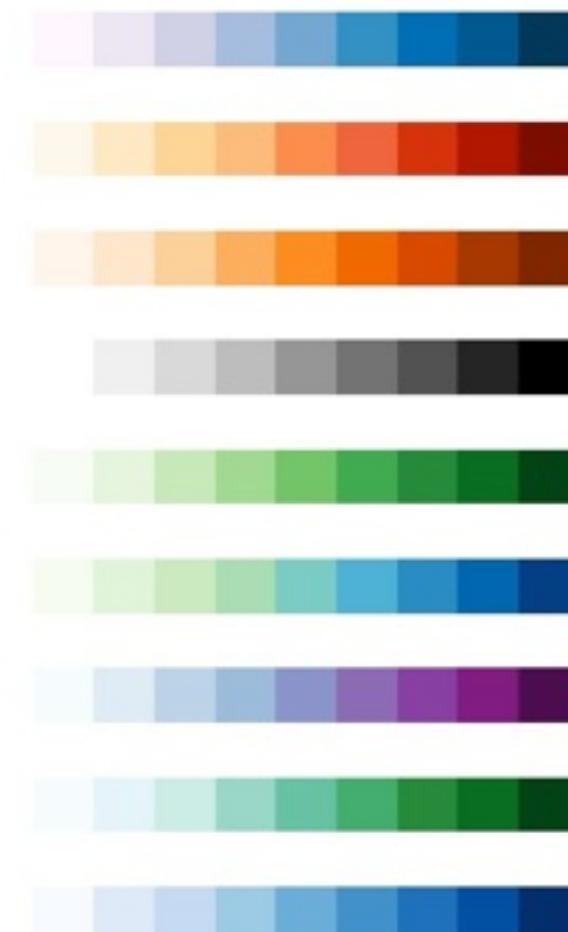


Effective vs.
Non Effective
Visualizations

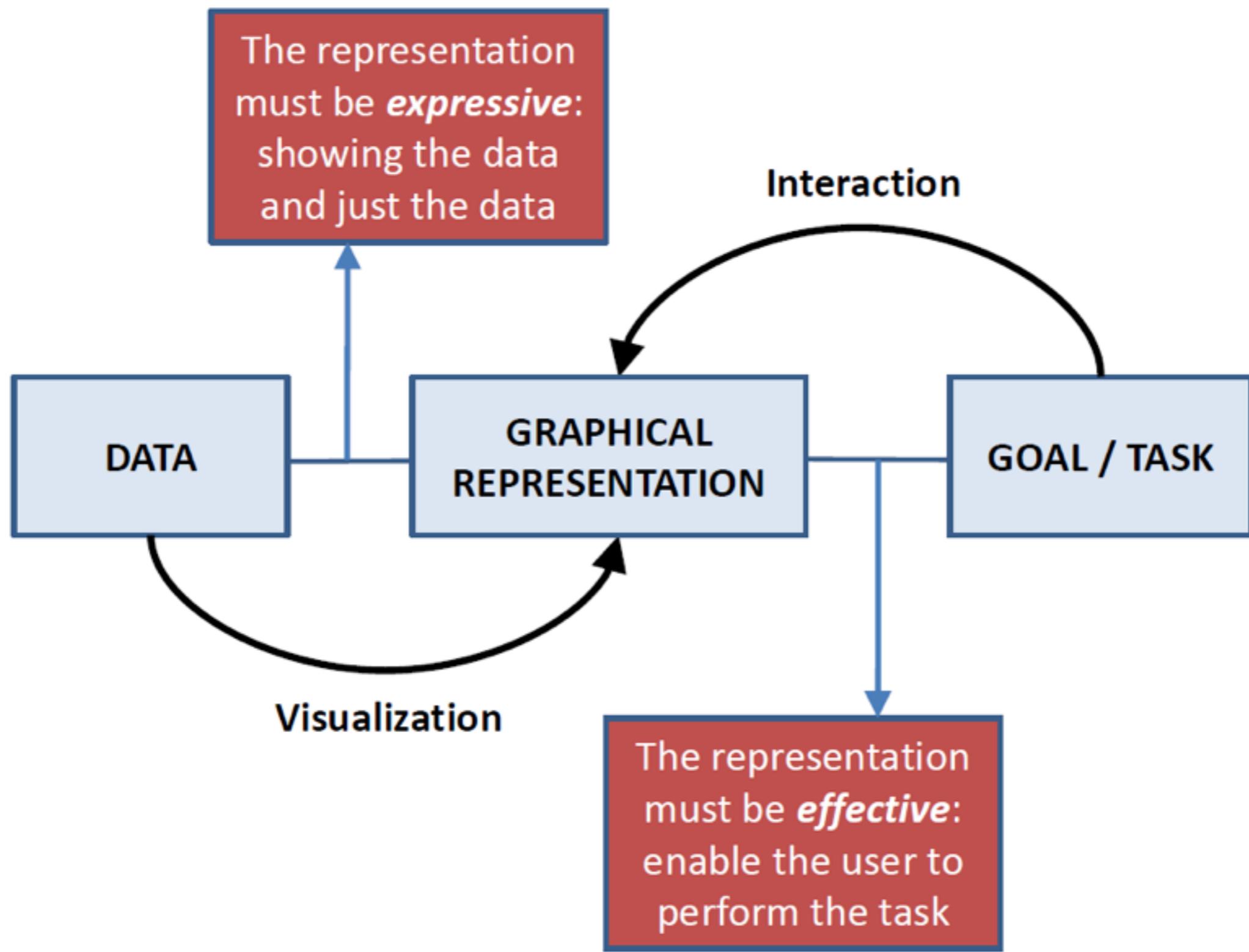
Visual
Attributes

Color

Design
Principles



Effective Visualizations



Not Effective...

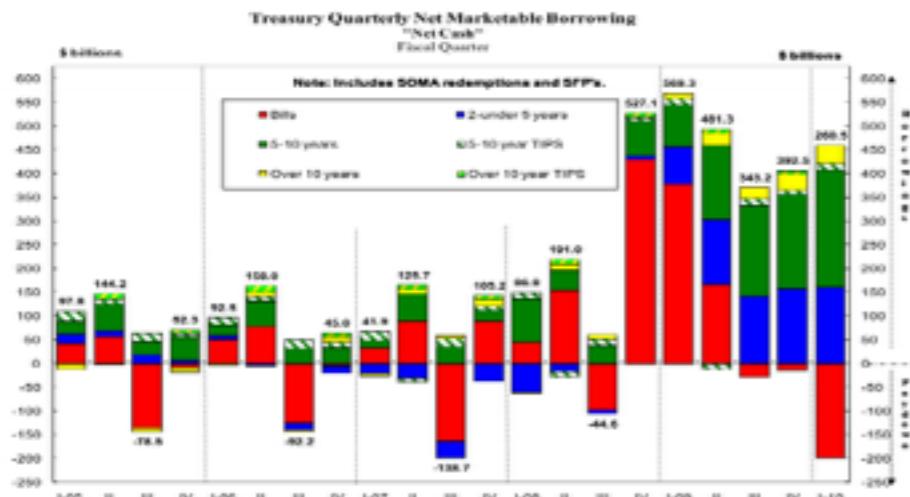


Figure 10

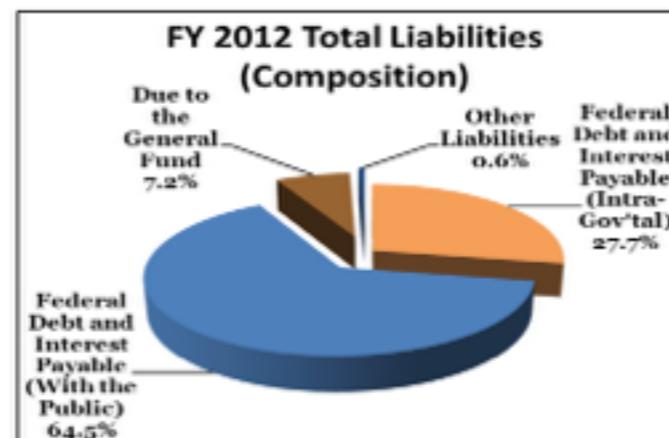
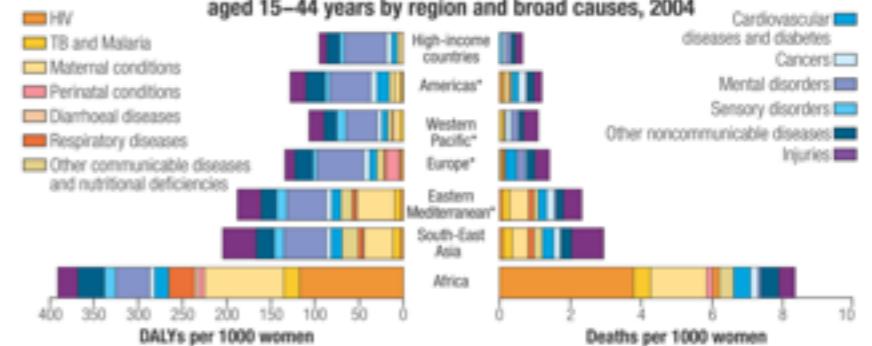


Figure 1 Mortality and disease burden (DALYs) in women aged 15–44 years by region and broad causes, 2004



* High-income countries are excluded from the regional groups.
Source: World Health Organization.¹

Source: World Health Organization.¹

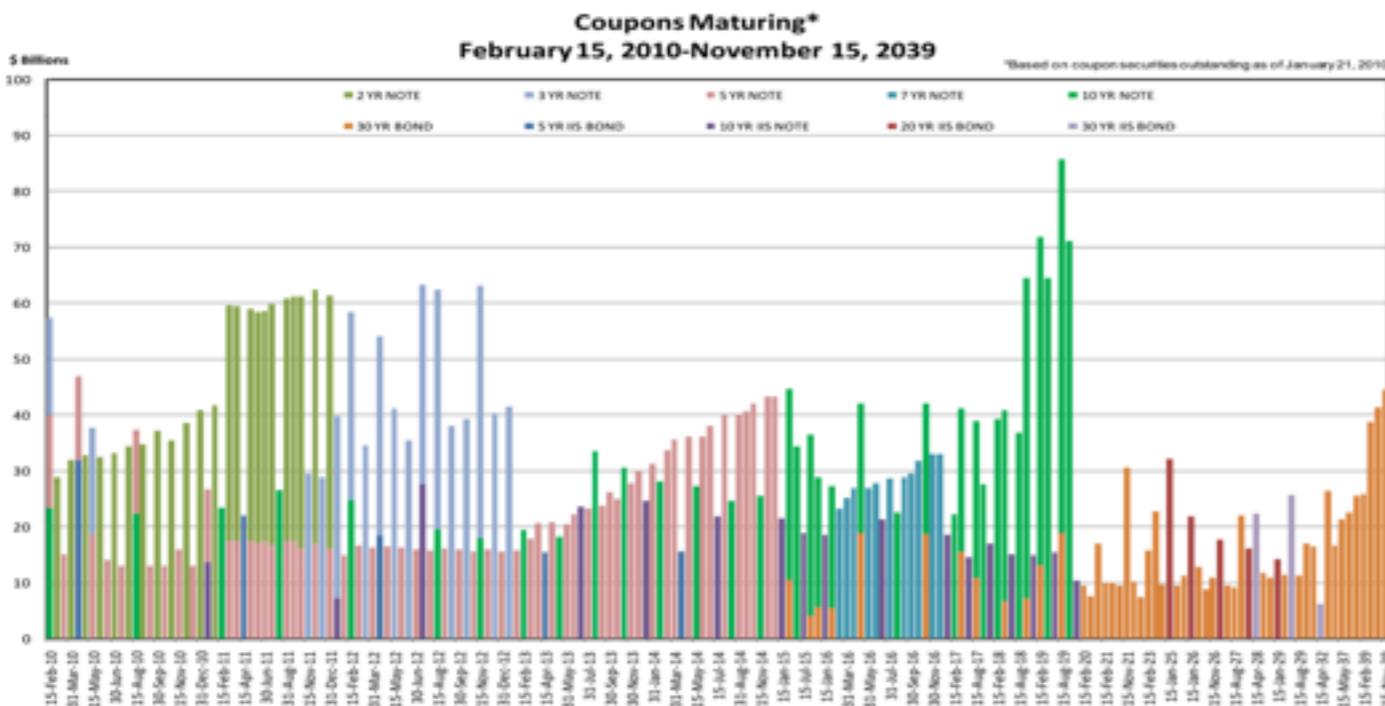
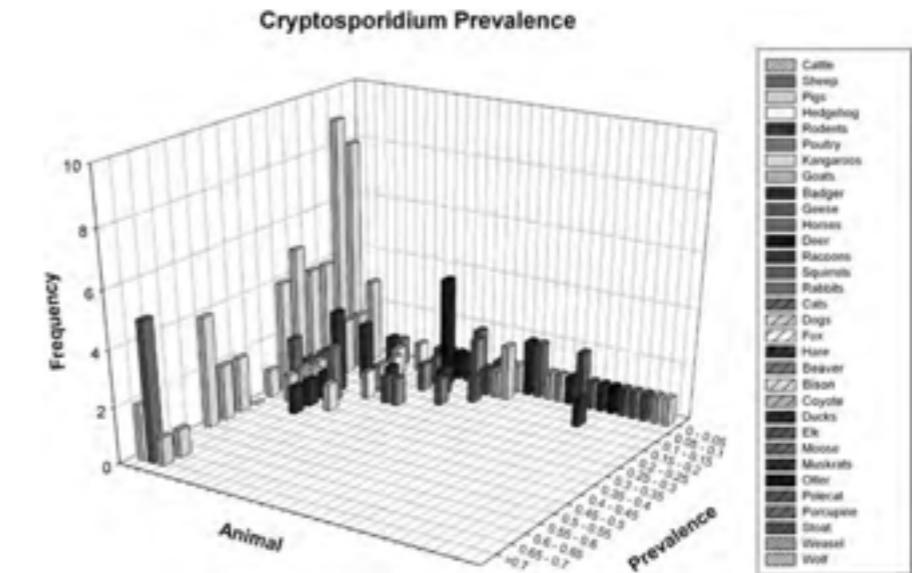
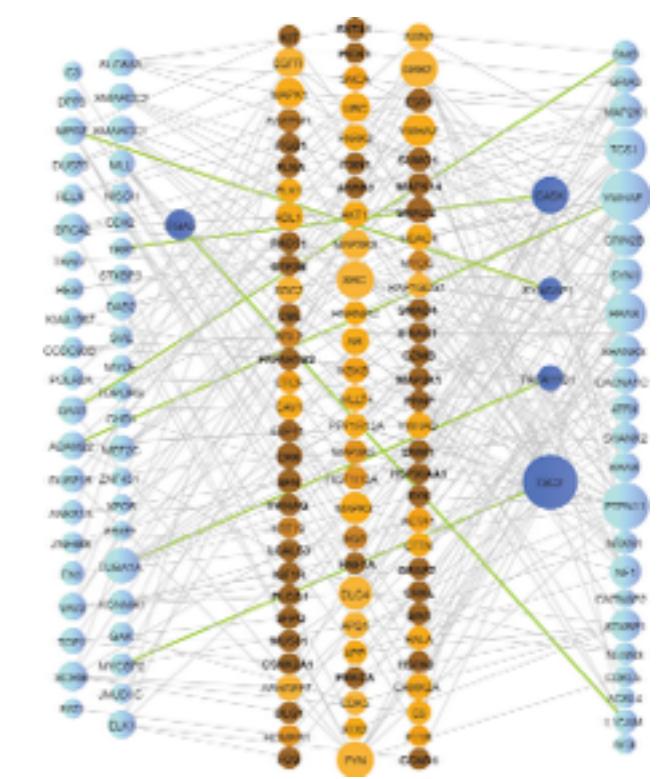
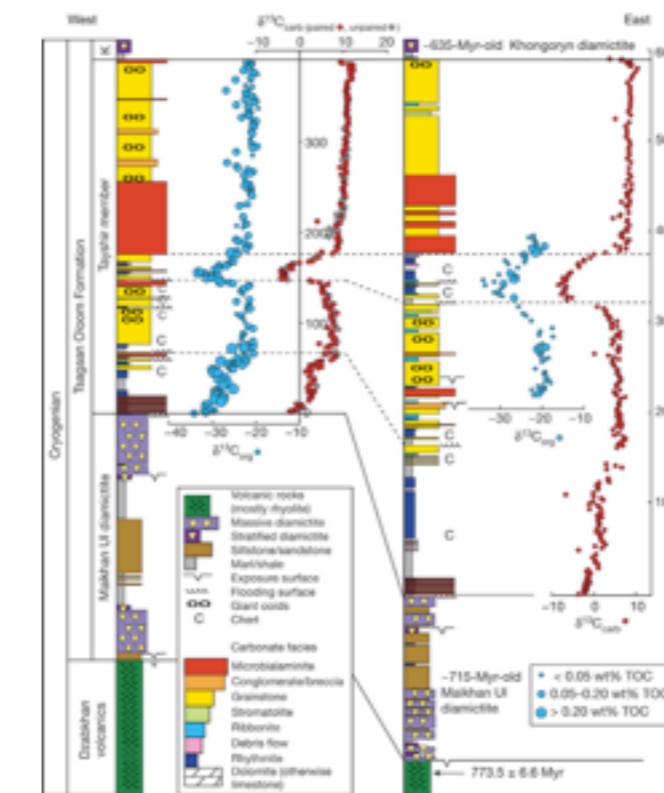
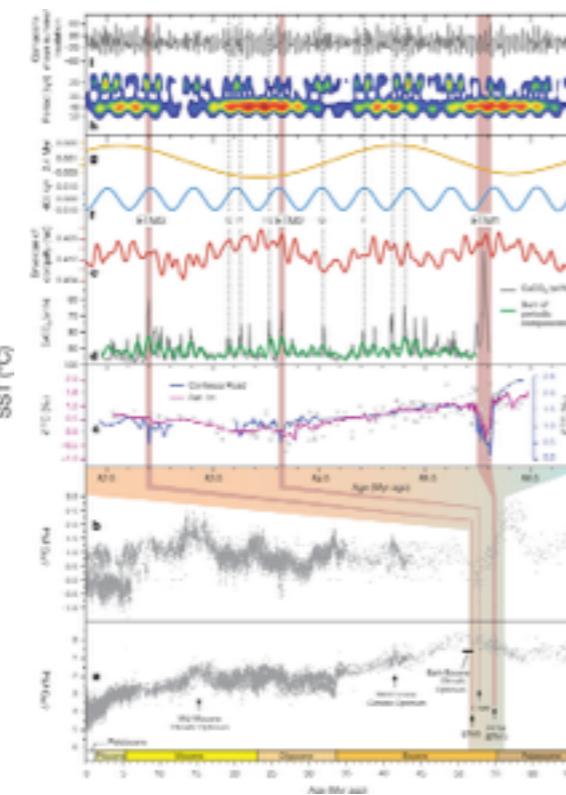
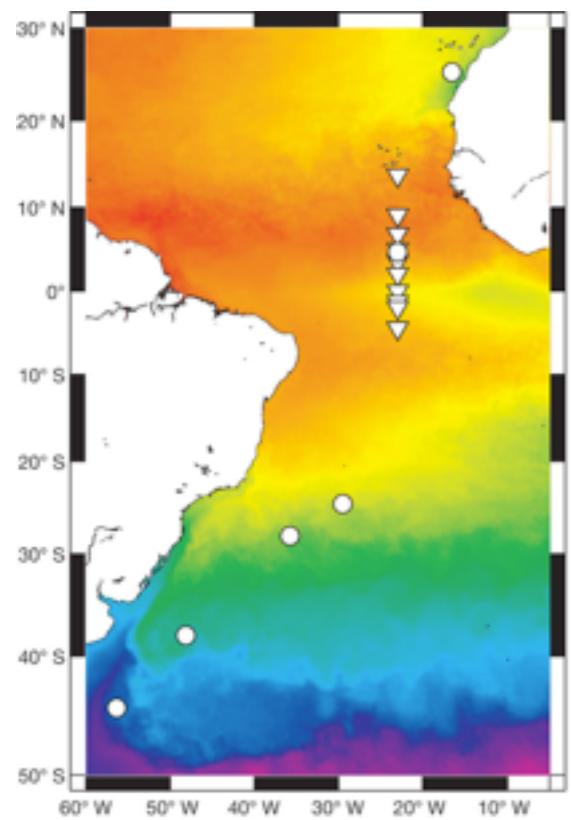
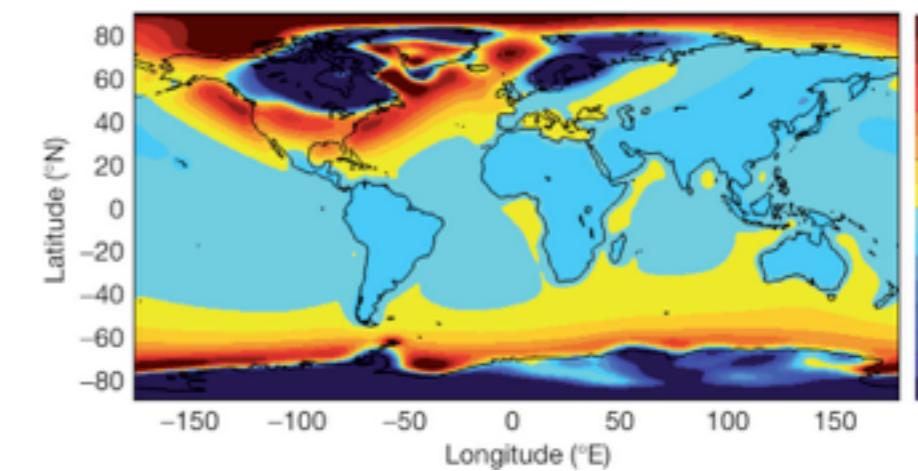
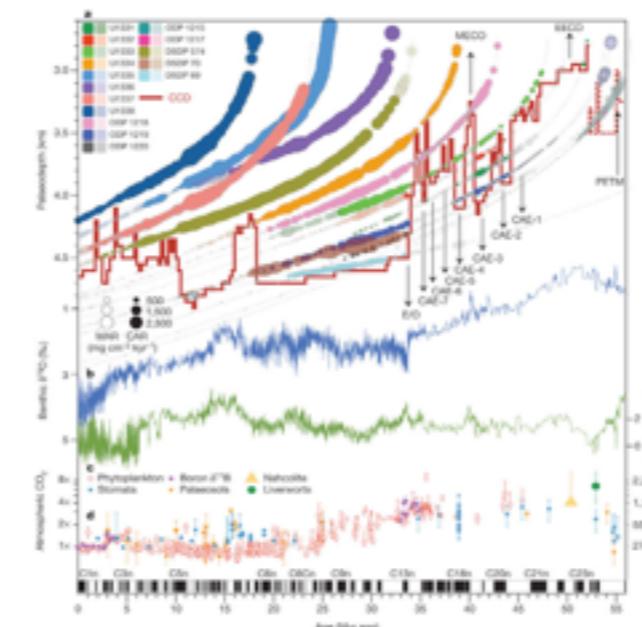
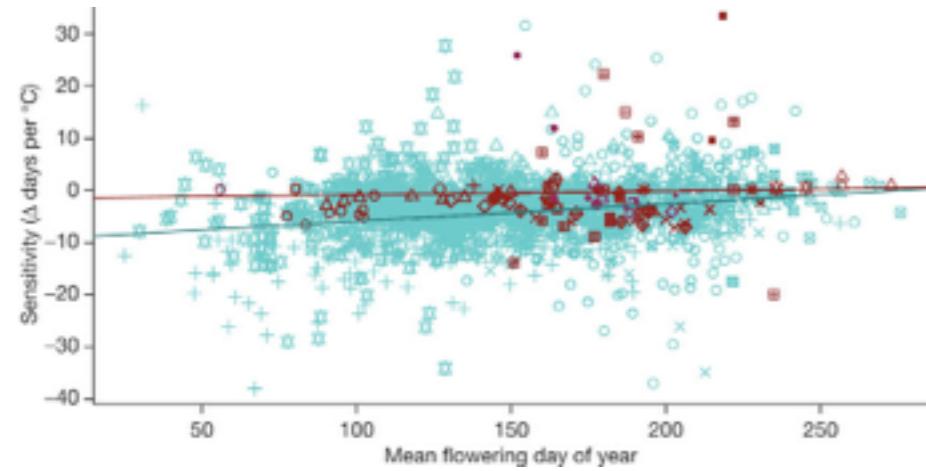


Figure 5.2 Mean prevalence rates of *Cryptosporidium* oocysts by animal species.



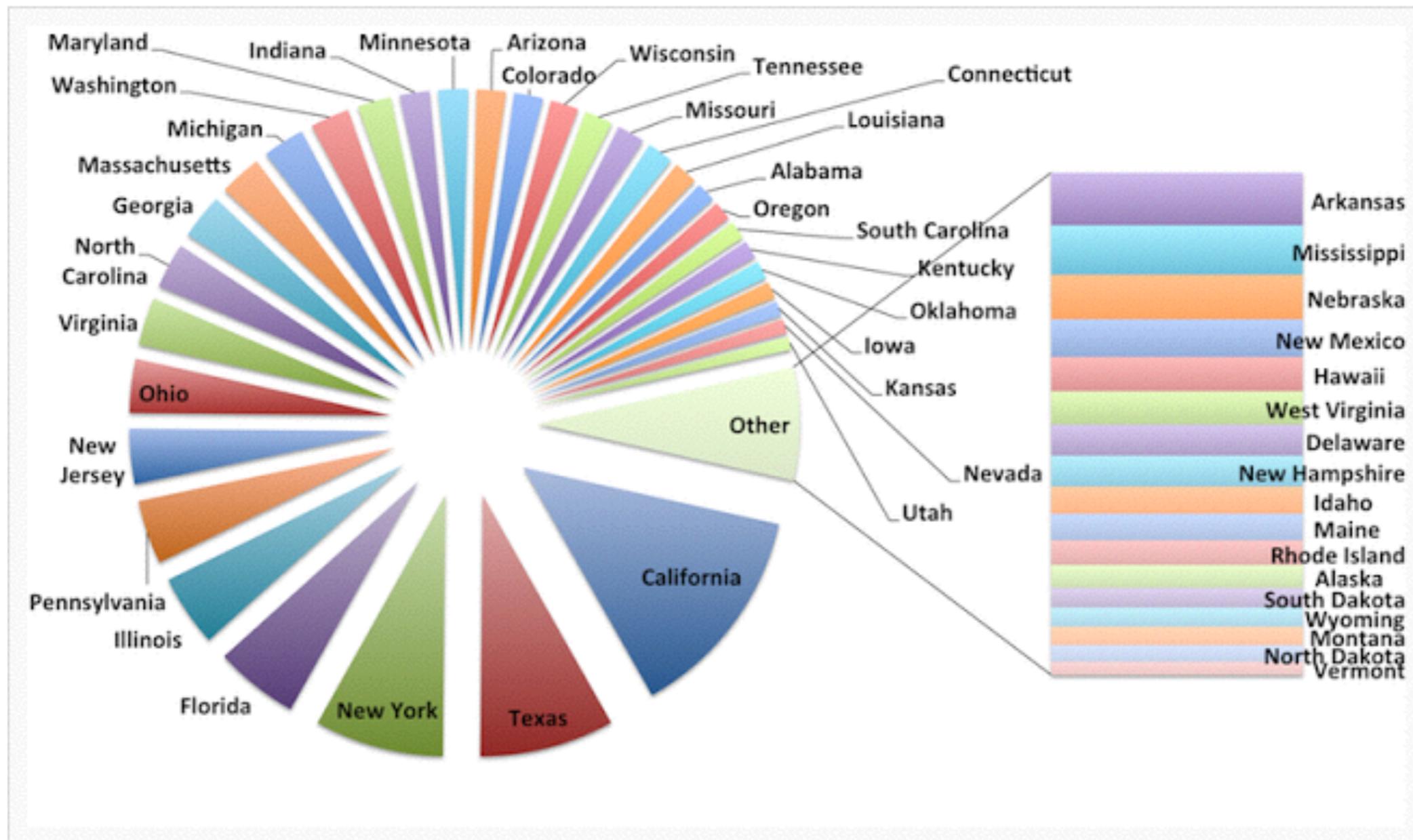
Sources: US Treasury and WHO reports

Also *not* effective...



WTF Visualizations

<http://wtfviz.net>



The United States GDP for individual states as a contribution to the total US GDP. Fraction of the total US GDP

per state was taken from [Wikipedia](#) and refers to 2010.

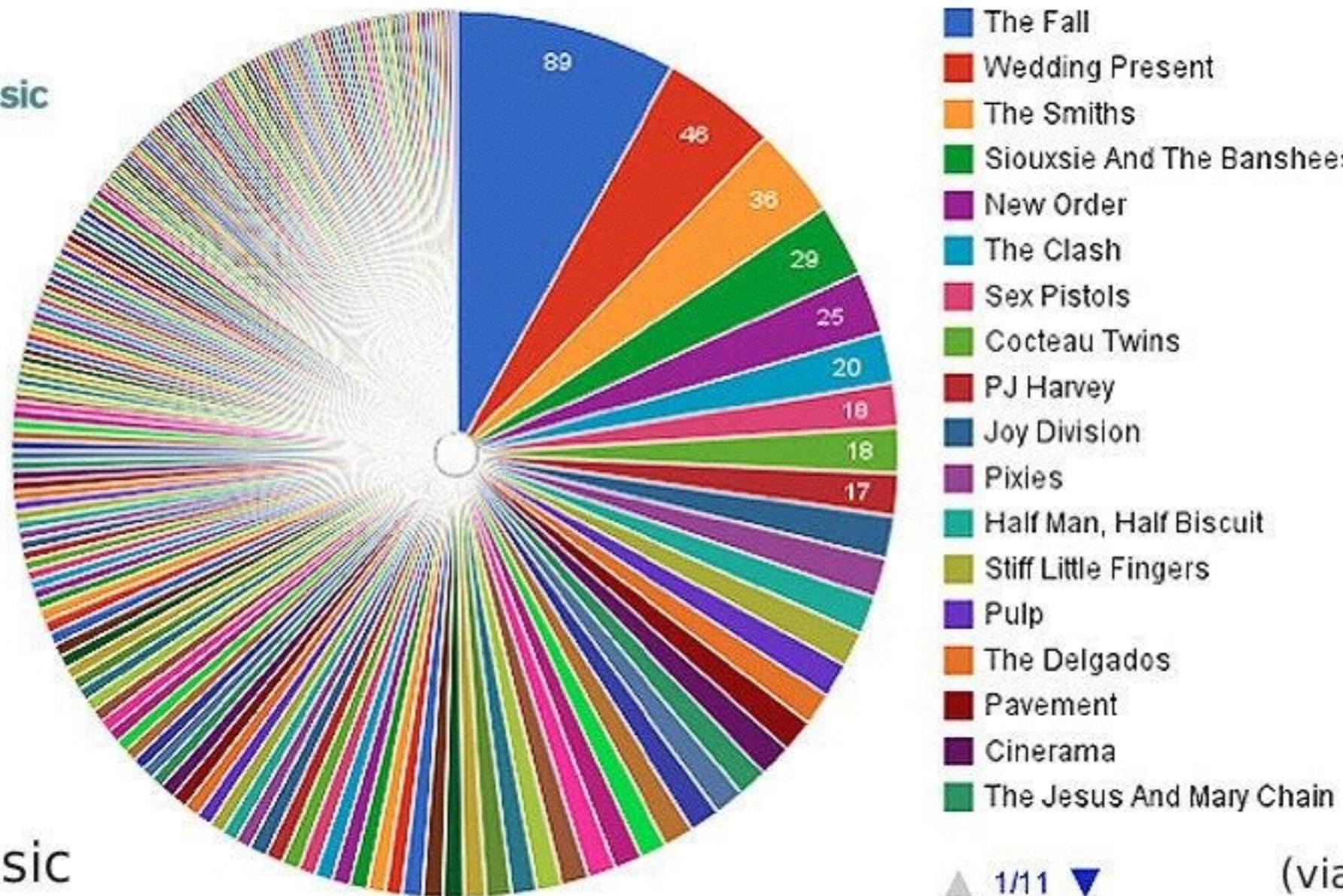
WTF Visualizations

<http://wtfviz.net>

John Peel's most played artists in his Festive 50s

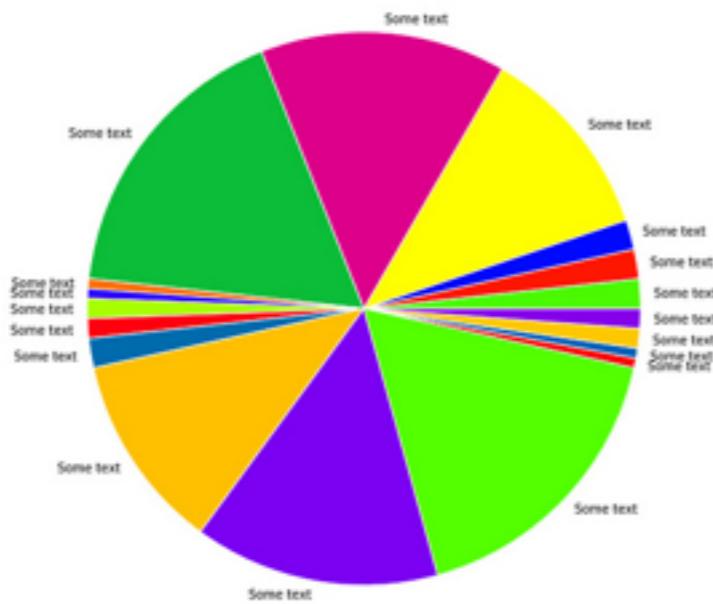
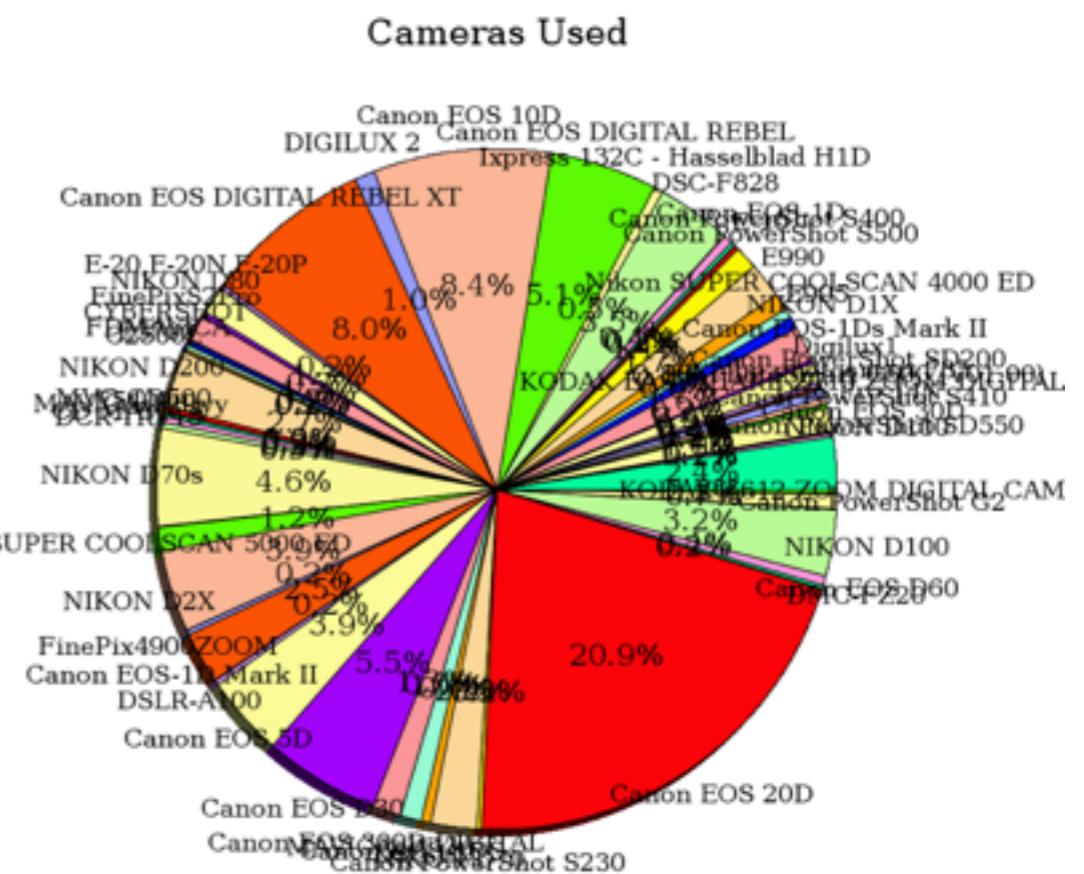
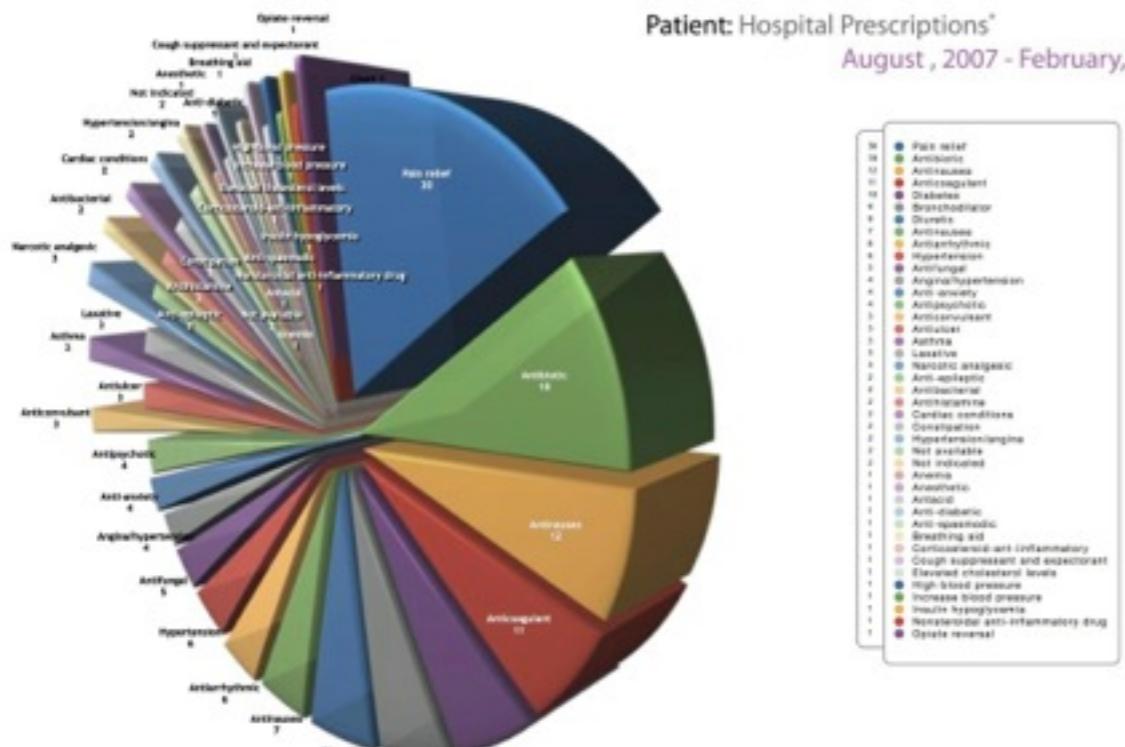
BBC

RADIO



#Peel6Music

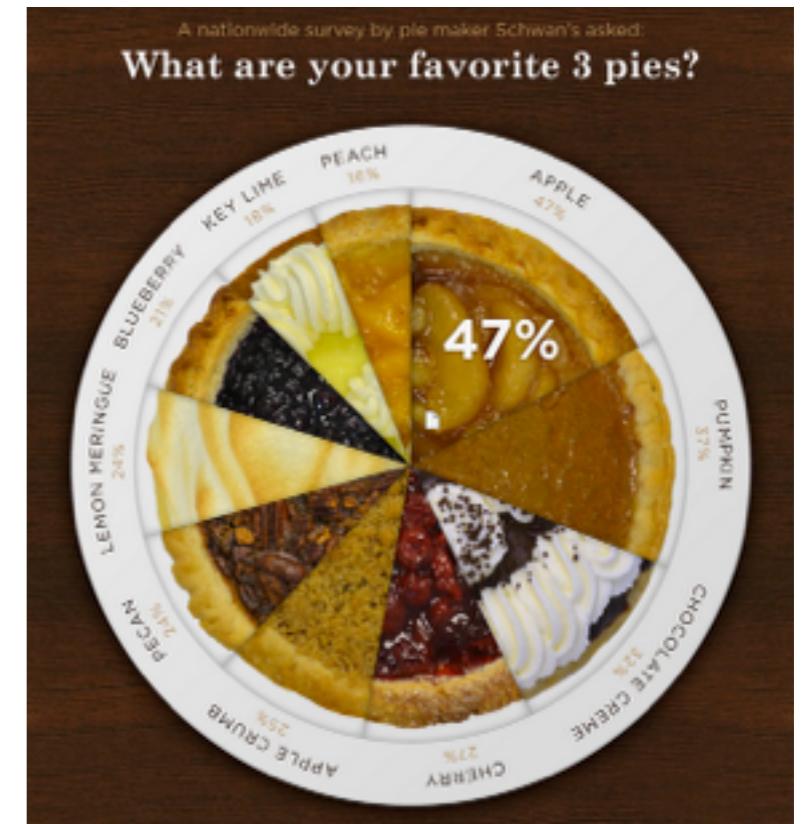
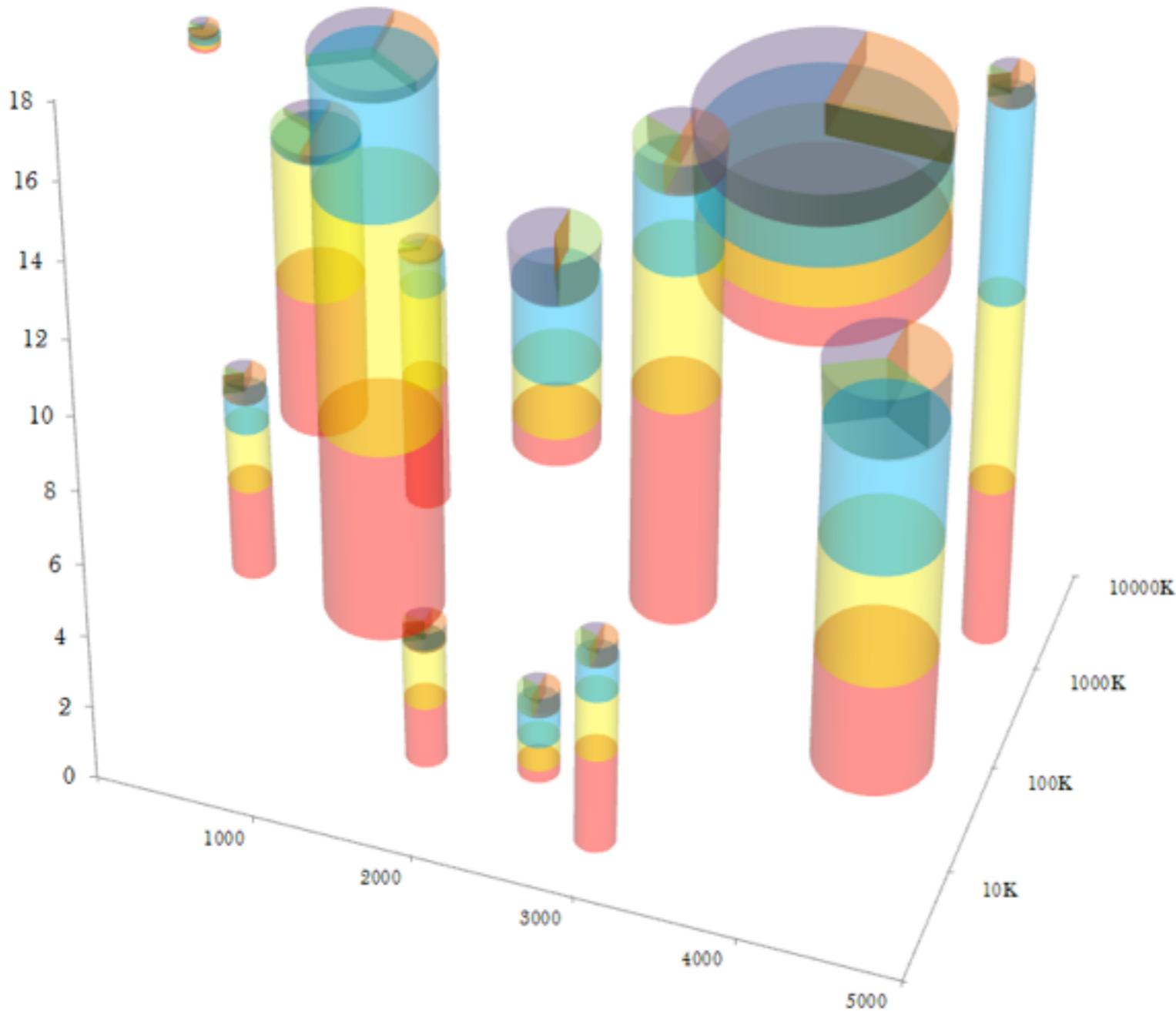
Don't



Job *

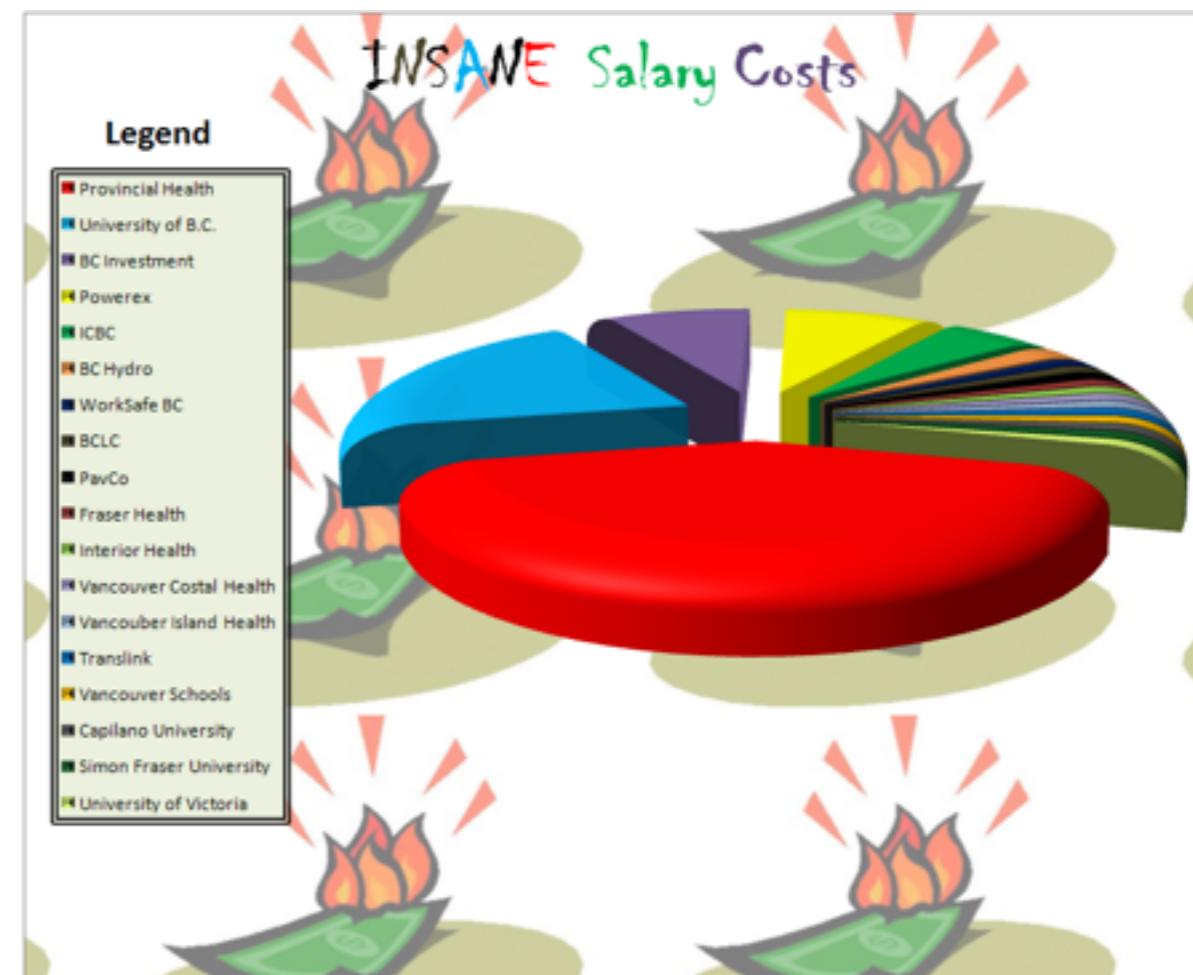
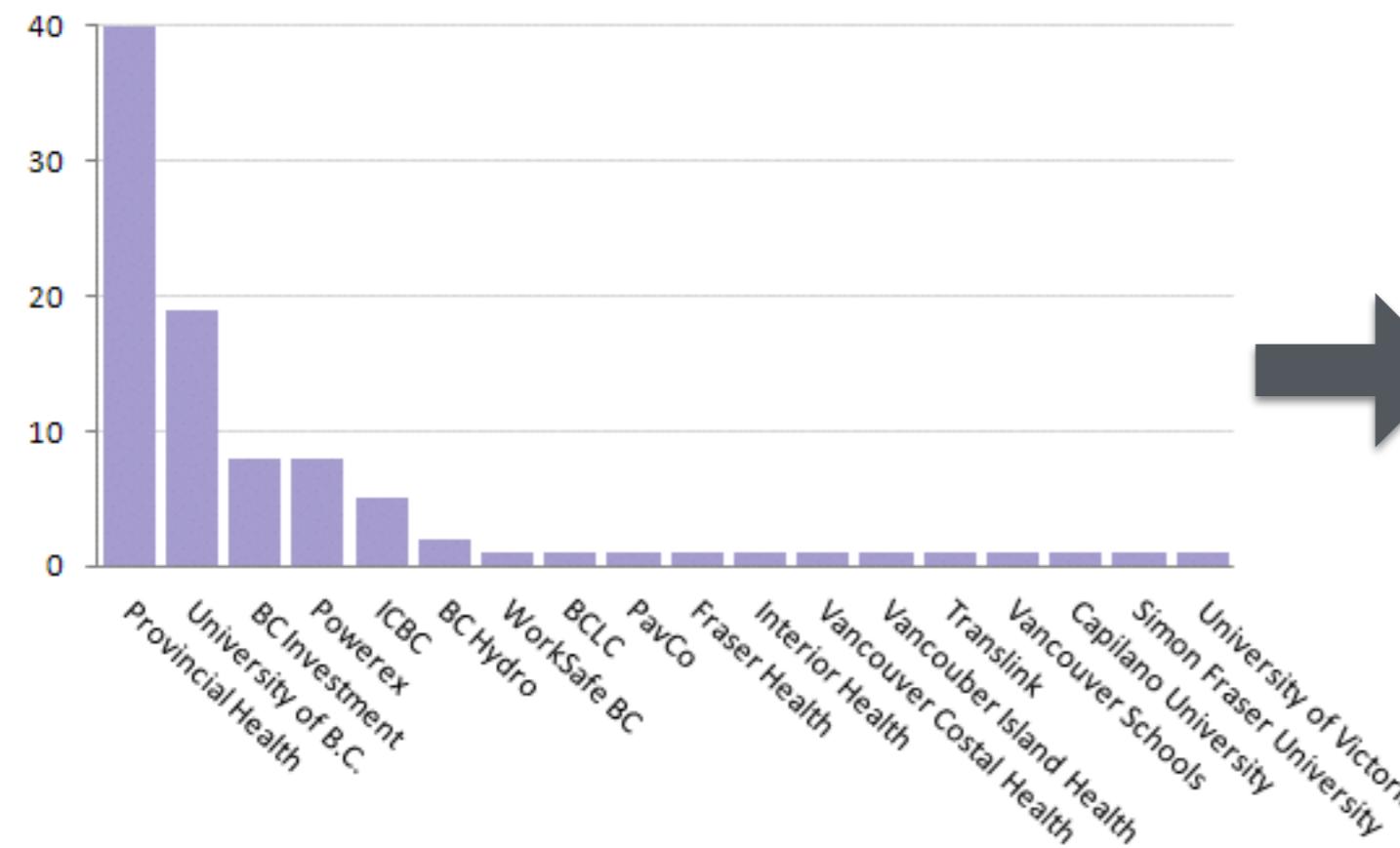
- 88% Broadcast reporter
 - 84% Camera Operator
 - 78% Columnist / Commentator
 - 78% Editor
 - 81% Photographer
 - 81% Internet reporter/writer
 - 81% Print reporter/writer
 - 78% Producer
 - 81% Publisher/Owner
 - 78% Technician

eagerpies.com



Close the Bars Down

<http://eagerpies.com/close-the-bars-down/>



The Periodic Table of the Elements

by Robert Creighton - version 1.4

18

4.002602
2372.3
He

Helium

$1s^2$

20.1797
2080.7

Ne

Neon

$1s^2\ 2s^2\ 2p^6$

39.948
1520.6

Ar

Argon

$[Ne]\ 3s^2\ 3p^6$

83.798
1350.8

Kr

Krypton

$[Ar]\ 3d^10\ 4s^2\ 4p^6$

132.9044
1008.4

Sb

Antimony

$[Kr]\ 4d^10\ 5s^2\ 5p^3$

126.9044
1008.4

Te

Tellurium

$[Kr]\ 4d^10\ 5s^2\ 5p^4$

131.293
1170.4

Xe

Xenon

$[Kr]\ 4d^10\ 5s^2\ 5p^6$

127.60
869.3

52

I

Iodine

$[Kr]\ 4d^10\ 5s^2\ 5p^5$

122.0
890.0

85

(220)

At

Astatine

$[Kr]\ 4f^14\ 5d^10\ 6s^2\ 6p^5$

117
(294)

Uuo

Ununoctium

$[Rn]\ 4f^14\ 5d^10\ 6s^2\ 6p^6$

| | |
|---------|----------|
| group 1 | 1 |
| H | Hydrogen |

| | |
|----|---------|
| 2 | 3 |
| Li | Lithium |

| | | |
|----|--------|-----------|
| 2 | 11 | 12 |
| Na | Sodium | Magnesium |

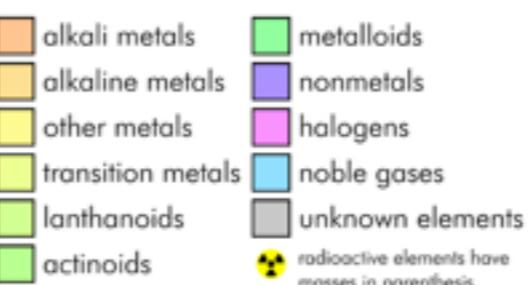
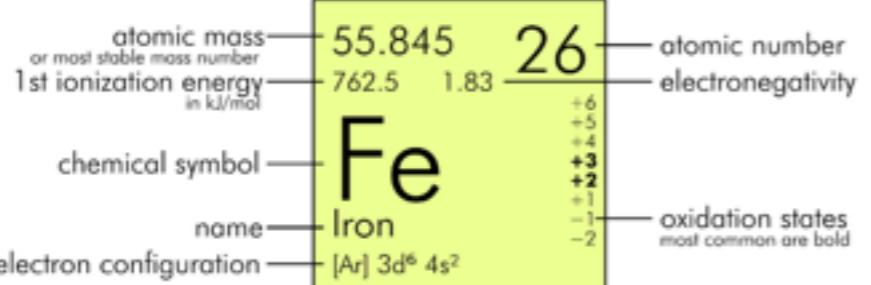
| | | |
|---|-----------|---------|
| 3 | 19 | 20 |
| K | Potassium | Calcium |

| | | |
|----|----------|----|
| 4 | 37 | 38 |
| Rb | Rubidium | Sr |

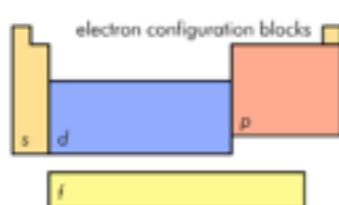
| | | |
|----|--------|----|
| 5 | 55 | 56 |
| Cs | Cesium | Ba |

| | | |
|----|----------|--------|
| 6 | 87 | 88 |
| Fr | Francium | Radium |

| | | |
|----|------------|---------------|
| 7 | 103 | 104 |
| Lr | Lawrencium | Rutherfordium |



| | | | | |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 13 | 14 | 15 | 16 | 17 |
| B | C | N | O | F |
| Boron | Carbon | Nitrogen | Oxygen | Fluorine |
| $[Ne]\ 2s^2\ 2p^1$ | $[Ne]\ 2s^2\ 2p^2$ | $[Ne]\ 2s^2\ 2p^3$ | $[Ne]\ 2s^2\ 2p^4$ | $[Ne]\ 2s^2\ 2p^5$ |
| 10.811 800.6 | 12.0107 1086.5 | 14.0067 1402.3 | 15.9994 1313.9 | 18.998403 1681.0 |
| 5 | 6 | 7 | 8 | 9 |
| Al | Si | P | S | Cl |
| Aluminium | Silicon | Phosphorus | Sulfer | Chlorine |
| $[Ne]\ 2s^2\ 2p^1$ | $[Ne]\ 2s^2\ 2p^2$ | $[Ne]\ 2s^2\ 2p^3$ | $[Ne]\ 2s^2\ 2p^4$ | $[Ne]\ 2s^2\ 2p^5$ |
| 26.98153 577.5 | 28.0855 786.5 | 30.97696 1011.8 | 32.065 999.6 | 35.453 1251.2 |
| 13 | 14 | 15 | 16 | 17 |
| Zn | Ga | Ge | As | Br |
| Zinc | Gallium | Germanium | Arsenic | Bromine |
| $[Ar]\ 3d^{10}\ 4s^2\ 4p^1$ | $[Ar]\ 3d^{10}\ 4s^2\ 4p^2$ | $[Ar]\ 3d^{10}\ 4s^2\ 4p^3$ | $[Ar]\ 3d^{10}\ 4s^2\ 4p^4$ | $[Ar]\ 3d^{10}\ 4s^2\ 4p^5$ |
| 69.723 578.8 | 72.64 782.0 | 74.92160 947.0 | 78.96 941.0 | 83.798 1350.8 |
| 31 | 32 | 33 | 34 | 35 |
| In | Ga | Ge | Se | Kr |
| Indium | Gallium | Germanium | Selenium | Krypton |
| $[Ar]\ 3d^{10}\ 4s^2\ 4p^5$ | $[Ar]\ 3d^{10}\ 4s^2\ 4p^6$ | $[Ar]\ 3d^{10}\ 4s^2\ 4p^7$ | $[Ar]\ 3d^{10}\ 4s^2\ 4p^8$ | $[Ar]\ 3d^{10}\ 4s^2\ 4p^9$ |
| 114.818 558.3 | 118.710 708.6 | 121.760 834.0 | 127.60 869.3 | 131.293 1170.4 |
| 49 | 50 | 51 | 52 | 54 |
| Cd | Sn | Sb | Te | Xe |
| Cadmium | Tin | Antimony | Tellurium | Xenon |
| $[Ar]\ 3d^{10}\ 4s^2\ 5p^1$ | $[Ar]\ 3d^{10}\ 4s^2\ 5p^2$ | $[Ar]\ 3d^{10}\ 4s^2\ 5p^3$ | $[Ar]\ 3d^{10}\ 4s^2\ 5p^4$ | $[Ar]\ 3d^{10}\ 4s^2\ 5p^5$ |
| 112.441 558.3 | 118.710 708.6 | 126.9044 1008.4 | 132.9327 1170.4 | 131.293 1170.4 |
| 48 | 50 | 51 | 52 | 54 |
| In | Sn | Sb | Te | Xe |
| Indium | Tin | Antimony | Tellurium | Xenon |
| $[Ar]\ 3d^{10}\ 4s^2\ 5p^5$ | $[Ar]\ 3d^{10}\ 4s^2\ 5p^6$ | $[Ar]\ 3d^{10}\ 4s^2\ 5p^7$ | $[Ar]\ 3d^{10}\ 4s^2\ 5p^8$ | $[Ar]\ 3d^{10}\ 4s^2\ 5p^9$ |
| 118.710 708.6 | 121.760 834.0 | 126.9044 1008.4 | 132.9327 1170.4 | 131.293 1170.4 |



notes

- * as of yet, elements 113-118 have no official name designated by the IUPAC.
- * 1 kJ/mol = 96.485 eV.
- * all elements are implied to have an oxidation state of zero.

| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-----------------------------|-----------------|----|-------------------|----|------------------|----|-------------------|----|------------------|-----|-------------------|-----|------------------|-----|
| 138.9054 538.1 | 57 | 140.116 534.4 | 58 | 140.9076 527.0 | 59 | 144.242 533.1 | 60 | (145) 540.0 | 61 | 150.36 544.5 | 62 | 151.964 547.1 | 63 | 157.25 553.4 | 64 | 158.9253 558.8 | 65 | 162.500 573.0 | 66 | 164.9303 581.0 | 67 | 167.259 589.3 | 68 | 168.9342 596.7 | 69 | 173.054 603.4 | |
| La | Ce | Pr | Nd | Pm | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | | | | | | | | | | | | | | |
| Lanthanum | Cerium | Praseodymium | Neodymium | Promethium | Samarium | Europium | Gadolinium | Terbium | Dysprosium | Holmium | Erbium | Thulium | Ytterbium | | | | | | | | | | | | | | |
| $[Ce]\ 5d^1\ 6s^2$ | $[Ce]\ 4f^1\ 5d^1\ 6s^2$ | $[Pr]\ 4f^1\ 5d^1\ 6s^2$ | $[Nd]\ 4f^2\ 5d^1\ 6s^2$ | $[Pm]\ 4f^1\ 5d^1\ 6s^2$ | $[Sm]\ 4f^2\ 5d^1\ 6s^2$ | $[Eu]\ 4f^3\ 5d^1\ 6s^2$ | $[Gd]\ 4f^4\ 5d^1\ 6s^2$ | $[Tb]\ 4f^5\ 5d^1\ 6s^2$ | $[Dy]\ 4f^6\ 5d^1\ 6s^2$ | $[Ho]\ 4f^7\ 5d^1\ 6s^2$ | $[Er]\ 4f^8\ 5d^1\ 6s^2$ | $[Tm]\ 4f^9\ 5d^1\ 6s^2$ | $[Yb]\ 4f^{10}\ 5d^1\ 6s^2$ | | | | | | | | | | | | | | |
| (227) 499.0 | 89 | 232.0380 587.0 | 90 | 231.0358 568.0 | 91 | 238.0289 597.6 | 92 | (237) 604.5 | 93 | (244) 584.7 | 94 | (243) 578.0 | 95 | (247) 581.0 | 96 | (247) 601.0 | 97 | (251) 608.0 | 98 | (252) 619.0 | 99 | (257) 627.0 | 100 | (258) 635.0 | 101 | (259) 642.0 | 102 |
| Ac | Th | Protactinium | Uranium | Neptunium | Plutonium | Americium | Curium | Berkelium | Cafornium | Einsteinium | Fermium | Mendelevium | No | | | | | | | | | | | | | | |
| Actinium | Thorium | Protactinium | Uranium | Neptunium | Plutonium | Americium | Curium | Berkelium | Cafornium | Einsteinium | Fermium | Mende | | | | | | | | | | | | | | | |

PERIODIC TABLE of WOOD

| | | | | | | | | | | | | | | | | | | | | | | | |
|--|-------------------------|---------------|------------------------|----------------|------------------------|-------------------|-------------------------|---------------|-------------------------|-------------------|------------------------|-------------------|-------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|------------------------|
| SITKA SPRUCE | 27 lbs/ft³ • 425 kg/m³ | NORTH AMERICA | | | | | | | | | | EUROPE | | | | | | | | | | | |
| WESTERN RED CEDAR | 22 lbs/ft³ • 370 kg/m³ | DOUGLAS FIR | 22 lbs/ft³ • 310 kg/m³ | | | | | | | | | ENGLISH YEW | 42 lbs/ft³ • 675 kg/m³ | WYCH ELM | 26 lbs/ft³ • 410 kg/m³ | LONDON PINE | 20 lbs/ft³ • 310 kg/m³ | EUROPEAN BEACH | 44 lbs/ft³ • 710 kg/m³ | ENGLISH WALNUT | 22 lbs/ft³ • 340 kg/m³ | NORWAY SPRUCE | 25 lbs/ft³ • 405 kg/m³ |
| RED ALDER | 28 lbs/ft³ • 450 kg/m³ | BOX ELDER | 30 lbs/ft³ • 480 kg/m³ | | | | | | | | | BOXWOOD | 41 lbs/ft³ • 675 kg/m³ | OLIVE | 32 lbs/ft³ • 520 kg/m³ | CEDAR OF LEBANON | 42 lbs/ft³ • 675 kg/m³ | ENGLISH OAK | 38 lbs/ft³ • 610 kg/m³ | SYCAMORE MAPLE | 42 lbs/ft³ • 680 kg/m³ | MASUR BIRCH | 42 lbs/ft³ • 680 kg/m³ |
| REDWOOD | 44 lbs/ft³ • 705 kg/m³ | HARD MAPLE | 35 lbs/ft³ • 540 kg/m³ | BASSWOOD | 36 lbs/ft³ • 575 kg/m³ | RED ELM | 42 lbs/ft³ • 675 kg/m³ | WHITE ASH | 43 lbs/ft³ • 680 kg/m³ | YELLOW BIRCH | 44 lbs/ft³ • 700 kg/m³ | SASSAFRAS | 31 lbs/ft³ • 485 kg/m³ | BUTTERNUT | 37 lbs/ft³ • 425 kg/m³ | AMERICAN CHESTNUT | 40 lbs/ft³ • 545 kg/m³ | AFRORMOSIA | 38 lbs/ft³ • 580 kg/m³ | EAST INDIAN ROSEWOOD | 42 lbs/ft³ • 675 kg/m³ | BAMBOO | 18 lbs/ft³ • 290 kg/m³ |
| QUARO WALNUT | 40 lbs/ft³ • 640 kg/m³ | OSAGE ORANGE | 54 lbs/ft³ • 835 kg/m³ | BLACK LOCUST | 58 lbs/ft³ • 800 kg/m³ | SHAGBARK HICKORY | 50 lbs/ft³ • 770 kg/m³ | WHITE OAK | 52 lbs/ft³ • 520 kg/m³ | EASTERN RED CEDAR | 47 lbs/ft³ • 735 kg/m³ | SYCAMORE | 34 lbs/ft³ • 545 kg/m³ | BLACK WALNUT | 29 lbs/ft³ • 455 kg/m³ | SOUTHERN YELLOW POPLAR | 36 lbs/ft³ • 410 kg/m³ | BALD CYPRESS | 32 lbs/ft³ • 515 kg/m³ | ODANGKOL | 31 lbs/ft³ • 515 kg/m³ | TEAK | 42 lbs/ft³ • 675 kg/m³ |
| KATALOK | 72 lbs/ft³ • 1150 kg/m³ | BOCOTE | 53 lbs/ft³ • 835 kg/m³ | COCOBOLA | 46 lbs/ft³ • 725 kg/m³ | HONDURAN MAHOGANY | 41 lbs/ft³ • 635 kg/m³ | REDHEART | 42 lbs/ft³ • 640 kg/m³ | ZI-COTE | 47 lbs/ft³ • 725 kg/m³ | HONDURAN ROSEWOOD | 75 lbs/ft³ • 1200 kg/m³ | KINGWOOD | 62 lbs/ft³ • 970 kg/m³ | CHICHEN | 43 lbs/ft³ • 680 kg/m³ | CHAXTE VIGA | 40 lbs/ft³ • 640 kg/m³ | AFRICAN MAHOGANY | 54 lbs/ft³ • 870 kg/m³ | LIPIA | 43 lbs/ft³ • 730 kg/m³ |
| SPANISH CEDAR | 29 lbs/ft³ • 470 kg/m³ | ZATIBA | 37 lbs/ft³ • 595 kg/m³ | PURPLEHEART | 38 lbs/ft³ • 595 kg/m³ | OSMUNDIA UNTA | 37 lbs/ft³ • 595 kg/m³ | GONCALO ALVES | 37 lbs/ft³ • 595 kg/m³ | SANTOS MAHOGANY | 36 lbs/ft³ • 595 kg/m³ | LEOPARDWOOD | 9 lbs/ft³ • 150 kg/m³ | BALSA | 29 lbs/ft³ • 445 kg/m³ | PRIMAVERA | 36 lbs/ft³ • 460 kg/m³ | MONKEYPOD | 40 lbs/ft³ • 955 kg/m³ | GAROOON EBONY | 42 lbs/ft³ • 685 kg/m³ | MAKORE | 45 lbs/ft³ • 725 kg/m³ |
| CENTRAL AMERICA | | SOUTH AMERICA | | | | | | | | | | AFRICA | | | | | | | | | | | |
| AVERAGE DRIED WEIGHT (AT 12% MOISTURE CONTENT) | 49 lbs/ft³ • 800 kg/m³ | MACACUSA | 48 lbs/ft³ • 700 kg/m³ | CUMARU | 27 lbs/ft³ • 430 kg/m³ | PERUVIAN WALNUT | 54 lbs/ft³ • 860 kg/m³ | PAU FERRO | 43 lbs/ft³ • 680 kg/m³ | MARKERWOOD | 42 lbs/ft³ • 680 kg/m³ | TULIPWOOD | 52 lbs/ft³ • 825 kg/m³ | GREENHEART | 50 lbs/ft³ • 825 kg/m³ | BRAZILIAN ROSEWOOD | 50 lbs/ft³ • 825 kg/m³ | SHARKWOOD | 50 lbs/ft³ • 825 kg/m³ | MUNINGA | 41 lbs/ft³ • 640 kg/m³ | IROKO | 47 lbs/ft³ • 670 kg/m³ |
| WOOD SAMPLE | 52 lbs/ft³ • 830 kg/m³ | CANARYWOOD | 52 lbs/ft³ • 825 kg/m³ | BLACK MESQUITE | 23 lbs/ft³ • 330 kg/m³ | LACEWOOD | 76 lbs/ft³ • 1180 kg/m³ | VERAWOOD | 44 lbs/ft³ • 1025 kg/m³ | CEBIL | 52 lbs/ft³ • 825 kg/m³ | IPÊ | 48 lbs/ft³ • 1000 kg/m³ | 48 lbs/ft³ • 640 kg/m³ | BLOODWOOD | 48 lbs/ft³ • 640 kg/m³ | IMBA | 34 lbs/ft³ • 530 kg/m³ | ANIGRE | 46 lbs/ft³ • 705 kg/m³ | PINK IVORY | 79 lbs/ft³ • 1270 kg/m³ | |
| COMMON NAME | | | | | | | | | | | | | | | | | | | | | | | |
| A SPECIAL THANKS TO STEVE EARL, JUSTIN HOLDRIDGE, AND KURT LOFGREN FOR PROVIDING SOME OF THE WOOD SAMPLES USED IN THIS POSTER. COMPILED BY © 2014 ERIC WEILER. ALL RIGHTS RESERVED. | | | | | | | | | | | | | | | | | | | | | | | |
| AUSTRALIAN RED CEDAR | | | | | | | | | | | | | | | | | | | | | | | |
| SILKY OAK | | | | | | | | | | | | | | | | | | | | | | | |
| AUSTRALIAN CYPRESS | | | | | | | | | | | | | | | | | | | | | | | |
| AUSTRALIAN BLACKWOOD | | | | | | | | | | | | | | | | | | | | | | | |

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The Periodic Table of ACCOUNTING ELEMENTS

<http://www.opencolleges.edu.au/careers/periodic-table-of-accounting-elements>

| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------|----------------------|--------------------|-------------------|----------------------|----------------------|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-----------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|-------------------|---------------------|----------------|---------------------|------------------|----------------|----------------|--------|
| CA | SDJ | FX | VA | PDJ | CRJ | MX | AE | DR | CR | AP | AR | PC | IN | COGS | LB | BS | RE | PIC | ADA | A | AM | L | OE | OC | RT | PO | |
| Chart of Accounts | Sales Distr. Journal | Fixed | Variable | Pur Distr. Journal | Cash Rec. Journal | Mixed | Accounting Equation | Debit | Credit | Accounts Payable | Accounts Receivable | Petty Cash | Inventory | Cost of Goods Sold | Ledger Balances | Balance Sheet | Retained Earnings | Paid In Capital | Allowance Doubtful Acc | Assets | Liability | Owners' Equity | Outstanding Cheques | Receiving Ticket | Purchase Order | | |
| SDJ | VA | PDJ | CRJ | MX | AE | DR | CR | AP | AR | PC | IN | COGS | LB | BS | RE | DWM | PS | CNC | ABP | TD | TDIT | TD | TD | TD | TD | | |
| Sales Distr. Journal | Variable | Pur Distr. Journal | Cash Rec. Journal | Mixed | Accounting Equation | Debit | Credit | Accounts Payable | Accounts Receivable | Petty Cash | Inventory | Cost of Goods Sold | Ledger Balances | Balance Sheet | Retained Earnings | Direct Write off Method | Percentage of Sales | Current & Non-Current | Adjusted Bal Book, Bank | Purchase Discount | Deposits In Transit | Trade Discount | Trade Discount | Trade Discount | Trade Discount | Trade Discount | |
| PDJ | CRJ | MX | AE | DR | CR | AP | AR | PC | IN | COGS | LB | BS | RE | DWM | PS | CNC | ABP | TD | TD | TD | TD | TD | TD | TD | TD | | |
| Cash Rec. Journal | Cash Paym. Journal | General Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | N30 | N30 | N30 | N30 | N30 | | | |
| CRJ | CPJ | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | | |
| Cash Paym. Journal | Cash Paym. Journal | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | |
| MX | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | | |
| Mixed | Contri Margin | General Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | |
| AE | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | | |
| Accounting Equation | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | |
| DR | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | | |
| Debit | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | |
| CR | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Credit | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| AP | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Accounts Payable | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| AR | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Accounts Receivable | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| PC | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Petty Cash | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| IN | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Inventory | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| COGS | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Cost of Goods Sold | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| LB | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Ledger Balances | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| BS | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Balance Sheet | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| RE | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Retained Earnings | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| DWM | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Direct Write off Method | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| PS | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Percentage of Sales | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| CNC | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Current & Non-Current | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 | Net 30 |
| ABP | CM | GL | TB | IS | GST | GSTP | GSTR | PIM | PDCIM | TF | CF | CI | TS | PAR | AAR | DDEP | PD | PD | PD | PD | PD | PD | PD | PD | PD | PD | |
| Adjusted Bal Book, Bank | Contri Margin | General Ledger | Trial Balance | Income Statement | Goods & Services Tax | GST Payable | GST Receivable | Perp Invent. Method | Perp Invent. Method | T Format | Columnar Format | Comprehen Income | Treasury Stock | Percentage of Acc Rec | Aging of Acc Rec | Demand Deposits | Net 30 | Net 30 | Net 30 | Net 30 | | | | | | | |

| | |
|-----|-----------------|
| H | He |
| Li | Heineken |
| Be | Bing |
| Tin | Coca-Cola |
| Na | Nestle |
| Mg | Oogle |
| K | F |
| Ca | Ne |
| Sc | He |
| Ti | Heineken |
| V | Heineken |
| Cr | Heineken |
| Mn | Heineken |
| Fe | Heineken |
| Co | Heineken |
| Ni | Heineken |
| Cu | Heineken |
| Zn | Heineken |
| Ga | Heineken |
| Ge | Heineken |
| As | Heineken |
| Se | Heineken |
| Br | Heineken |
| Kr | Heineken |
| Rb | Canadian Club |
| Sr | Schweppes |
| Y | TIME |
| Zr | Dove Magazine |
| Nb | TIME |
| Mo | TIME |
| Tc | TIME |
| Ru | TIME |
| Pd | TIME |
| Ag | TIME |
| Cd | TIME |
| In | TIME |
| Sn | TIME |
| Sb | TIME |
| Te | TIME |
| I | TIME |
| Xe | TIME |
| Cs | British Airways |
| Ba | Hillshire Farm |
| Hf | Hillshire Farm |
| Ta | Hillshire Farm |
| W | Hillshire Farm |
| Re | Hillshire Farm |
| Os | Hillshire Farm |
| Ir | Hillshire Farm |
| Pt | Hillshire Farm |
| Au | Hillshire Farm |
| Hg | Hillshire Farm |
| Tl | Hillshire Farm |
| Pb | Hillshire Farm |
| Bi | Hillshire Farm |
| Po | Hillshire Farm |
| At | Hillshire Farm |
| Rn | Hillshire Farm |
| Fr | RadioShack |
| Ra | RadioShack |
| Rf | RadioShack |
| Db | RadioShack |
| Sg | RadioShack |
| Bh | RadioShack |
| Hs | RadioShack |
| Mt | RadioShack |
| Ds | RadioShack |
| Rg | RadioShack |
| Cn | RadioShack |
| Uut | RadioShack |
| A | RadioShack |
| Uup | RadioShack |
| Lv | RadioShack |
| Uus | RadioShack |
| Uuo | RadioShack |
| La | Century 21 |
| Ce | Century 21 |
| Pr | Progressive |
| Nd | Progressive |
| Pm | Progressive |
| Sm | Progressive |
| Eu | Progressive |
| Gd | Progressive |
| Tb | Progressive |
| Dy | Progressive |
| Ho | Progressive |
| Er | Progressive |
| Tm | Progressive |
| Yb | Progressive |
| Lu | Progressive |
| Ac | Under Armour |
| Th | Under Armour |
| Pa | Under Armour |
| U | Under Armour |
| Np | Under Armour |
| Pu | Under Armour |
| Am | Under Armour |
| Cm | Under Armour |
| Bk | Under Armour |
| Cr | Under Armour |
| Es | Under Armour |
| Fm | Under Armour |
| Md | Under Armour |
| No | Under Armour |
| Lr | Under Armour |



Periodic Table of Marketing Elements

1 Cu
Curiosity

2 Da
Display Advertising

3 Ns
Natural Search (SEO)

4 Em
Email

6 Ps
Paid Search

7 Sm
Social Media

8 Dm
Direct Mail

9 Rt
Retargeting

13 Af
Affiliate Program

14 Bl
Blogging

15 Im
Images

16 We
Website Enhancements

17 Bc
Basecamp

18 Lc
Liveclicker

19 S7
Scene 7

20 Pw
PR Web

21 Ir
Internet Retailer

22 Bg
Bing Ads Editor

23 Et
Exact Target

24 Tw
Twitter

25 Wp
Wordpress

26 Sr
SEM Rush

27 Ce
CEO Letter

28 Cn
Contests

29 Ep
Empathy

30 Sf
SureFit Guarantees

31 Sh
Shopping Engines

32 Pr
Public Relations

33 Pm
Promotions

34 Fs
Free Samples

35 Gz
Gomez

36 Lv
Livperson

37 Ps
Photoshop

38 Ci
Cision

39 So
Shop.org

40 Pn
Pinterest

41 Bv
Bazaarvoice

42 Fb
Facebook

43 Sv
Survey Monkey

44 Ck
Cake

45 Ut
User Testing

46 Cg
Crazy Egg

47 Sp
Speed

48 Cs
Customer Service

49 Np
New Products

50 Ba
Brand Ambassadors

51 Ab
A/B Testing

52 Mc
Merchandising

53 Tt
Test & Target

54 Fw
Fireworks

55 Pp
Premiere Pro

56 Mb
Media Bistro

57 Ad
Google Adwords

58 Mn
Mantis

59 El
Excel

60 Yt
Youtube

61 Sk
Shortstack

62 Ex
Experimenting

63 Be
Brightedge

64 Ss
Site Surveys

65 Cl
Call Reviews

66 F2
Face2Face

67 Ra
Radio

68 Ap
Apps

69 Mv
Multivariate Testing

70 Bt
Behavioural Targeting

71 Om
Omniture

72 Dw
Dreamweaver

73 Ae
After Effects

74 Ai
Illustrator

75 Ss
Sprout Social

76 Hz
Houzz

77 Ga
Google Analytics

78 Go
Google Optimizer

79 Gt
Google Trends

80 Ev
eSearch Vision

81 Ja
Coffee

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Attract Prospects
Convert Prospects into Customers
Tools
Get Customer Feedback
Make it Surprisingly Easy and Exciting So They Tell Everyone!

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1st Time Right

10 Fs
Free Shipping

11 Vi
Videos

12 Rp
Referral Programs

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A PERIODIC TABLE OF VISUALIZATION METHODS

| | | | |
|--|---|---|---|
| > < C continuum | Data Visualization Visual representations of quantitative data in schematic form (either with or without axes) | Strategy Visualization The systematic use of complementary visual representations in the analysis, development, formulation, communication, and implementation of strategies in organizations. | G graphic facilitation |
| > < Tb table | > < Ca cartesian coordinates | Information Visualization The use of interactive visual representations of data to amplify cognition. This means that the data is transformed into an image, it is mapped to screen space. The image can be changed by users as they proceed working with it | Metaphor Visualization Visual Metaphors position information graphically to organize and structure information. They also convey an insight about the represented information through the key characteristics of the metaphor that is employed |
| > < Pi pie chart | > < L line chart | Concept Visualization Methods to elaborate (mostly) qualitative concepts, ideas, plans, and analyses. | Compound Visualization The complementary use of different graphic representation formats in one single schema or frame |
| > < B bar chart | > < Ac area chart | > < R radar chart cobweb | > < Me meeting trace |
| > < Hi histogram | > < Sc scatterplot | > < Sa sankey diagram | > < Mm metro map |
| > < Hy hyperbolic tree | > < Pa parallel coordinates | > < Hy hyperbolic tree | > < Tm temple |
| > < Cy cycle diagram | > < Ey cycle diagram | > < T timeline | < > St story template |
| > < Ve venn diagram | > < Ve venn diagram | > < Mi mindmap | > < Tr tree |
| > < Li layer chart | < > Sq square of oppositions | > < Cc concentric circles | G graphic facilitation |
| > < Cl clustering | > < Ar argument slide | > < Sw swim lane diagram | > < Ct cartoon |
| > < Fl flow chart | > < Co communication diagram | > < Gc gantt chart | |
| > < Cl clustering | > < Fp flight plan | > < Pm perspectives diagram | |
| > < Py minto pyramid technique | > < Ds dilemma diagram | > < D dilemma diagram | |
| > < Ce cause-effect chains | > < Tl toulmin map | > < Pr parameter ruler | |
| > < Tl toulmin map | > < Dt decision tree | > < Kn knowledge map | |
| > < Cp cpm critical path method | > < Cf concept fan | > < Ic iceberg | |
| > < Cp concept fan | > < Co concept map | > < Lm learning map | |
| > < Ev evocative knowledge map | > < V Vee diagram | > < Hh heaven 'n' hell chart | |
| > < Pe pert chart | > < I infomural | | |
| > < Pr process event chains | | | |
| > < Le force field diagram | | | |
| > < Il ibis argumentation map | | | |
| > < Pr process event chains | | | |
| > < Pe pert chart | | | |
| > < Ev evocative knowledge map | | | |
| > < V Vee diagram | | | |
| > < Hh heaven 'n' hell chart | | | |
| > < I infomural | | | |

Cy Process Visualization

Note: Depending on your location and connection speed it can take some time to load a pop-up picture.

version 1.5

Hy Structure Visualization

○ Overview
□ Detail

○ Detail AND Overview

< > Divergent thinking

> < Convergent thinking

| | | | | | | | | | | | | | |
|---|--|--|---|---|--------------------------------------|--|------------------------------------|--|--|-------------------------------|--|------------------------------------|--|
| > < Su supply demand curve | > < Pc performance charting | > < St strategy map | > < Oc organisation chart | < > Ho house of quality | > < Fd feedback diagram | □ Ft failure tree | > < Mq magic quadrant | > < Ld life-cycle diagram | > < Po porter's five forces | < > S s-cycle | > < Sm stakeholder map | ○ Is ishikawa diagram | > < Tc technology roadmap |
| > < Ed edgeworth box | > < Pf portfolio diagram | > < Sg strategic game board | > < Mz mintzberg's organigraph | < > Z zwicky's morphological box | < > Ad affinity diagram | □ De decision discovery diagram | > < Bm bcg matrix | > < Stc strategy canvas | > < Vc value chain | < > Hy hye-cycle | > < Sr stakeholder rating map | > < Ta taps | < > Sd spray diagram |

http://www.visual-literacy.org/periodic_table/periodic_table.html

Visualization is not Periodic, Period!

Robert Kosara, <http://eagereyes.org/blog/2009/visualization-is-not-periodic-html>

Much better...

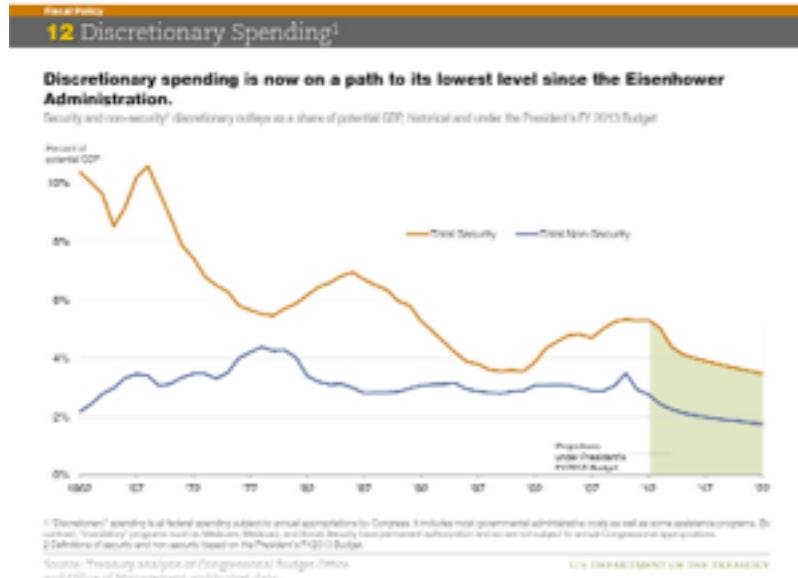
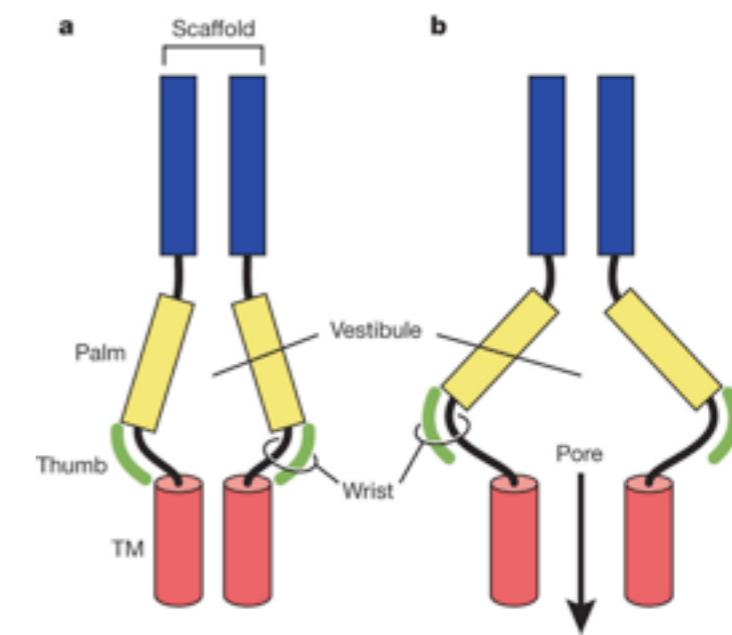
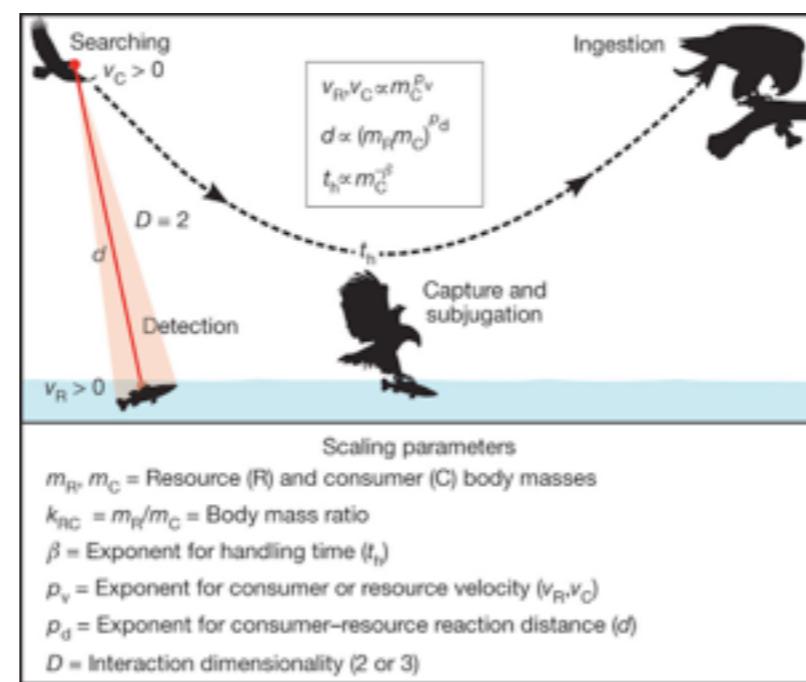
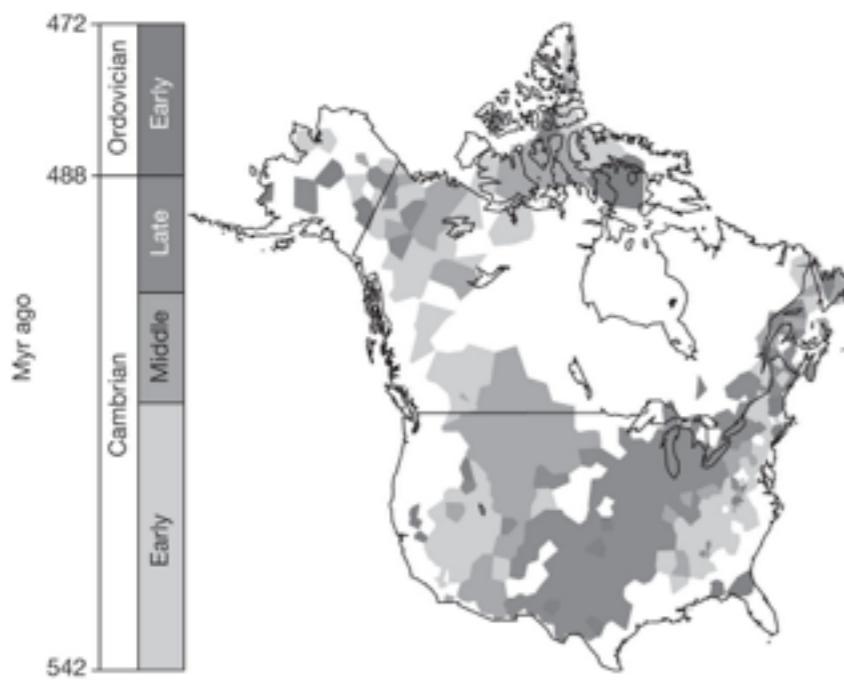
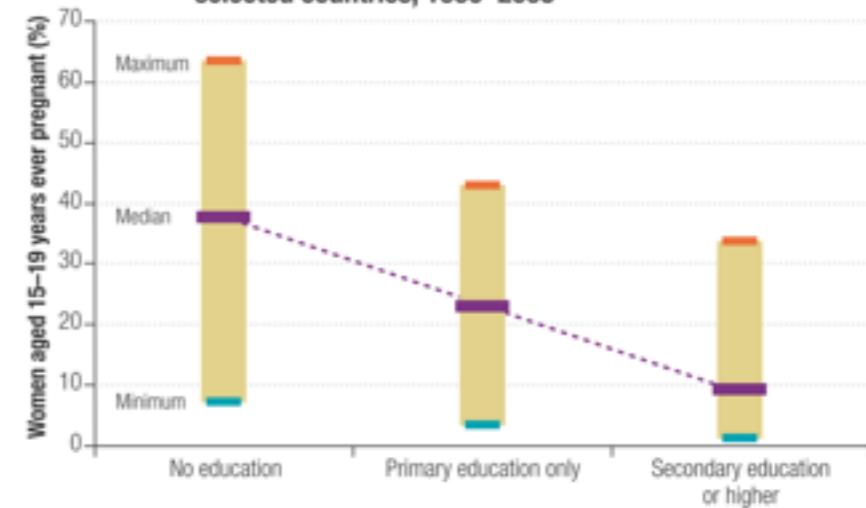
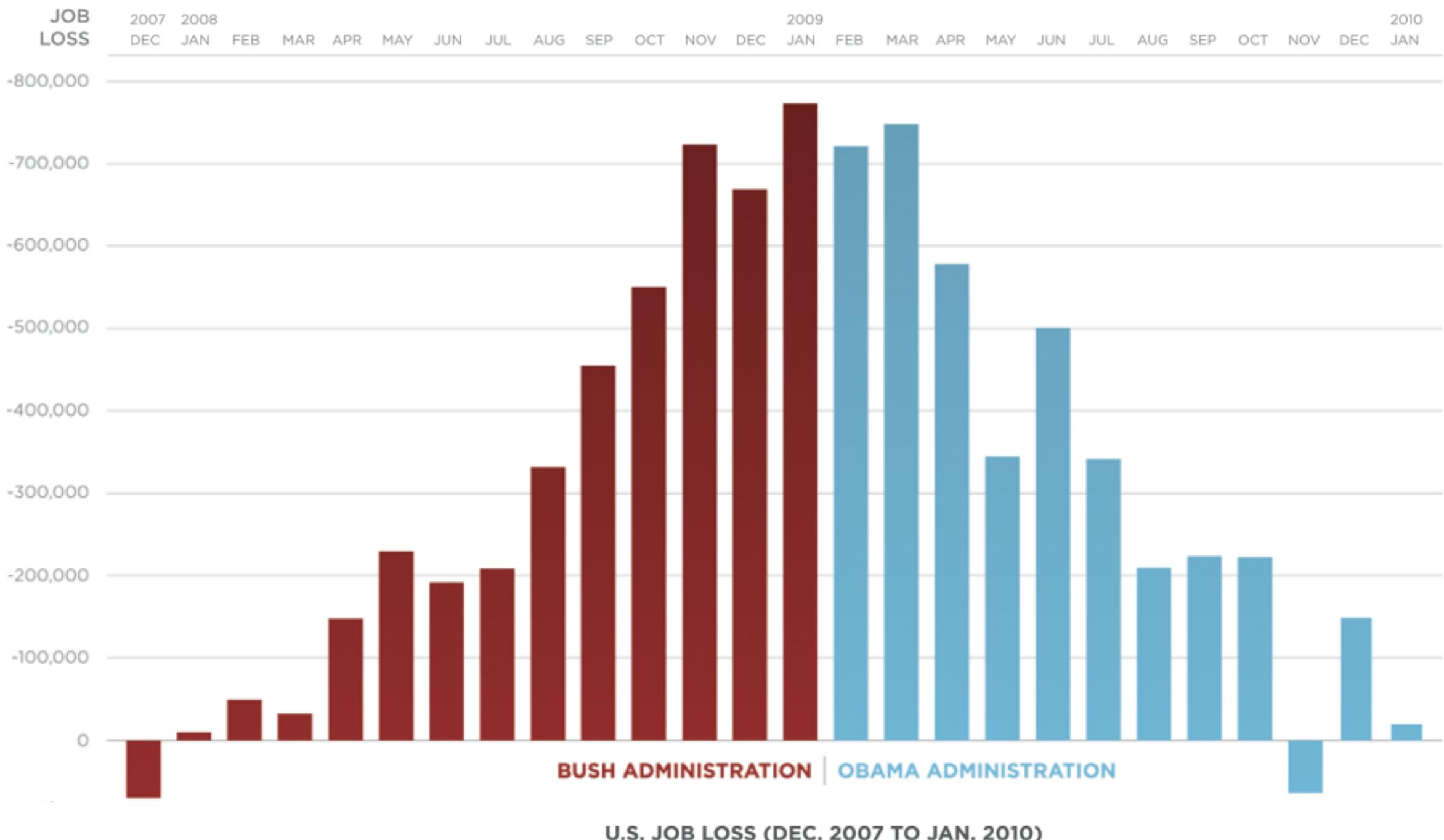


Figure 2 Adolescence pregnancy rates by educational level, selected countries, 1990–2005



Sources: US Treasury, WHO, Nature

Bikini Chart



SOURCE: BUREAU OF LABOR STATISTICS, 02/12/2010

What exactly makes a
visualization effective?

Visual Variables

Jacques Bertin

French cartographer
[1918-2010]

Book: Semiology of Graphics
[1967]

Theoretical principles for
visual encodings



Visual Marks

Basic geometric elements

→ Points



0D

→ Lines



1D

→ Areas



2D

Visual Variables (aka Channels)

④ Position

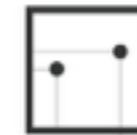
→ Horizontal



→ Vertical



→ Both



④ Color



④ Shape



④ Tilt



④ Size

→ Length



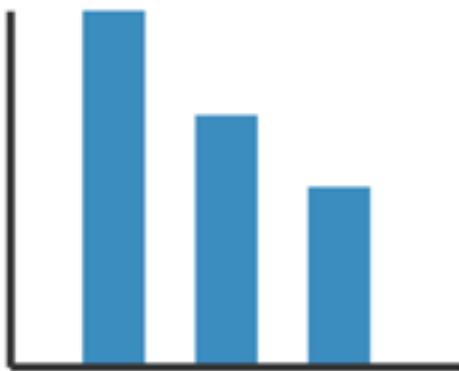
→ Area



→ Volume



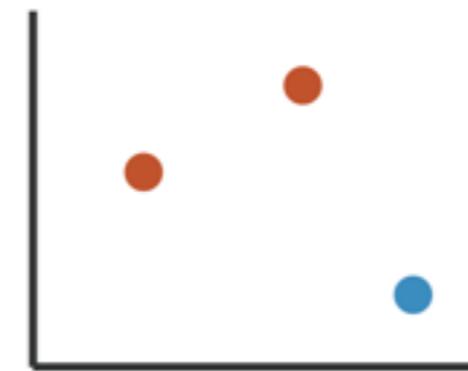
Using Marks and Attributes



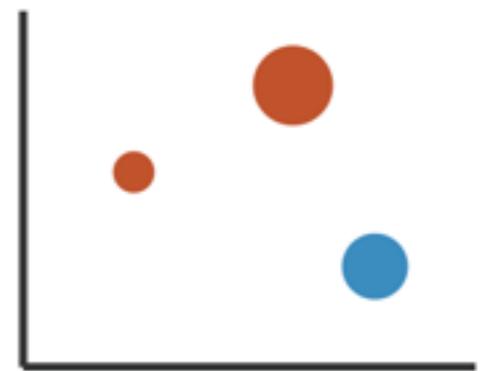
Length



Position



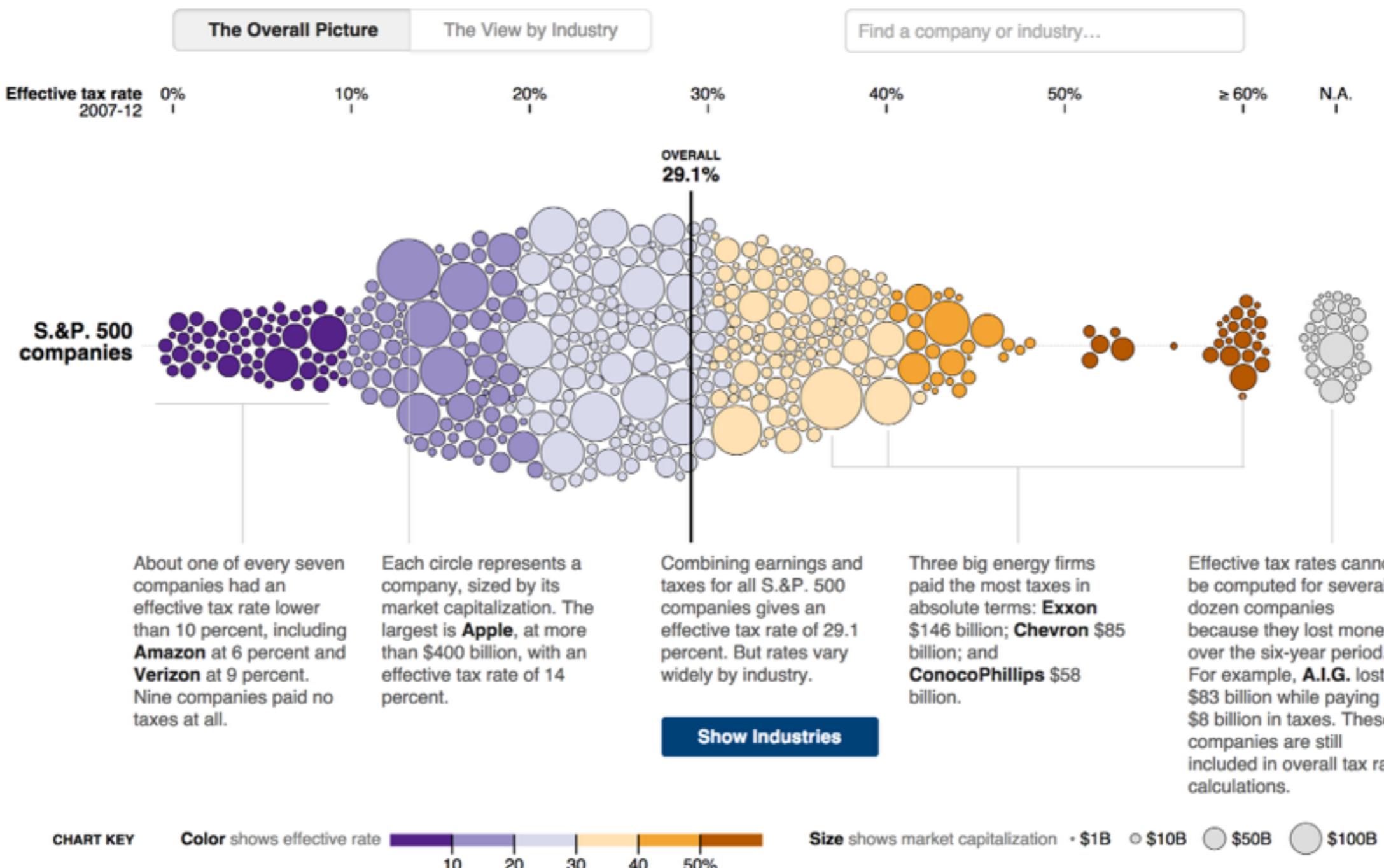
Color



Size

Across U.S. Companies, Tax Rates Vary Greatly

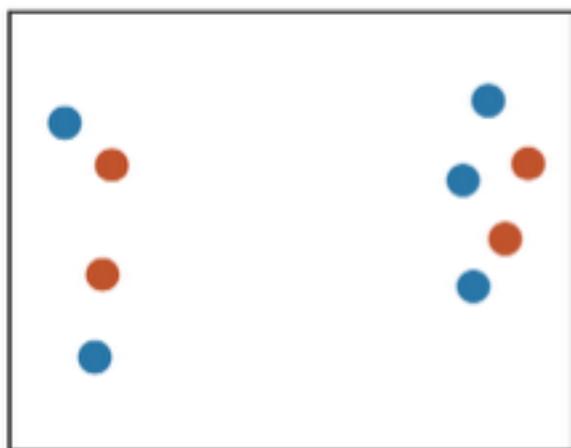
Last week, in a Congressional hearing, Apple got grilled for its low-tax strategy. But not every business can copy that approach. Here is a look at what S&P 500 companies paid in corporate income taxes — federal, state, local and foreign — from 2007 to 2012, according to S&P Capital IQ. [Related Article »](#)



What visual variables are used?

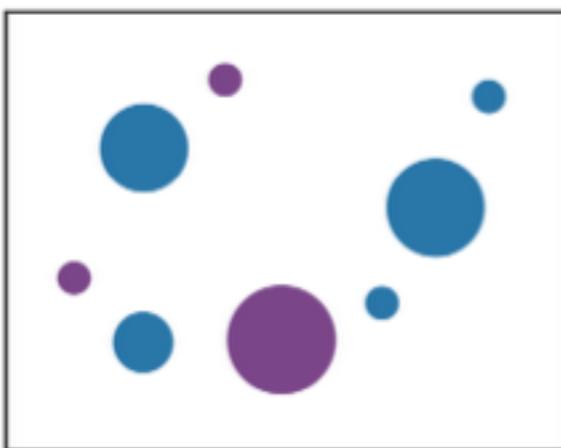
Separability of Attributes

Position
+ Hue (Color)



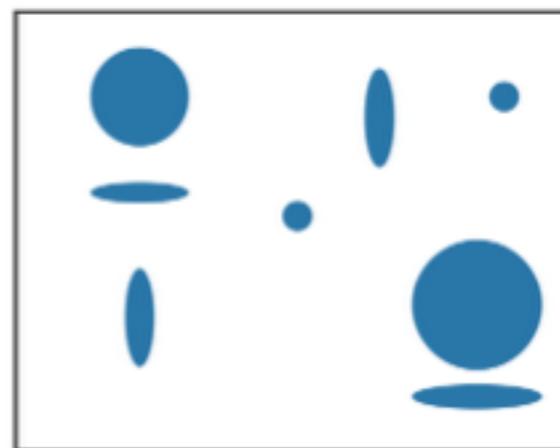
Fully separable

Size
+ Hue (Color)



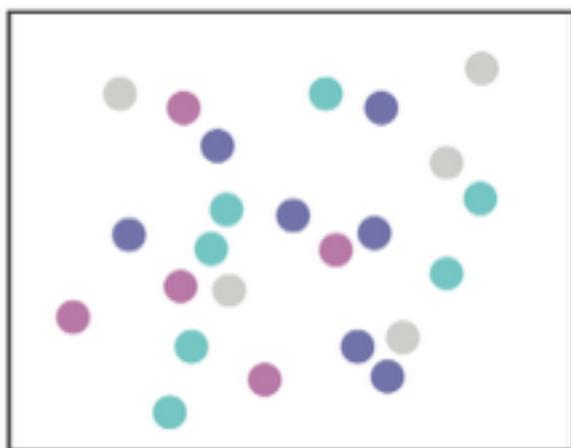
Some interference

Width
+ Height



Some/significant
interference

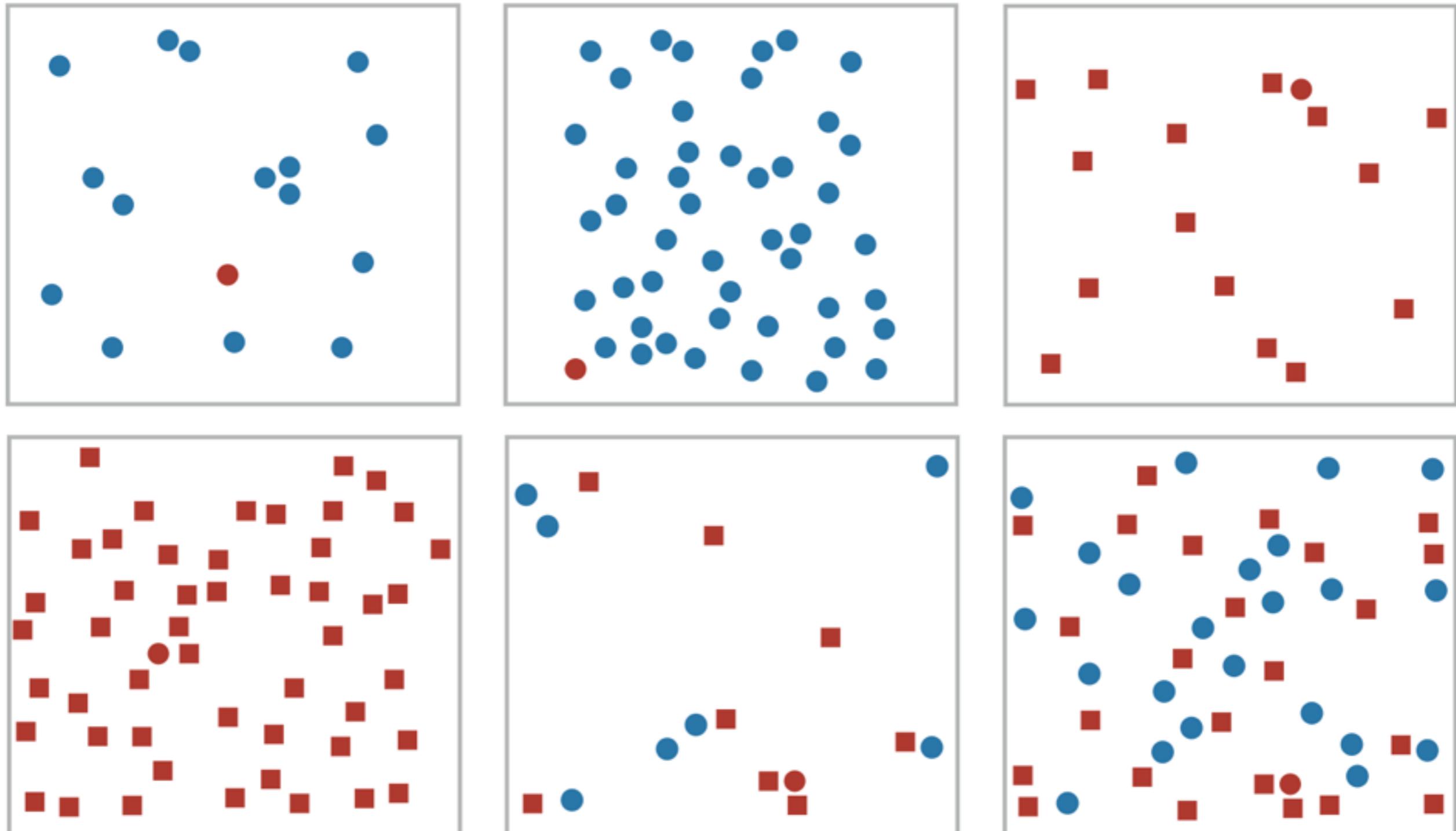
Red
+ Green



Major interference

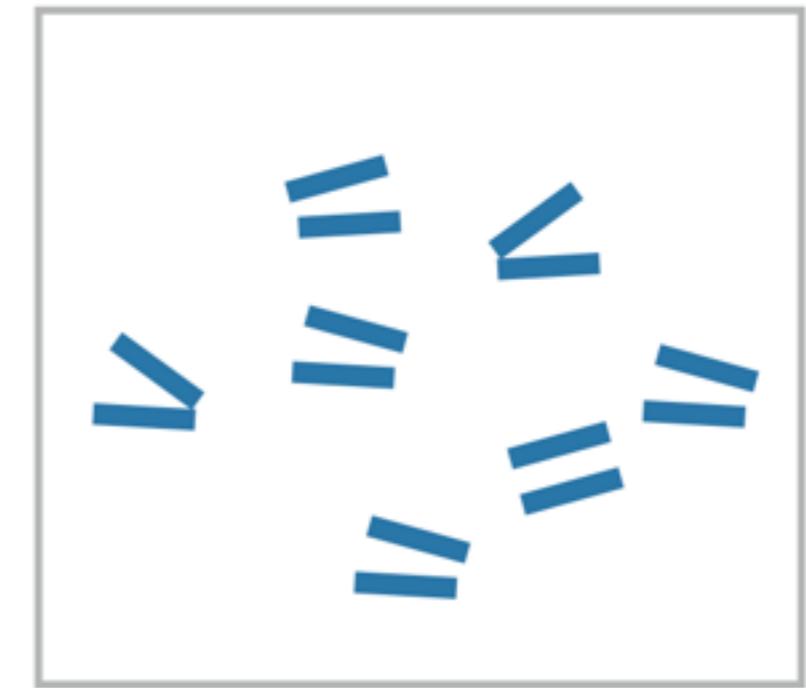
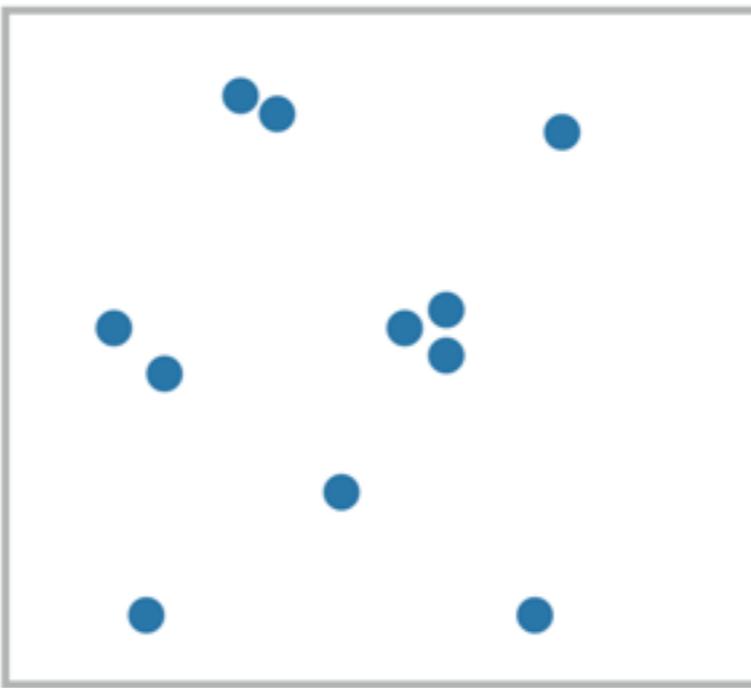
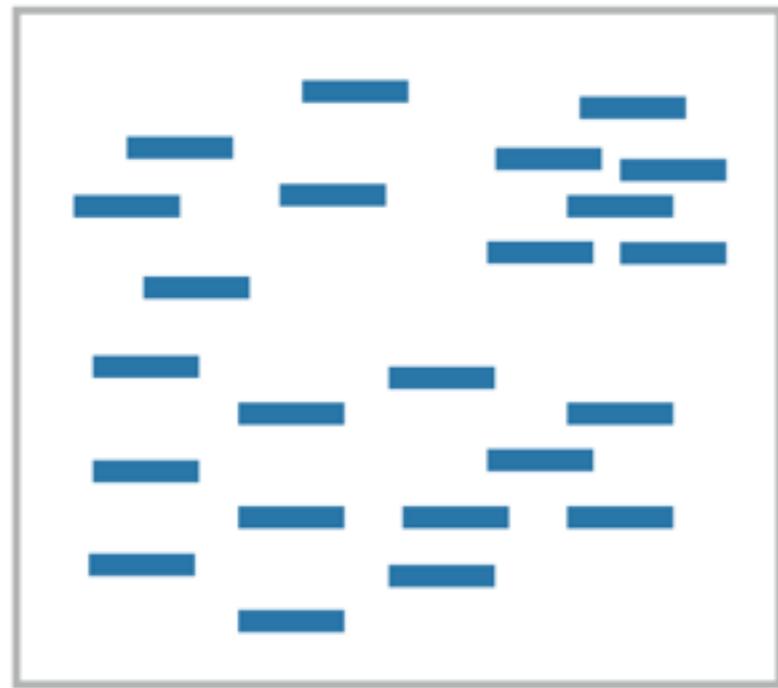
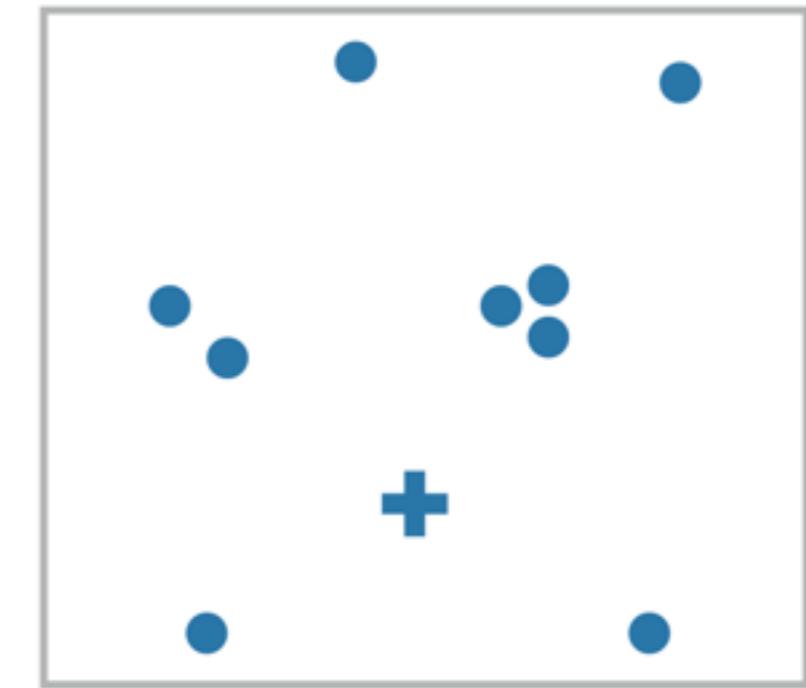
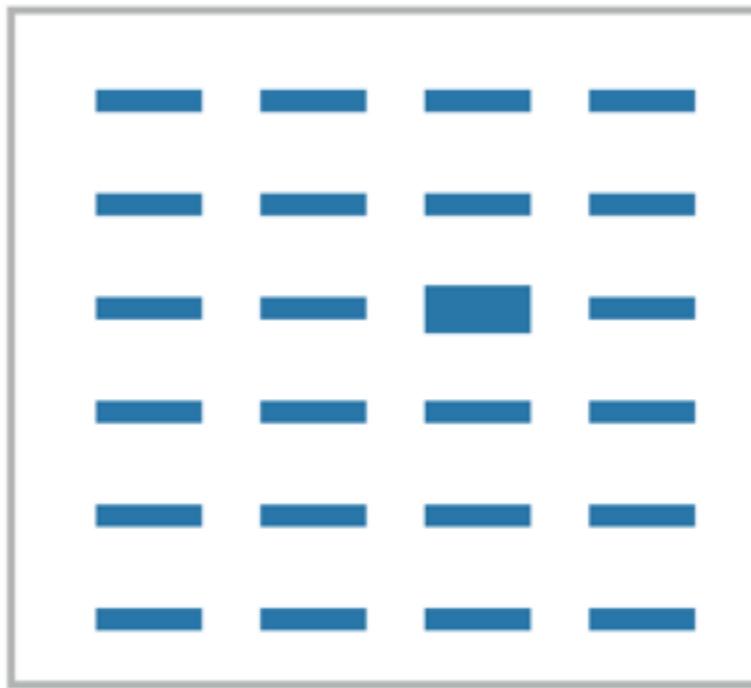
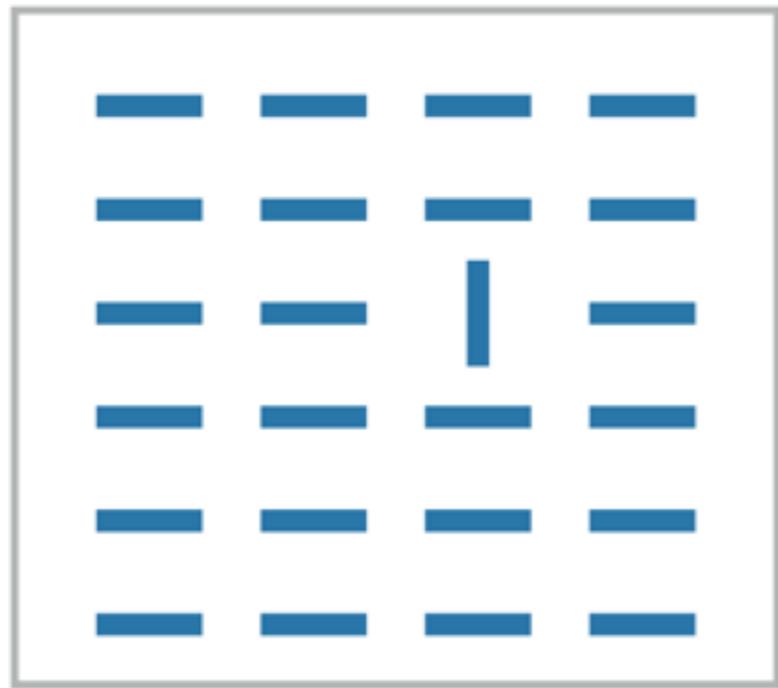
Visual Popout

Preattentive Features

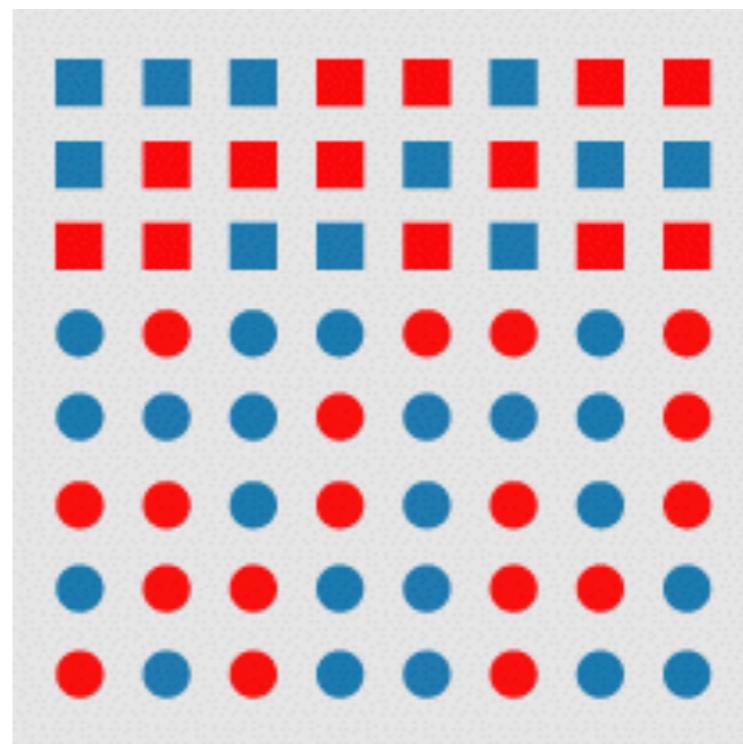
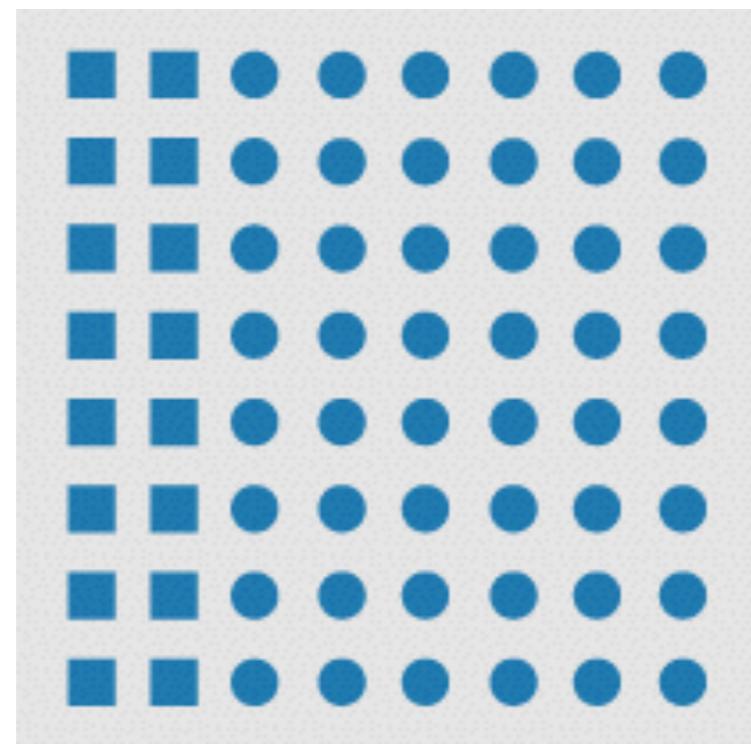
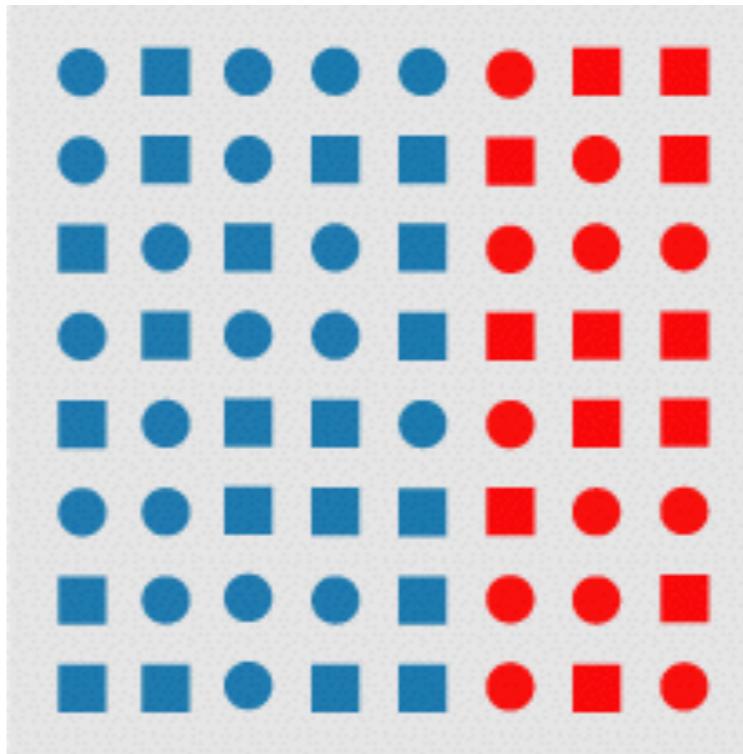
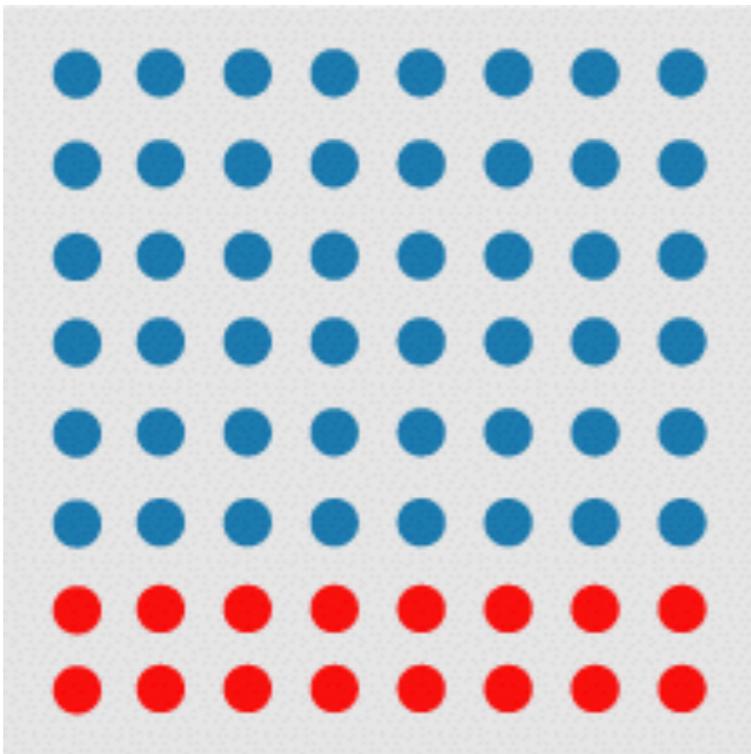


Visual Popout

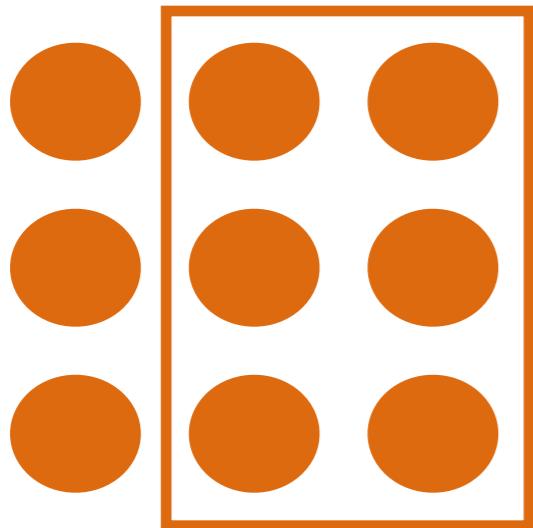
Preattentive Features



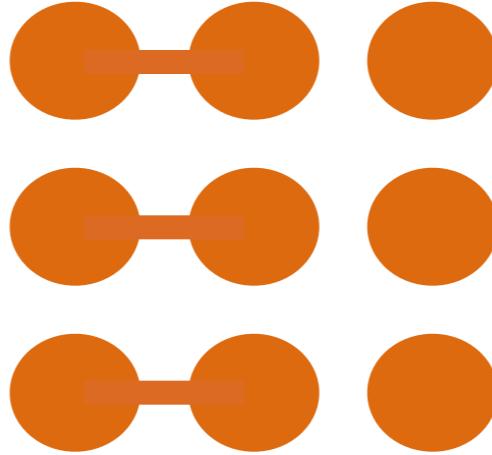
Feature Hierarchy



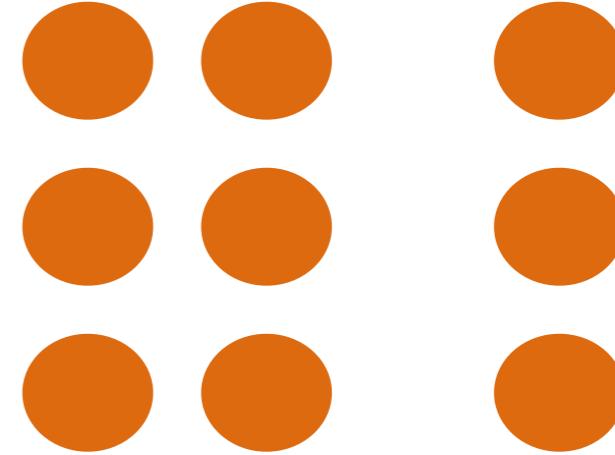
Grouping Principles



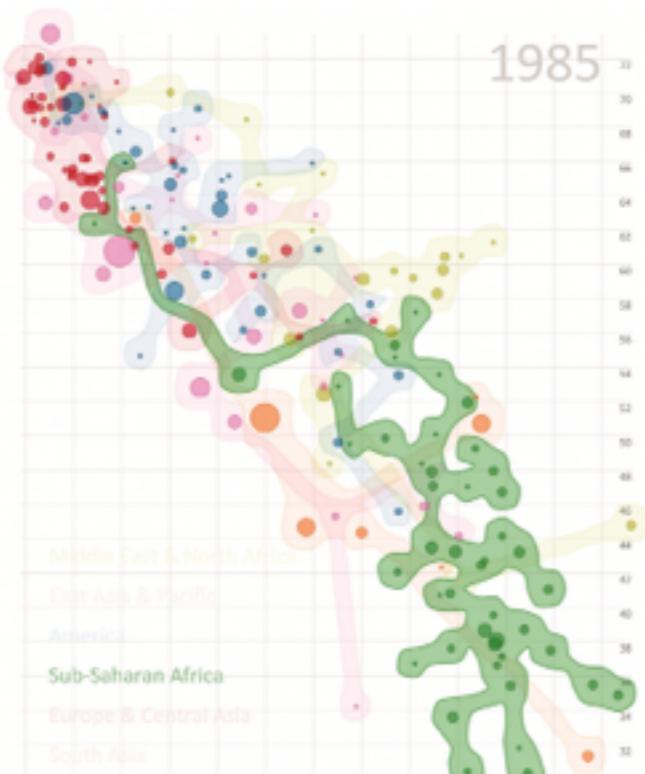
Containment



Connection



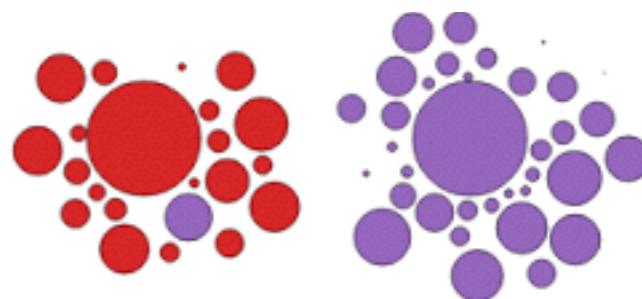
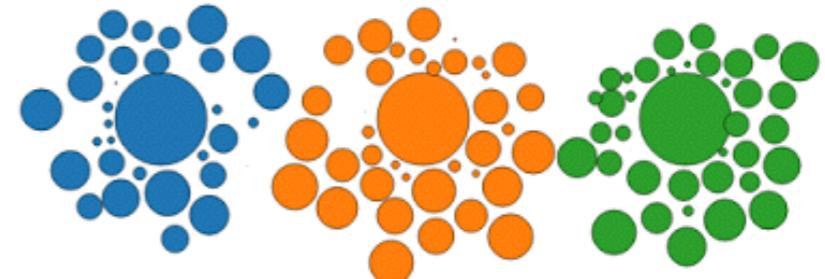
Proximity



Collins et al. 2009

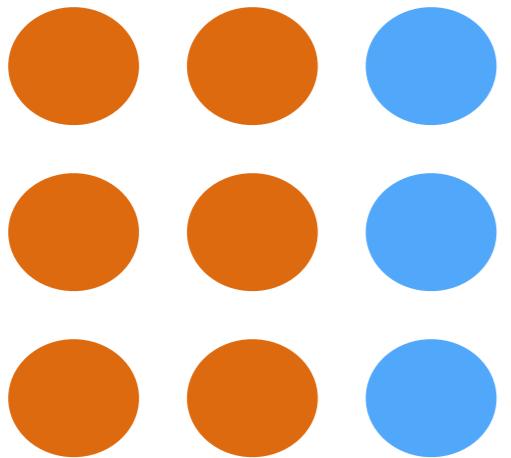


D3.js Example

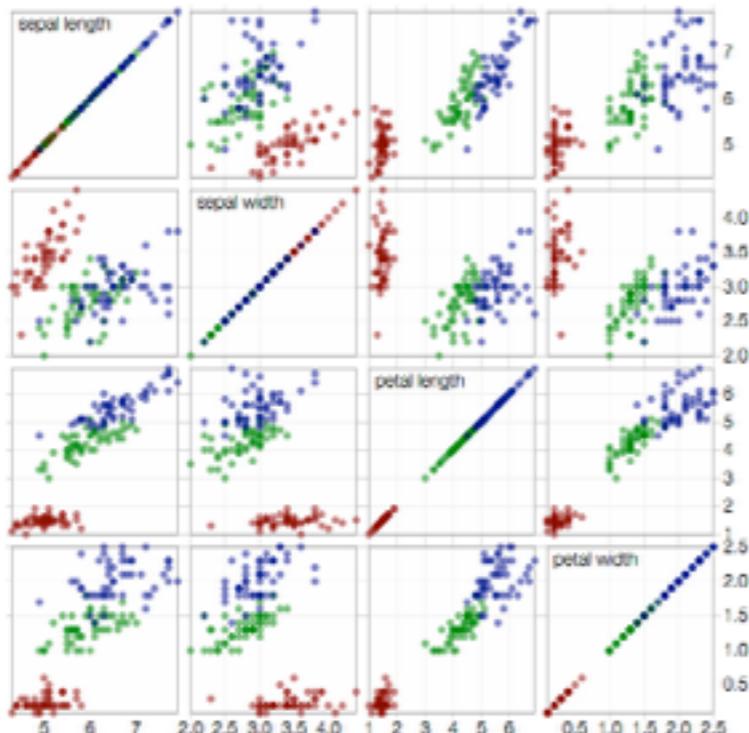


D3.js Example

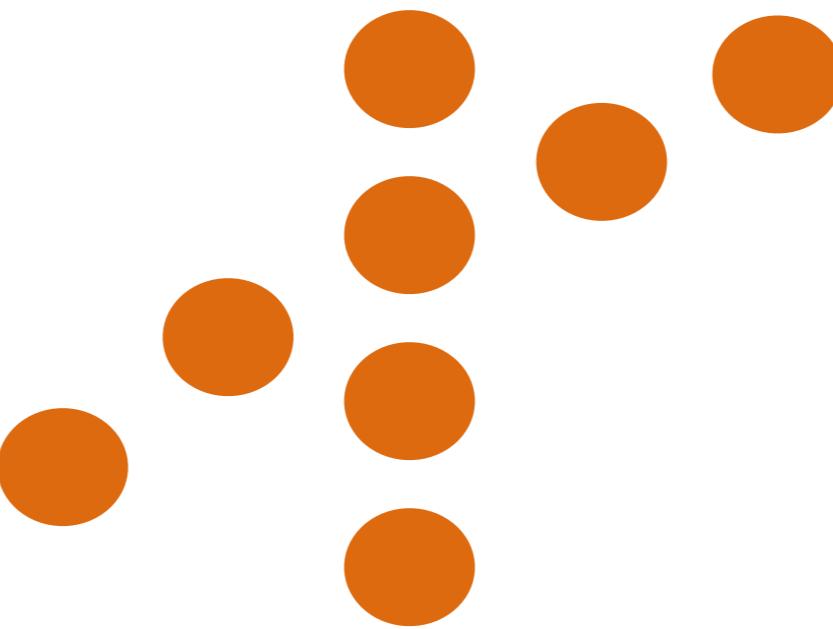
Grouping Principles



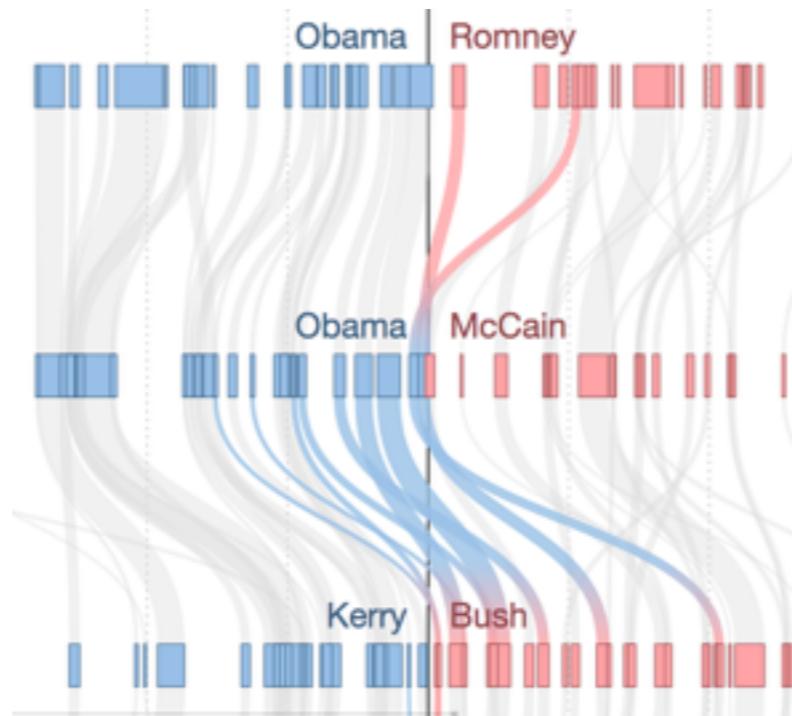
Similarity



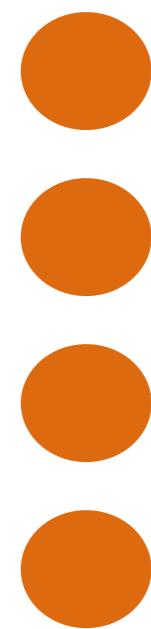
D3.js Example



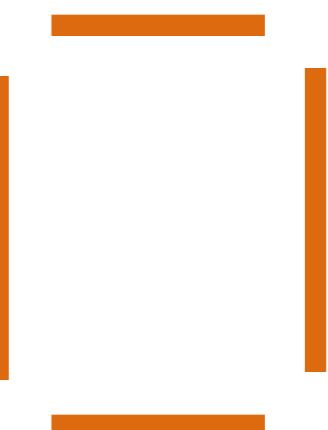
Continuity



NYT Swing States



Common Fate



Closure

Visual Attributes by Data Type

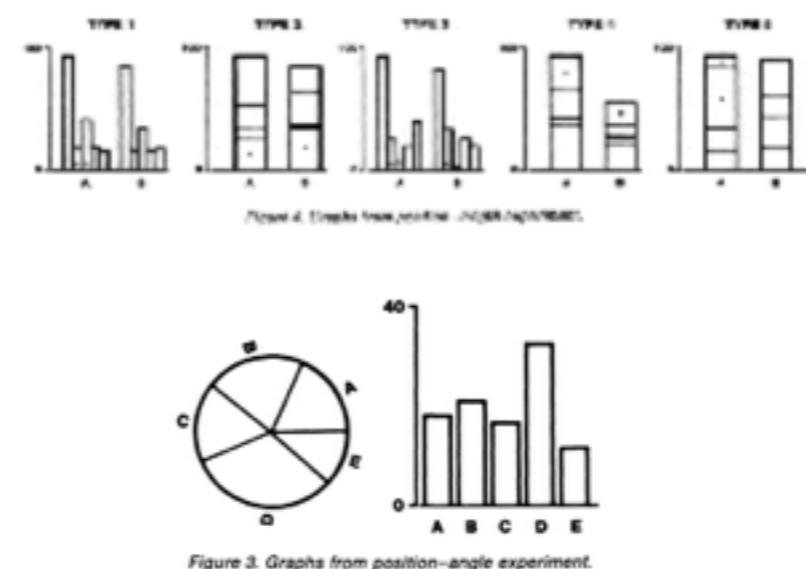
Bertin, 1967

| | Categories | Ordinal | Quantitative |
|------------|------------|---------|--------------|
| Position | ✓ | ✓ | ✓ |
| Length | ✓ | ✓ | ✓ |
| Brightness | ✓ | ✓ | ~ |
| Texture | ✓ | ~ | ✗ |
| Color | ✓ | ~ | ✗ |
| Angle | ✓ | ✗ | ✗ |
| Shape | ✓ | ✗ | ✗ |

✓ = Good
 ~ = OK
 ✗ = Bad

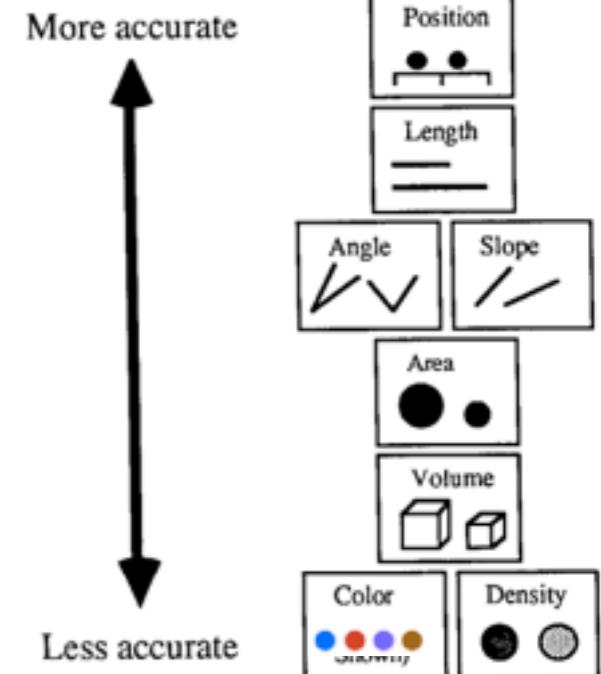
Bertin, Semiology of Graphics, 1967

Cleveland / McGill, 1984



William S. Cleveland; Robert McGill , “Graphical Perception: Theory, Experimentation, and Application to the Development of Graphical Methods.” 1984

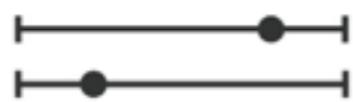
Mackinlay, 1986



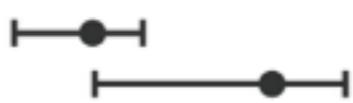
Jock Mackinlay “Automating The Design of Graphical Presentations.” 1986

→ Magnitude Channels: Ordered Attributes

Position on common scale



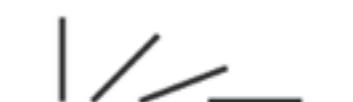
Position on unaligned scale



Length (1D size)



Tilt/angle



Area (2D size)



Depth (3D position)



Color luminance



Color saturation



Curvature



Volume (3D size)



→ Identity Channels: Categorical Attributes

Spatial region



Color hue



Motion



Shape



Most ▲

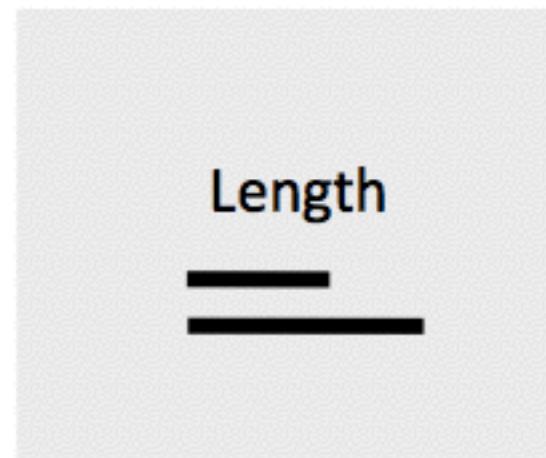
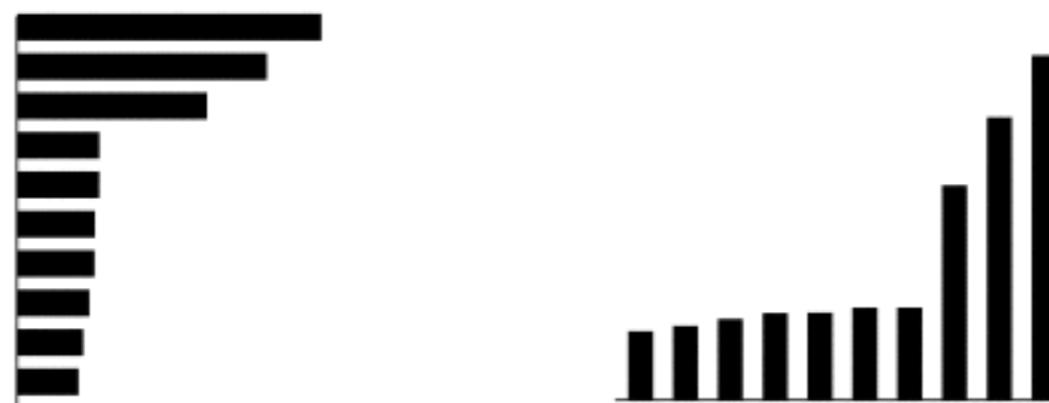
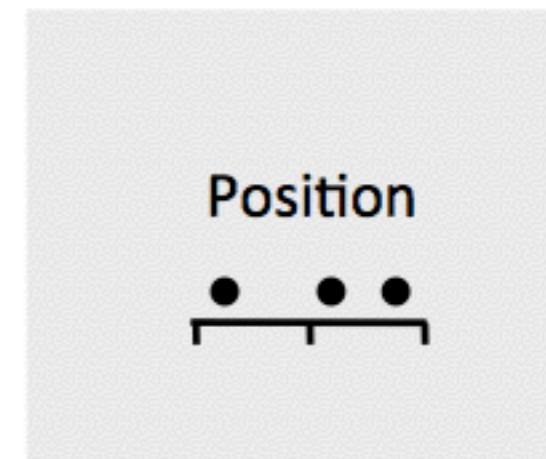
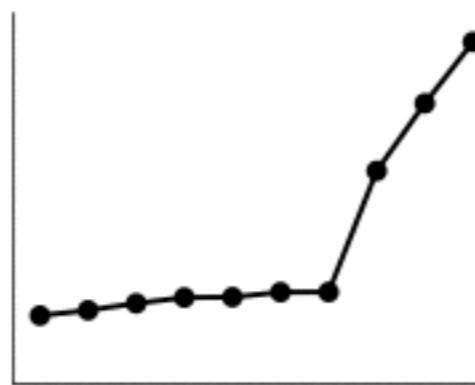
Effectiveness

Least ▼

Same] [Same]

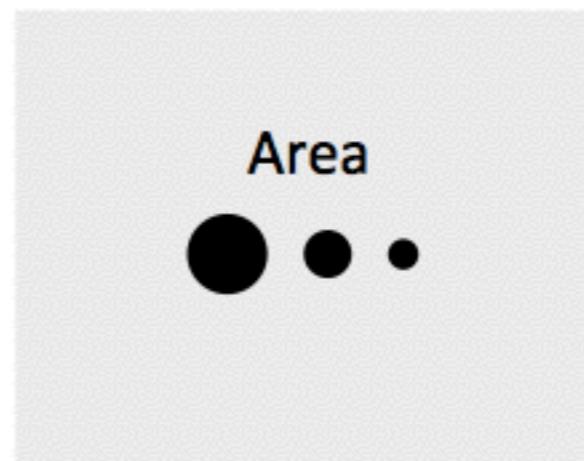
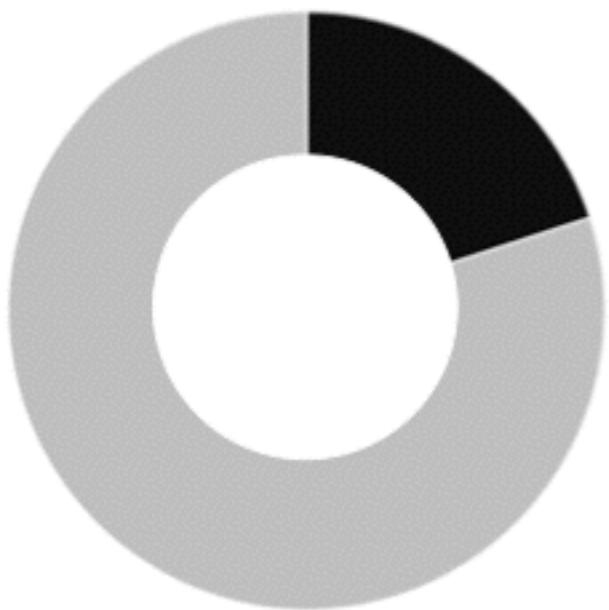
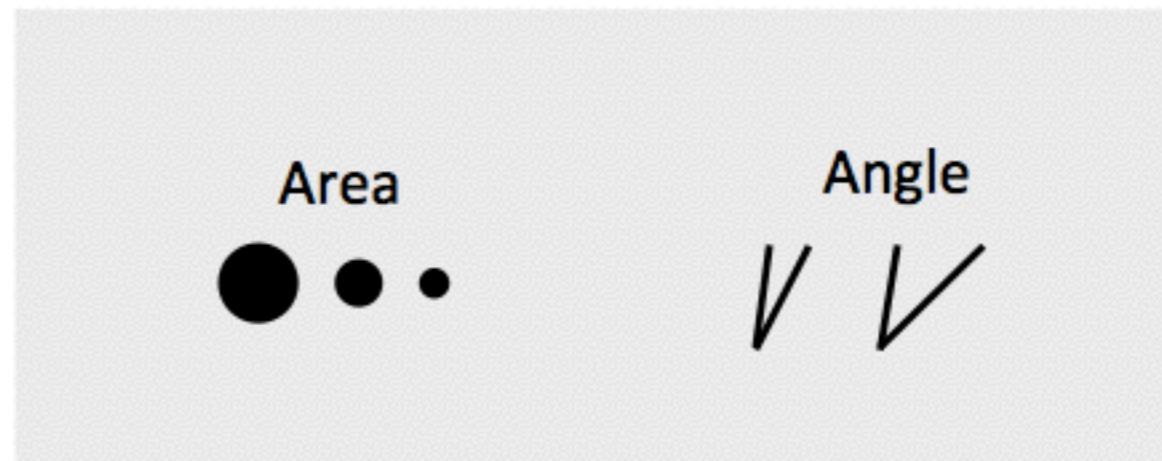
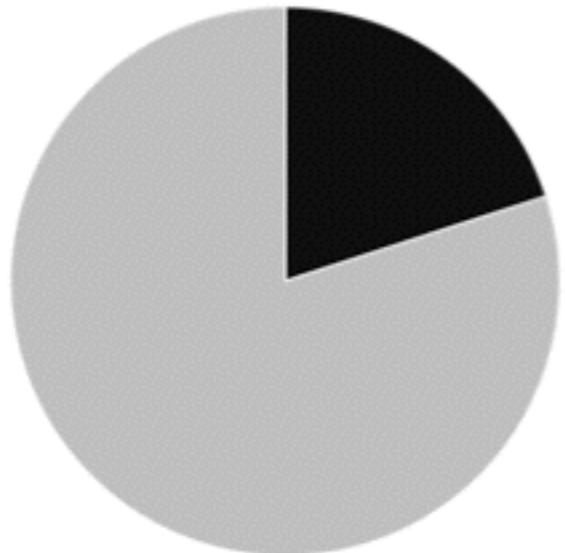
Most Effective

For Quantitative/Ordinal Data



Less Effective

For Quantitative/Ordinal Data



Least Effective: Color For Quantitative/Ordinal Data

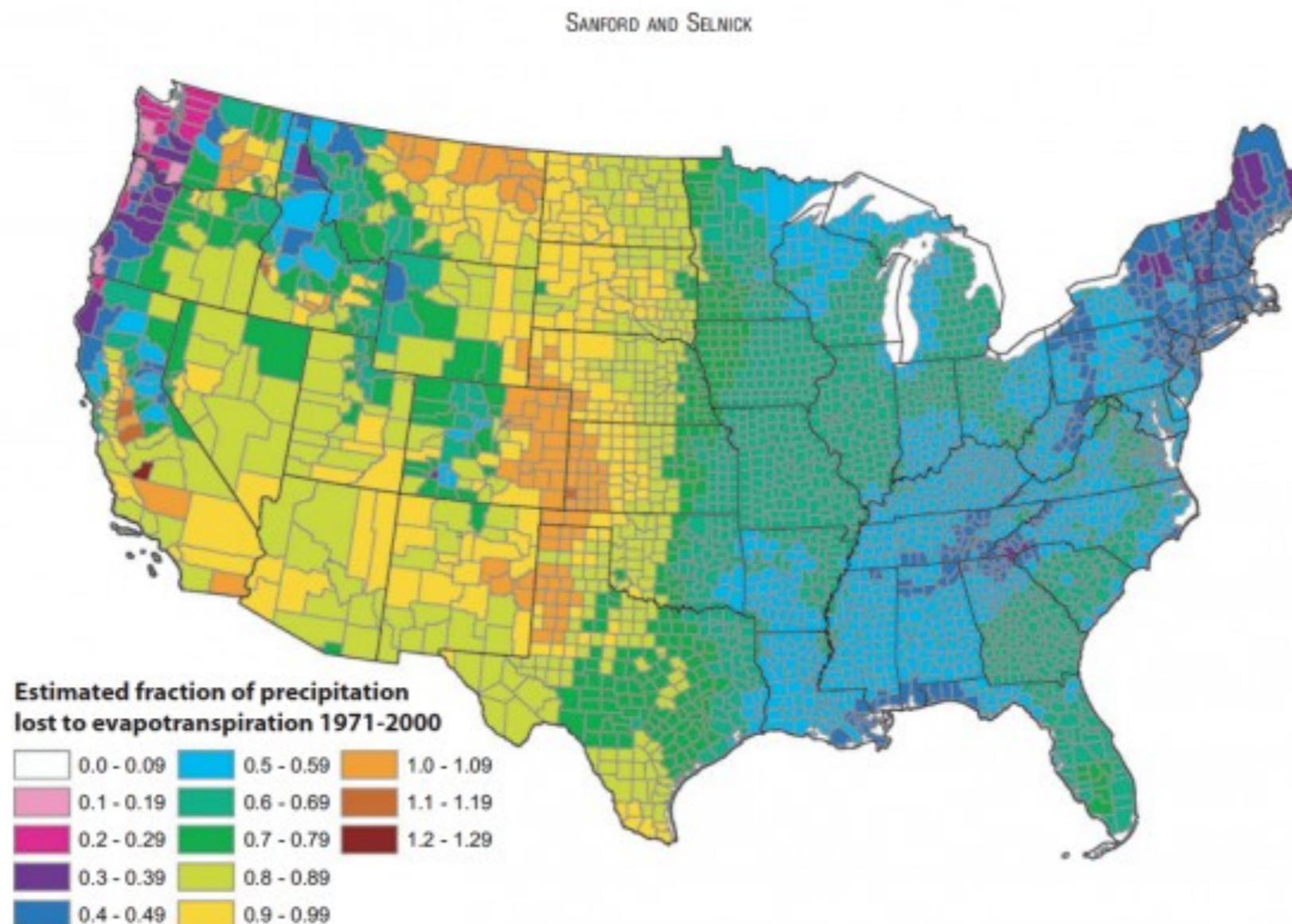
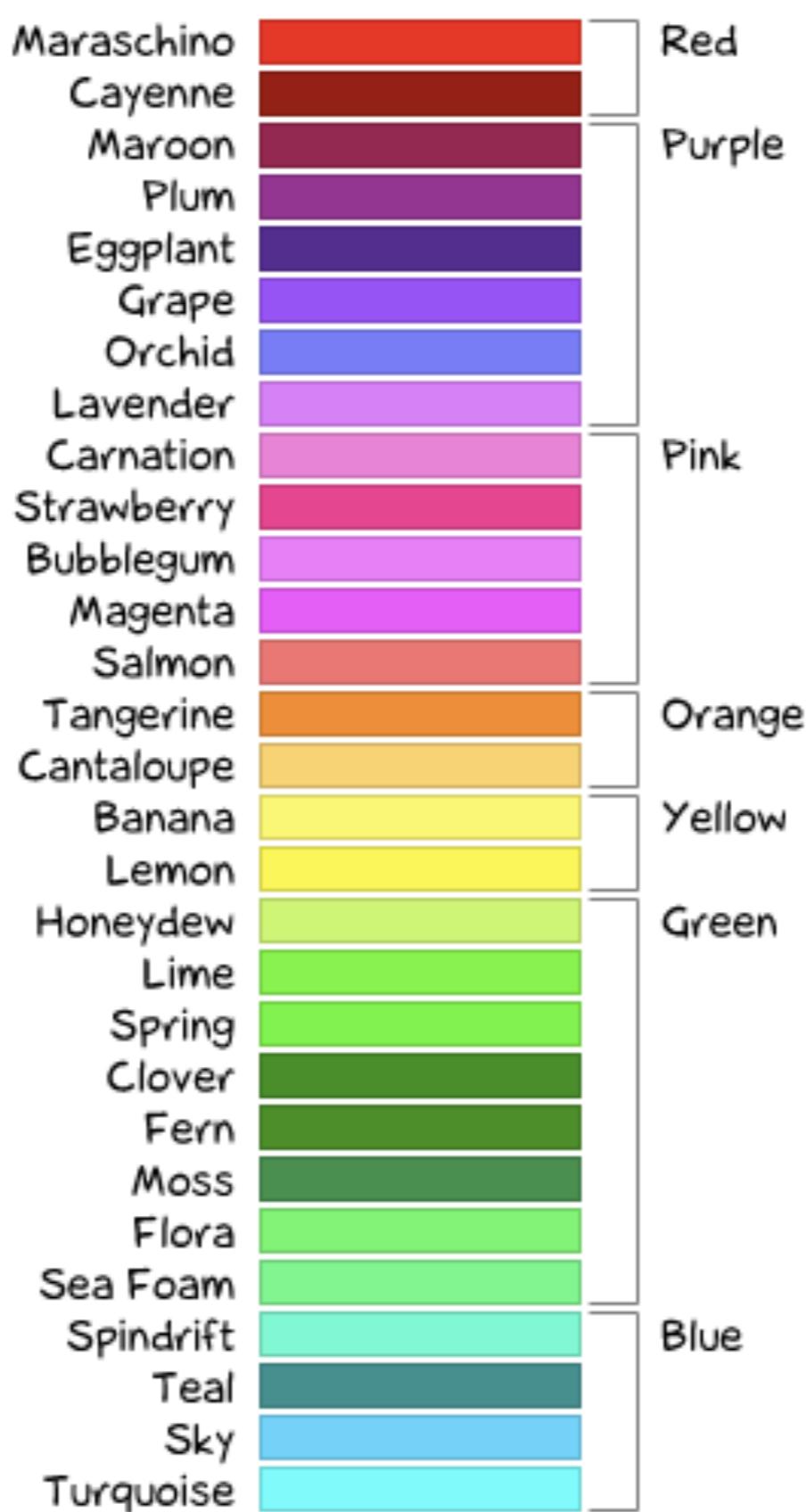


FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM climate data. The mean values for the counties (shown) were then calculated by averaging the 800-m values within each county. Areas with fractions >1 are agricultural counties that either import surface water or mine deep groundwater.

Color

Color names if
you're a girl...



Color names if
you're a guy...

Doghouse Diaries

*Actual color names
if you're a girl ...*



*Actual color names
if you're a guy ...*

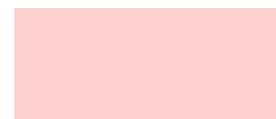
Order These Colors



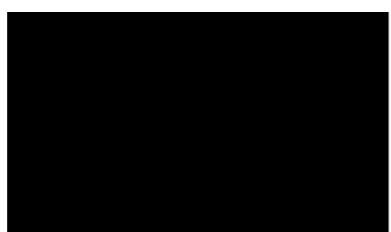
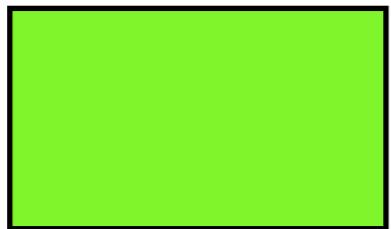
Order These Colors



Order These Colors



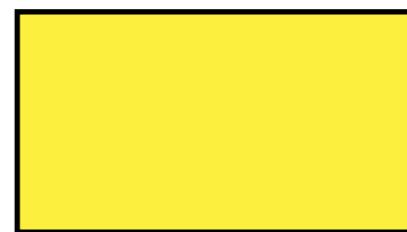
Brightness



Saturation



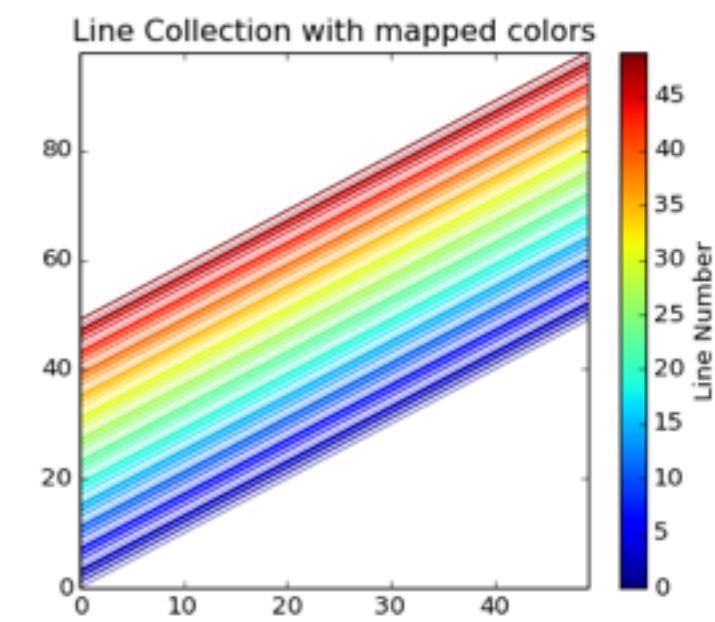
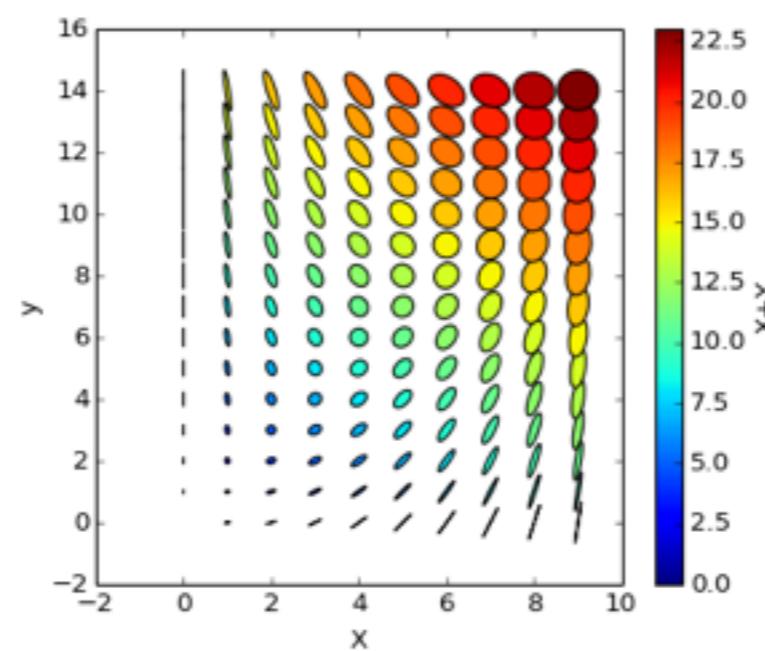
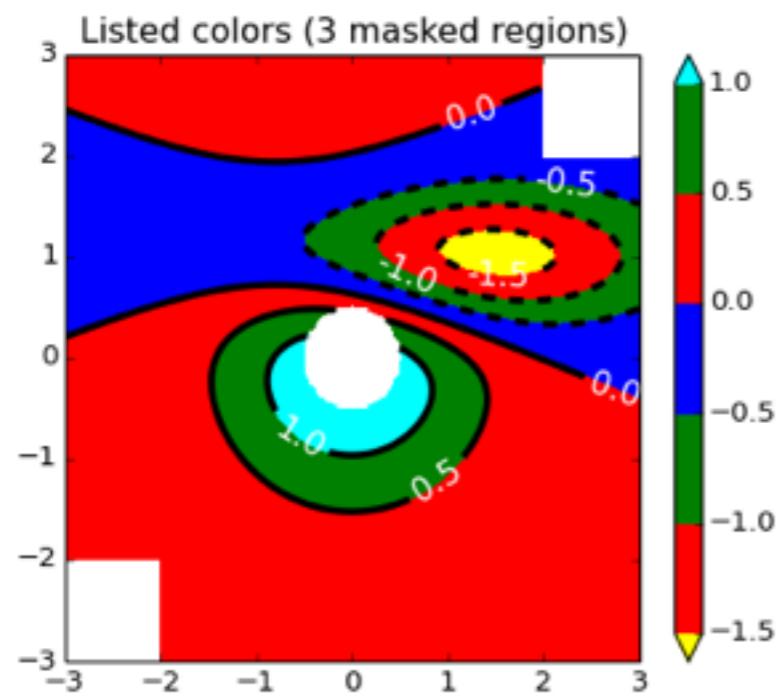
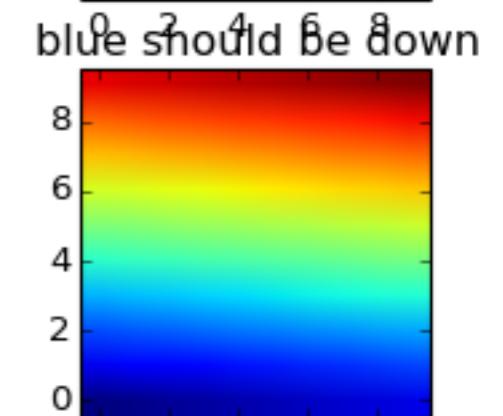
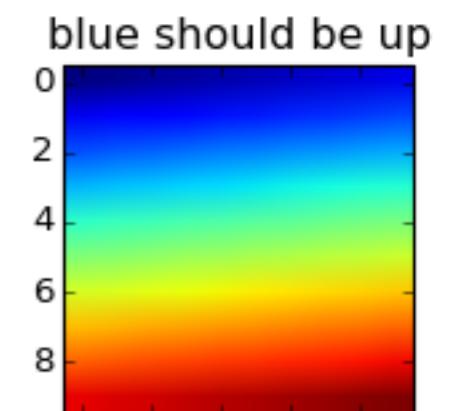
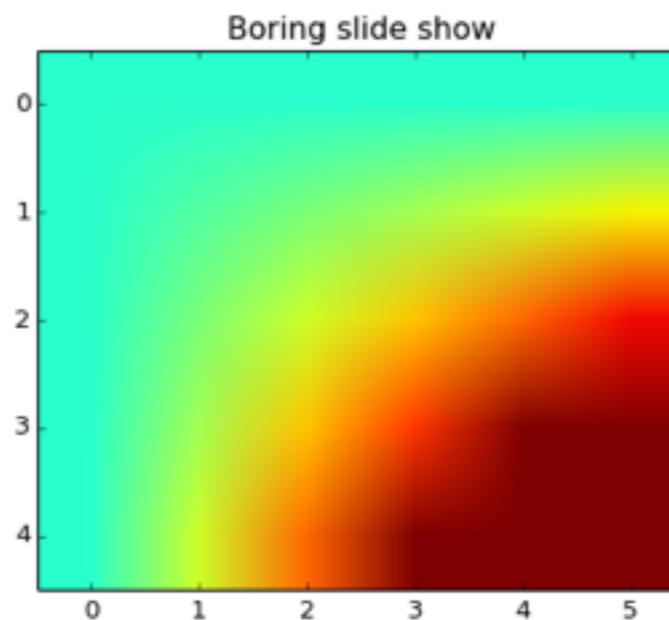
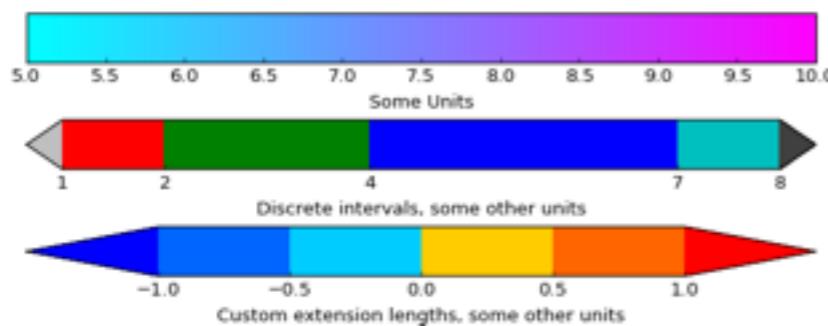
Hue



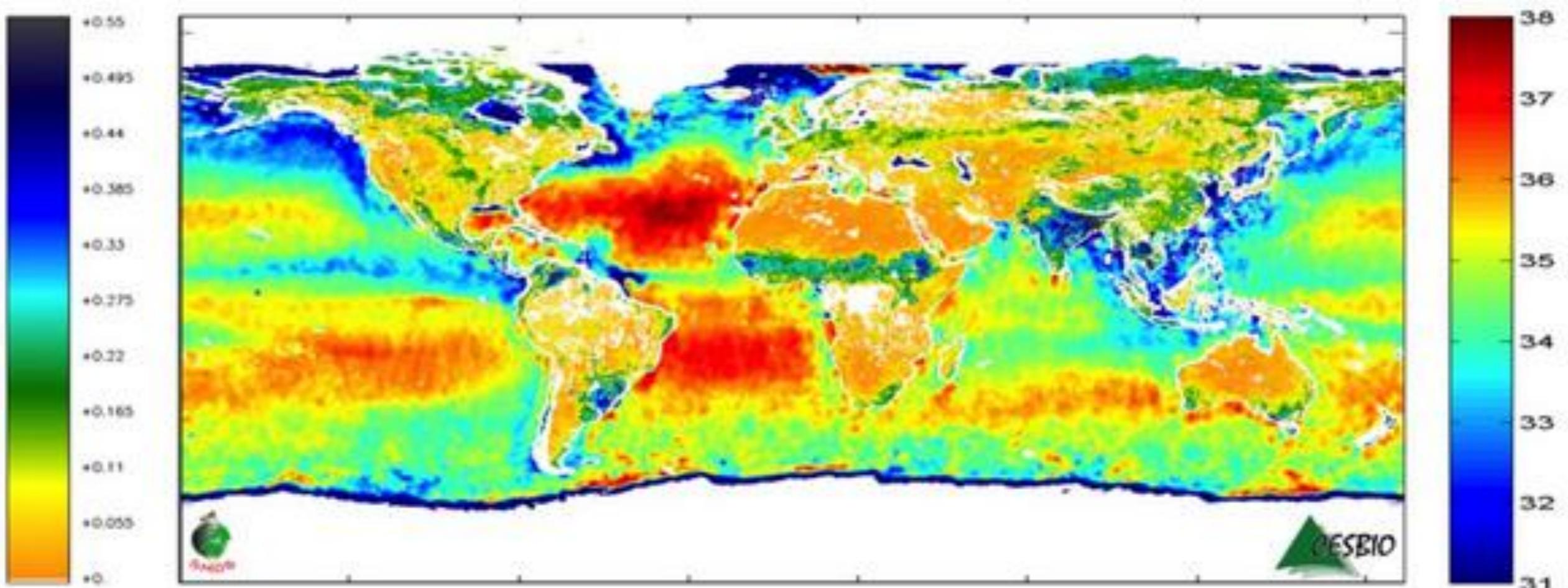
Perceived as Ordered

Not as much

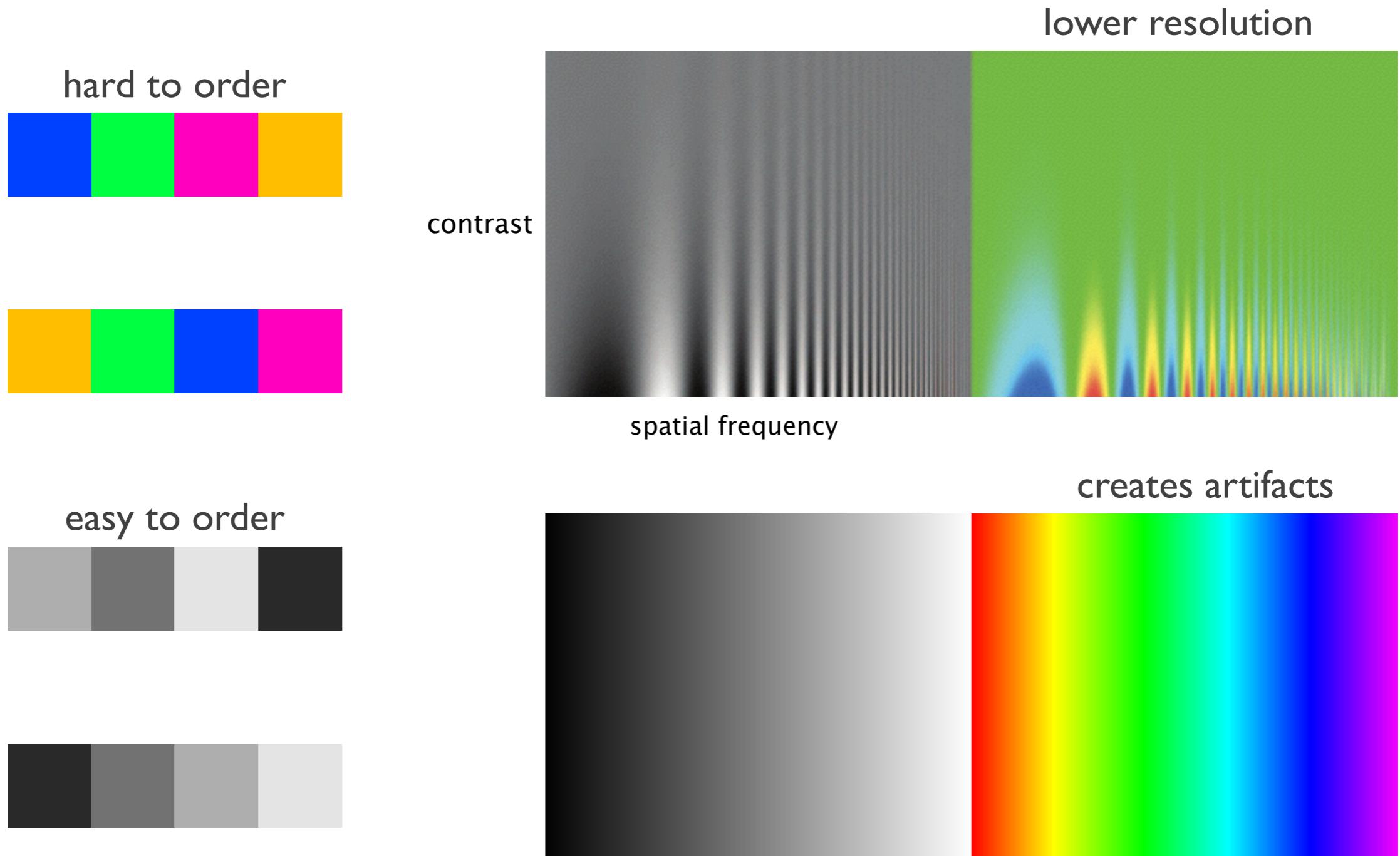
Rainbow Colors



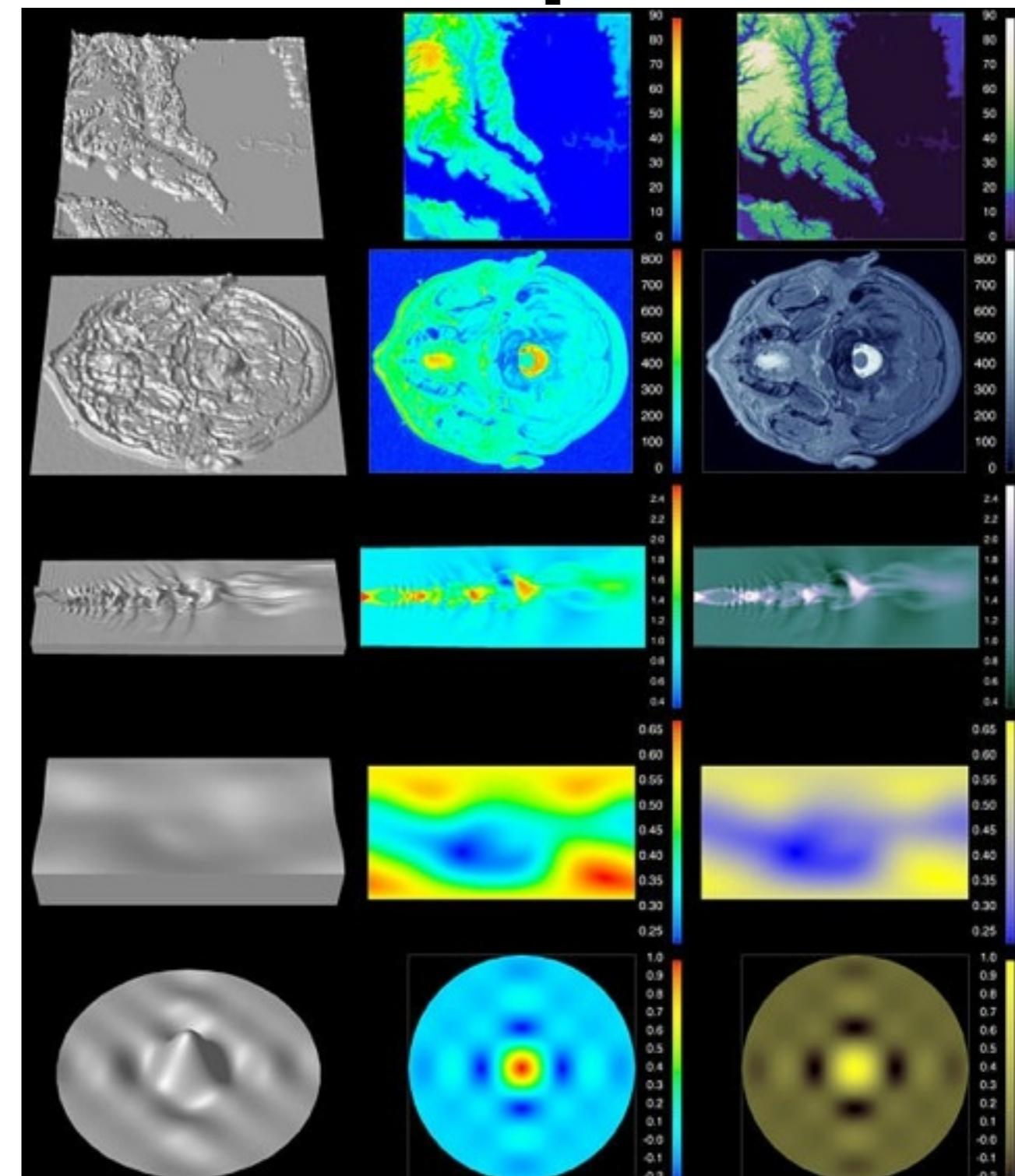
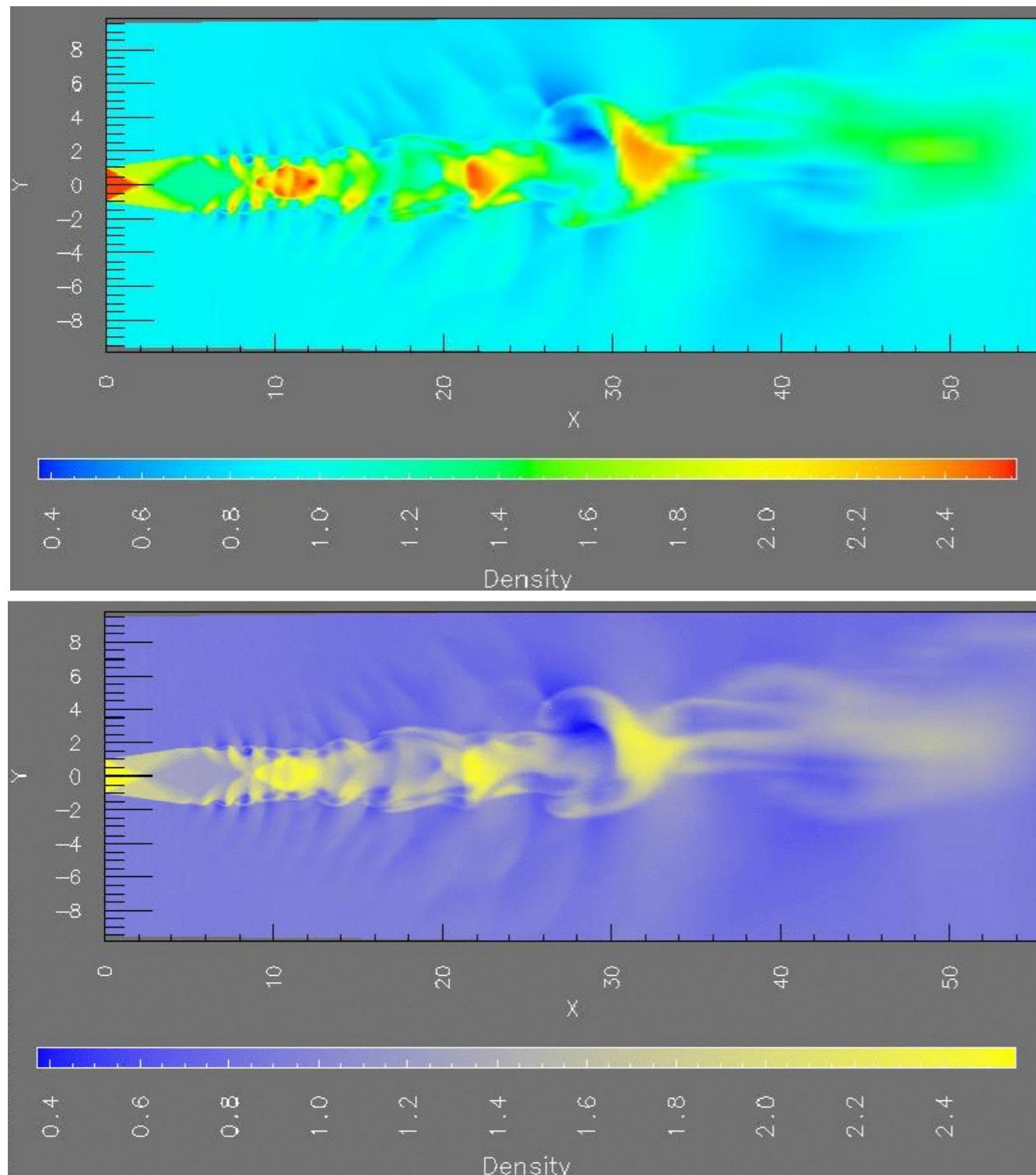
Rainbow Colormap



Rainbow Colormap

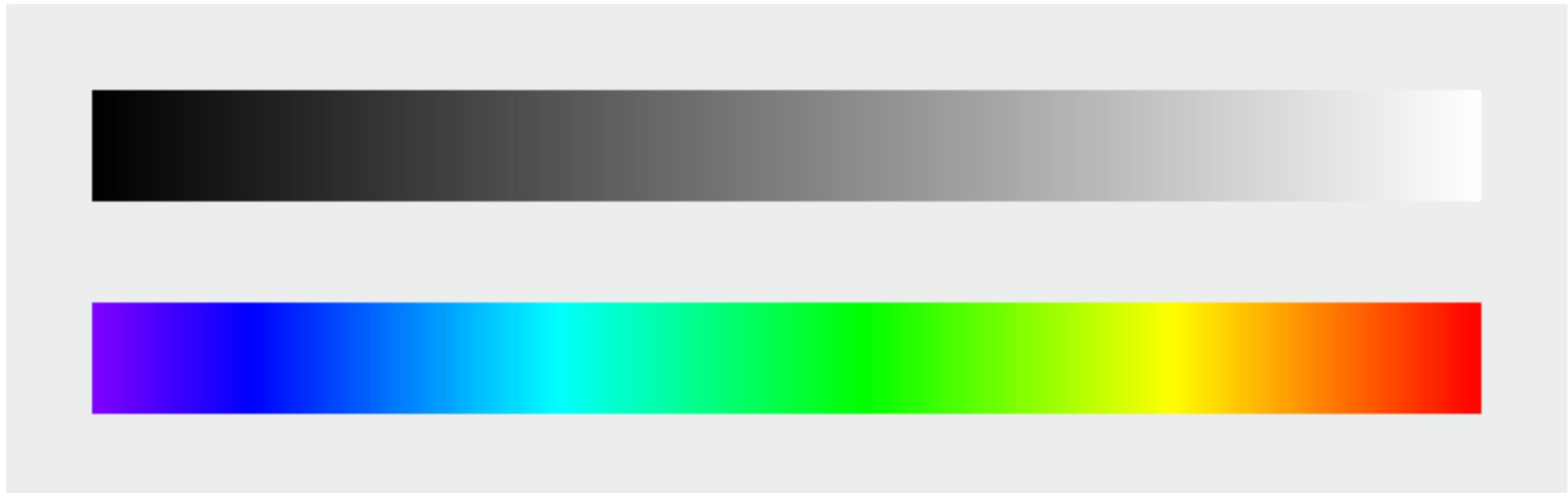


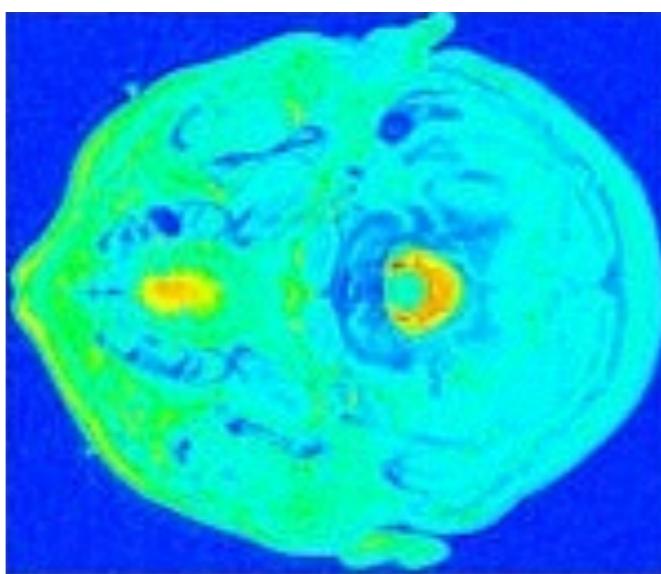
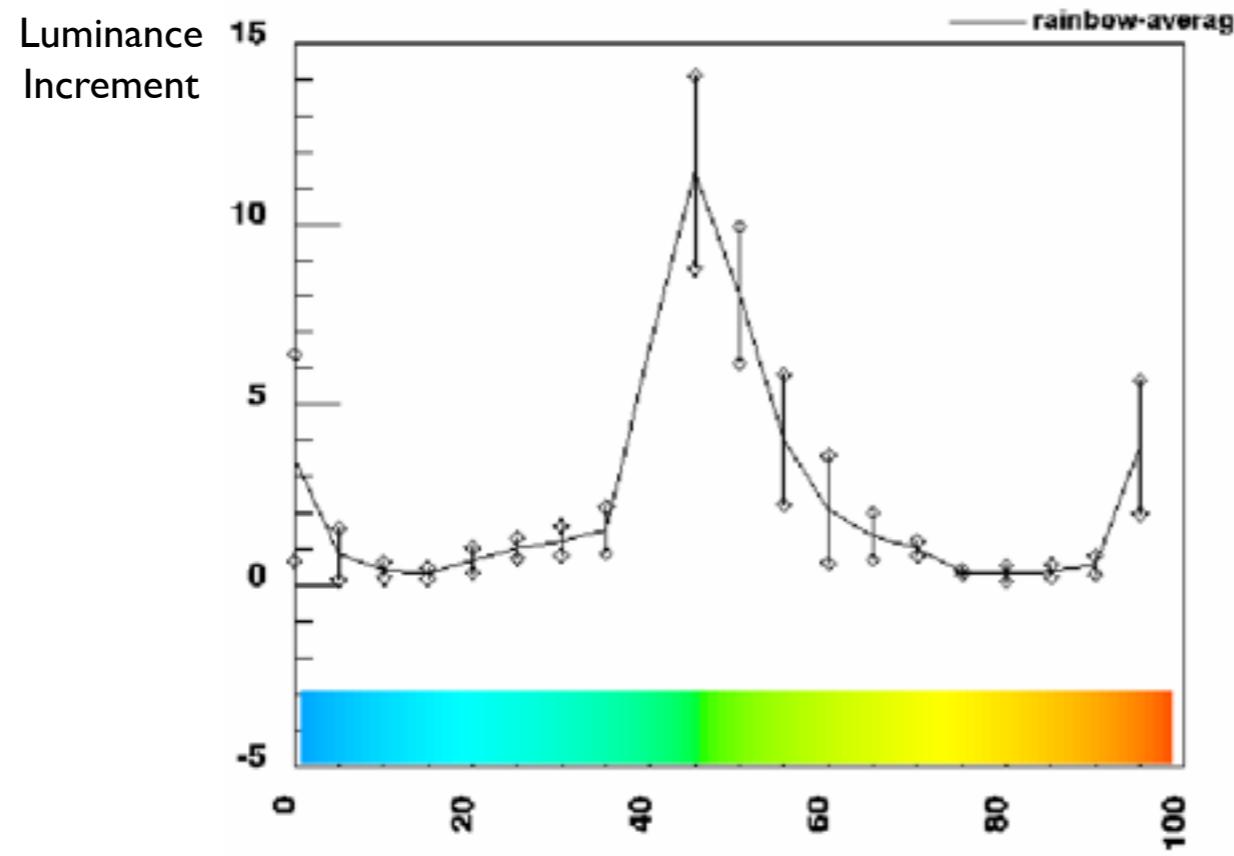
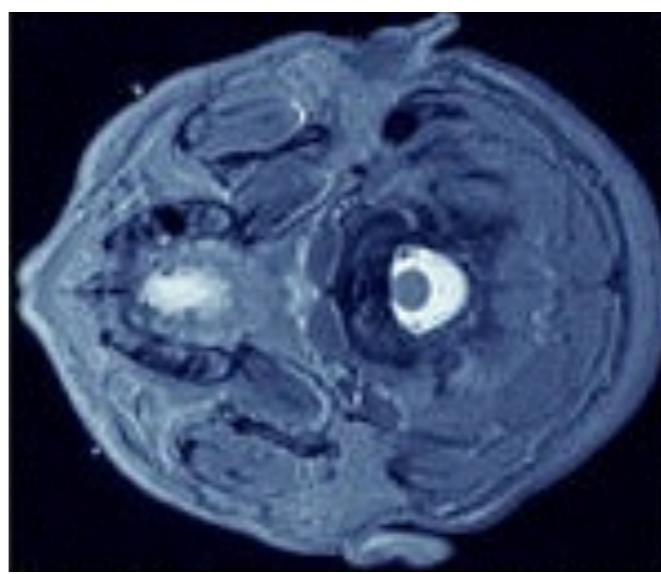
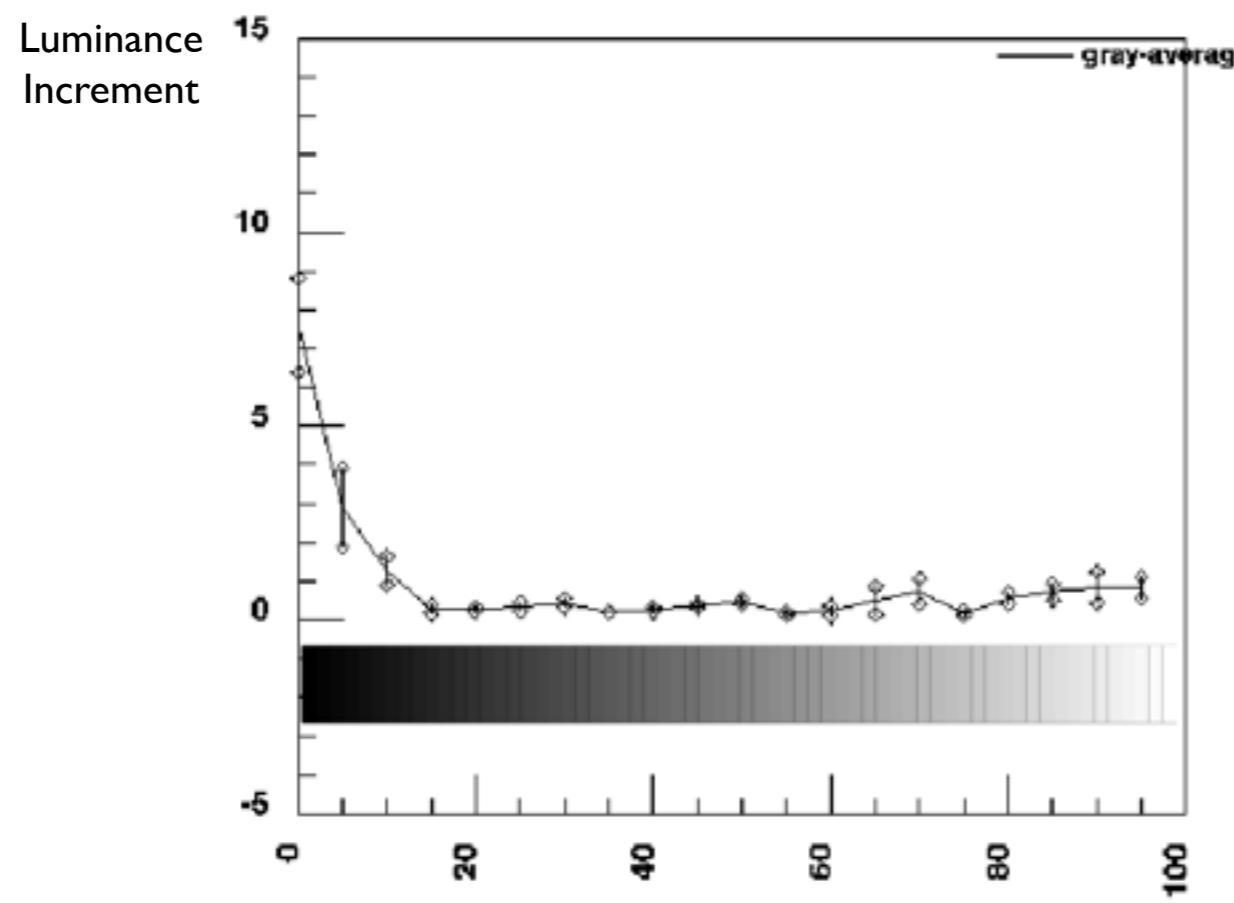
Rainbow Colormap



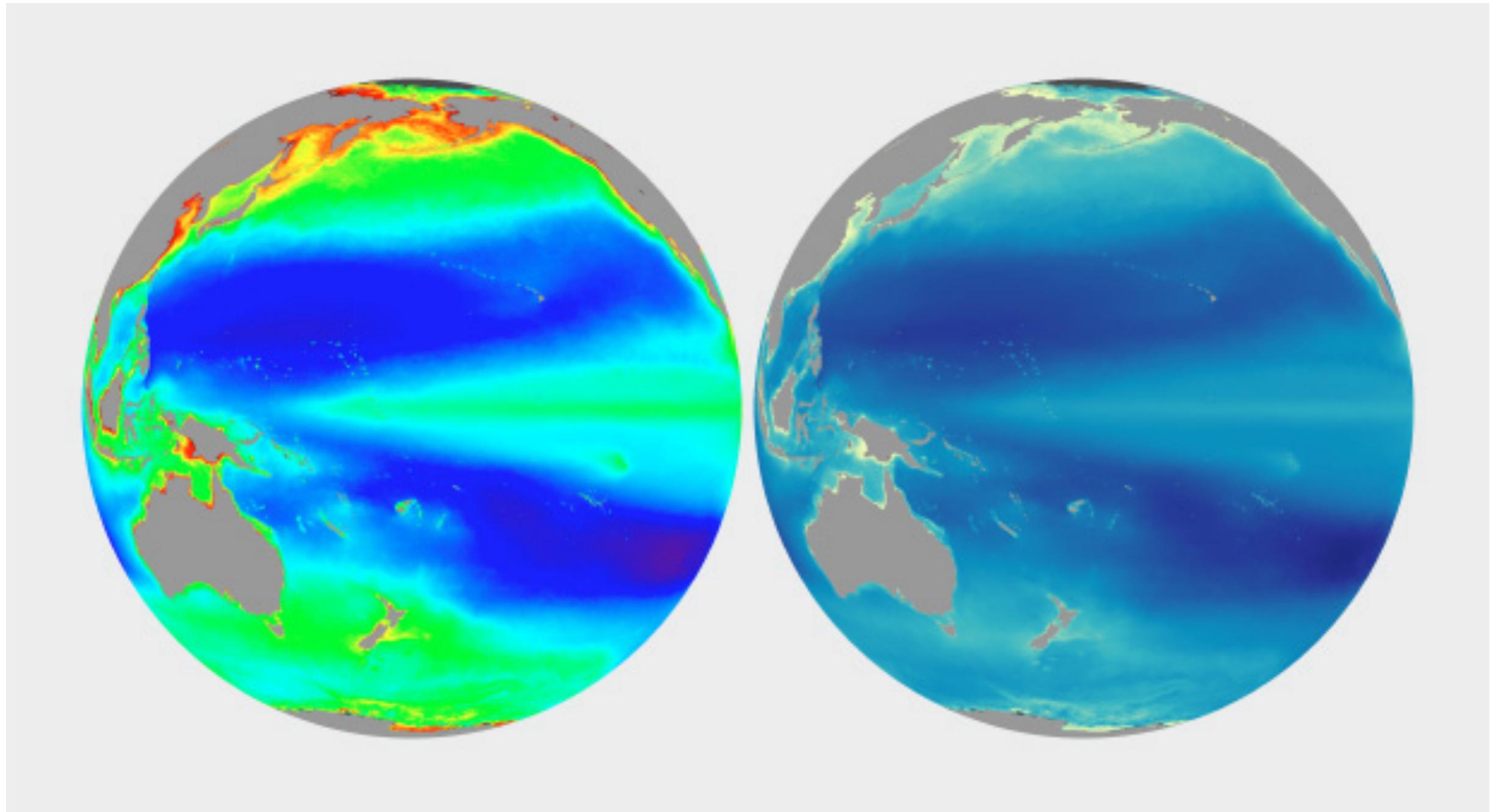
Rainbow Colormap

Rainbow colormap is perceptually nonlinear





Rainbow Colormap



Map Example Revisited

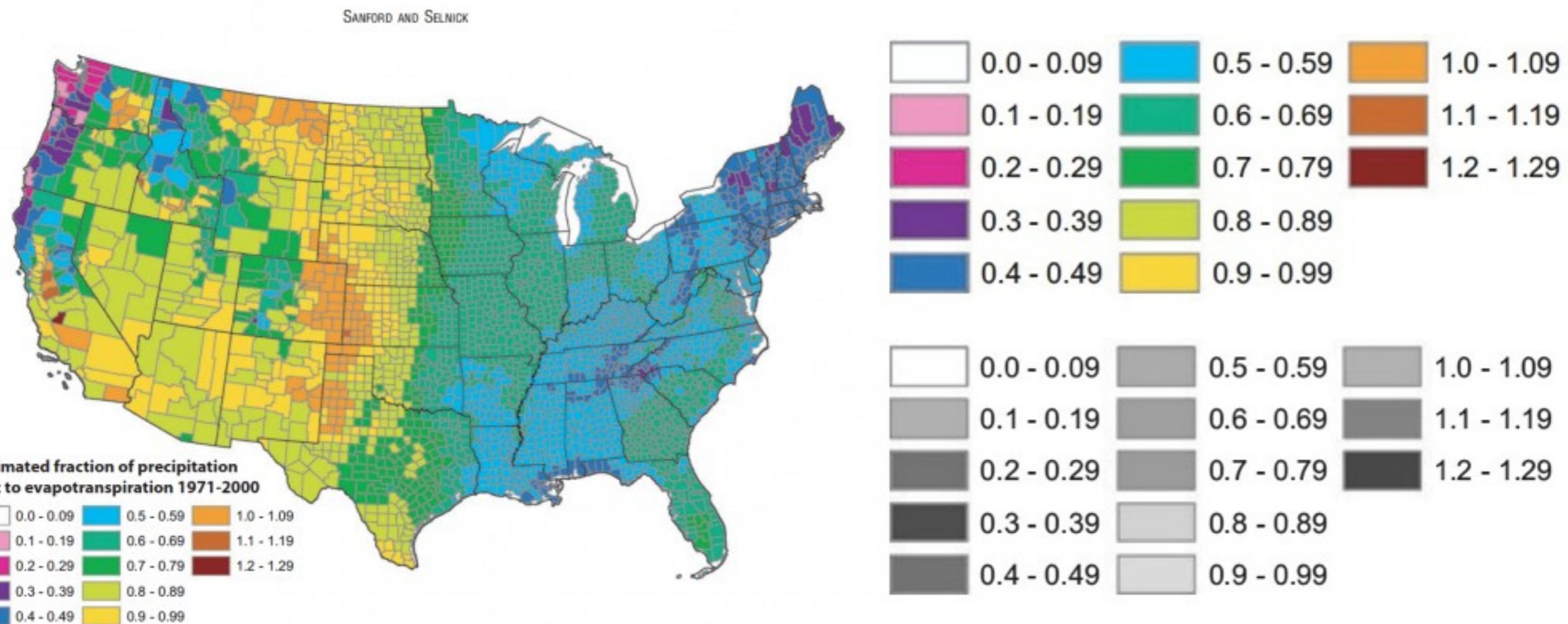
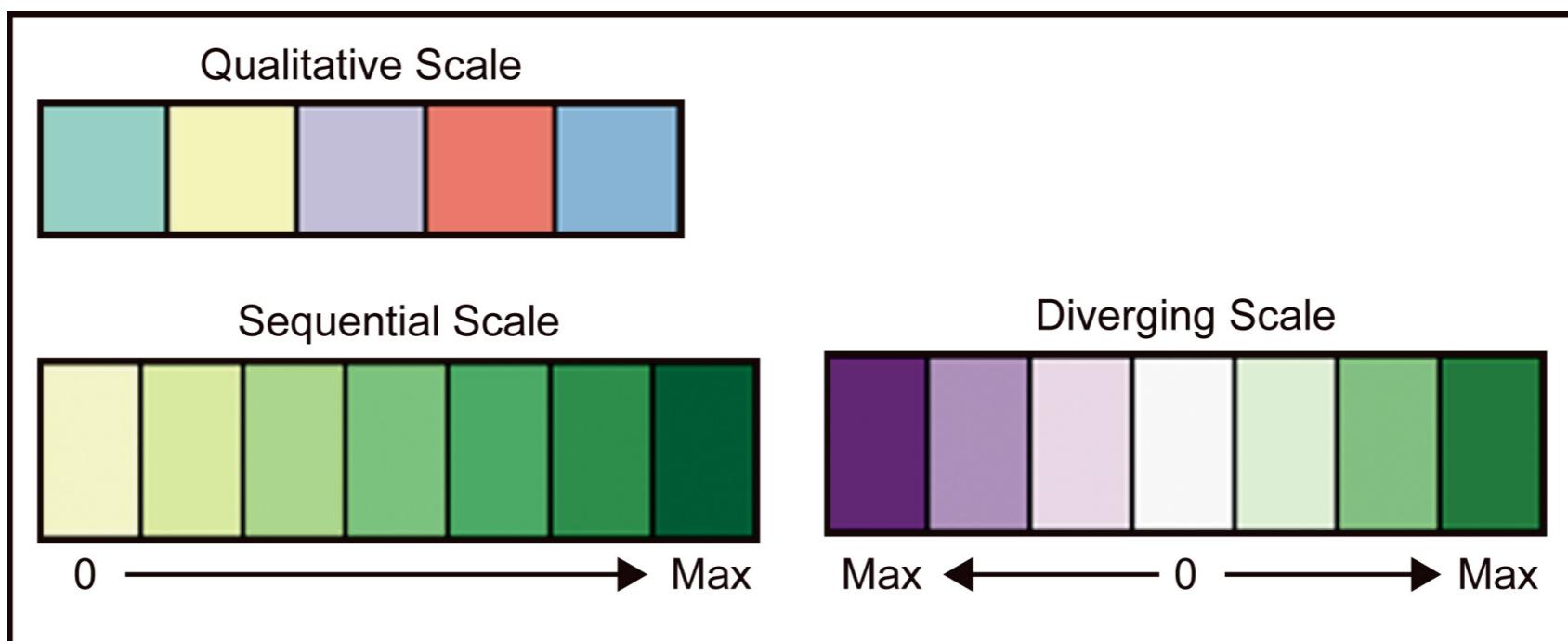


FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM climate data. The mean values for the counties (shown) were then calculated by averaging the 800-m values within each county. Areas with fractions >1 are agricultural counties that either import surface water or mine deep groundwater.

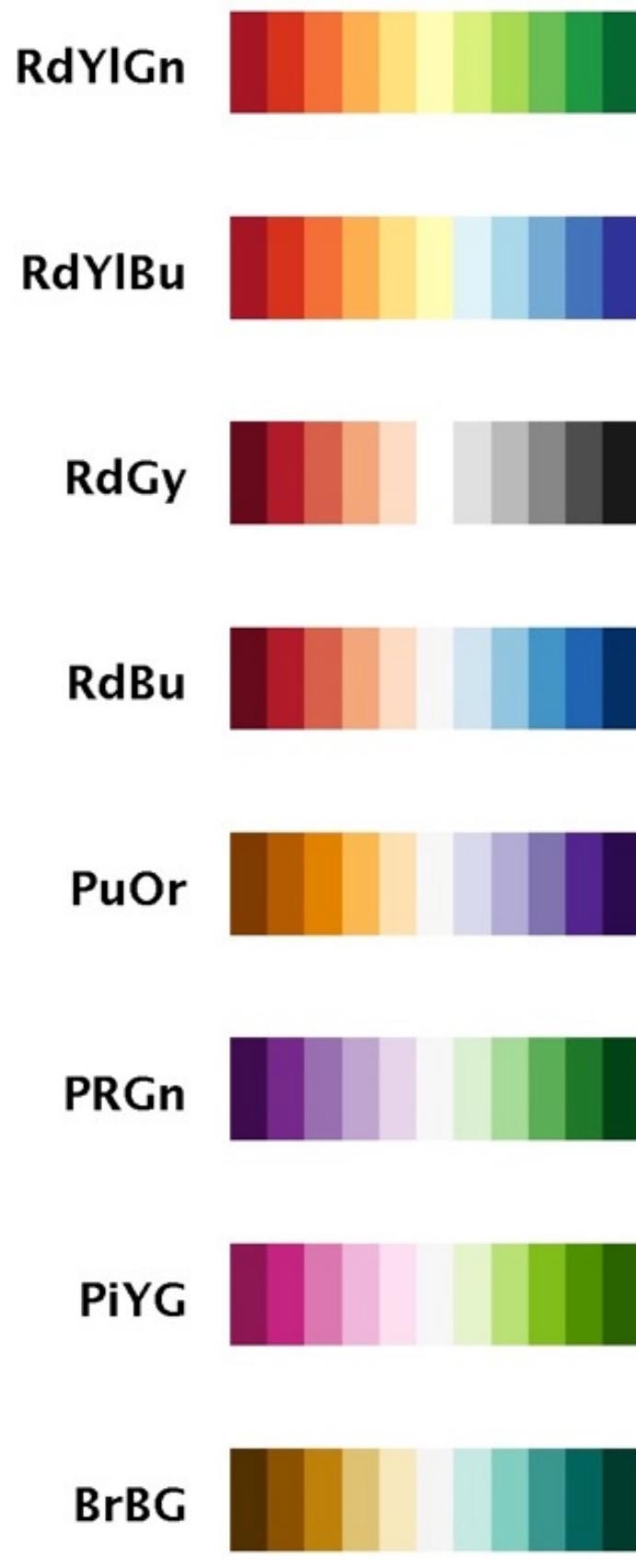
Brewer Scales

Nominal



Ordinal

Diverging



Sequential



Qualitative



number of data classes on your map

3 | [learn more >](#)

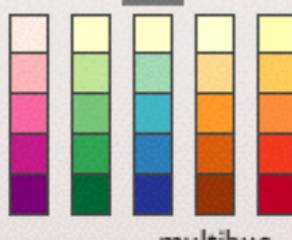
how to use | updates | credits

COLORBREWER 2.0
color advice for cartography

the nature of your data

sequential | [learn more >](#)

pick a color scheme: GnBu



single hue

(optional) only show schemes that are:

colorblind safe print friendly

photocopy-able [learn more >](#)

pick a color system

224, 243, 219 RGB CMYK HEX

168, 221, 181

67, 162, 202

RGB CMYK HEX

adjust map context

roads

cities

borders

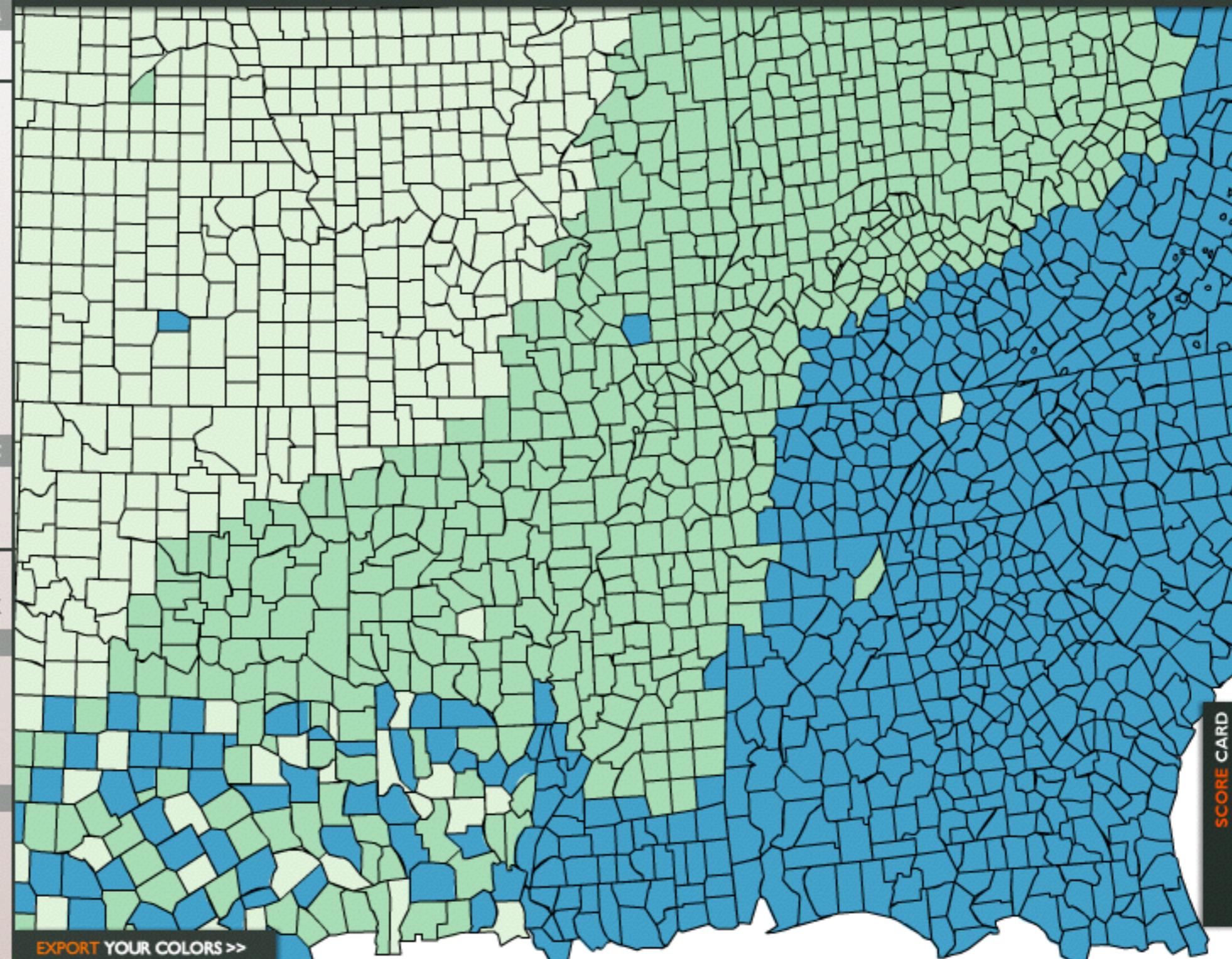
select a background

solid color

terrain

color transparency

[learn more >](#)



SCORE CARD

© Cynthia Brewer, Mark Harrower and The Pennsylvania State University

[Support](#)

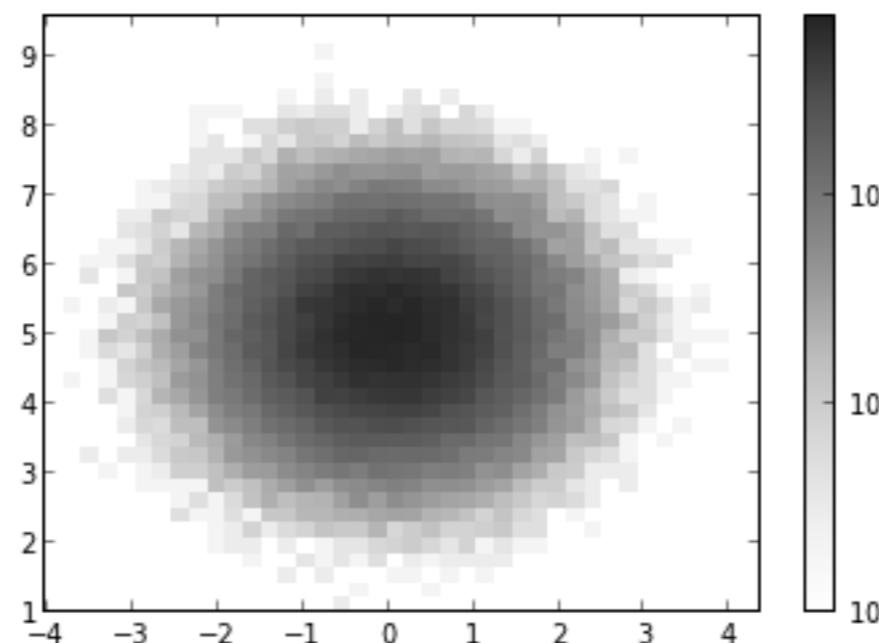
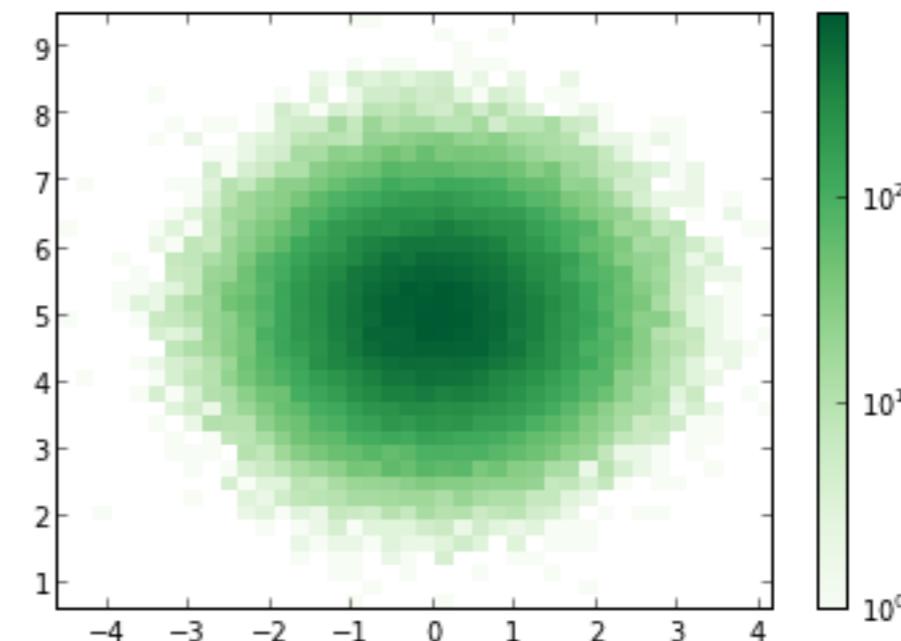
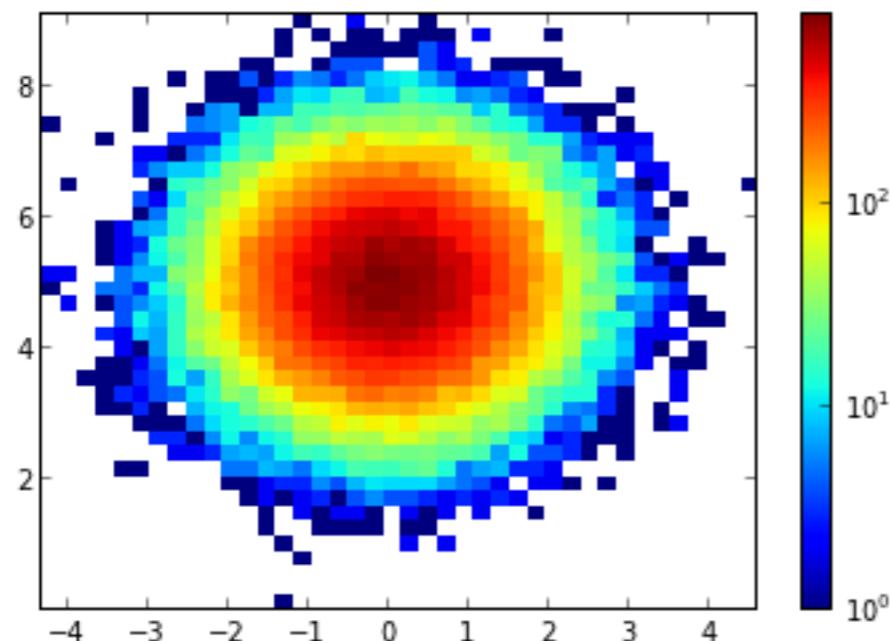
[Back to ColorBrewer 1.0](#)

axm

<http://colorbrewer2.org>

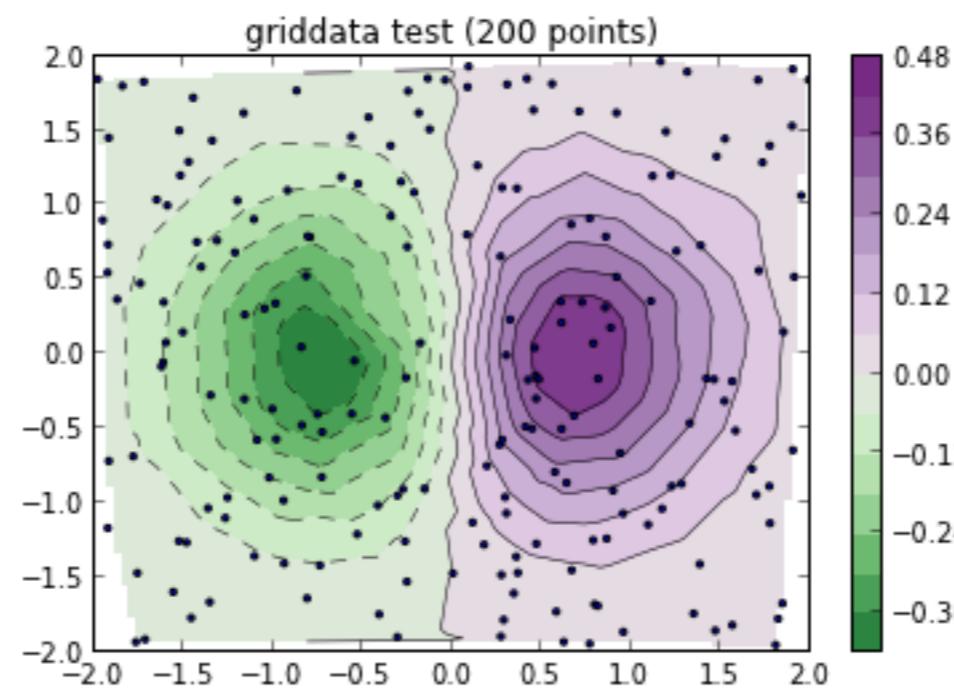
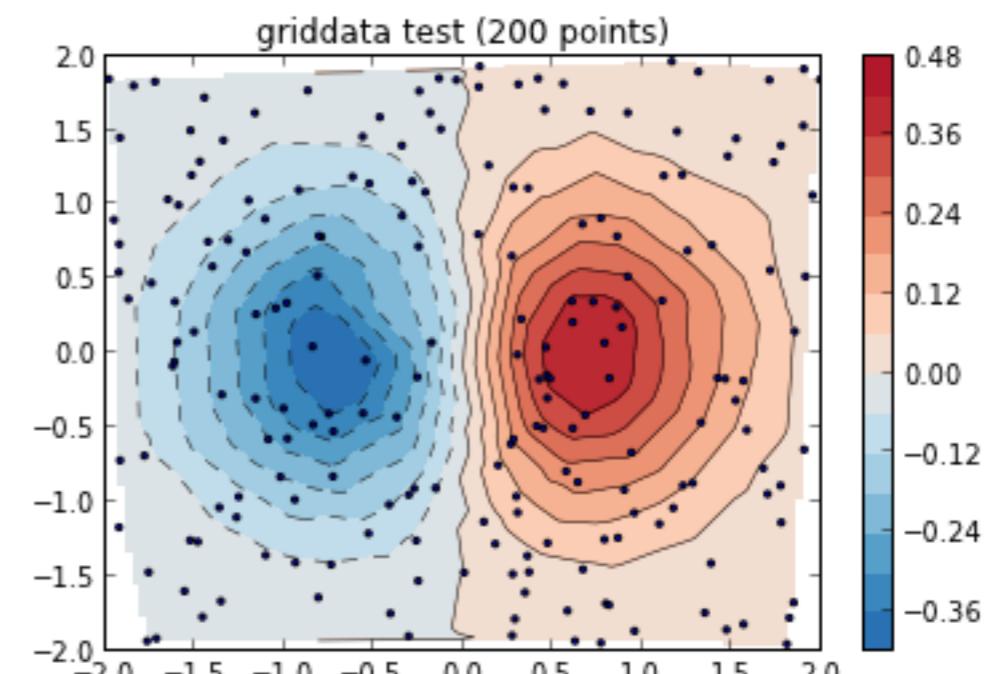
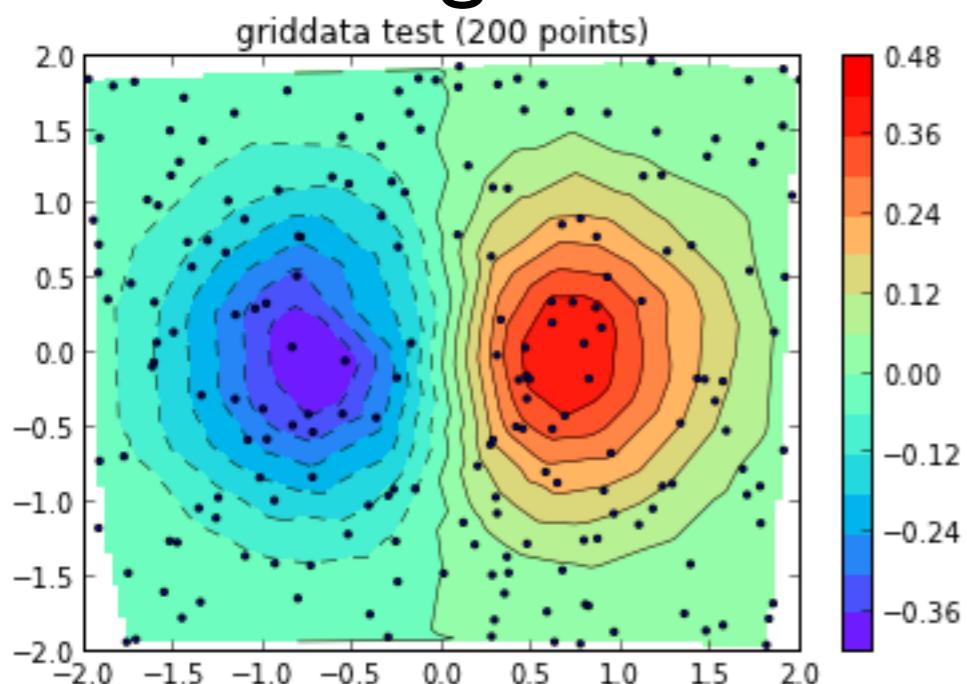
Sequential Brewer Scales

No!

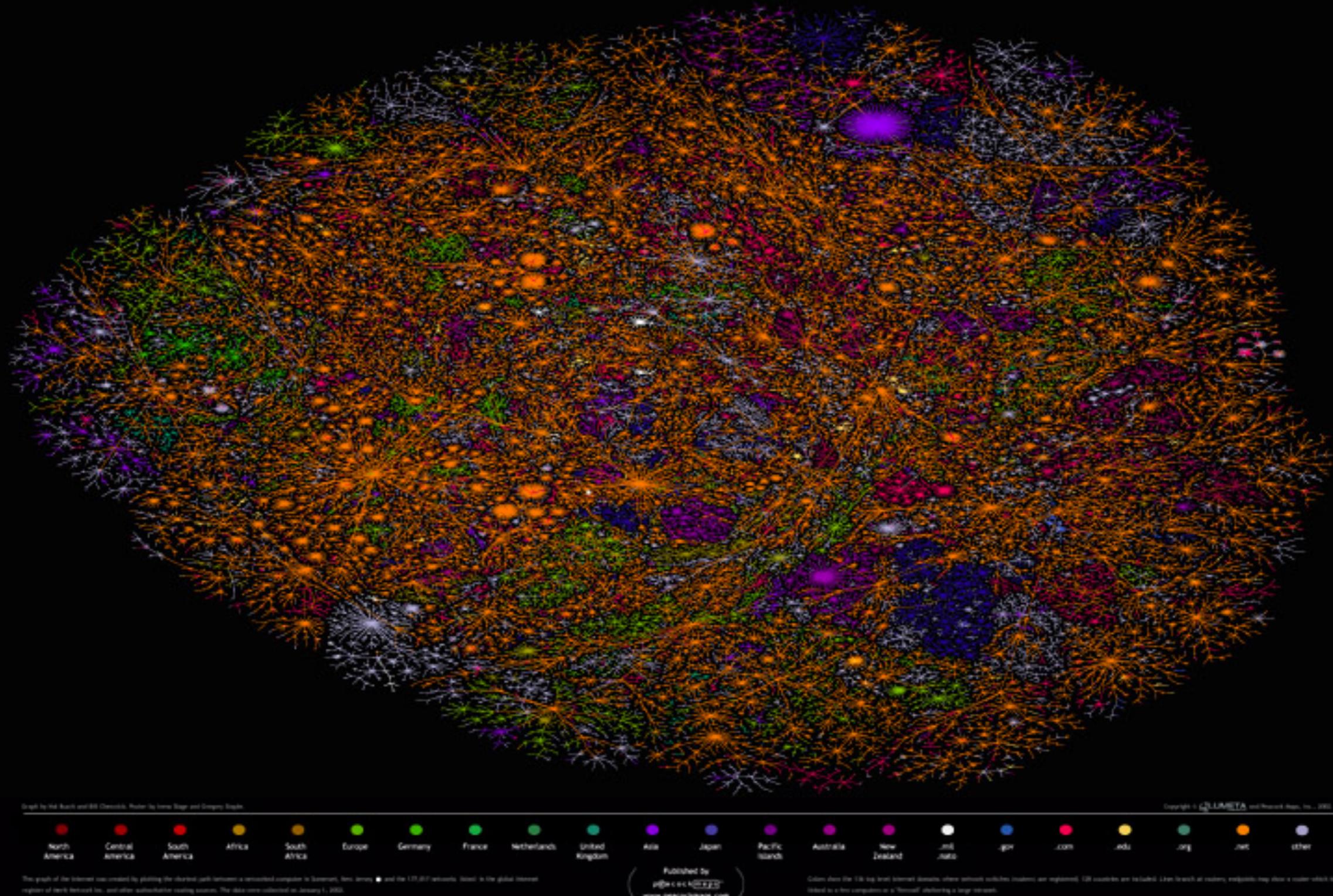


Divergent Brewer Scales

Not great

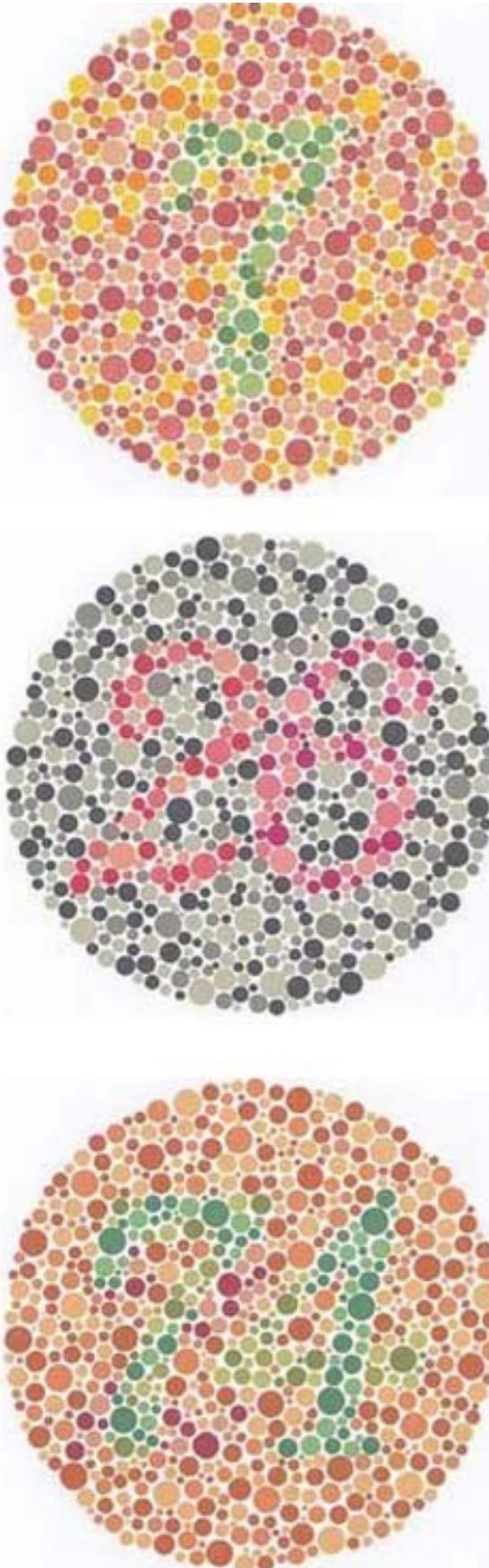


The Internet: 2002



Peacock Maps, 2002

Nominal Data: Do not use more than 6-10 colors!



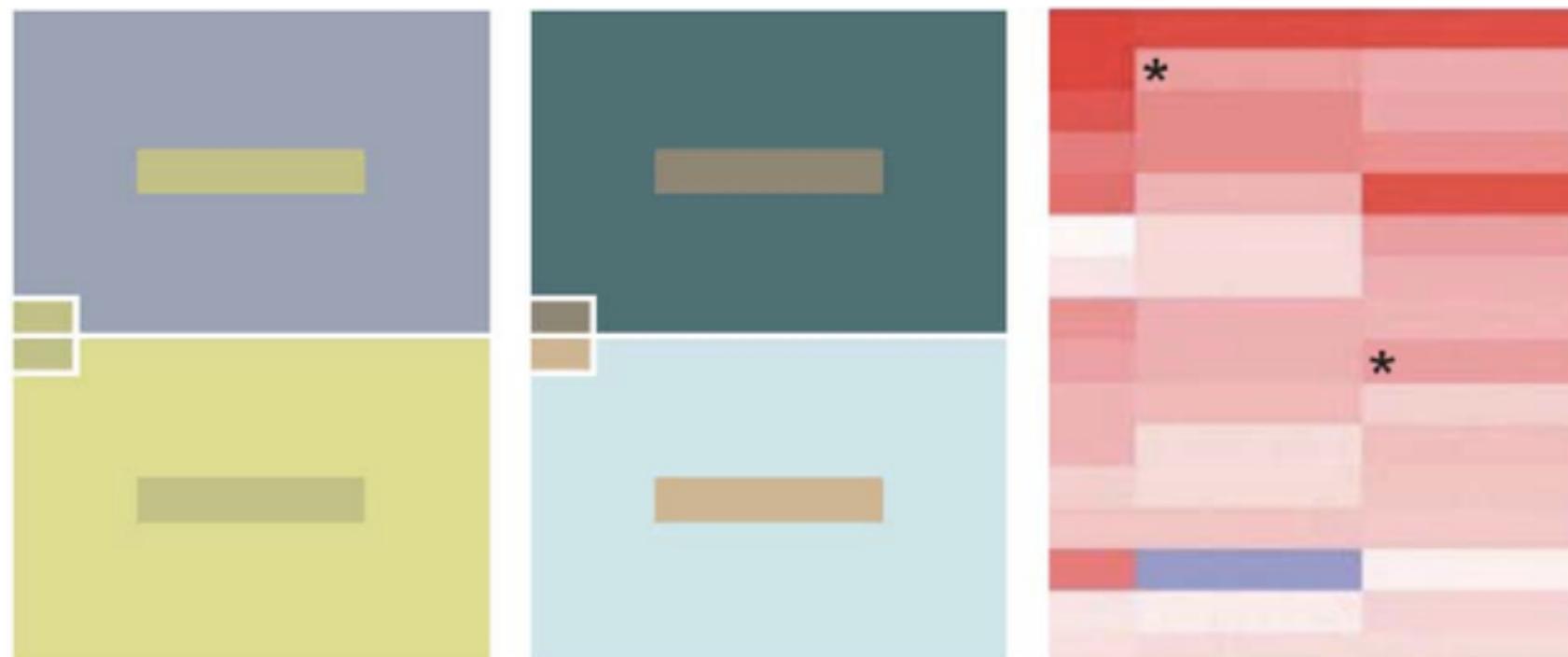
Color Blindness

8% of males, 1% of females

Most common is red-green weakness / blindness

| Color | Color name | RGB (1–255) | CMYK (%) | P | D |
|-------|----------------|---------------|---------------|---|---|
| | Black | 0, 0, 0 | 0, 0, 0, 100 | | |
| | Orange | 230, 159, 0 | 0, 50, 100, 0 | | |
| | Sky blue | 86, 180, 233 | 80, 0, 0, 0 | | |
| | Bluish green | 0, 158, 115 | 97, 0, 75, 0 | | |
| | Yellow | 240, 228, 66 | 10, 5, 90, 0 | | |
| | Blue | 0, 114, 178 | 100, 50, 0, 0 | | |
| | Vermillion | 213, 94, 0 | 0, 80, 100, 0 | | |
| | Reddish purple | 204, 121, 167 | 10, 70, 0, 0 | | |

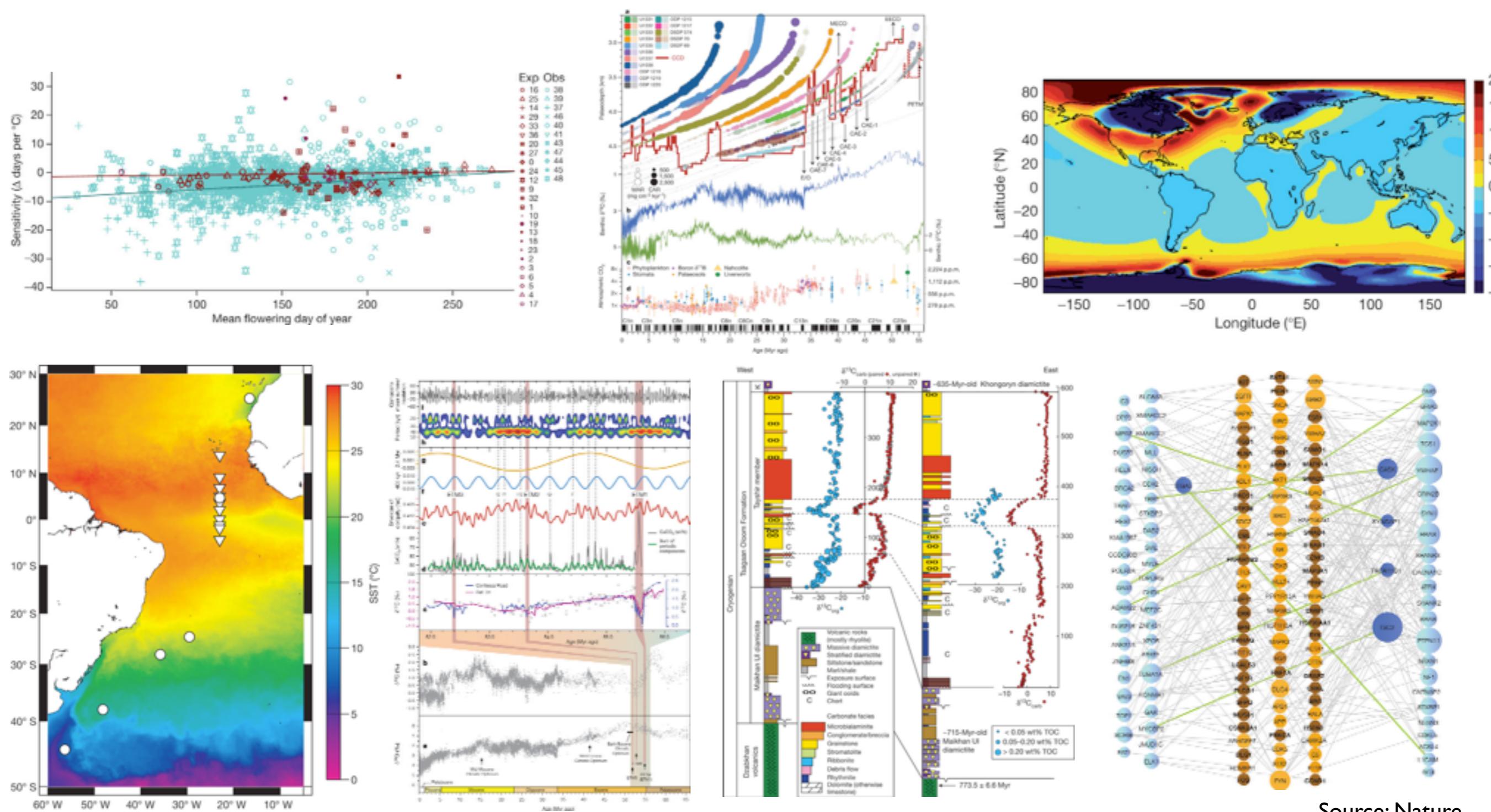
Color is Relative



Design Principles

Non Effective Examples

Revisited...



Source: Nature

« [Job openings at American University](#)

[False memories and statistical analysis](#) »

What we need here is some peer review for statistical graphics

Posted by [Andrew](#) on 8 September 2013, 9:49 am

Under the heading, "Bad graph candidate," Kevin Wright points to [this article](#) [link fixed], writing:

Some of the figures use the same line type for two different series.

More egregious are the confidence intervals that are constant width instead of increasing in width into the future.

Indeed. What's even more embarrassing is that these graphs appeared in an article in the magazine *Significance*, sponsored by the American Statistical Association and the Royal Statistical Society.

Perhaps every scientific journal could have a graphics editor whose job is to point out really horrible problems and require authors to make improvements.

The difficulty, as always, is that scientists write these articles for free and as a public service (publishing in *Significance* doesn't pay, nor does it count as a publication in an academic record), so it might be difficult to get authors to fix their graphs. On the other hand, if an article is worth writing at all, it's worth trying to convey conclusions clearly.

I'm not angry at the authors for publishing bad graphs—scientists typically don't get training in how to construct or evaluate graphical displays, indeed I've seen stuff just as bad in JASA and other top statistics journals—but it would be good to catch this stuff before it gets out for public consumption.



Filed under [Sociology](#), [Statistical graphics](#)

[Comment \(RSS\)](#) | [Trackback](#) | [Permalink](#)

Points of View (PoV)



Bang
Wong



Nils
Gehlenborg

Points of Significance (PoS)



Martin
Krzywinski

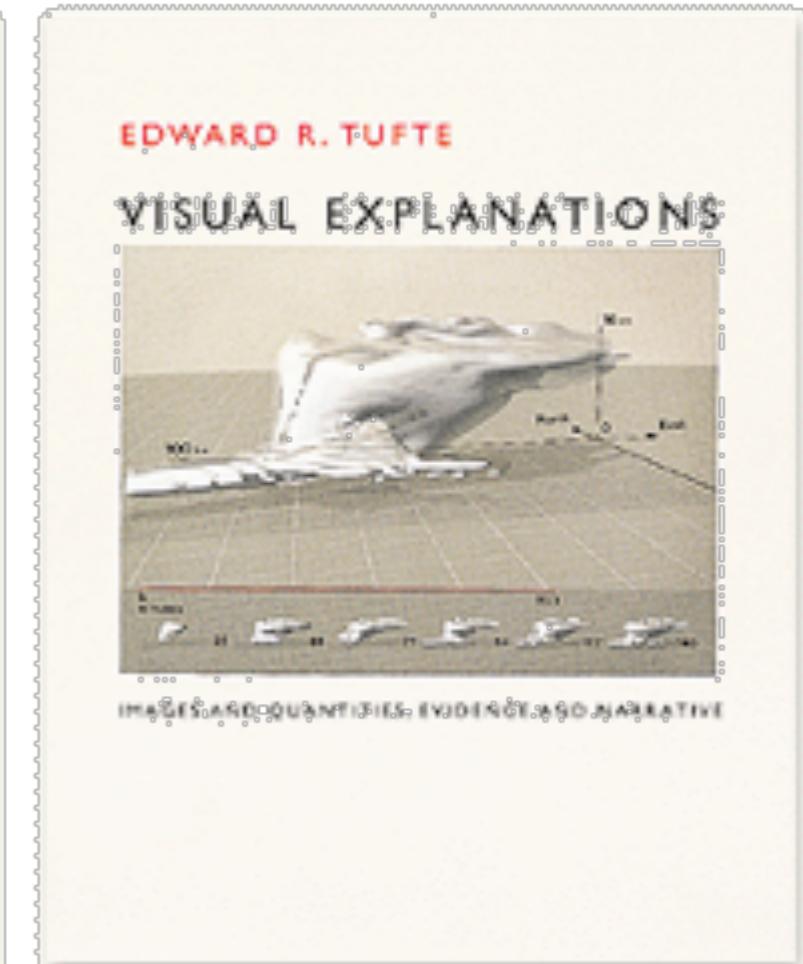
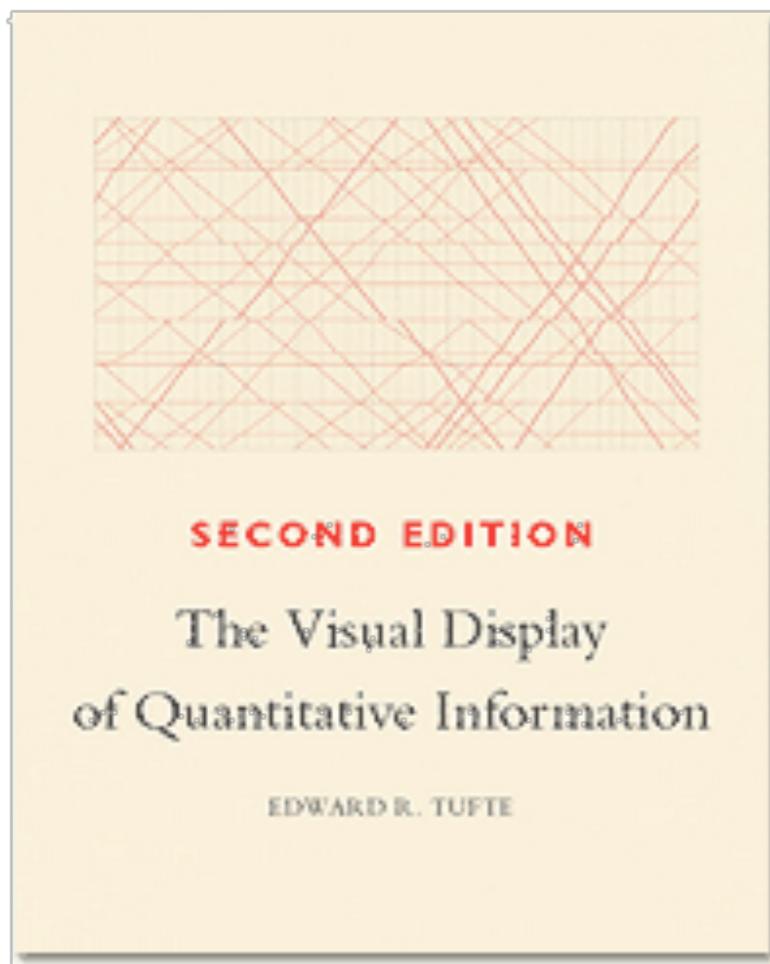


Naomi
Altman

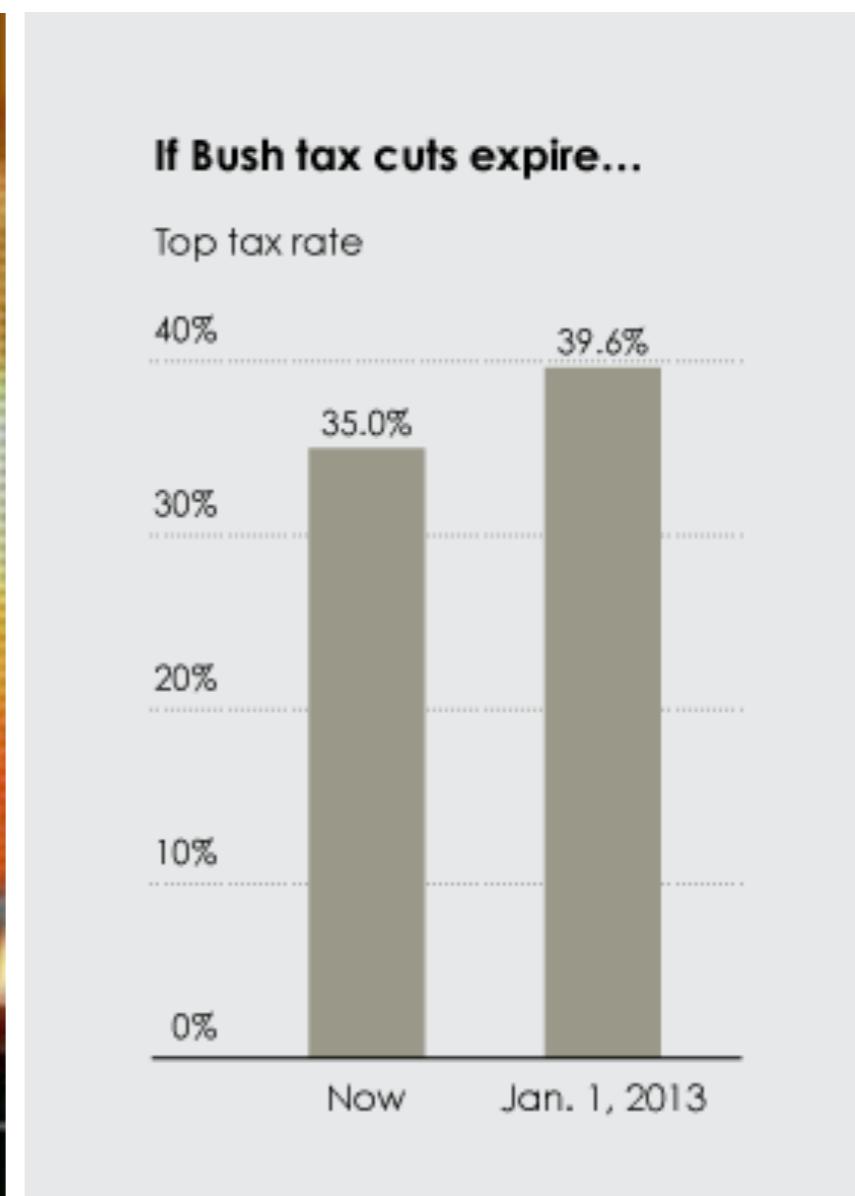
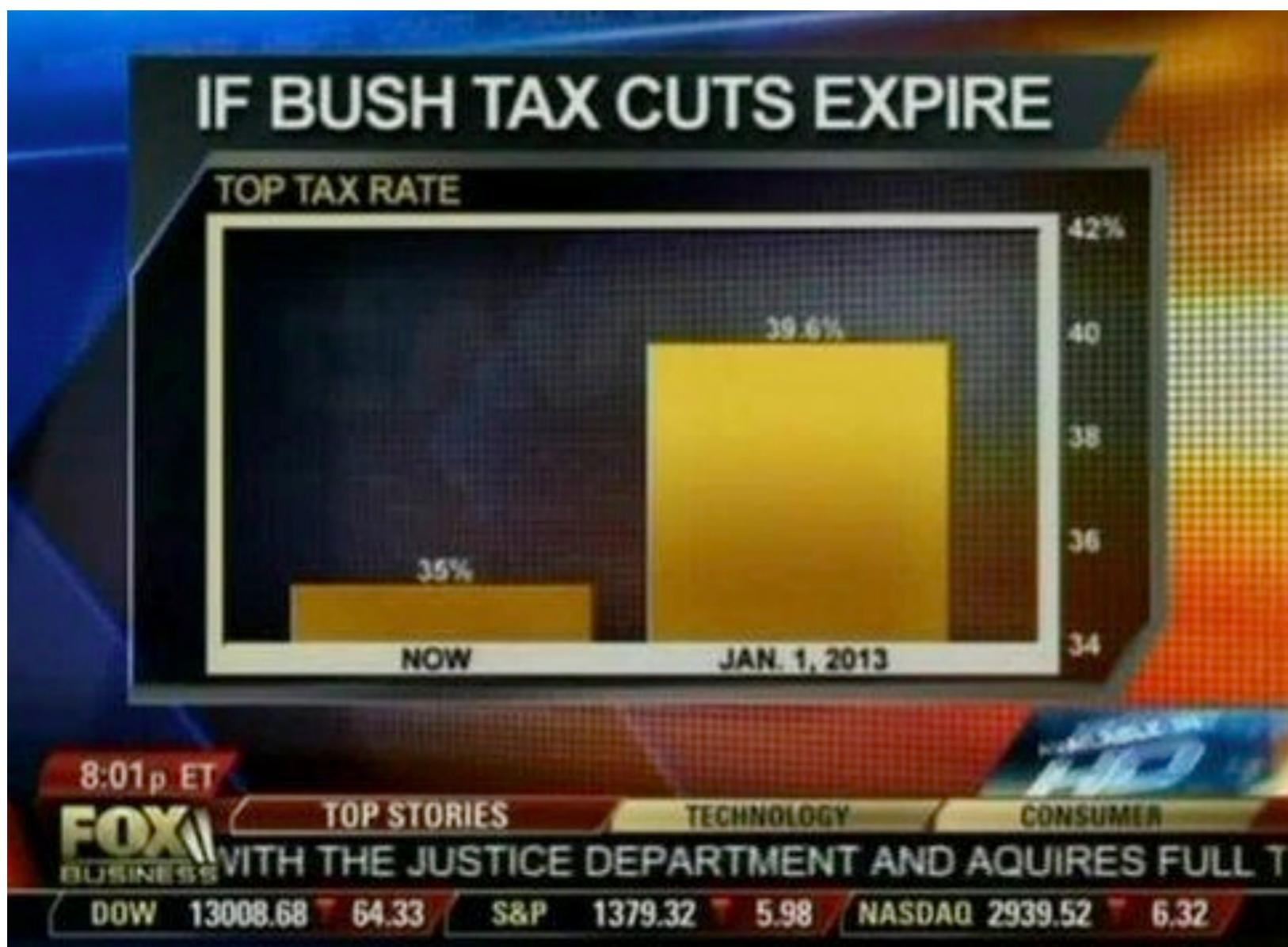
Summary of PoV and PoS articles

<http://blogs.nature.com/methagora/2013/07/data-visualization-points-of-view.html>

Edward Tufte



Scale Distortions



Scale Distortions

How 2012 STACKS UP

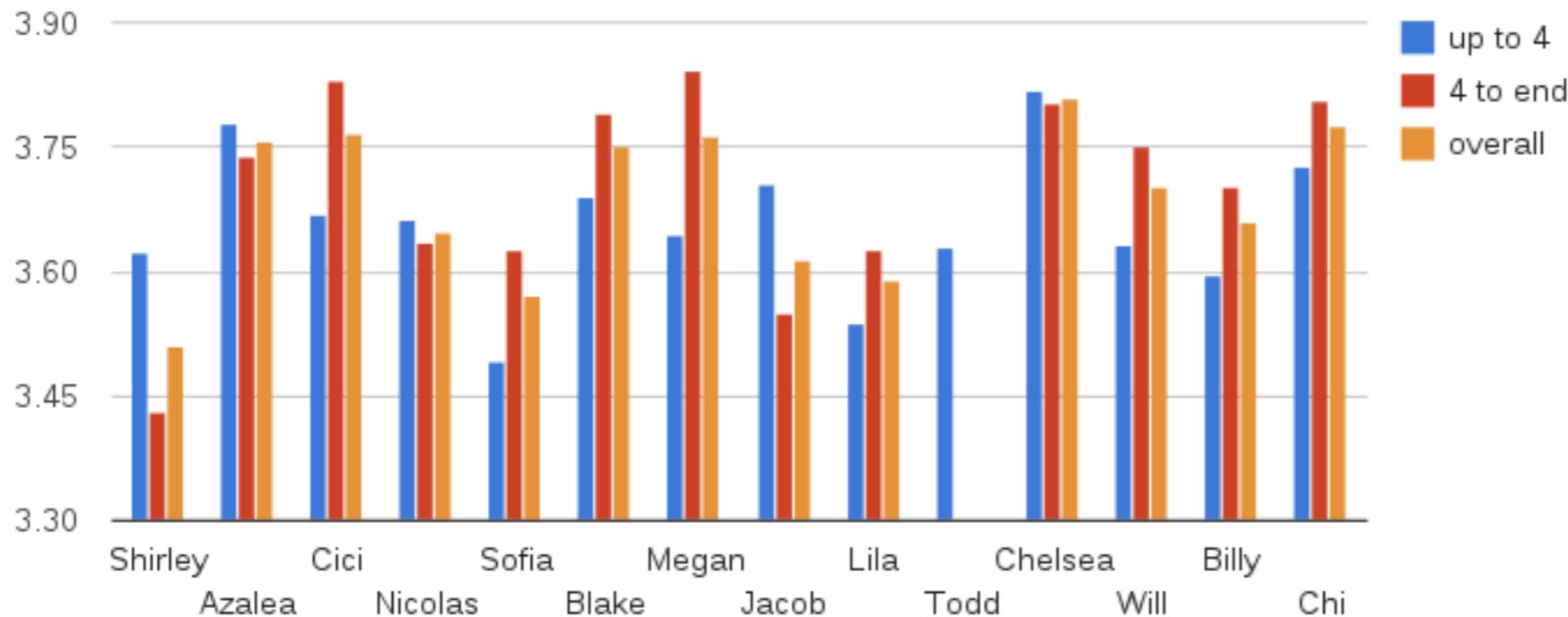
THE WARMEST YEARS ON RECORD
CONTIGUOUS U.S.



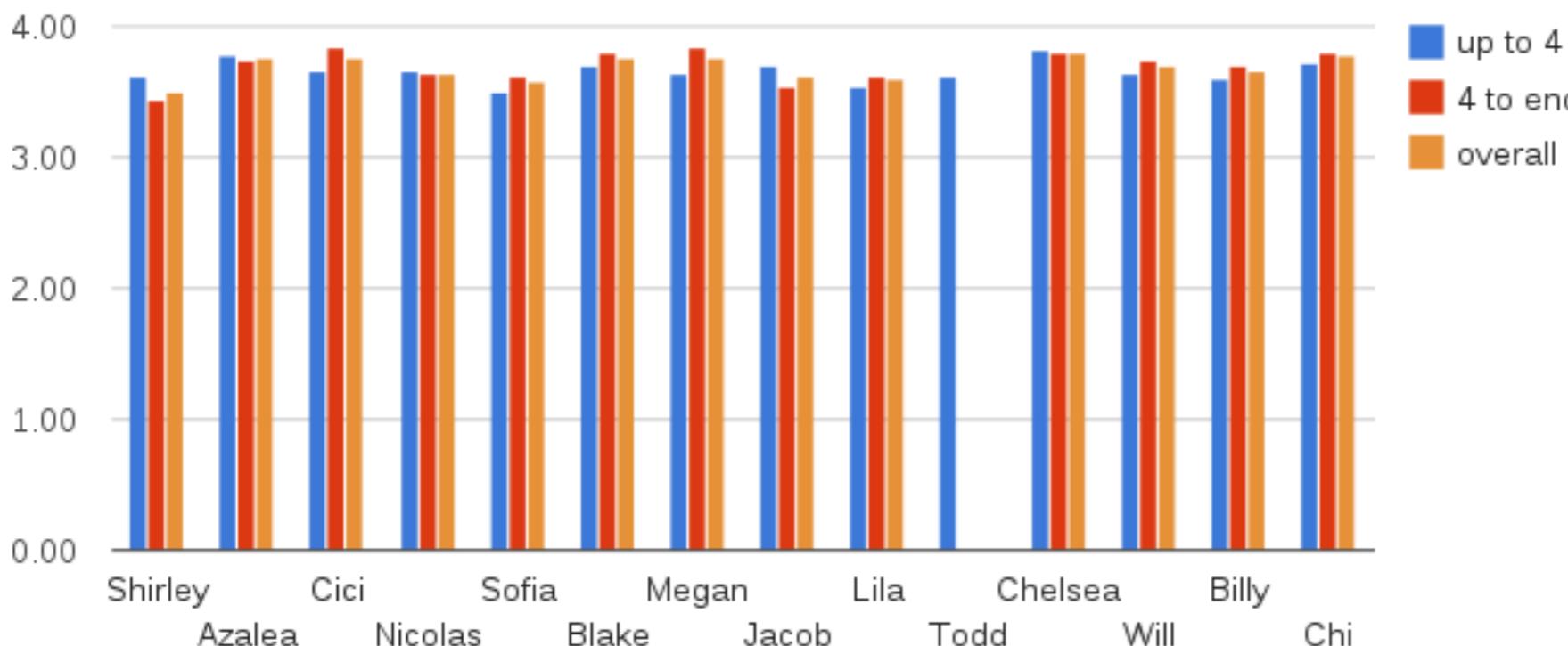
Source: NOAA's National Climatic Data Center - State of the Climate National Overview

CLIMATE  CENTRAL

Scale Distortions

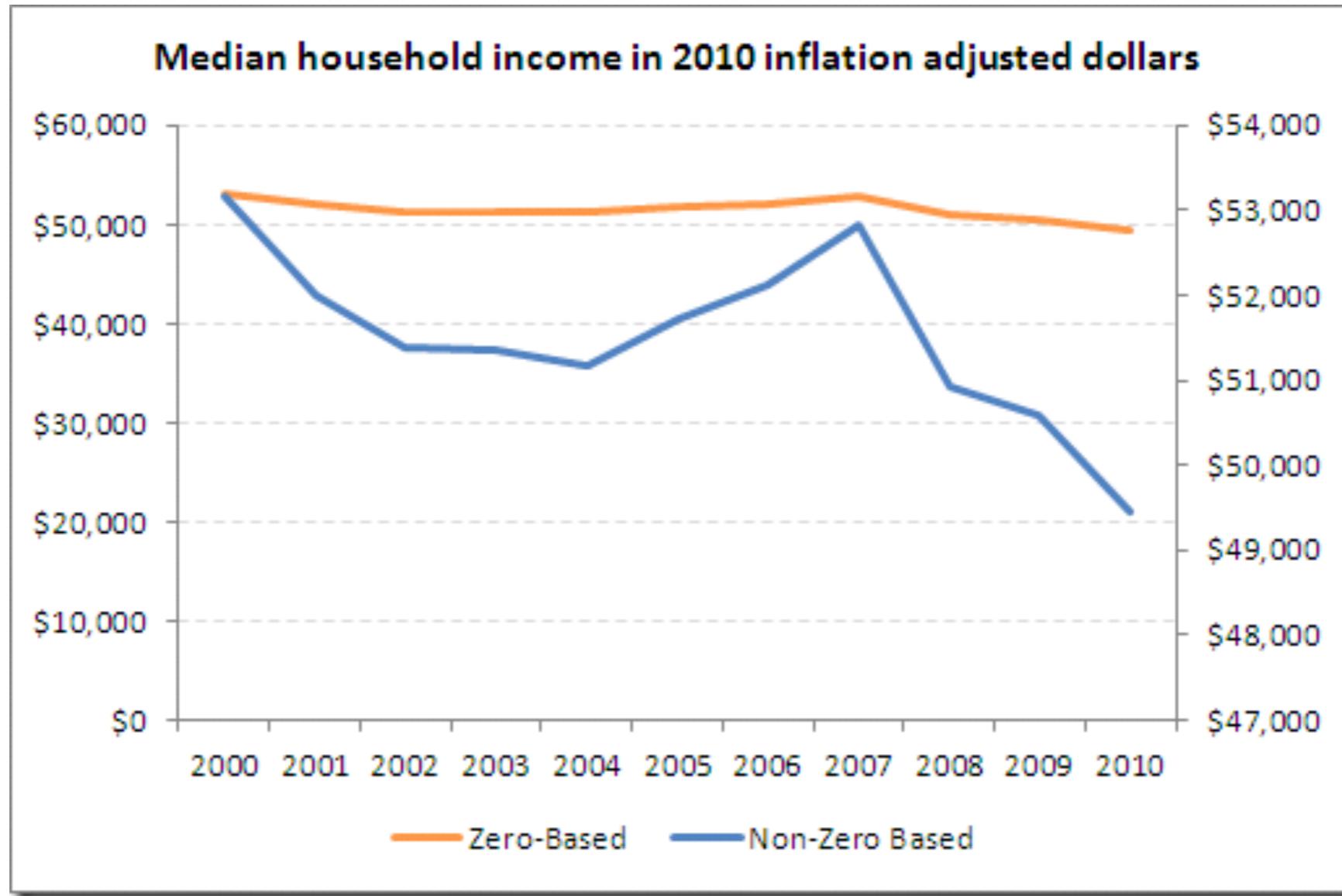


Grade Fluctuation

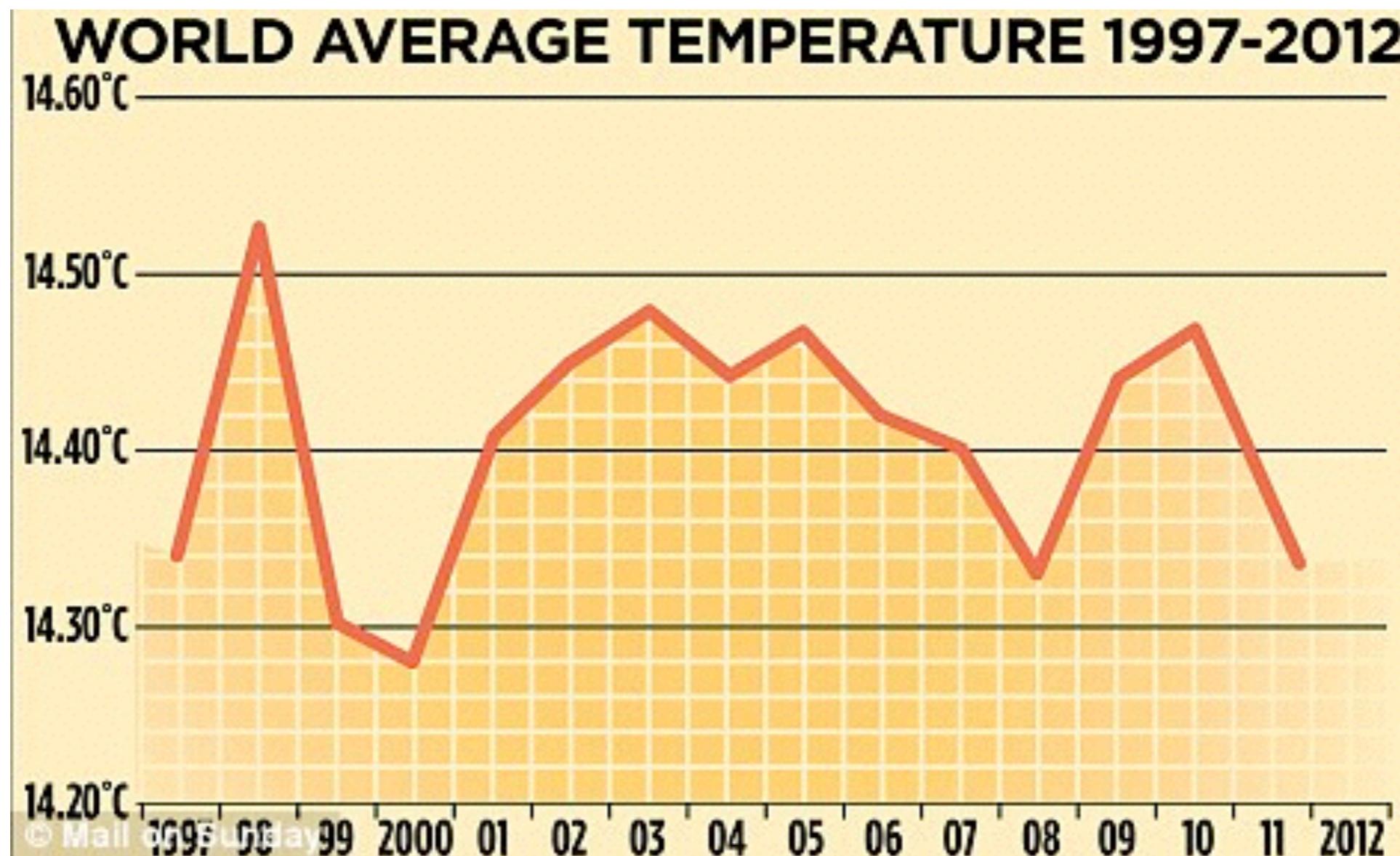


*Always start your
bar graphs at zero!*

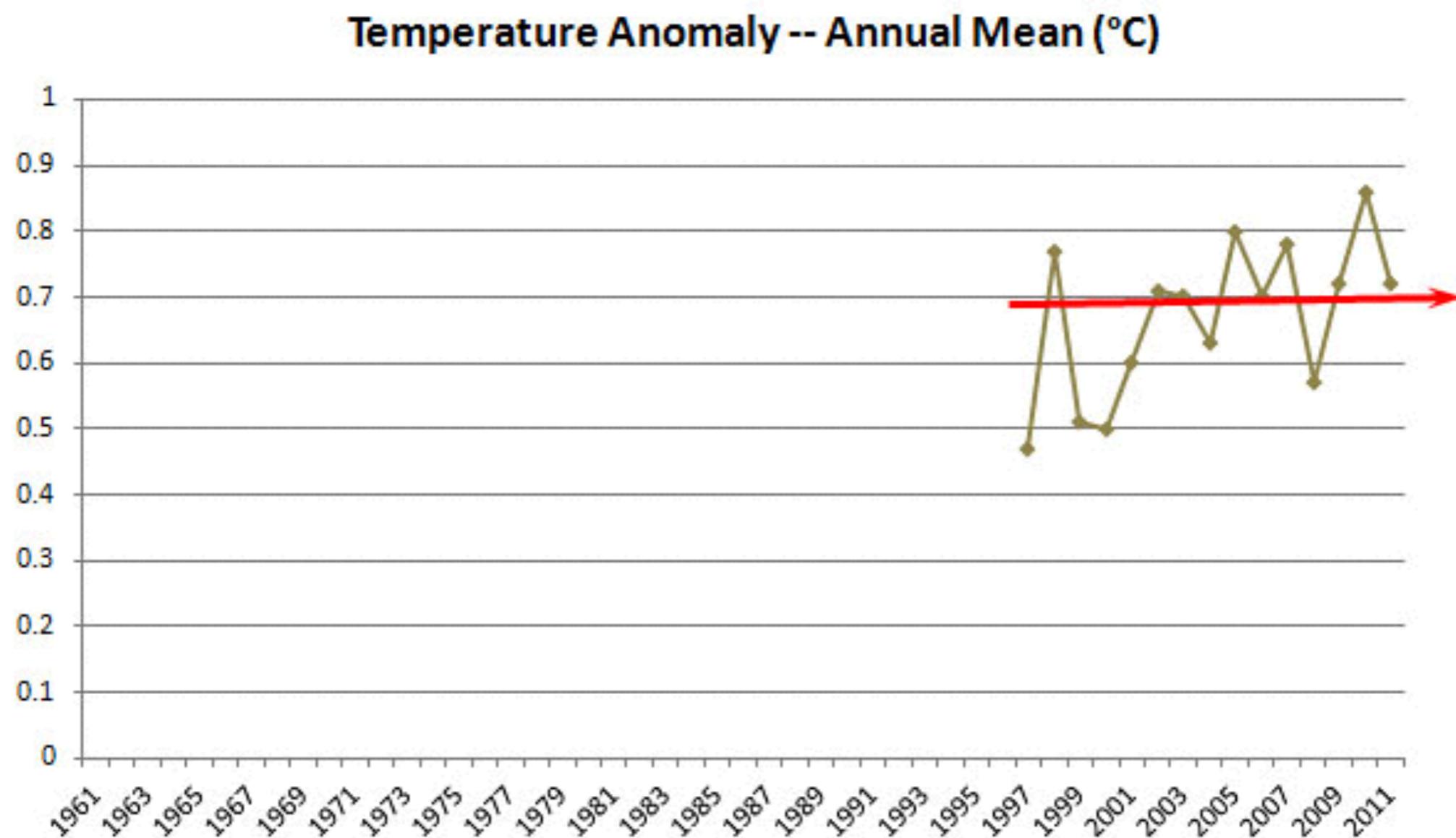
Scale Distortions



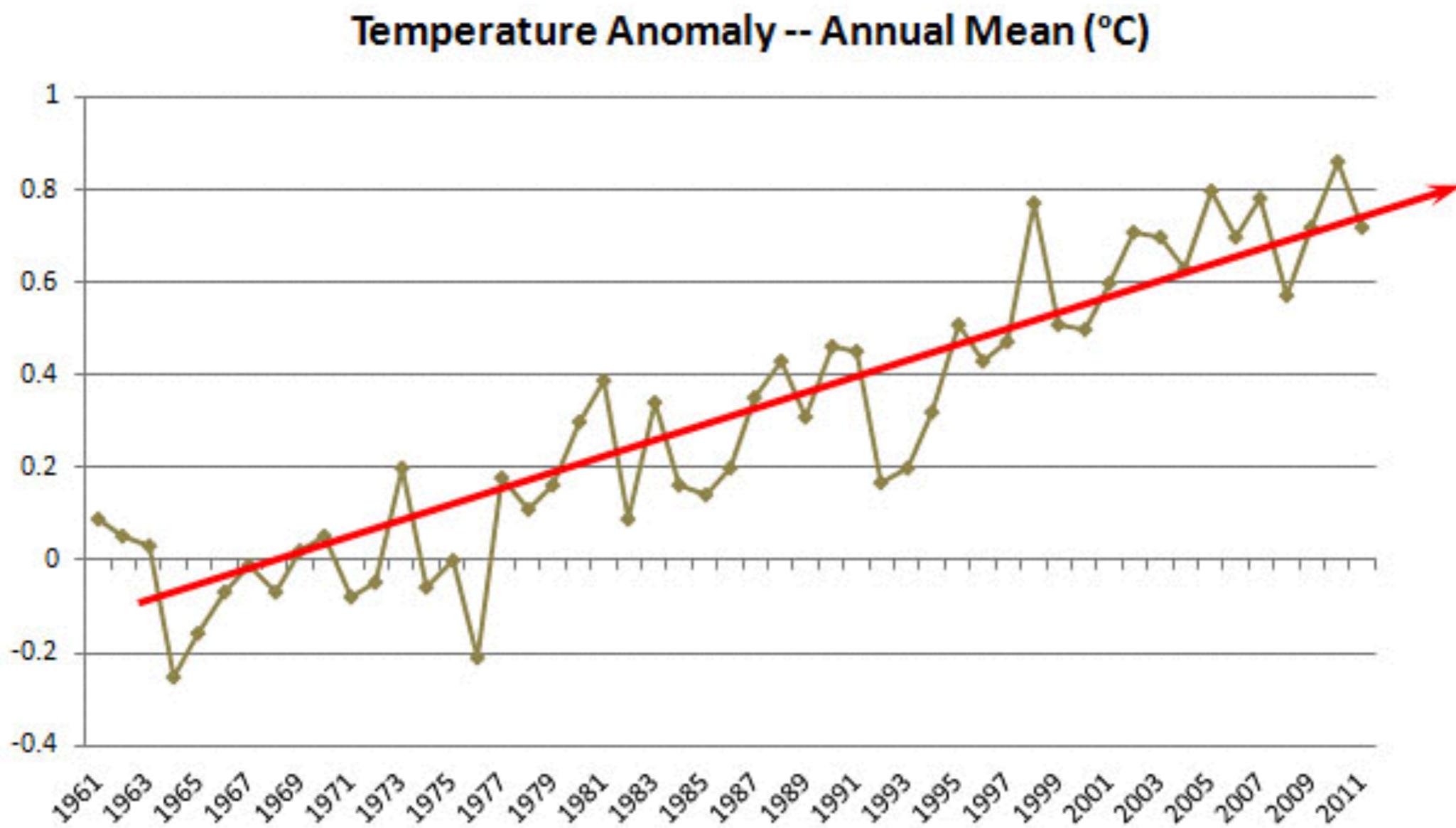
Global Warming?



Global Warming?

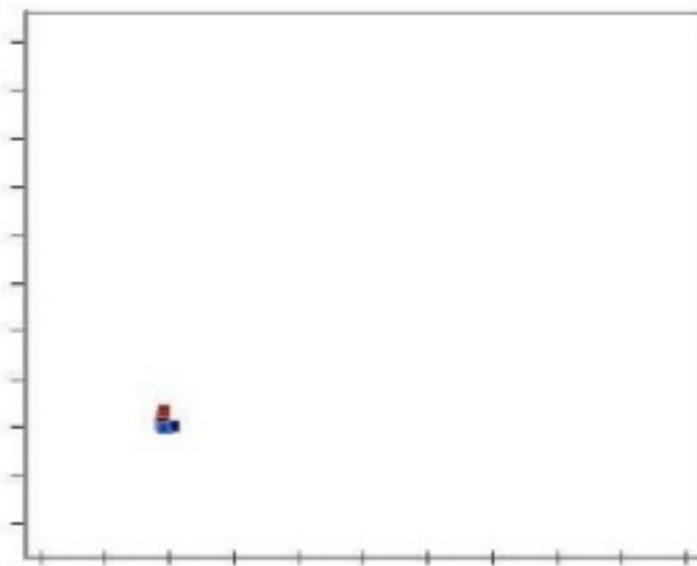


Global Warming!

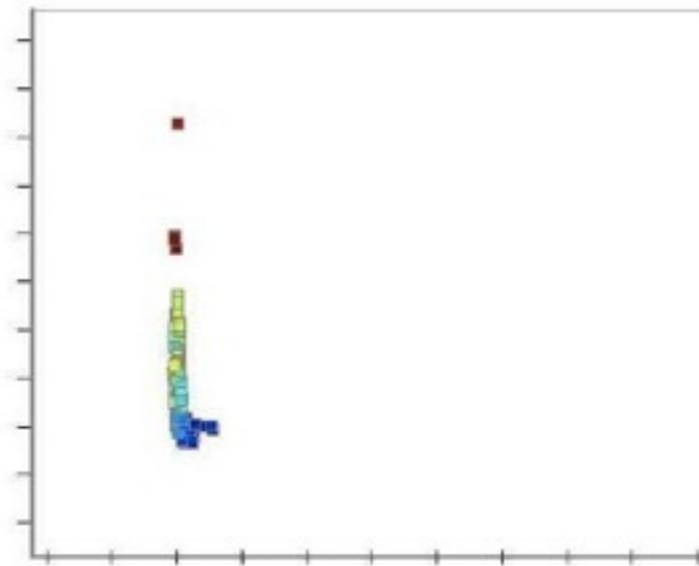


Lying with Scales

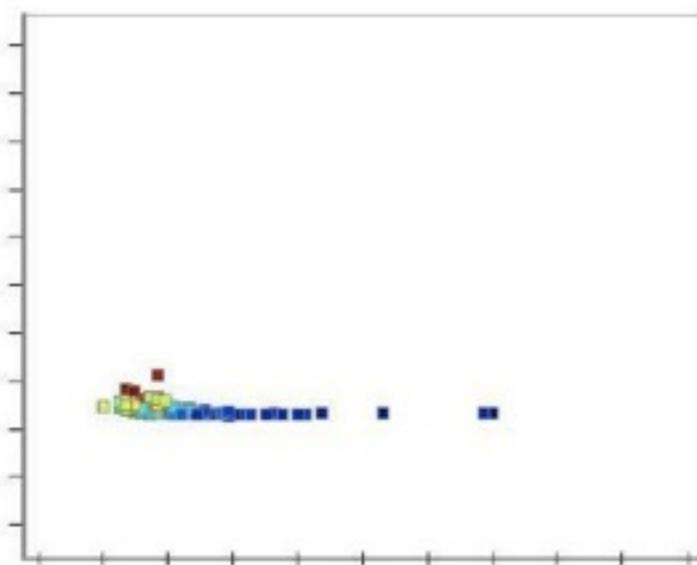
Same data - different scales



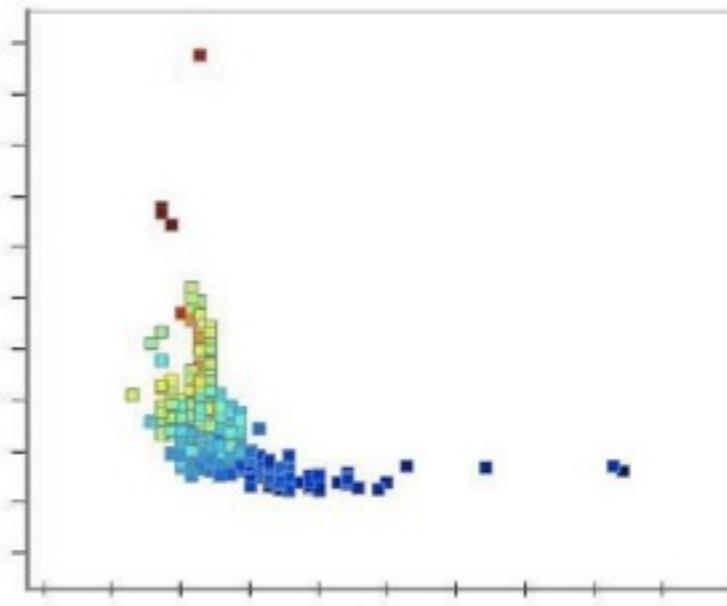
Uniform scale in both x and y



Larger scale in y



Larger scale in x



Larger scale in x and y

Scales are critical!

What are your bounds – upper and lower?

What scale works?

Linear? Log? Clipping? Breaks?

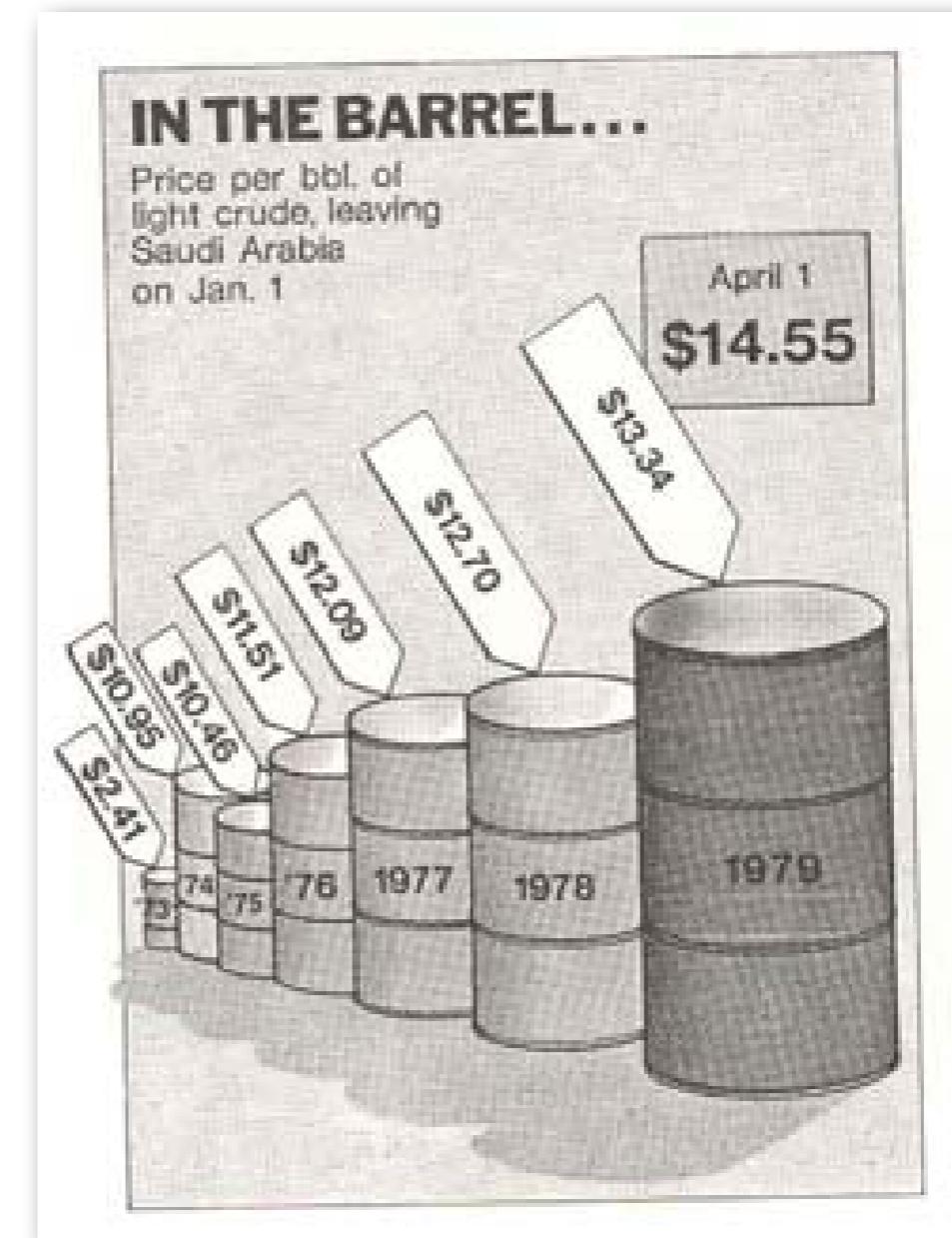
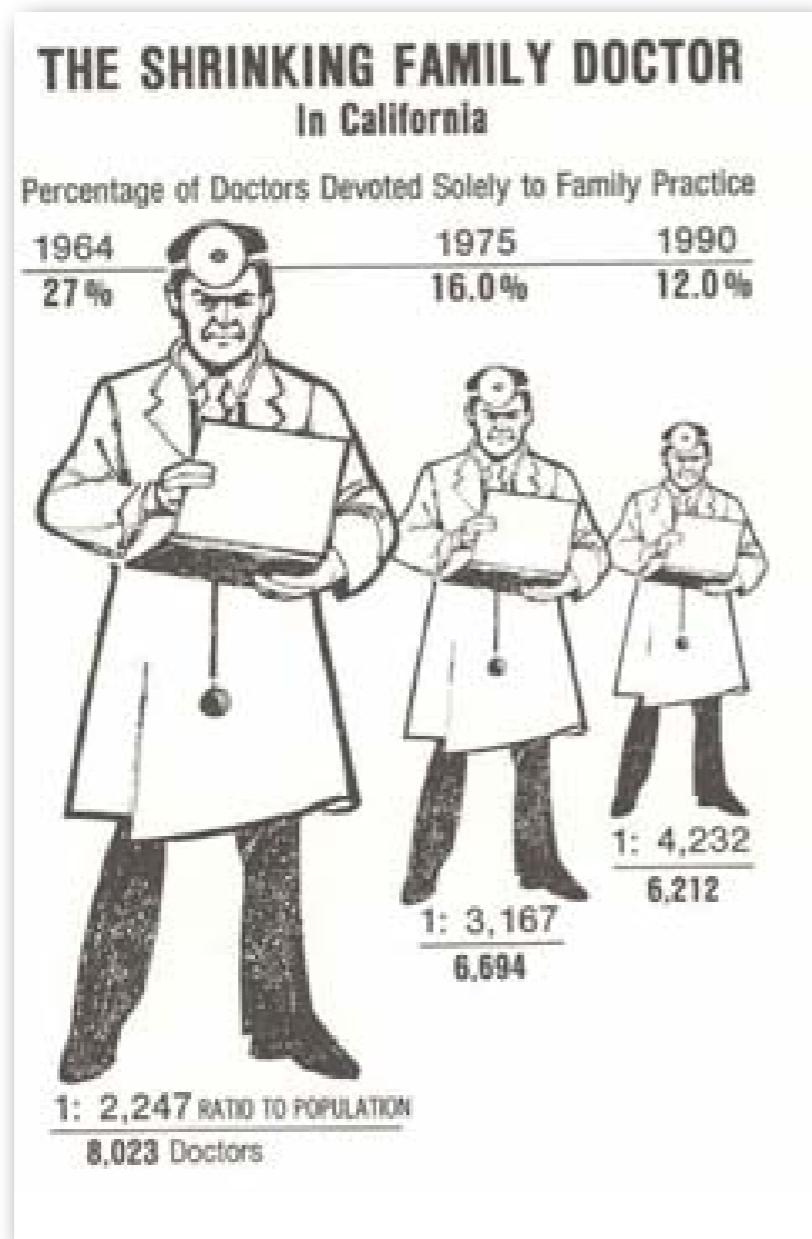
Relative or absolute values?

How can you make things comparable?

The Lie Factor

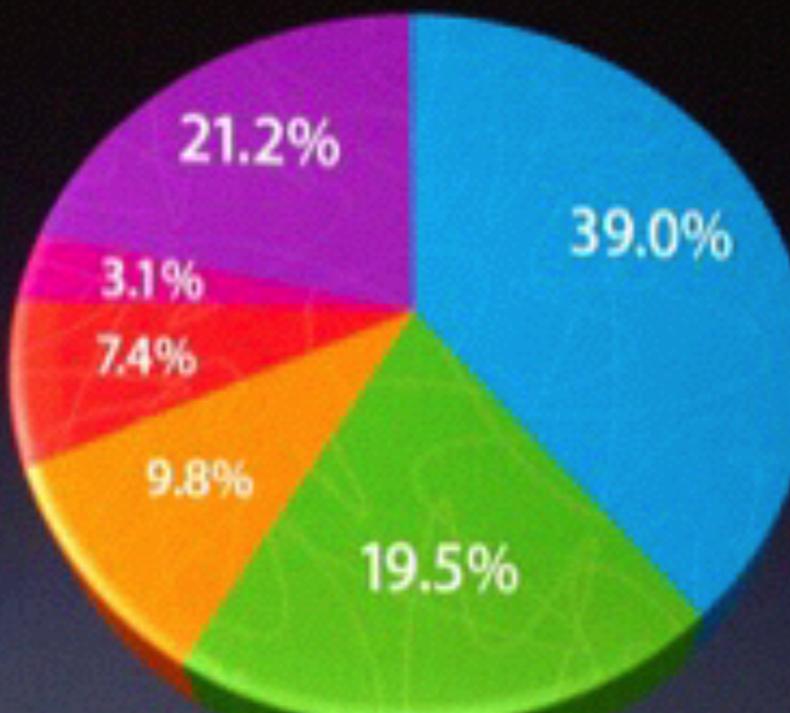
Size of effect shown in graphic

Size of effect in data



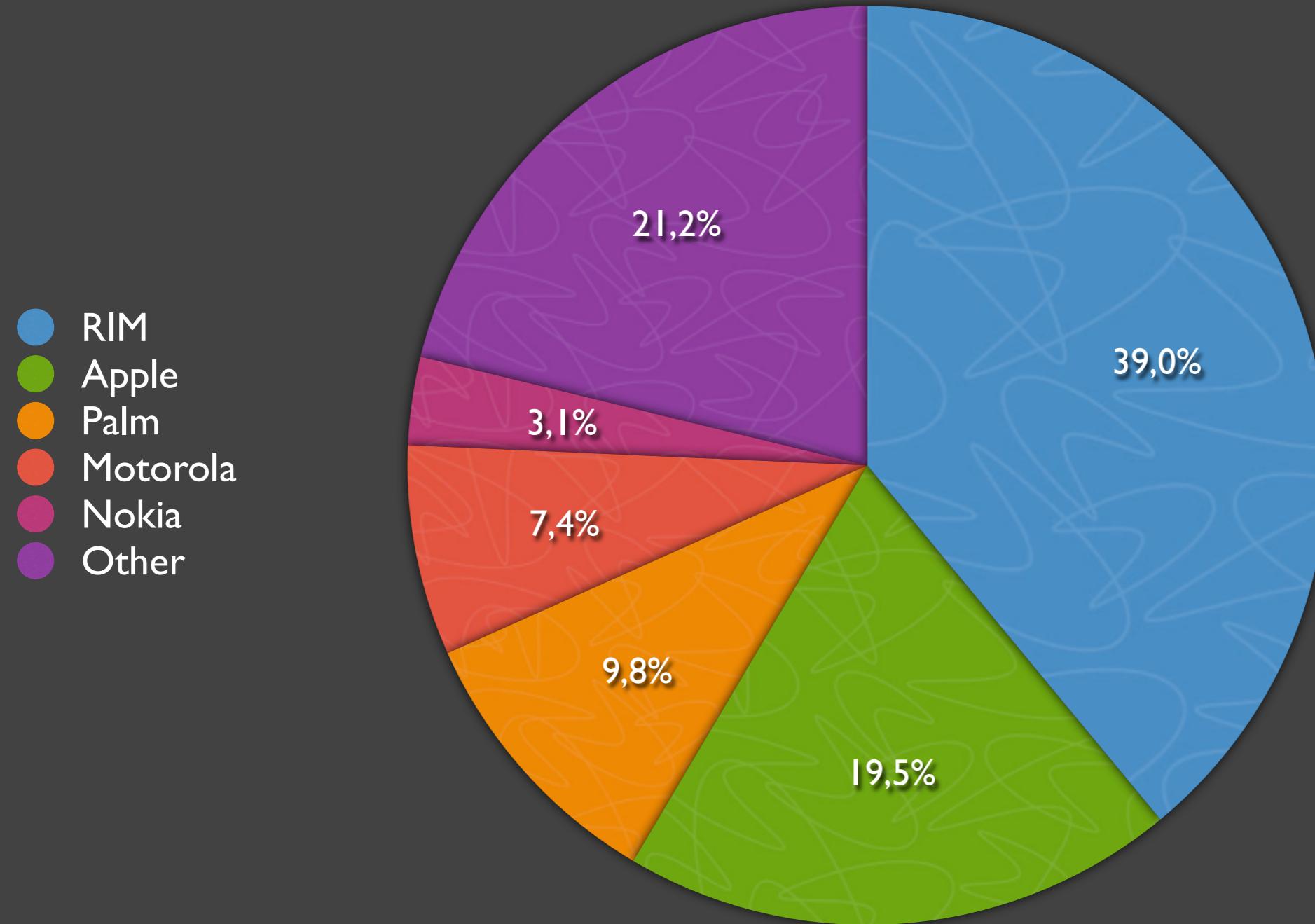
U.S. SmartPhone Marketshare

- RIM
- Apple
- Palm
- Motorola
- Nokia
- Other

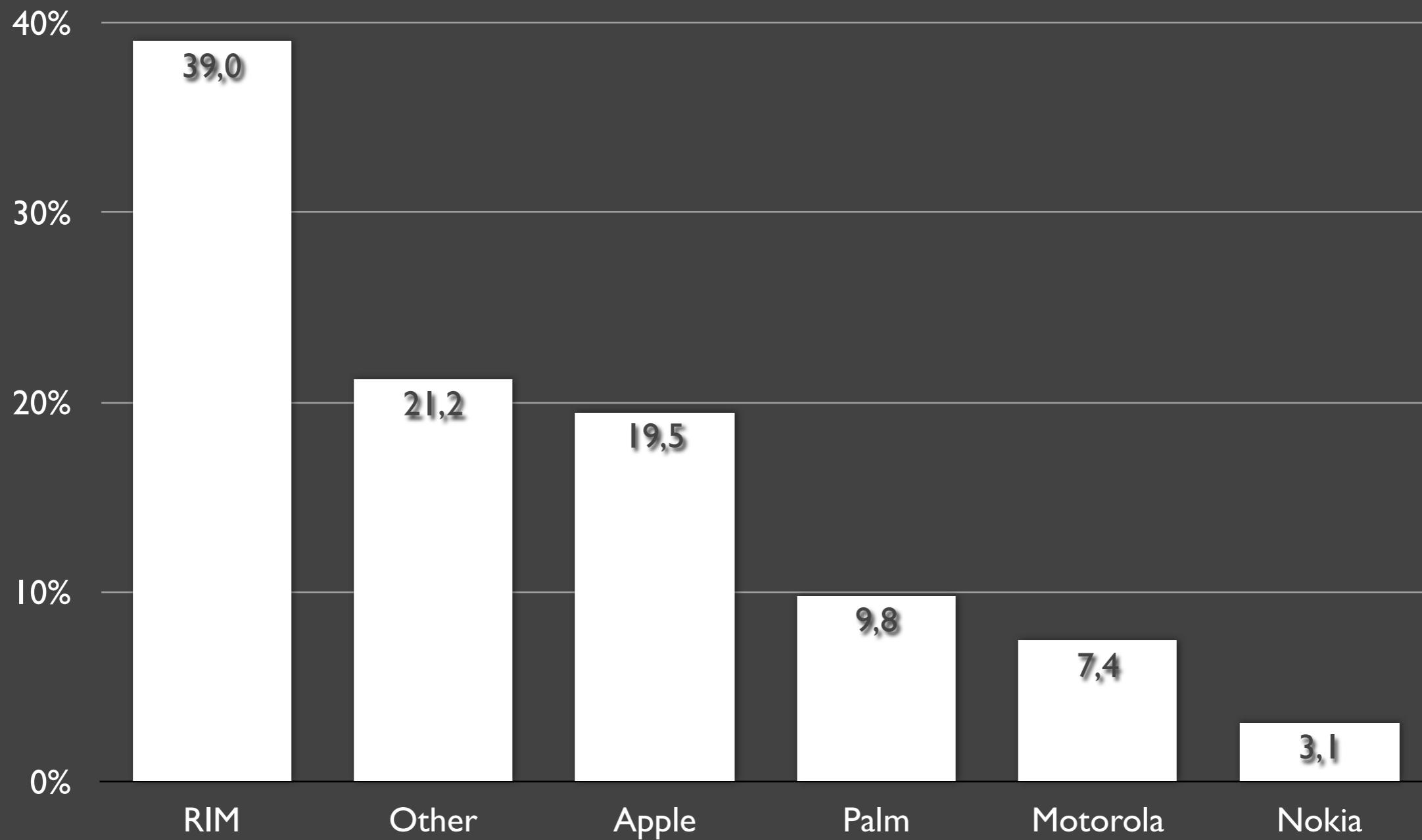


Engage Gartner for

U.S. SmartPhone Marketshare



U.S. SmartPhone Marketshare



*Same Veritas. More Lux.*

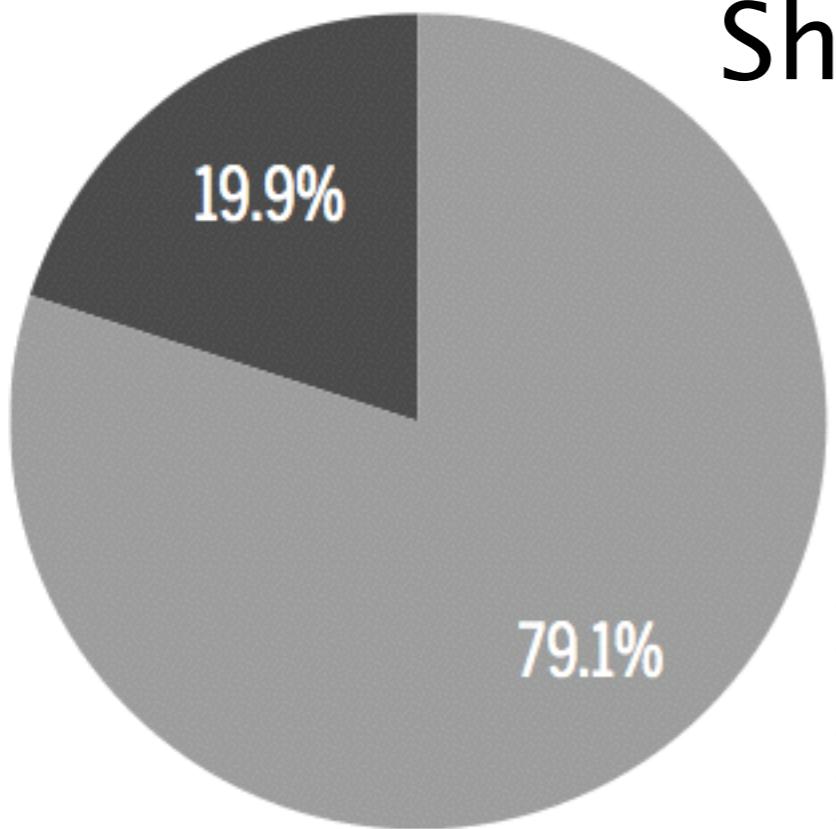
Yale Summer Session

Over 200 full-credit courses.

June 4 – July 6 , July 9 – Aug 10

2012 *experience Yale*

CHART YALE GRADUATES' MAJORS, CLASS OF 2011



Should always add up to 100

Facebook Recommendations



[Shake Shack to open in New Haven](#)
277 people recommend this



[Popular anti-religion creates false dichotomy](#)
15 people recommend this.



[Friends remember Foucher LAW '14](#)
10 people recommend this.



[AIDS activist speaks about documentary film](#)
8 people recommend this.



[Panel outlines changes in hip-hop](#)
30 people recommend this.



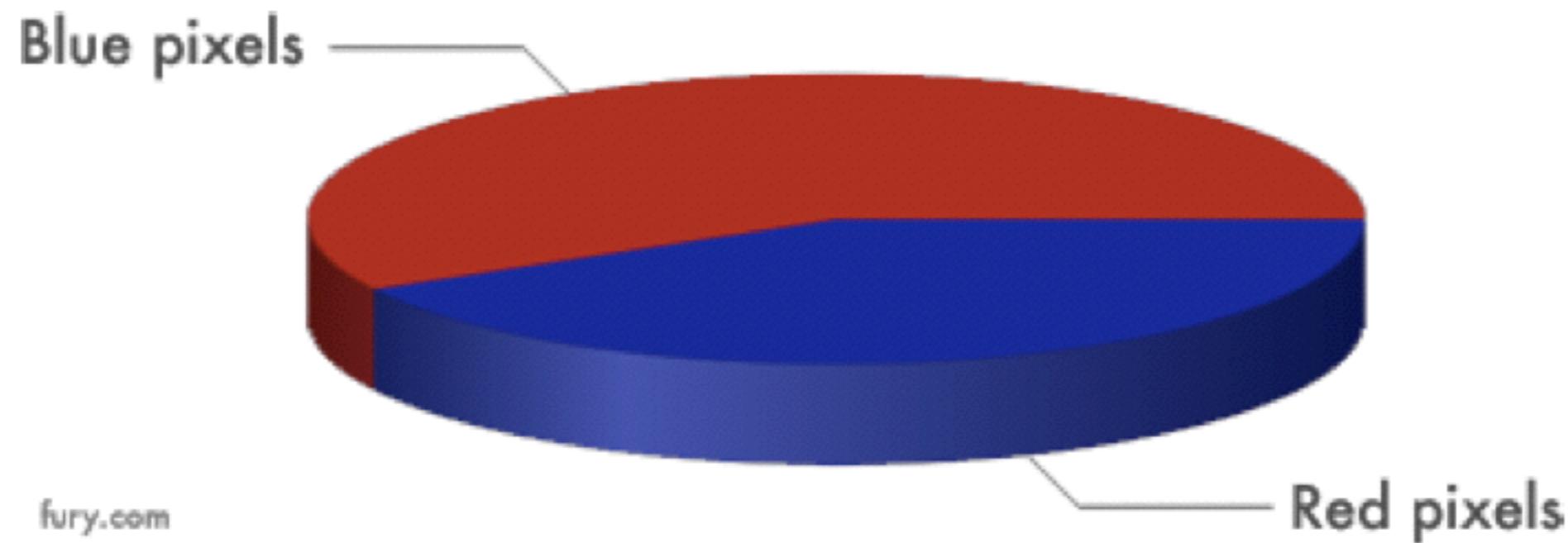
[Facebook social plugin](#)

Advertisement

Featured

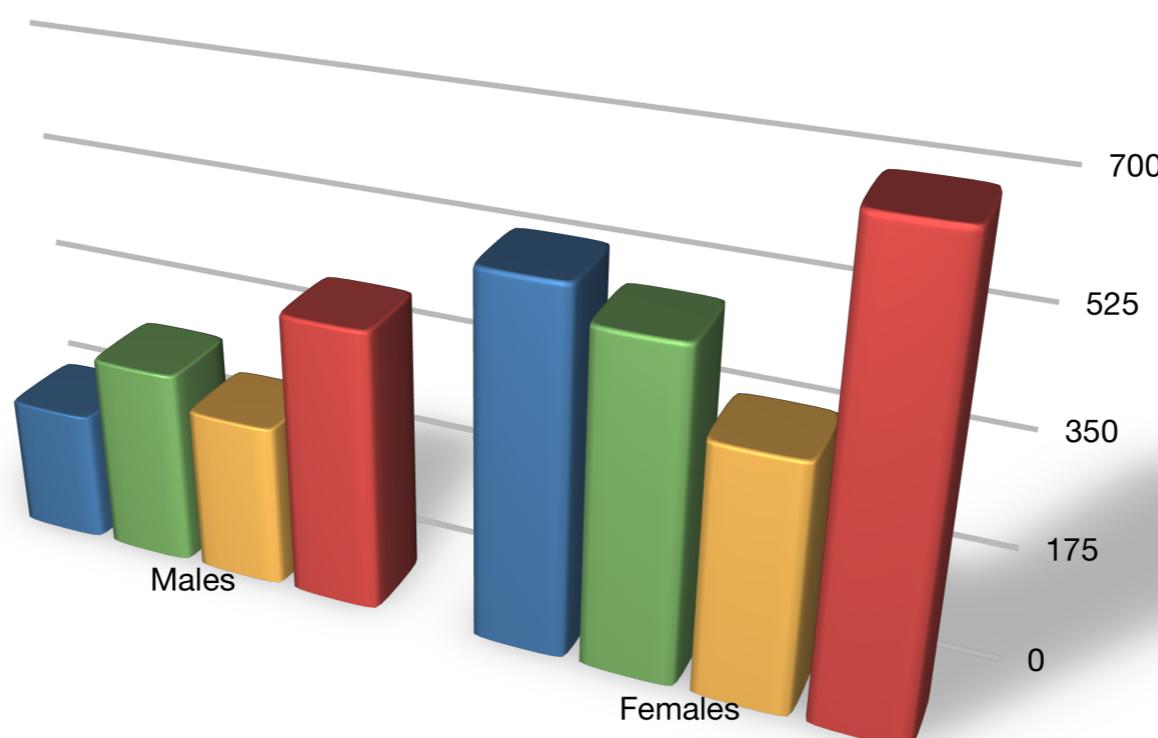
Jobs

Why 3D Pie Charts are Bad



Maximize Data-Ink Ratio

Data-Ink Ratio = $\frac{\text{Data ink}}{\text{Total ink used in graphic}}$



■ 0-\$24,999

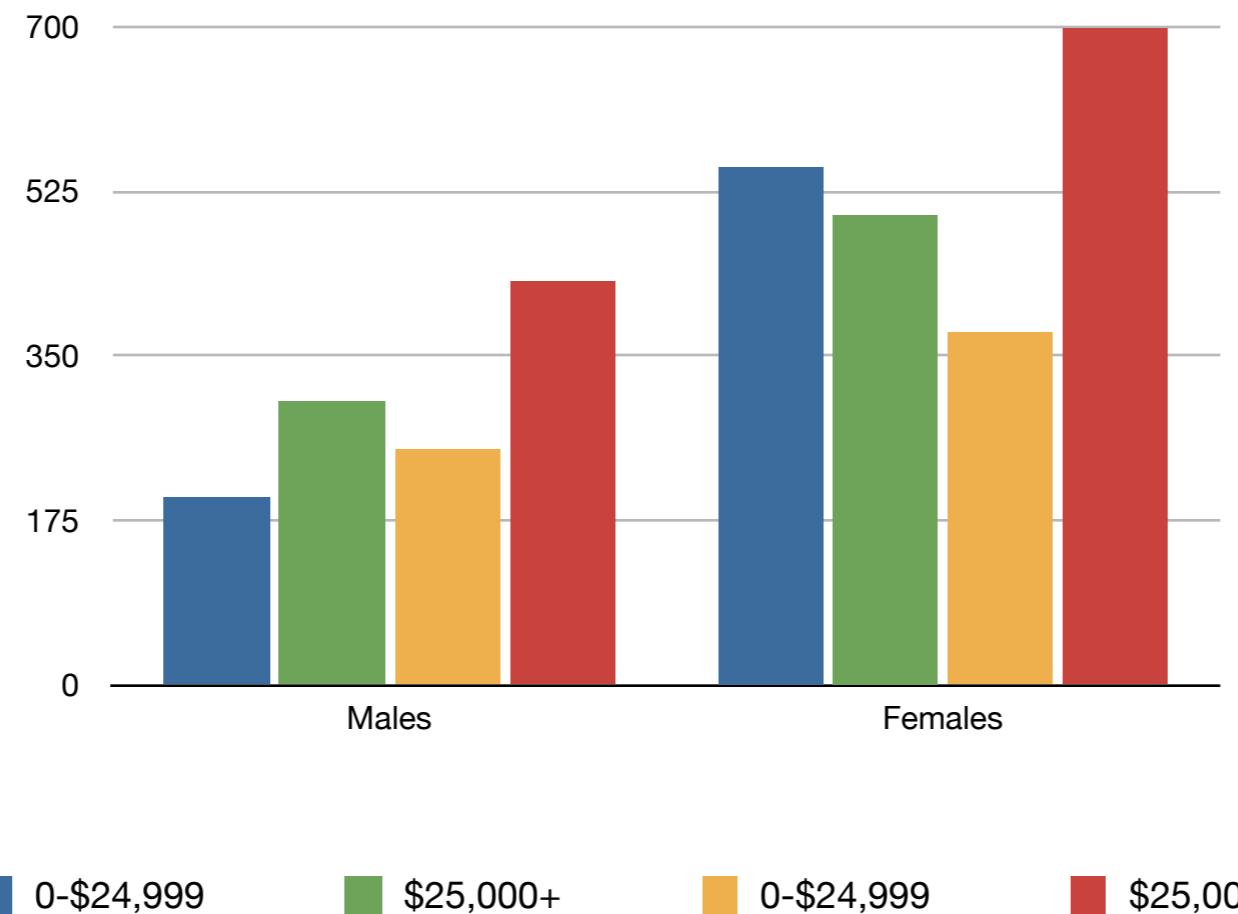
■ \$25,000+

■ 0-\$24,999

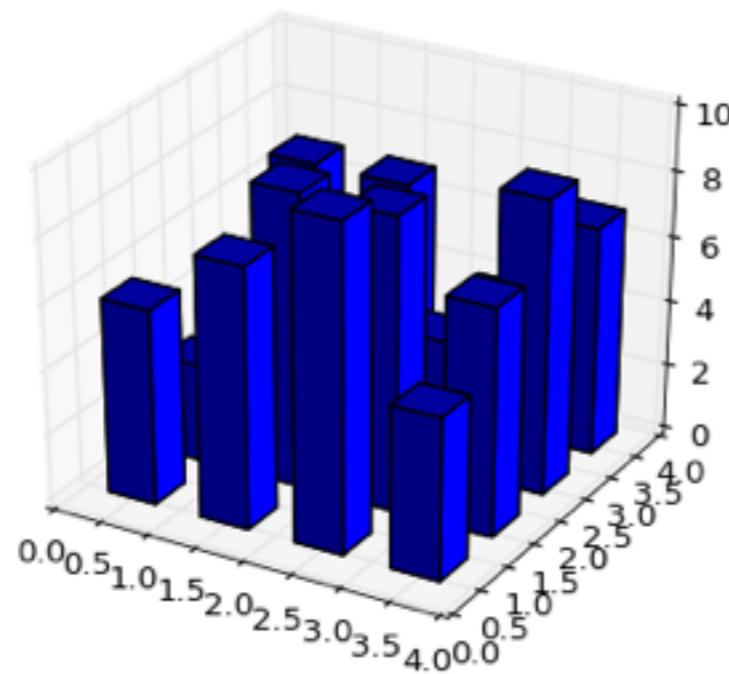
■ \$25,000+

Maximize Data-Ink Ratio

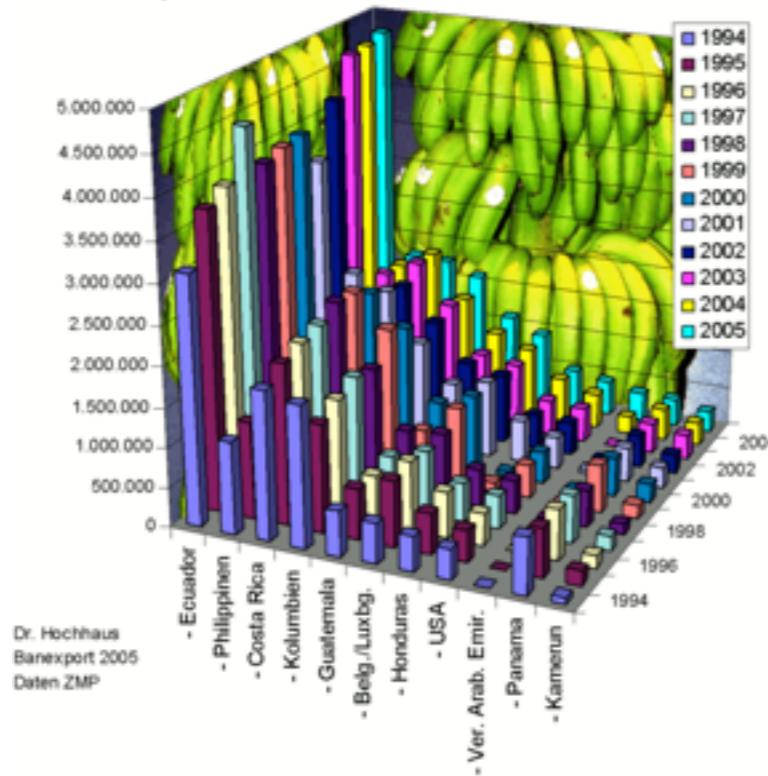
Data-Ink Ratio = $\frac{\text{Data ink}}{\text{Total ink used in graphic}}$



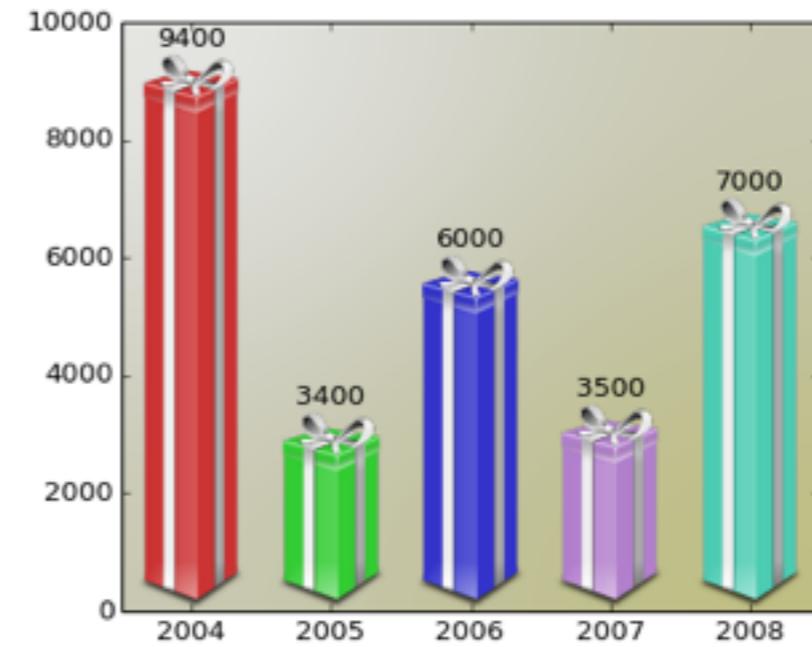
Don't Use 3D



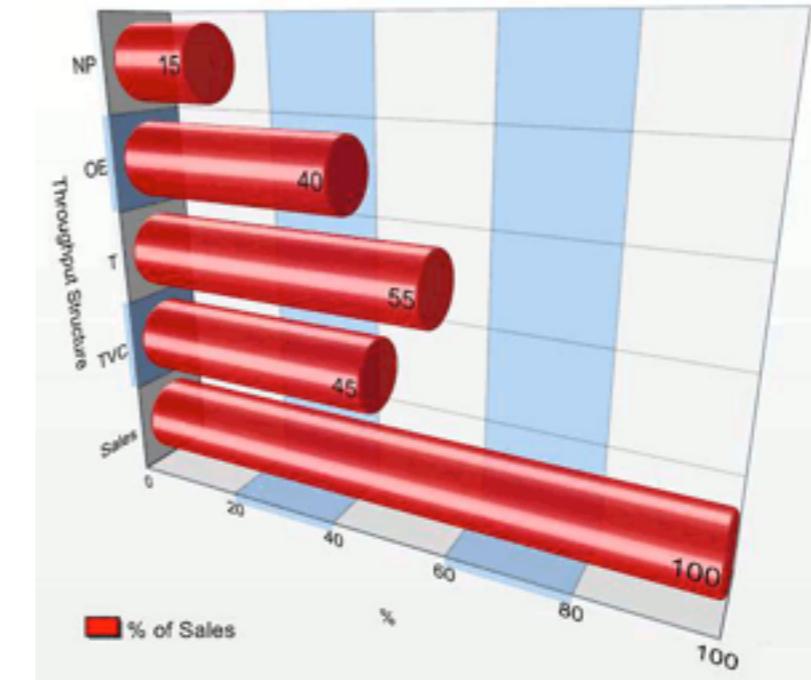
Export von Bananen in Tonnen von 1994-2005



Dr. Hochhaus
Banlexport 2005
Daten ZMP



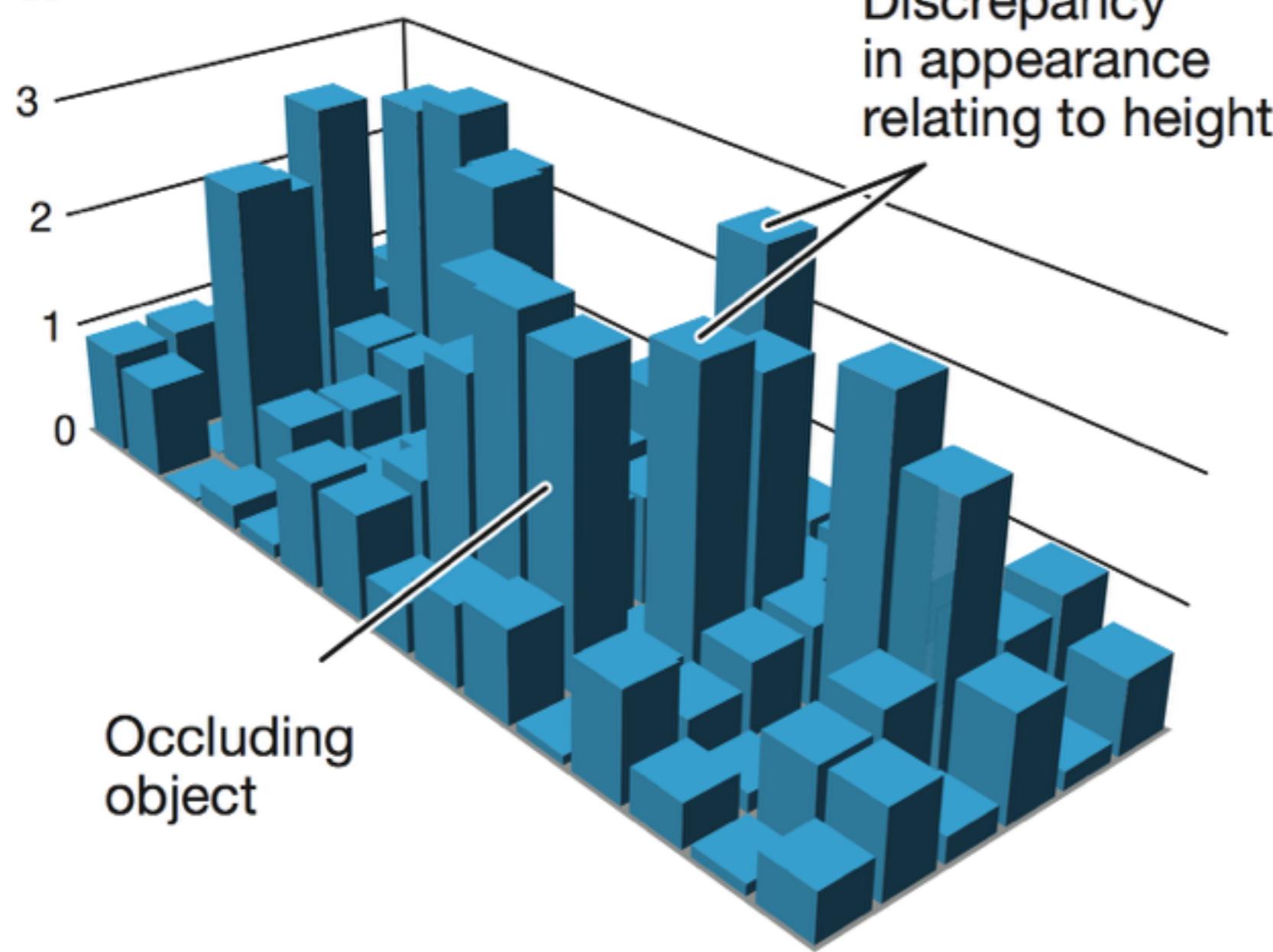
matplotlib gallery



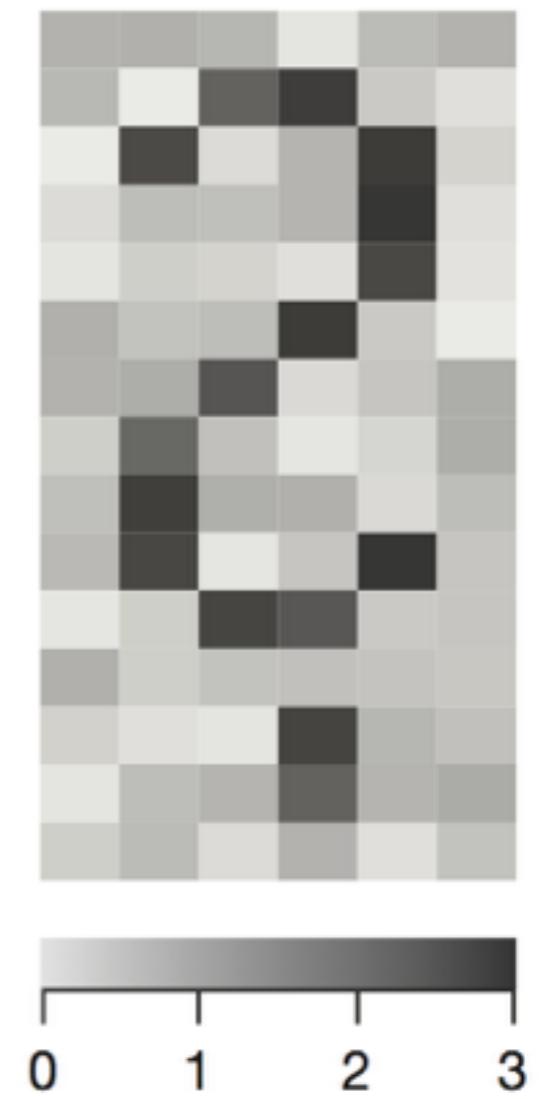
Excel Charts Blog

3D Bar Plot

a



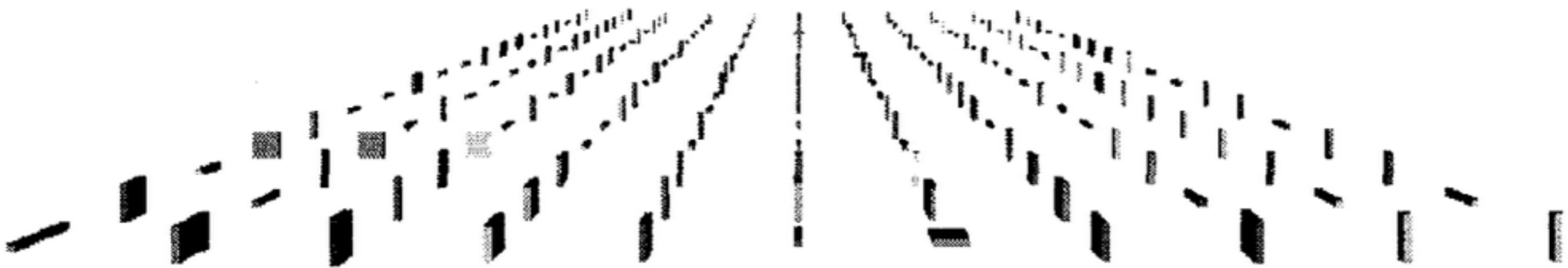
b



Which one is the tallest bar?
What is the pattern in the data?

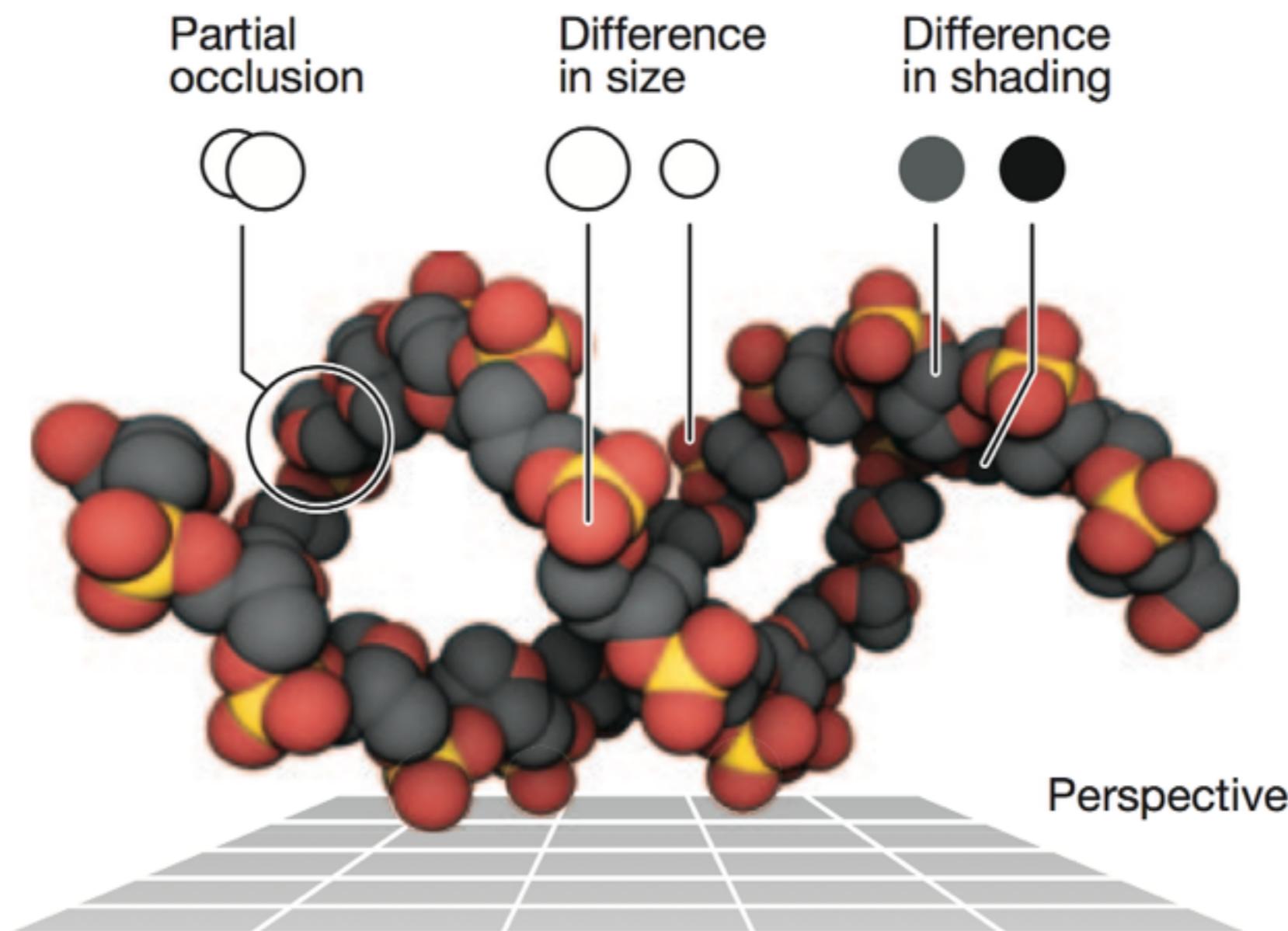
Gehlenborg & Wong, PoV, Nature Methods, 2012

Perspective Distortion in 3D



Position and size channel are negatively affected

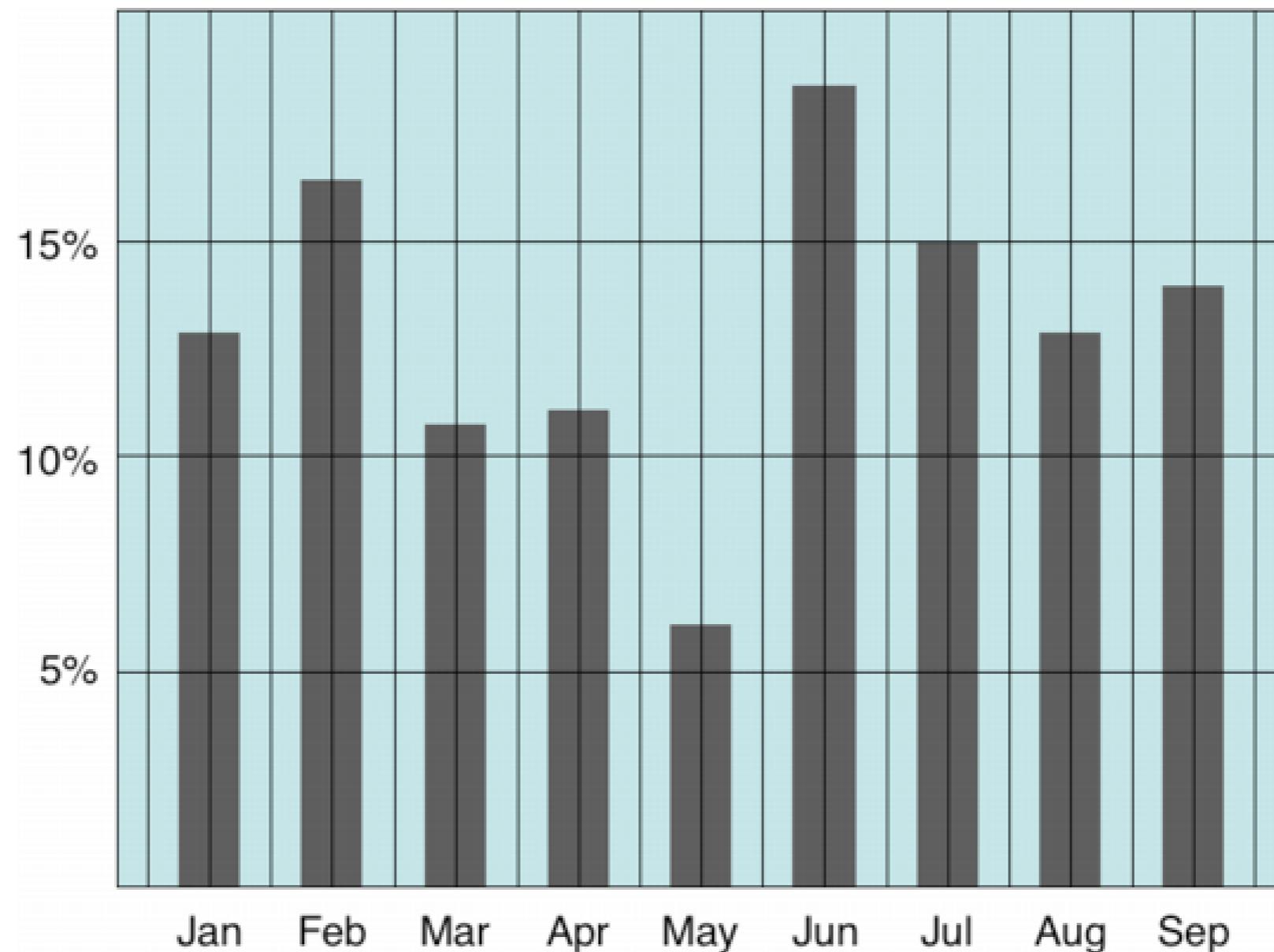
Exception: 3D Phenomena



Depth cues enable us to perceive 2D images as 3D objects

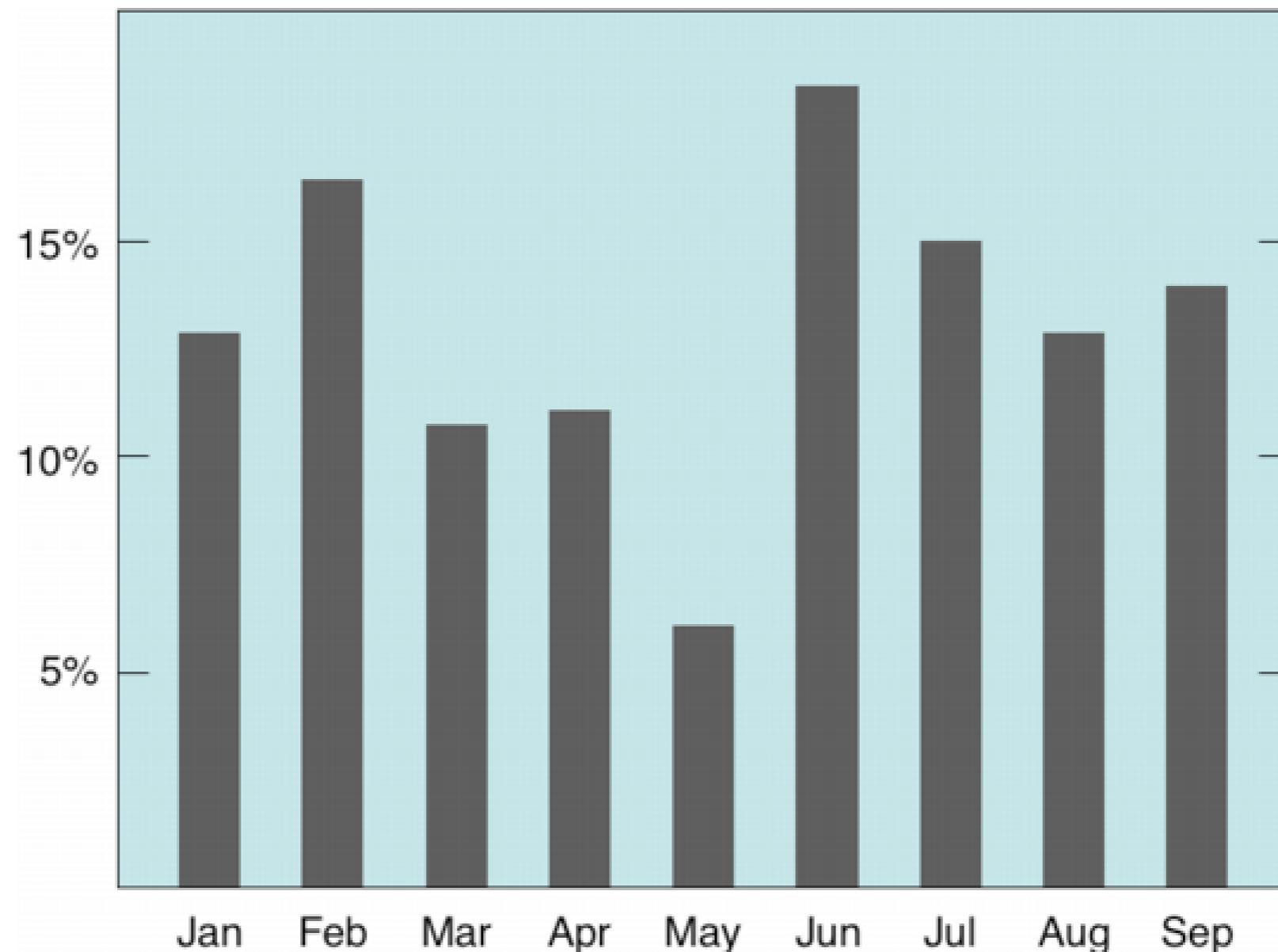
Avoid Chart Junk

Extraneous visual elements that distract from the message



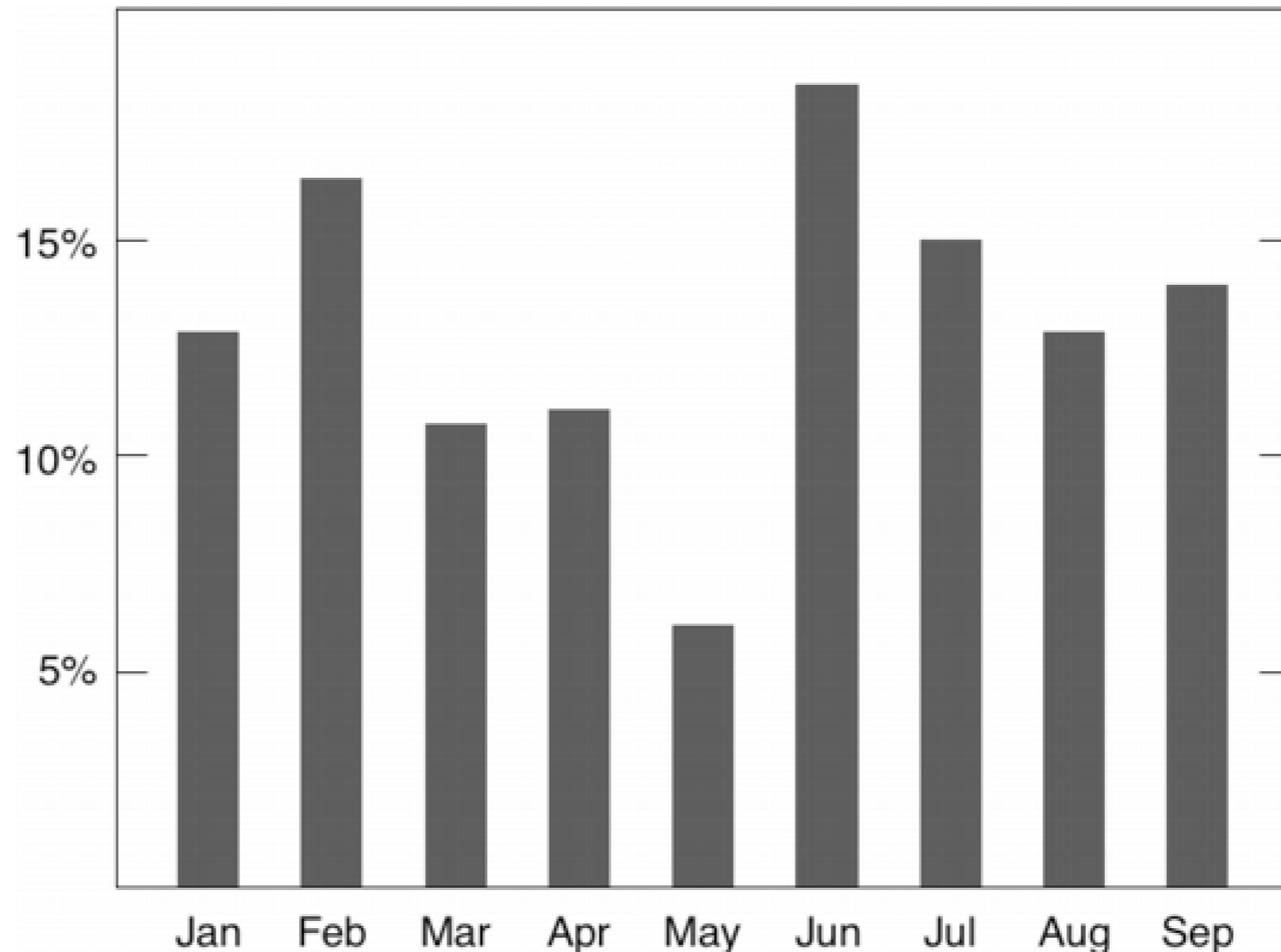
Avoid Chart Junk

Extraneous visual elements that distract from the message



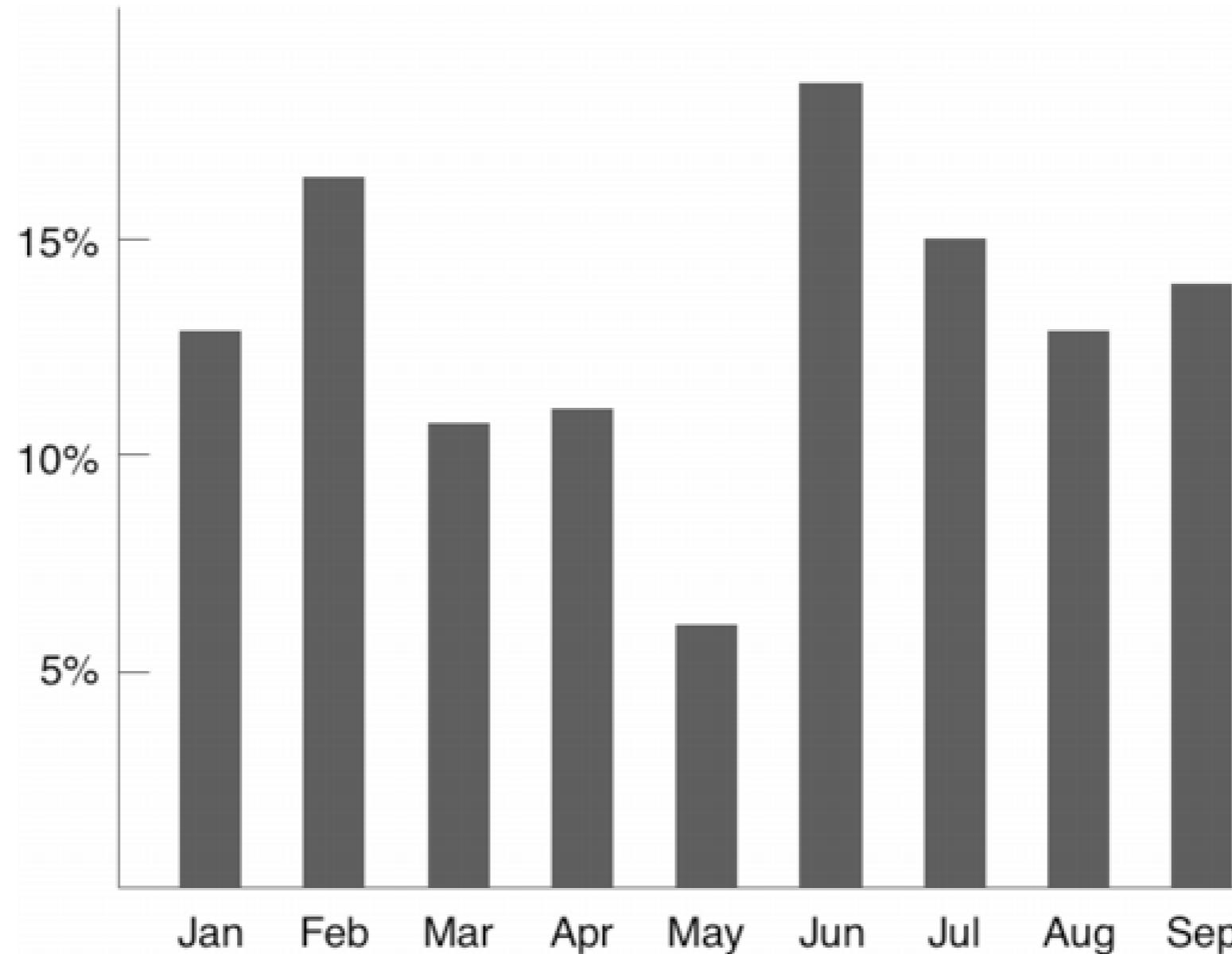
Avoid Chart Junk

Extraneous visual elements that distract from the message



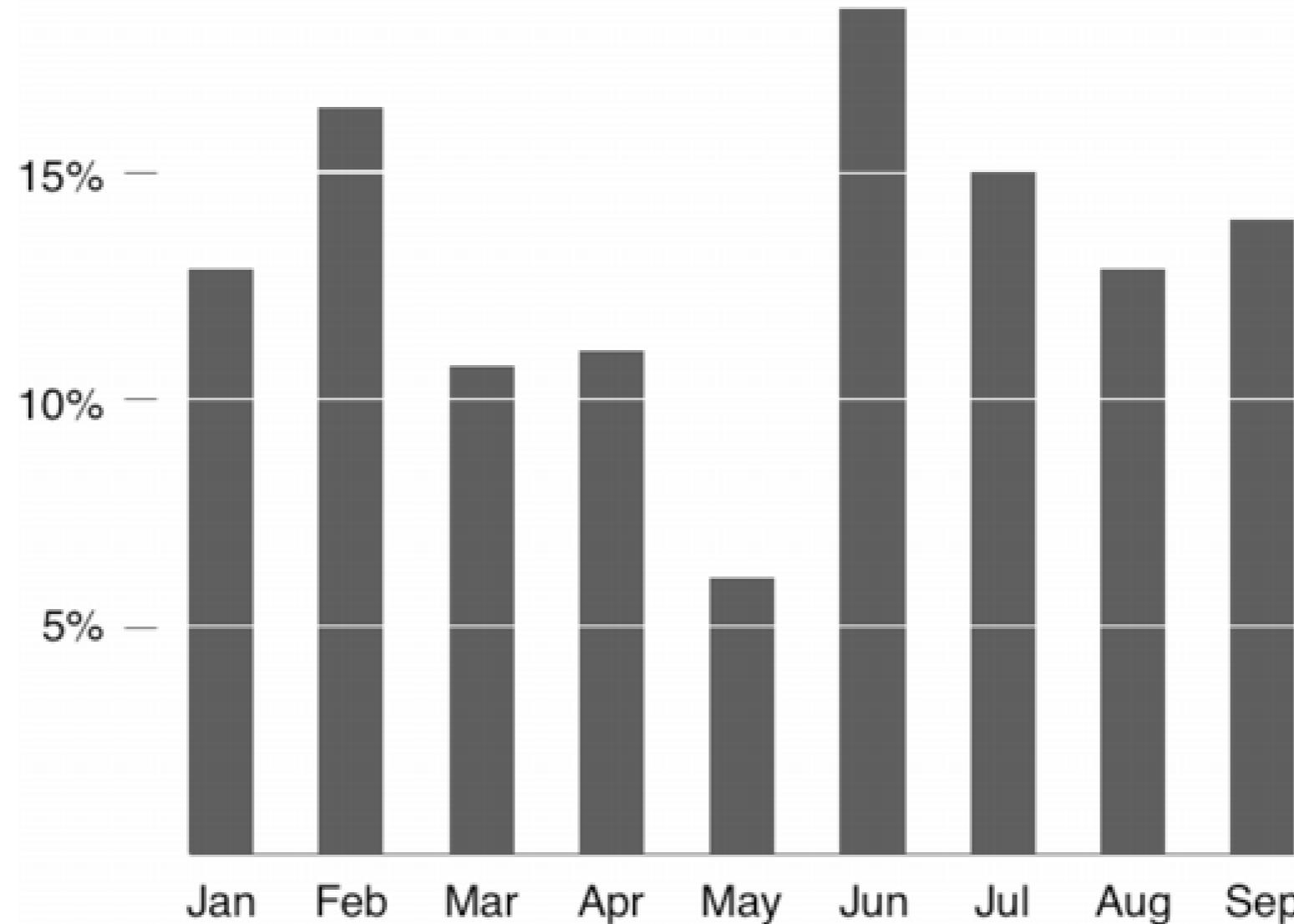
Avoid Chart Junk

Extraneous visual elements that distract from the message



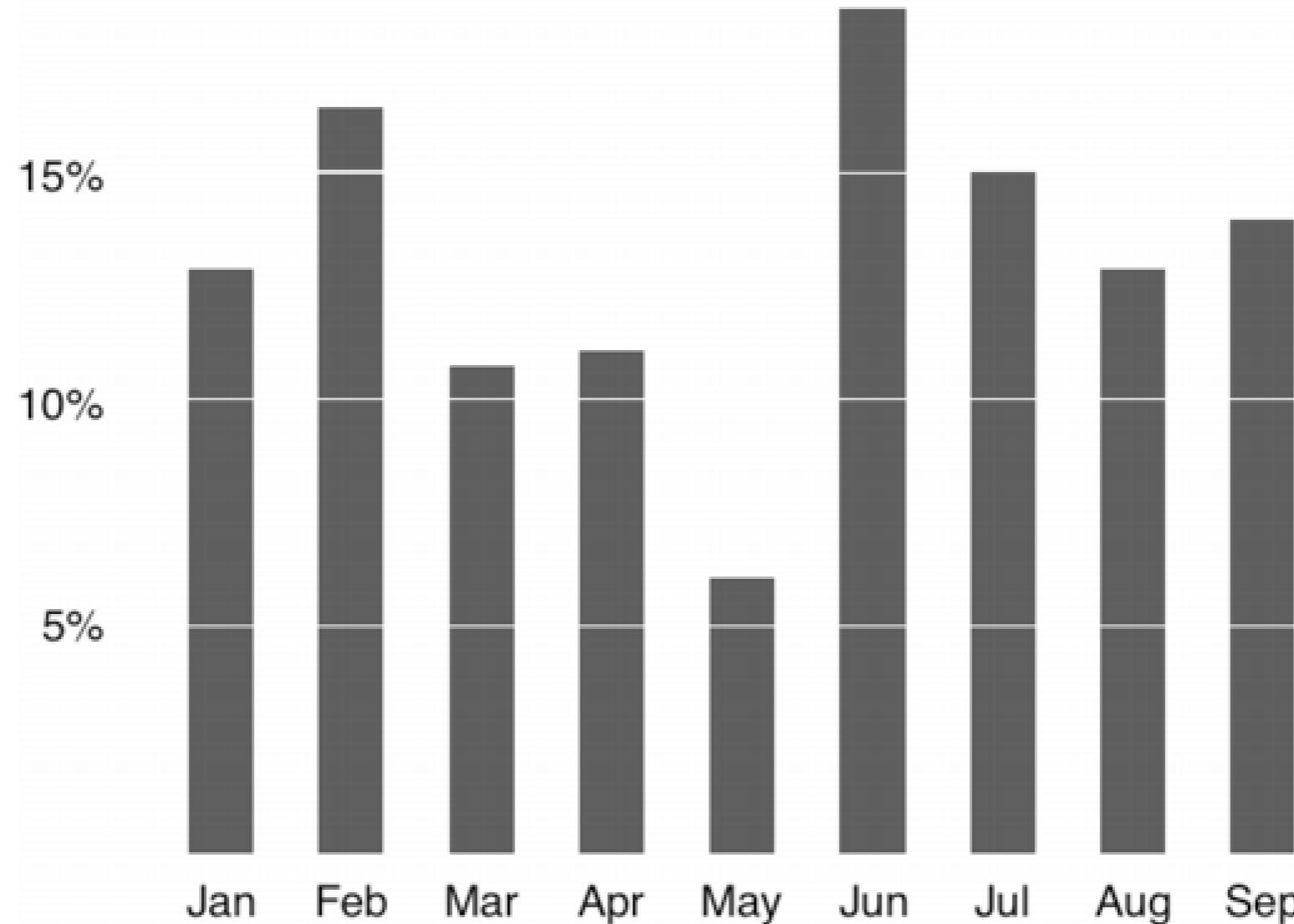
Avoid Chart Junk

Extraneous visual elements that distract from the message

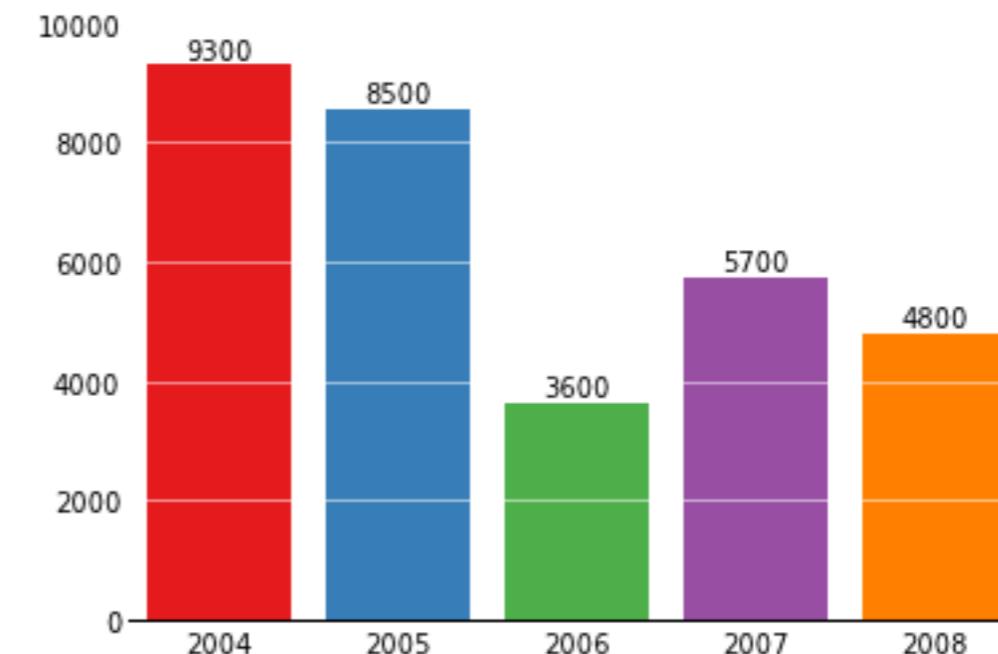
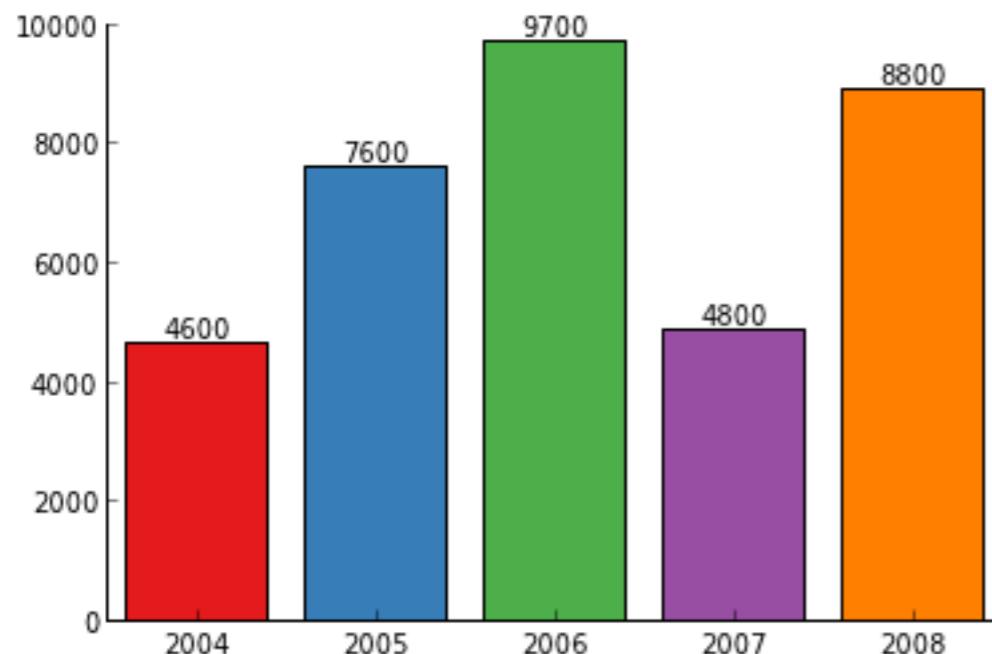
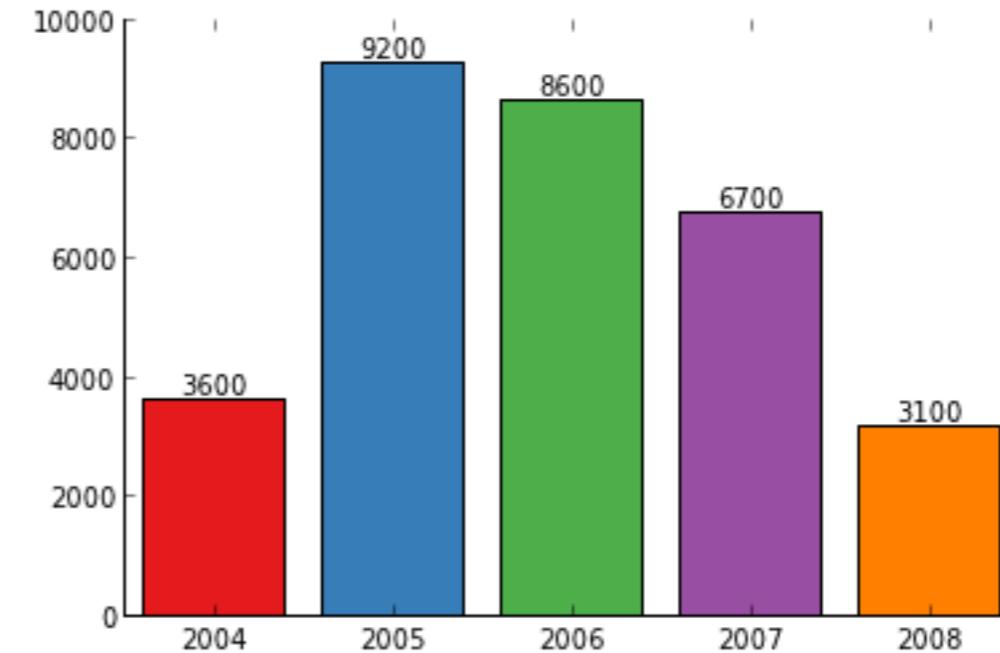
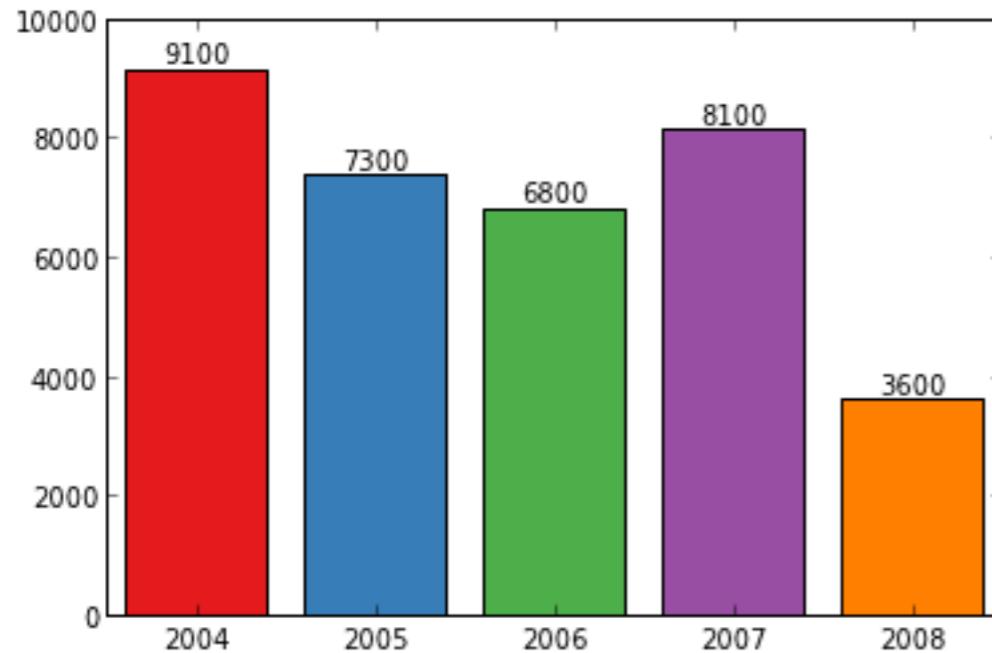


Avoid Chart Junk

Extraneous visual elements that distract from the message



Matplotlib Example



Tufte's Design Principles

Clear, detailed, and thorough labeling and appropriate scales

Size of the graphic effect should be directly proportional to the numerical quantities (“lie factor”)

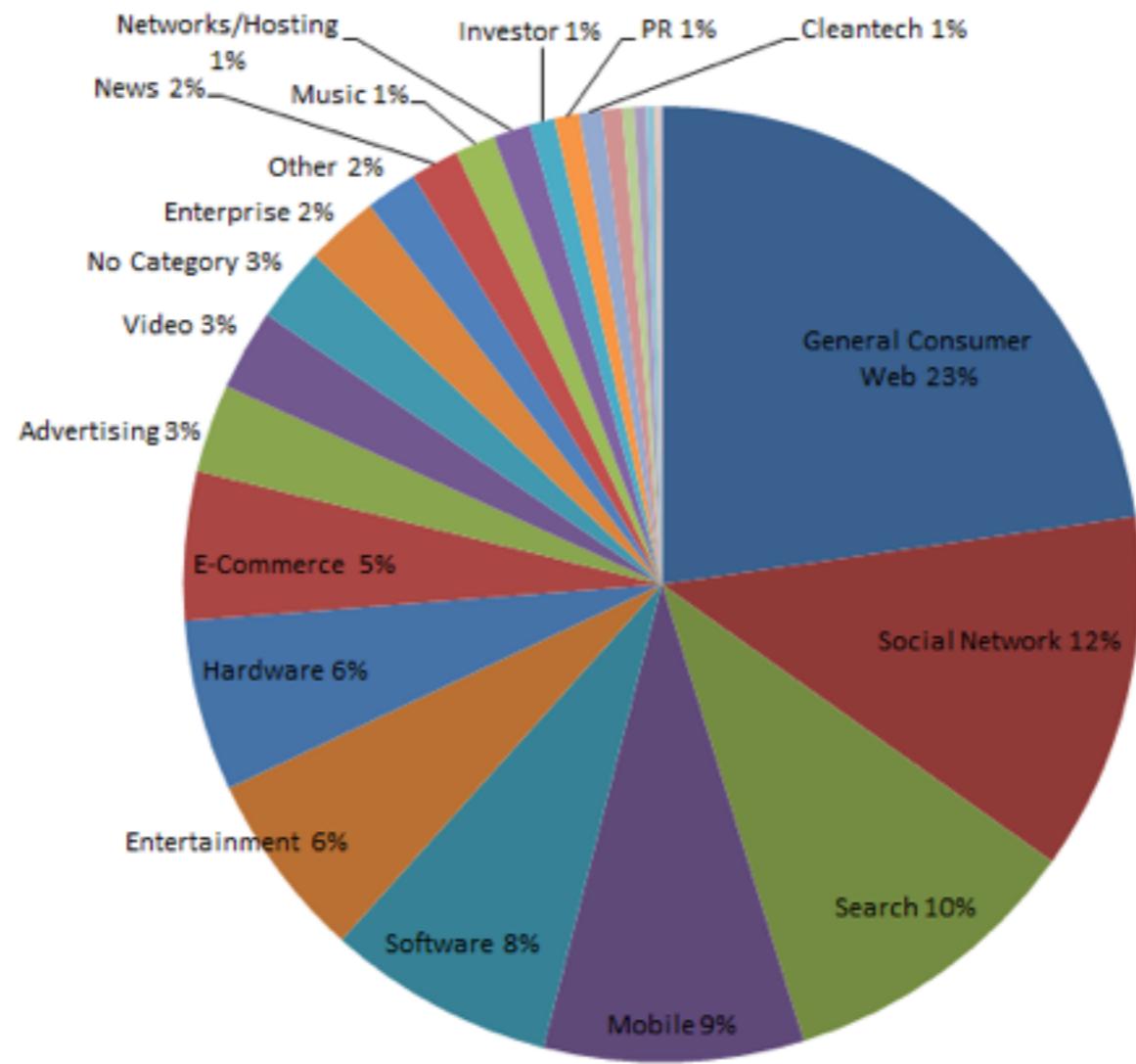
Maximize data-ink ratio

Avoid chart junk



Visualization Critique

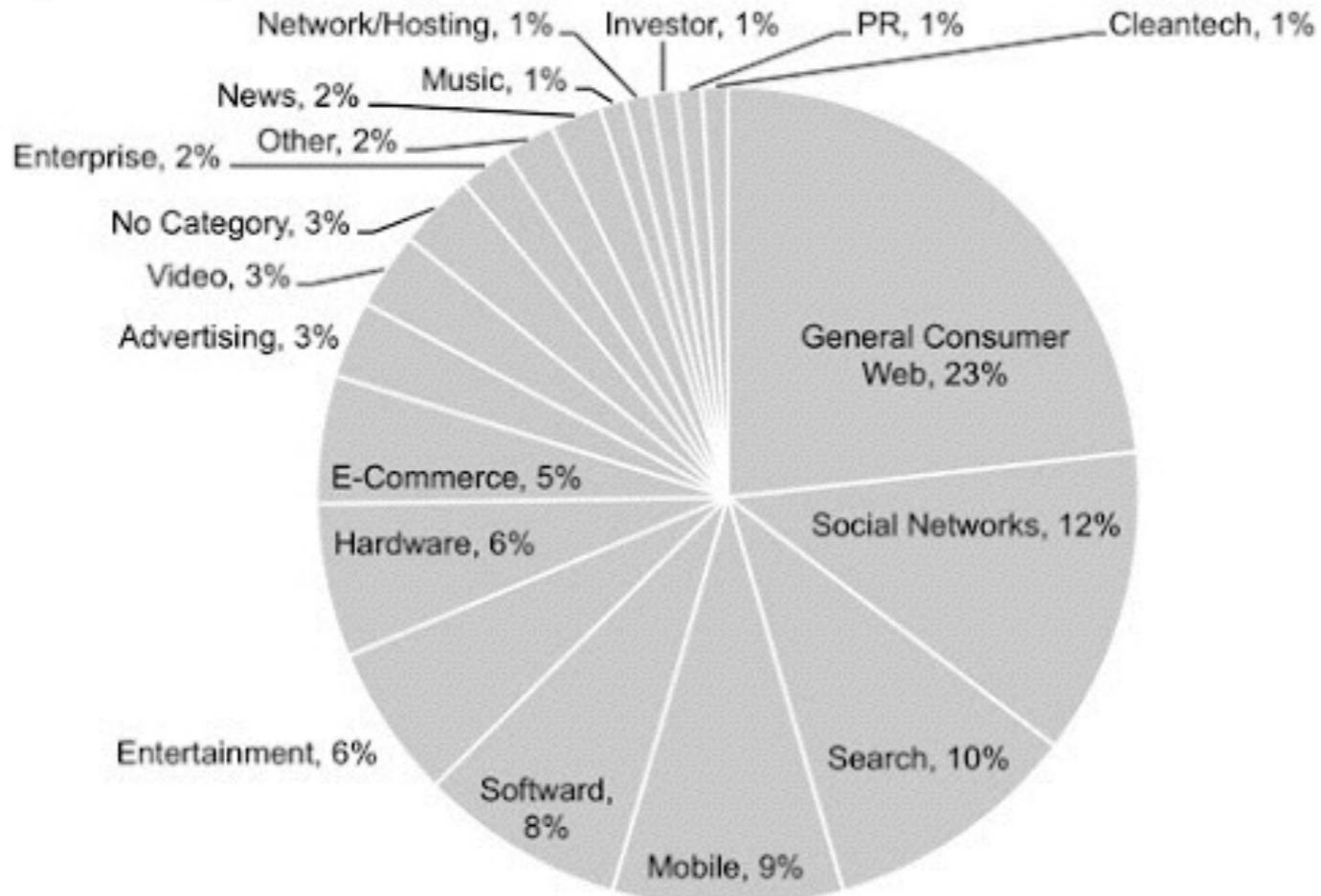
Death to Pie Charts



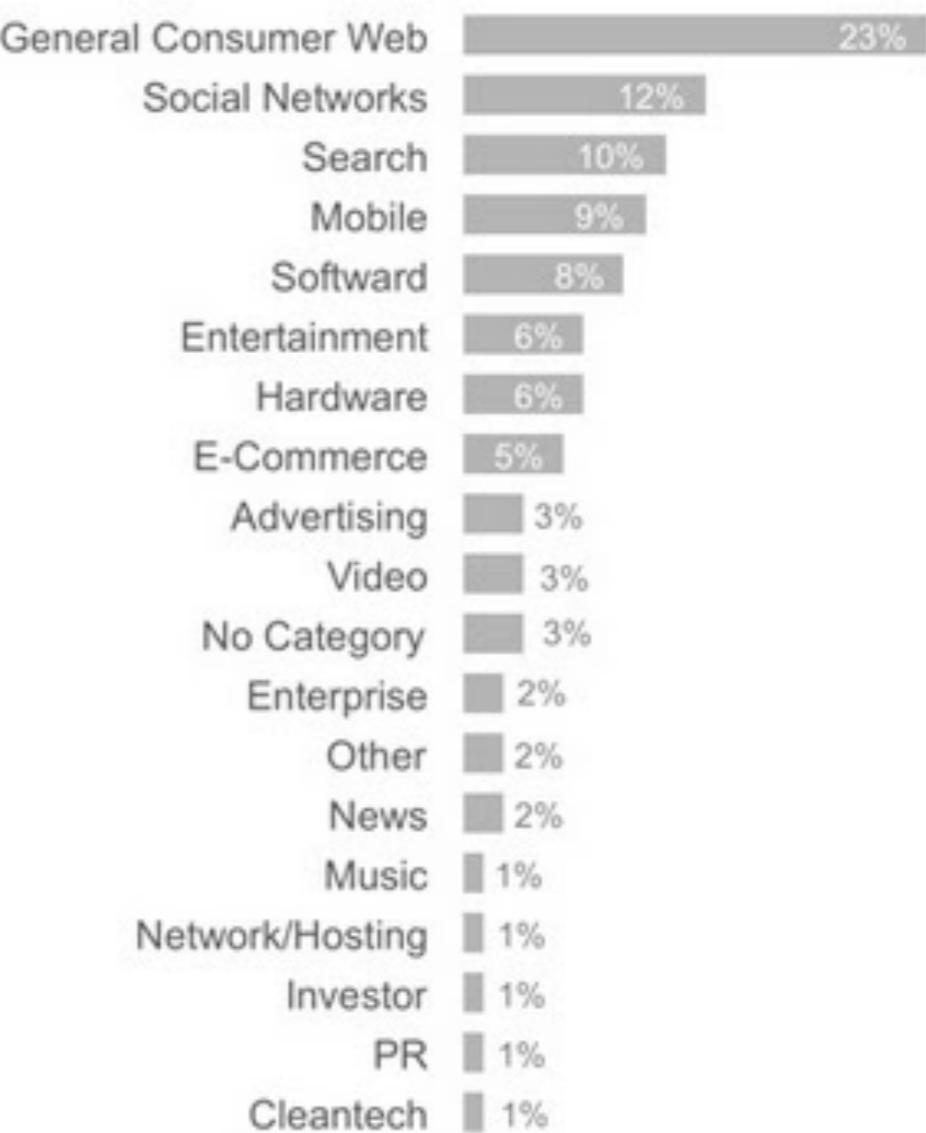
“I hate pie charts.
I mean, really hate them.”

Redesign

TechCrunch Coverage: 2005 - 2011 *A slightly better pie?*



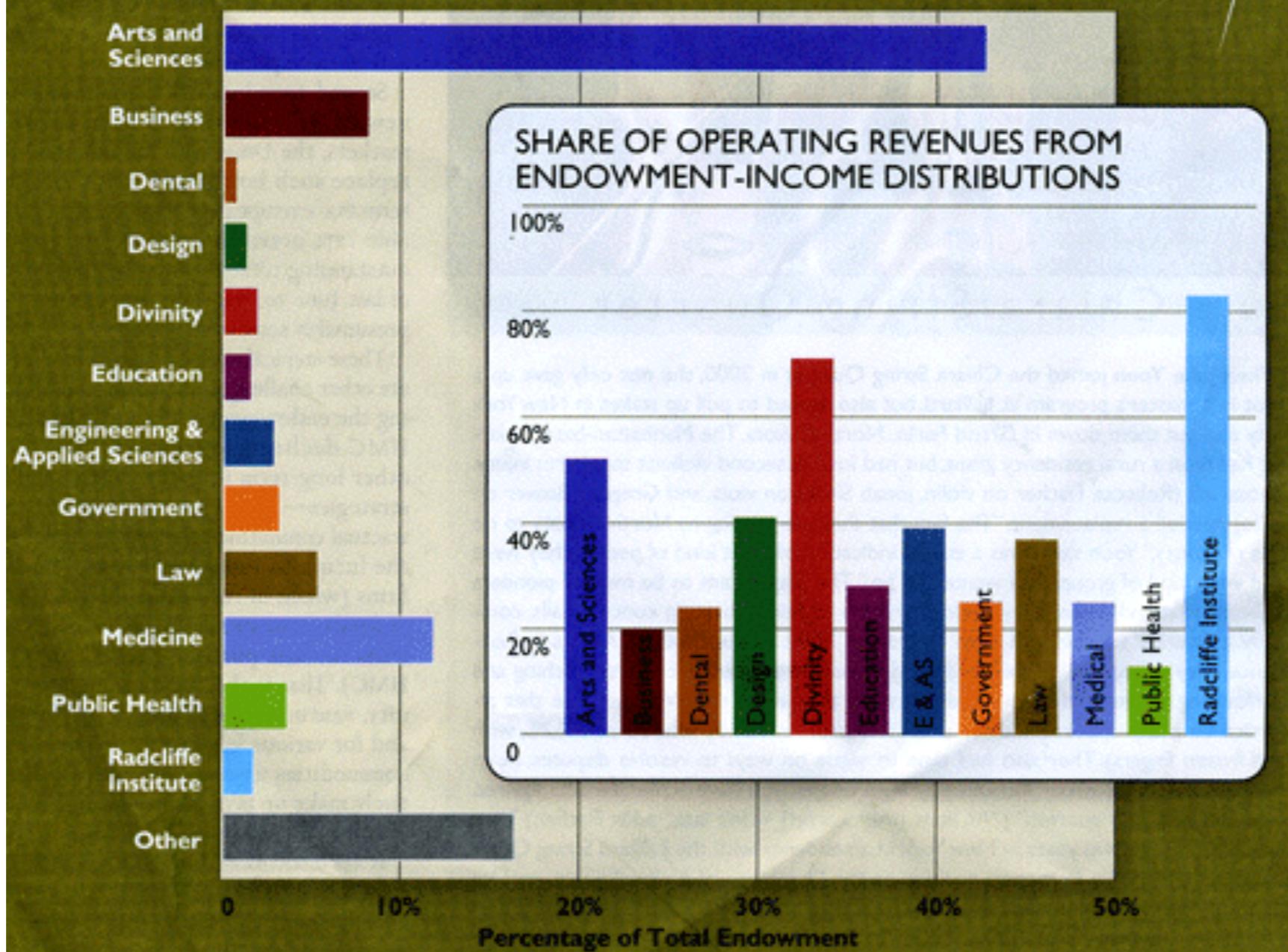
TechCrunch Coverage: 2005 - 2011 *Bars are best!*



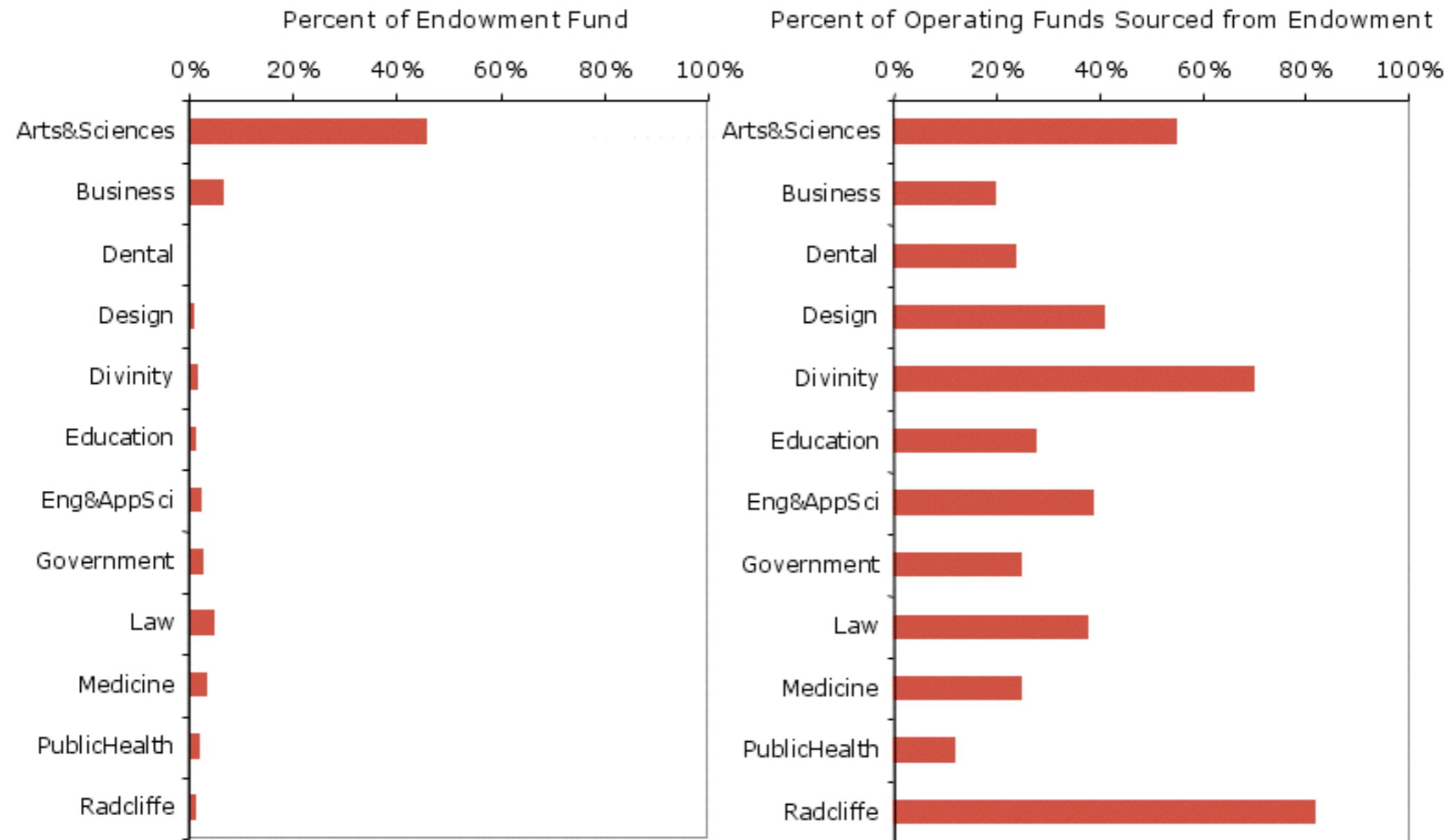
Harvard's Troubles

THE ENDOWMENT: EACH SCHOOL'S STAKE

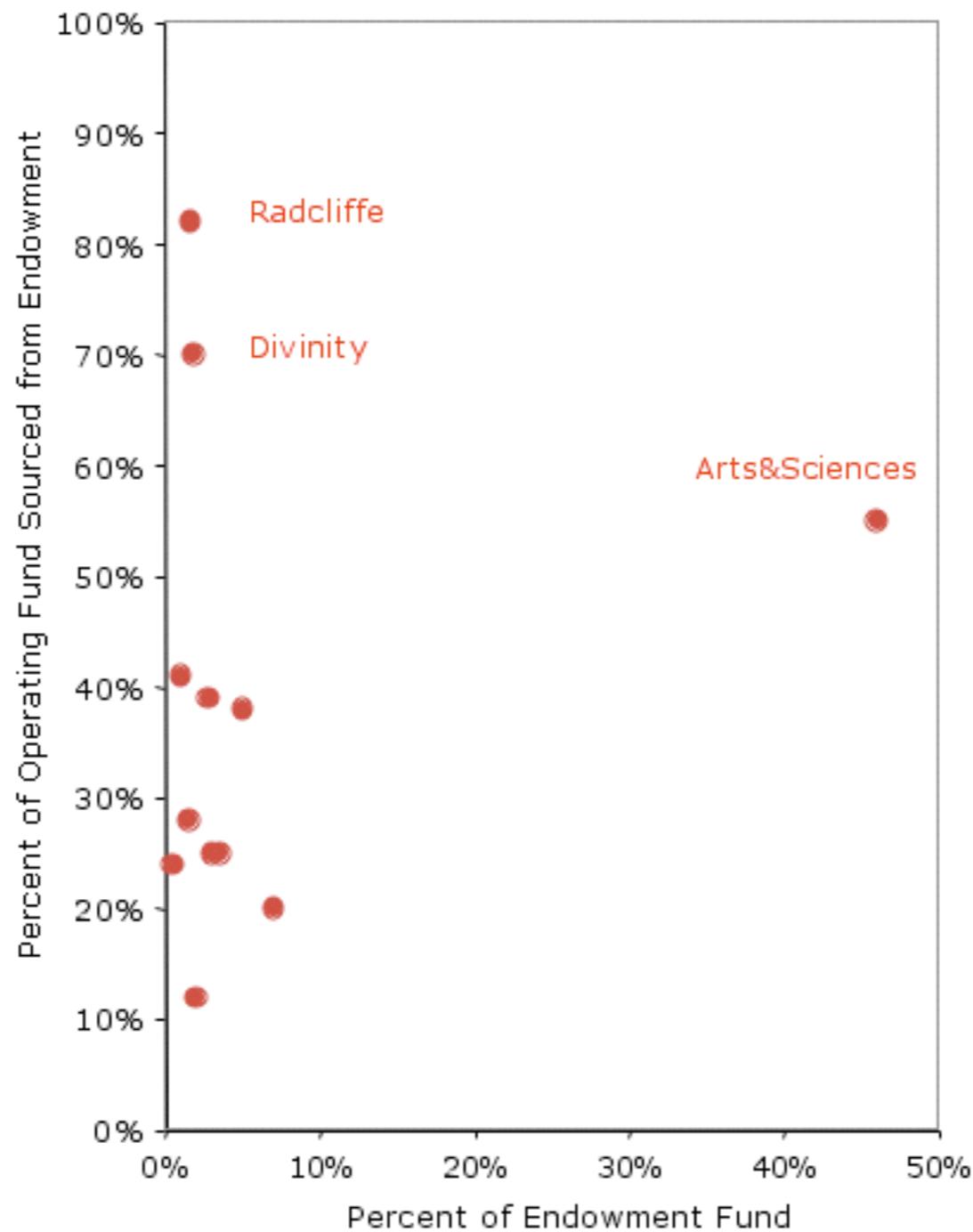
Harvard's endowment, valued at \$36.9 billion as of last June 30, in fact belongs to the separate schools and other academic departments. The large chart shows the share of the endowment owned by each (the Faculty of Arts and Sciences loomed largest, at \$15.7 billion—nearly 43 percent of the total). Of crucial importance is each school's dependence on distributions from the endowment for its operating budget, shown in the inset chart. Source: *Harvard University Financial Report, Fiscal Year 2008*.



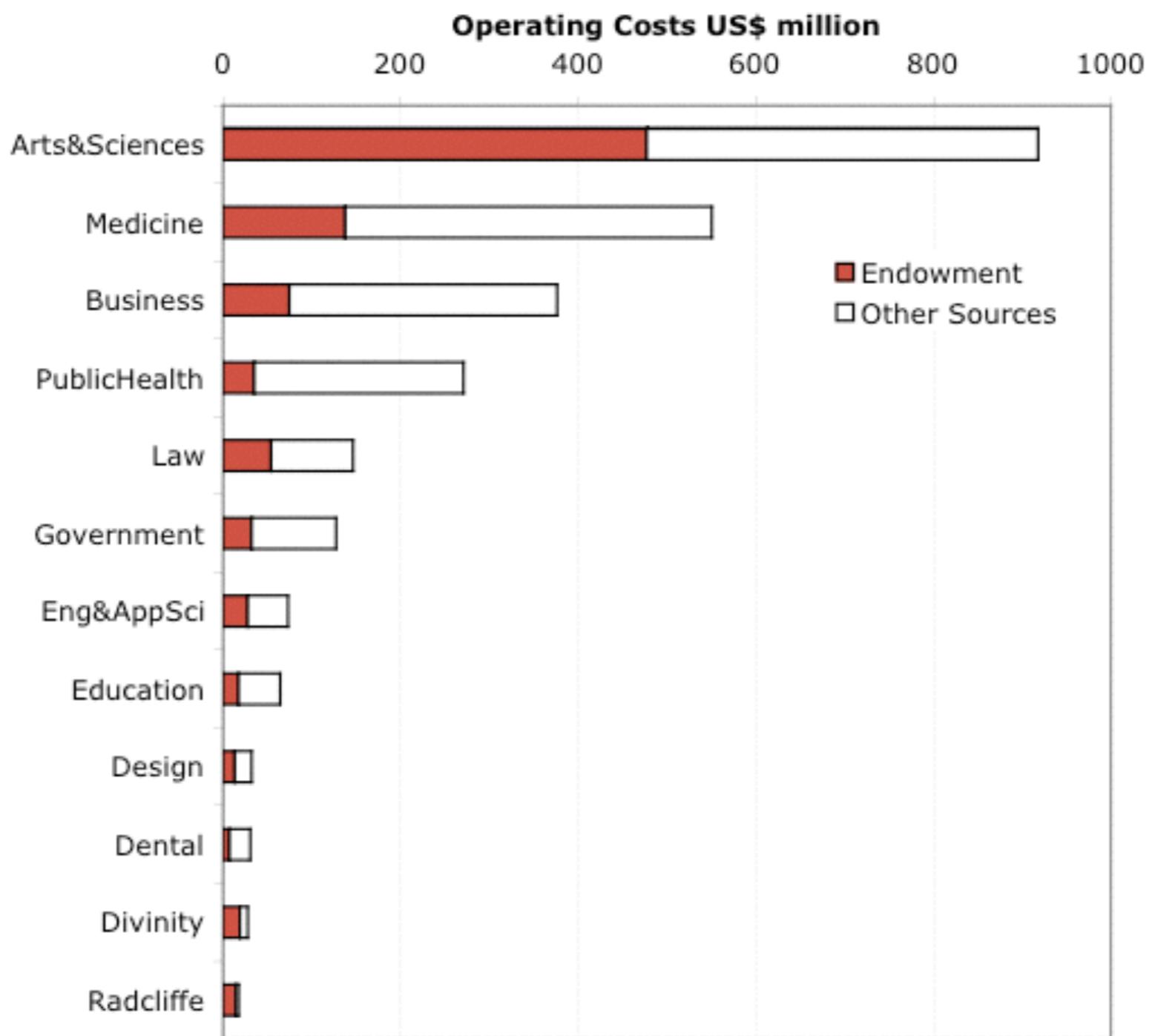
Redesign I



Redesign II

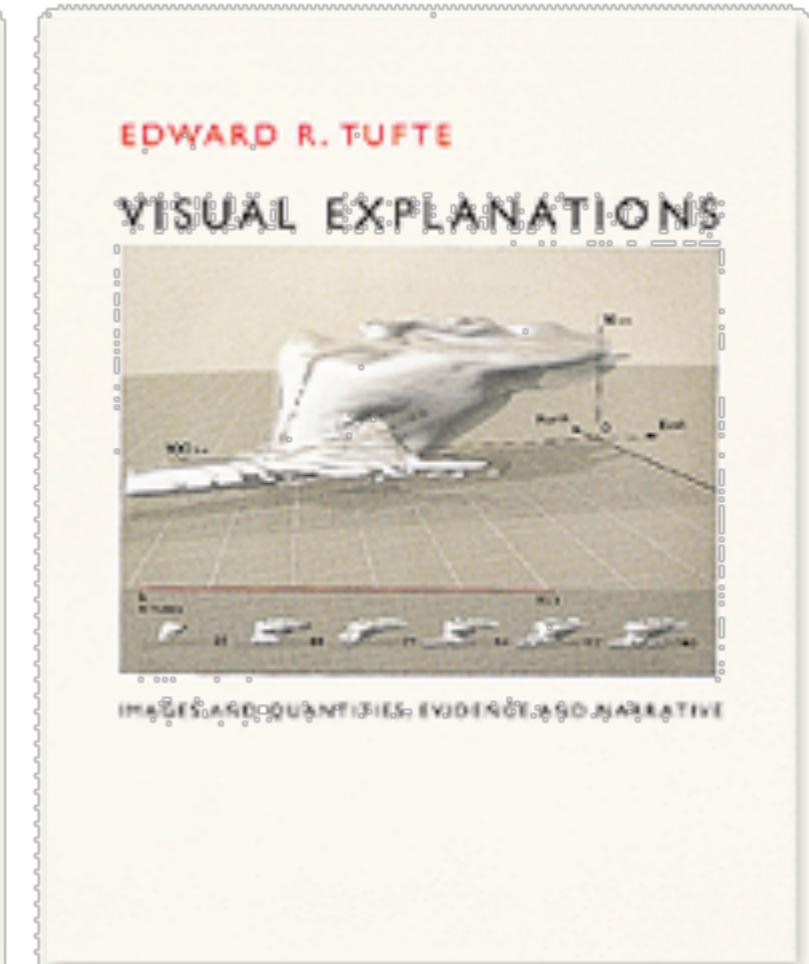
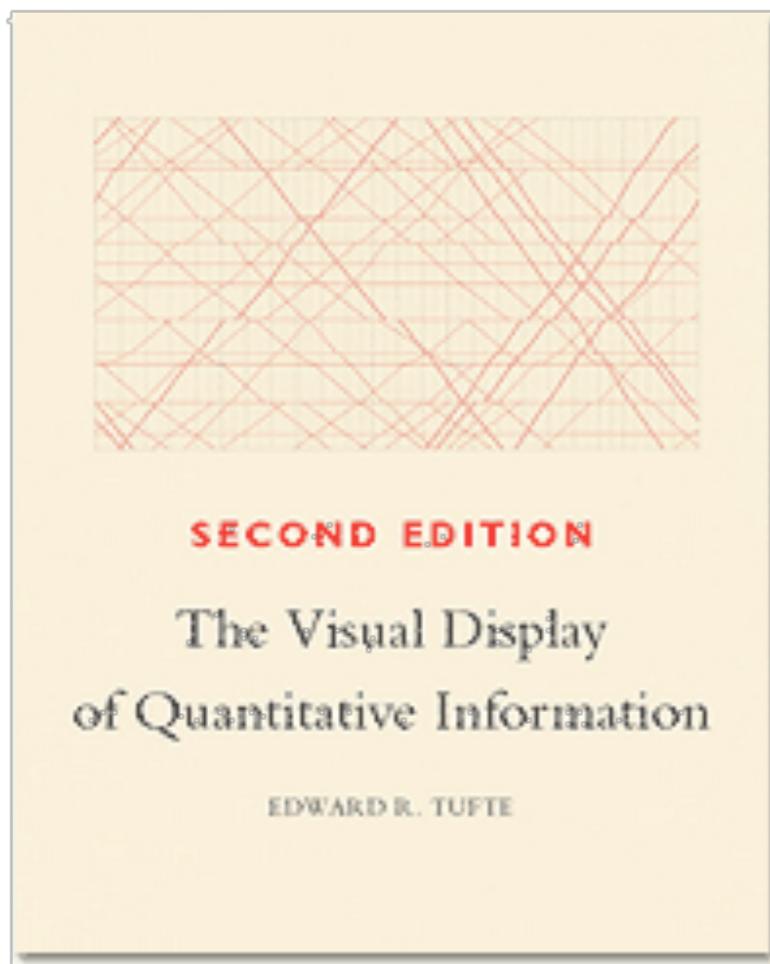


Redesign III

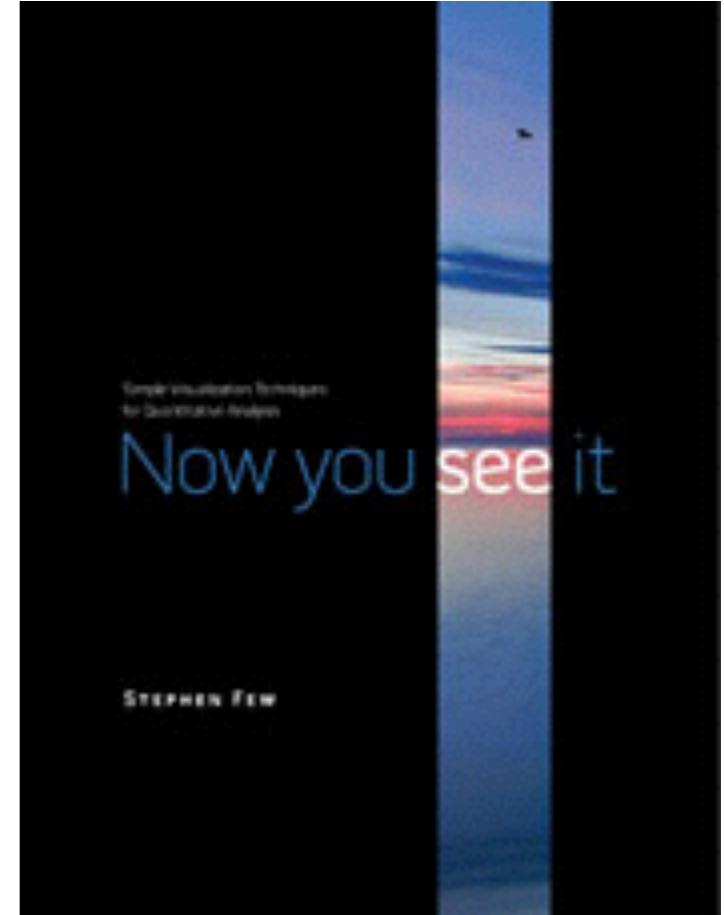
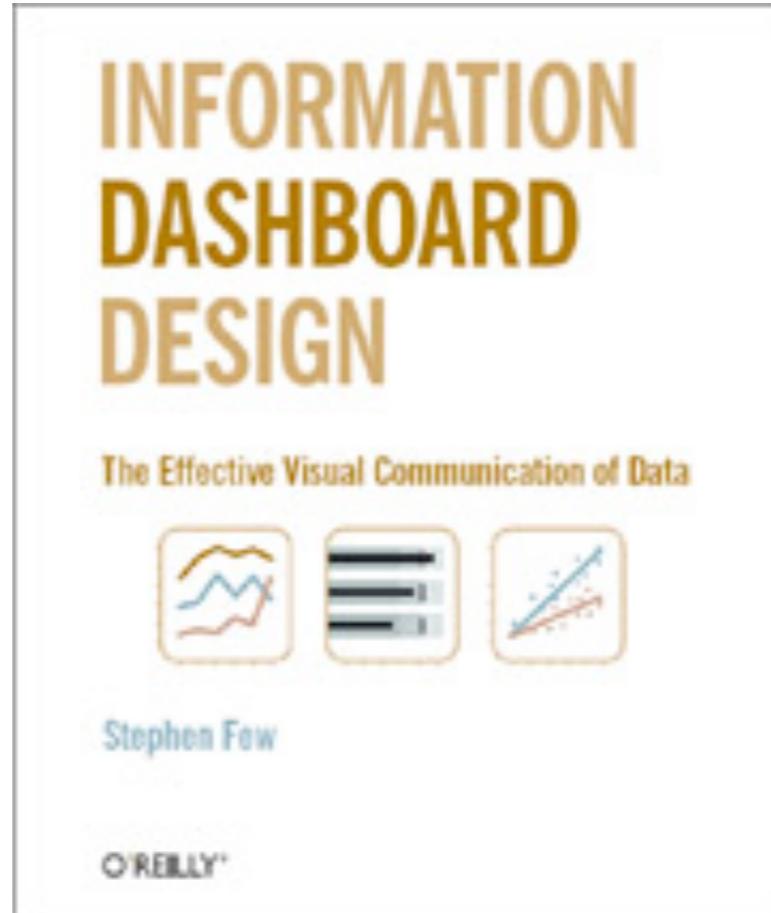
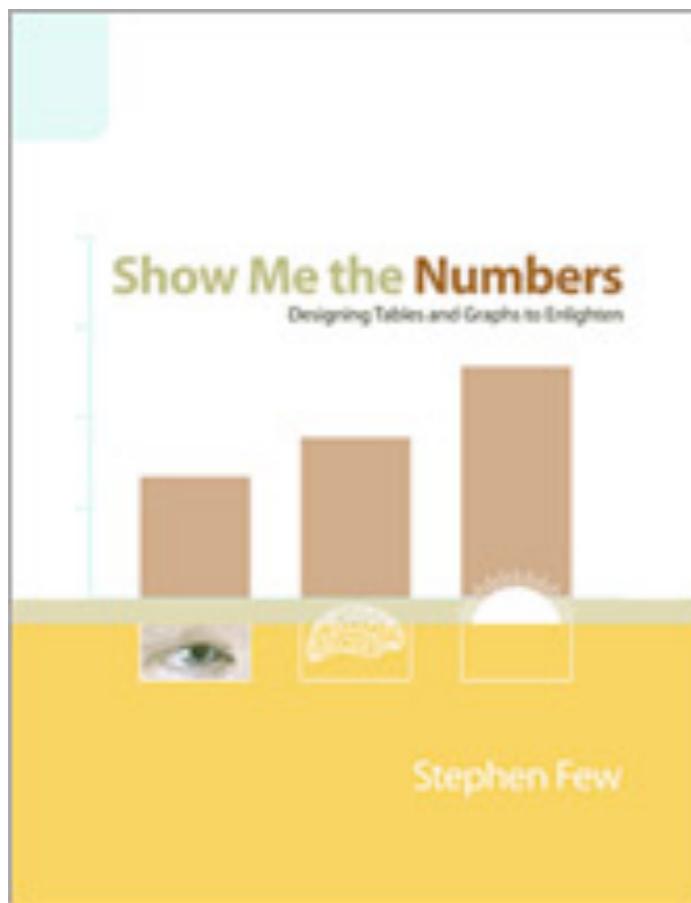
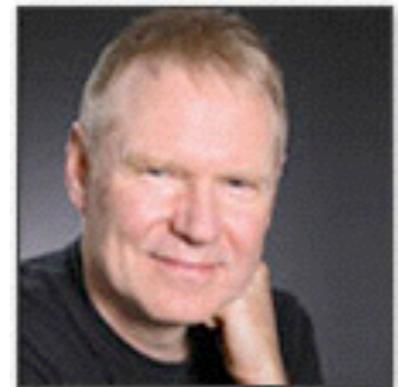


Further Reading

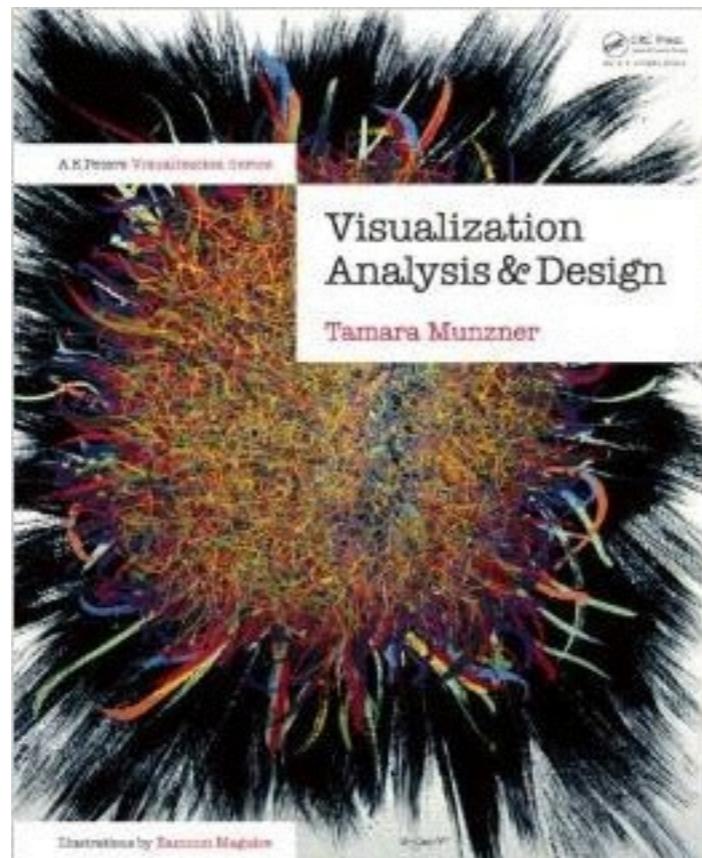
Edward Tufte



Stephen Few

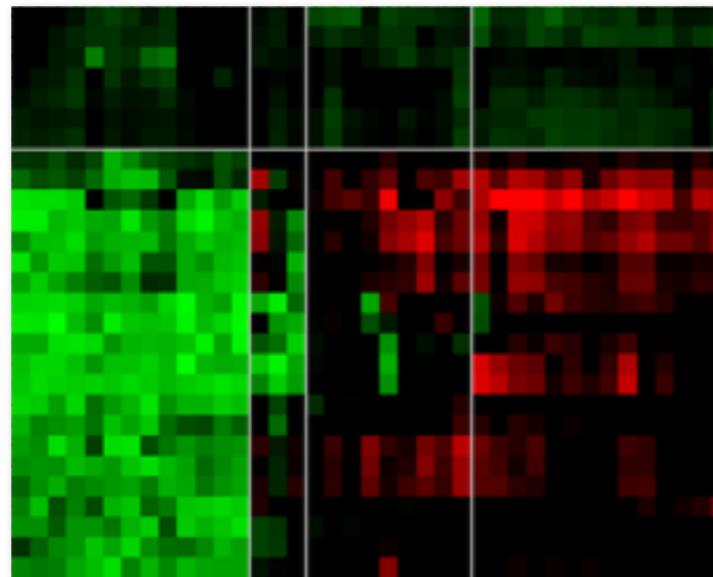
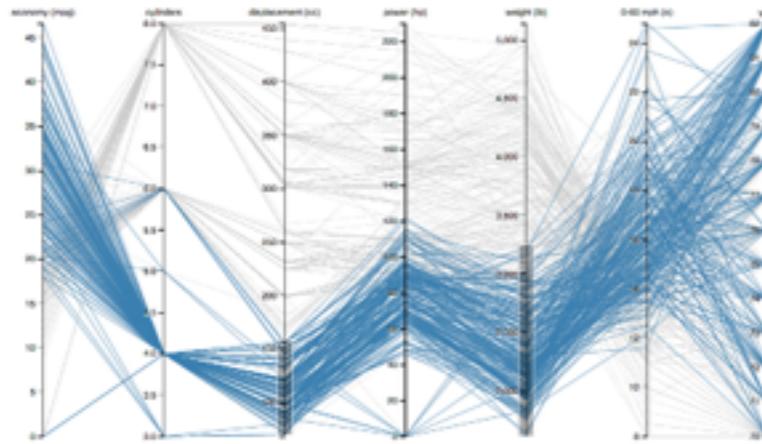


Tamara Munzner

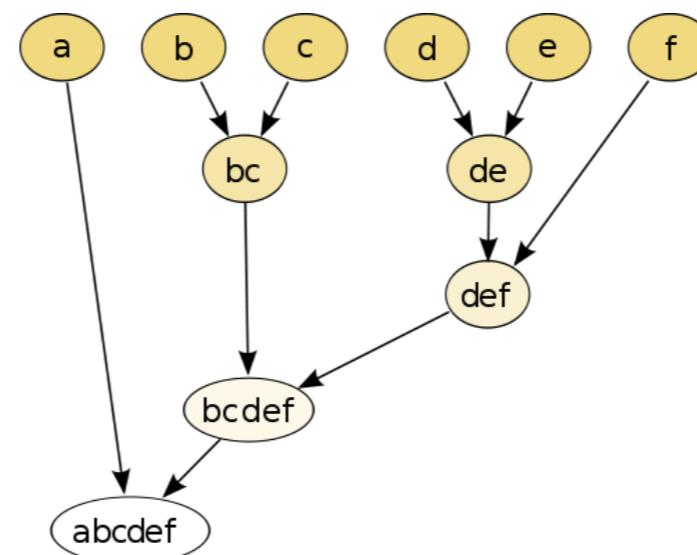


Visualization Analysis and Design

Next Tuesday

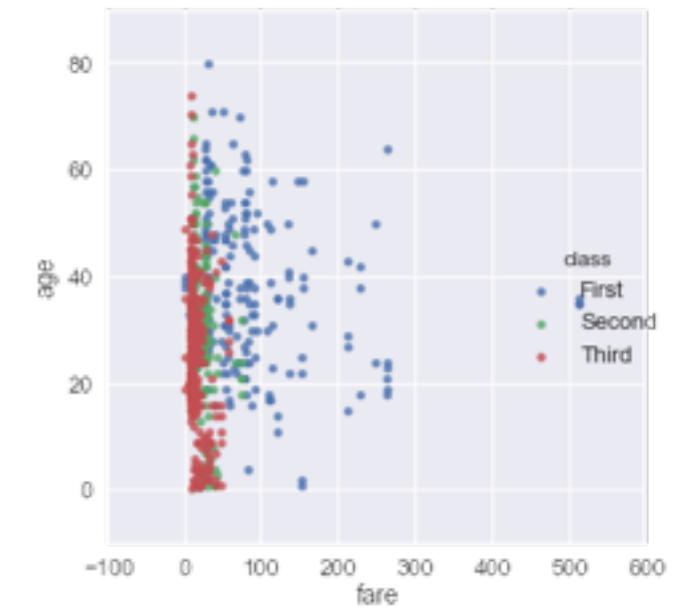


Multi-Dimensional
Data Visualization



Distance,
Clustering

| survived | pclass | sex | age | sibsp | parch | fare | embarked | class | who | adult_male | deck | embark_town | alive | alone |
|----------|--------|--------|------|-------|-------|---------|----------|--------|-------|------------|------|-------------|-------|-------|
| 0 | 3 | male | 22.0 | 1 | 0 | 7.25 | S | Third | man | True | | Southampton | no | False |
| 1 | 1 | female | 38.0 | 1 | 0 | 71.2833 | C | First | woman | False | C | Cherbourg | yes | False |
| 1 | 3 | female | 26.0 | 0 | 0 | 7.925 | S | Third | woman | False | | Southampton | yes | True |
| 1 | 1 | female | 35.0 | 1 | 0 | 53.1 | S | First | woman | False | C | Southampton | yes | False |
| 0 | 3 | male | 35.0 | 0 | 0 | 8.05 | S | Third | man | True | | Southampton | no | True |
| 0 | 3 | male | 0 | 0 | 0 | 8.4583 | Q | Third | man | True | | Queenstown | no | True |
| 0 | 1 | male | 54.0 | 0 | 0 | 51.8625 | S | First | man | True | E | Southampton | no | True |
| 0 | 3 | male | 2.0 | 3 | 1 | 21.075 | S | Third | child | False | | Southampton | no | False |
| 1 | 3 | female | 27.0 | 0 | 2 | 11.1333 | S | Third | woman | False | | Southampton | yes | False |
| 1 | 2 | female | 14.0 | 1 | 0 | 30.0708 | C | Second | child | False | | Cherbourg | yes | False |
| 1 | 3 | female | 4.0 | 1 | 1 | 16.7 | S | Third | child | False | G | Southampton | yes | False |
| 1 | 1 | female | 58.0 | 0 | 0 | 26.55 | S | First | woman | False | C | Southampton | yes | True |
| 0 | 3 | male | 20.0 | 0 | 0 | 8.05 | S | Third | man | True | | Southampton | no | True |
| 0 | 3 | male | 39.0 | 1 | 5 | 31.275 | S | Third | man | True | | Southampton | no | False |
| 0 | 3 | female | 14.0 | 0 | 0 | 7.8542 | S | Third | child | False | | Southampton | no | True |
| 1 | 2 | female | 55.0 | 0 | 0 | 16.0 | S | Second | woman | False | | Southampton | yes | True |
| 0 | 3 | male | 2.0 | 4 | 1 | 29.125 | Q | Third | child | False | | Queenstown | no | False |
| 1 | 2 | male | 0 | 0 | 0 | 13.0 | S | Second | man | True | | Southampton | yes | True |
| 0 | 3 | female | 31.0 | 1 | 0 | 18.0 | S | Third | woman | False | | Southampton | no | False |
| 1 | 3 | female | 0 | 0 | 0 | 7.225 | C | Third | woman | False | | Cherbourg | yes | True |
| 0 | 2 | male | 35.0 | 0 | 0 | 26.0 | S | Second | man | True | | Southampton | no | True |
| 1 | 2 | male | 34.0 | 0 | 0 | 13.0 | S | Second | man | True | D | Southampton | yes | True |
| 1 | 3 | female | 15.0 | 0 | 0 | 8.0292 | Q | Third | child | False | | Queenstown | yes | True |



Dimensionality
Reduction

Questions

