Developing scientific data visualizations for non-specialist audiences

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SCIENTIFIC AMERICAN

www.ScientificAmerican.com

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data, n. (Oxford English Dictionary)

1. As a count noun: an item of information; a datum; a set of data.
2. As a mass noun:

   a. **Related items of (chiefly numerical) information considered collectively, typically obtained by scientific work and used for reference, analysis, or calculation.**

   b. Computing. Quantities, characters, or symbols on which operations are performed by a computer, considered collectively.
   Also (in non-technical contexts): information in digital form.

visualization, n. (Oxford English Dictionary)

1. The action or fact of visualizing; the power or process of forming a mental picture or vision of something not actually present to the sight; a picture thus formed.

2. **The action or process of rendering visible.**

data visualization

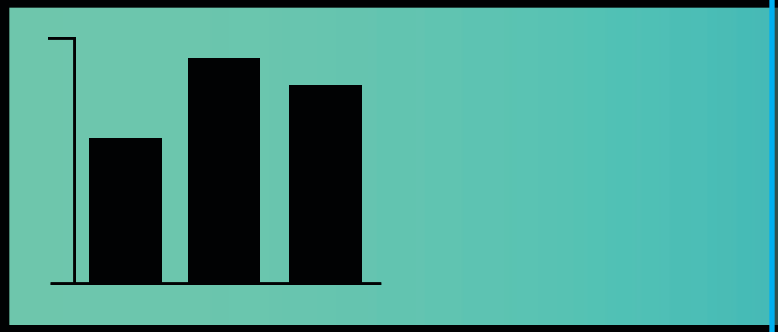
Information (chiefly numerical), made visible.

data visualization

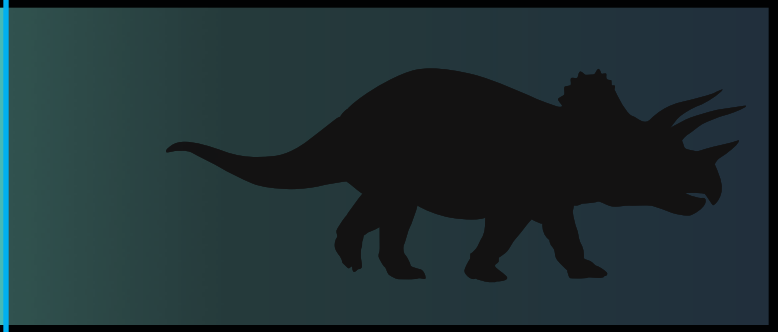
Information (chiefly numerical), made visible.

data visualization

Information (chiefly numerical), made visible.



abstract representations



figurative illustrations

[content]

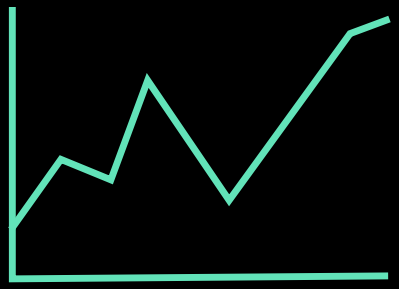
Information (chiefly numerical), made visible.

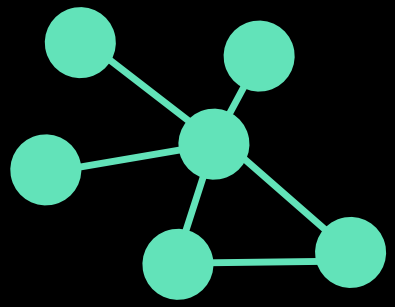
[context]

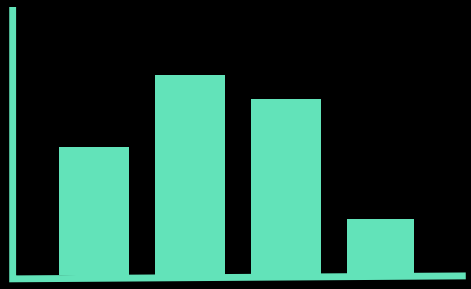
For whom and why?

[content]

data / information

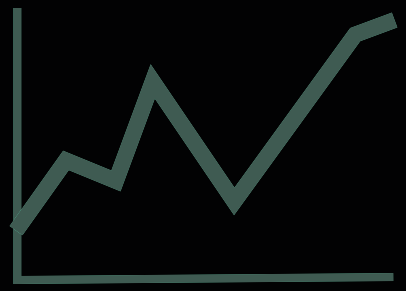


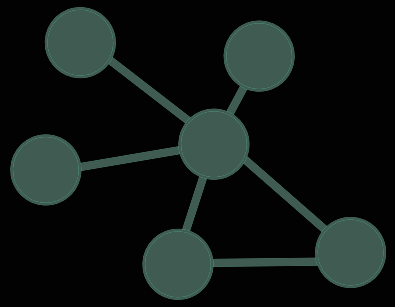


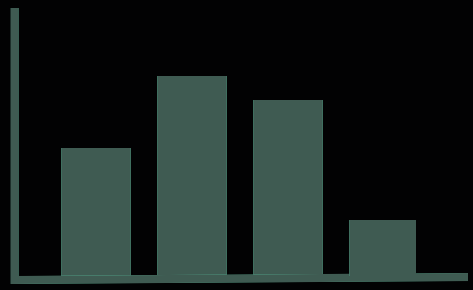


[content]

data / information



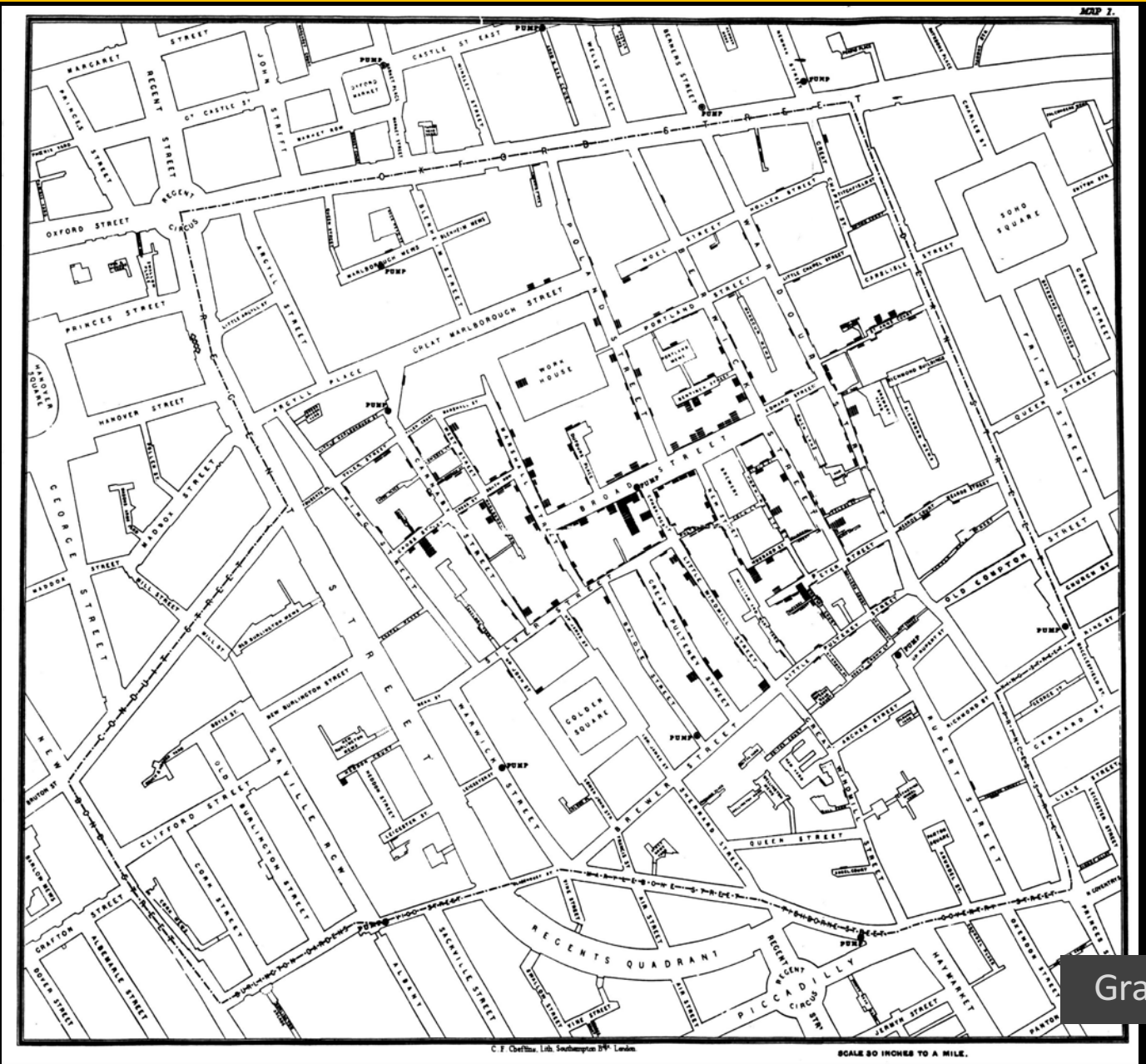




[context]

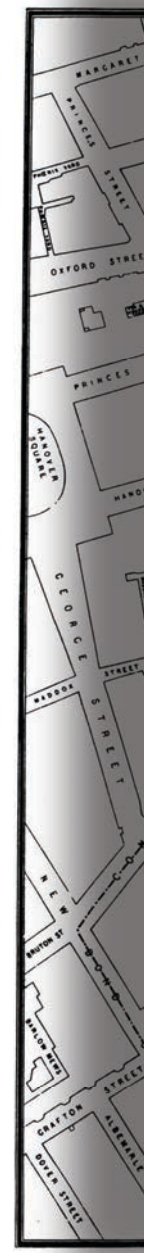
audience and purpose

investigative tool



Graphic by John Snow (~1854)

communicate results to peers



Evaluation of Artery Visualizations for Heart Disease Diagnosis

Michelle A. Borkin, *Student Member, IEEE*, Krzysztof Z. Gajos, Amanda Peters, Dimitrios Mitsouras, Simone Melchionna, Frank J. Rybicki, Charles L. Feldman, & Hanspeter Pfister, *Senior Member, IEEE*

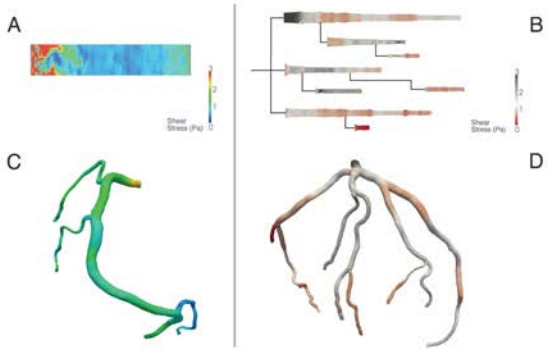


Fig. 1. Left: Traditional 2D projection (A) of a single artery, and 3D representation (C) of a right coronary artery tree with a rainbow color map. Right: 2D tree diagram representation (B) and equivalent 3D representation (D) of a left coronary artery tree with a diverging color map.

Abstract— Heart disease is the number one killer in the United States, and finding indicators of the disease at an early stage is critical for treatment and prevention. In this paper we evaluate visualization techniques that enable the diagnosis of coronary artery disease. A key physical quantity of medical interest is endothelial shear stress (ESS). Low ESS has been associated with sites of lesion formation and rapid progression of disease in the coronary arteries. Having effective visualizations of a patient's ESS data is vital for the quick and thorough non-invasive evaluation by a cardiologist. We present a task taxonomy for hemodynamics based on a formative user study with domain experts. Based on the results of this study we developed HemoVis, an interactive visualization application for heart disease diagnosis that uses a novel 2D tree diagram representation of coronary artery trees. We present the results of a formal quantitative user study with domain experts that evaluates the effect of 2D versus 3D artery representations and of color maps on identifying regions of low ESS. We show statistically significant results demonstrating that our 2D visualizations are more accurate and efficient than 3D representations, and that a perceptually appropriate color map leads to fewer diagnostic mistakes than a rainbow color map.

Index Terms—Quantitative evaluation, qualitative evaluation, biomedical and medical visualization.

1 Introduction

In the United States, the leading cause of death is heart disease resulting in over 600,000 deaths per year [24]. Early prevention and treatment is vital for saving lives, and visualization plays an essential role for patient diagnosis in cardiovascular imaging. A new non-invasive diagnostic technique under development uses Computed Tomography Angiography (CTA) data from patients combined with blood flow simulations to calculate hemodynamic risk factors, in particular Endothelial Shear Stress (ESS), in coronary arteries [40]. Visualization methods of this data are of great value for this emerging research and have the potential to lead to faster, more accurate heart disease diagnoses.

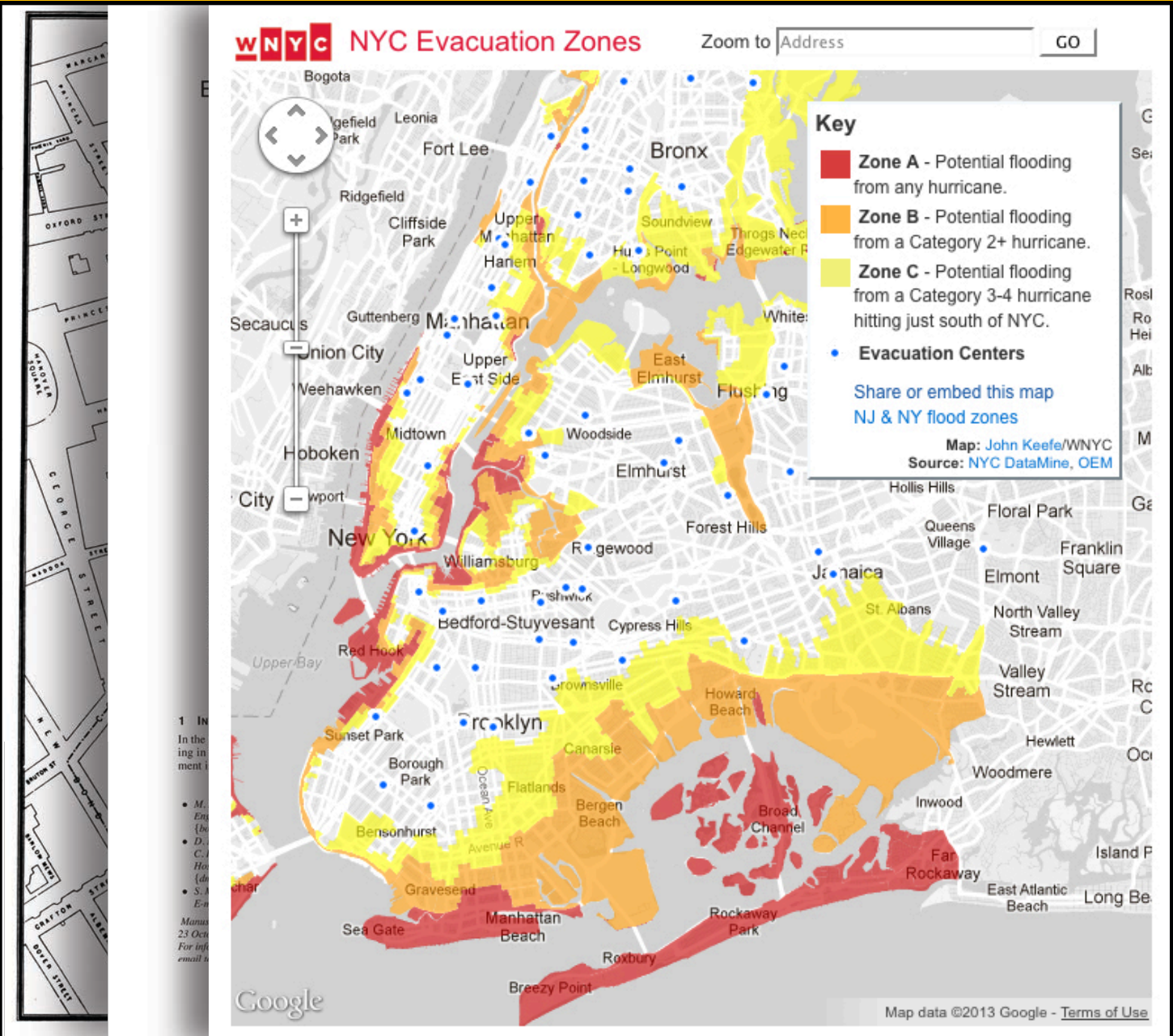
Current visualizations techniques, as shown in Fig. 1 (left), use either a 2D cylindrical projection of a single artery or a 3D curvan-

- *M. Borkin, K. Gajos, A. Peters, and H. Pfister are with the School of Engineering & Applied Sciences, Harvard University, E-mail: {borkin,kgajos,apeters,pfister}@seas.harvard.edu .*
- *D. Mitsouras & F. Rybicki are with the Applied Imaging Science Lab and C. Feldman is with the Vascular Profiling Lab at Brigham and Women's Hospital & Harvard Medical School, E-mail: {dmitsouras,frybicki,cfeldman}@partners.org .*
- *S. Melchionna is with the IPCF-CNR, Consiglio Nazionale delle Ricerche, E-mail: simone.melchionna@roma1.infn.it .*

Manuscript received 31 March 2011; accepted 1 August 2011; posted online 23 October 2011; mailed on 14 October 2011.
For information on obtaining reprints of this article, please send email to: tvcg@computer.org.

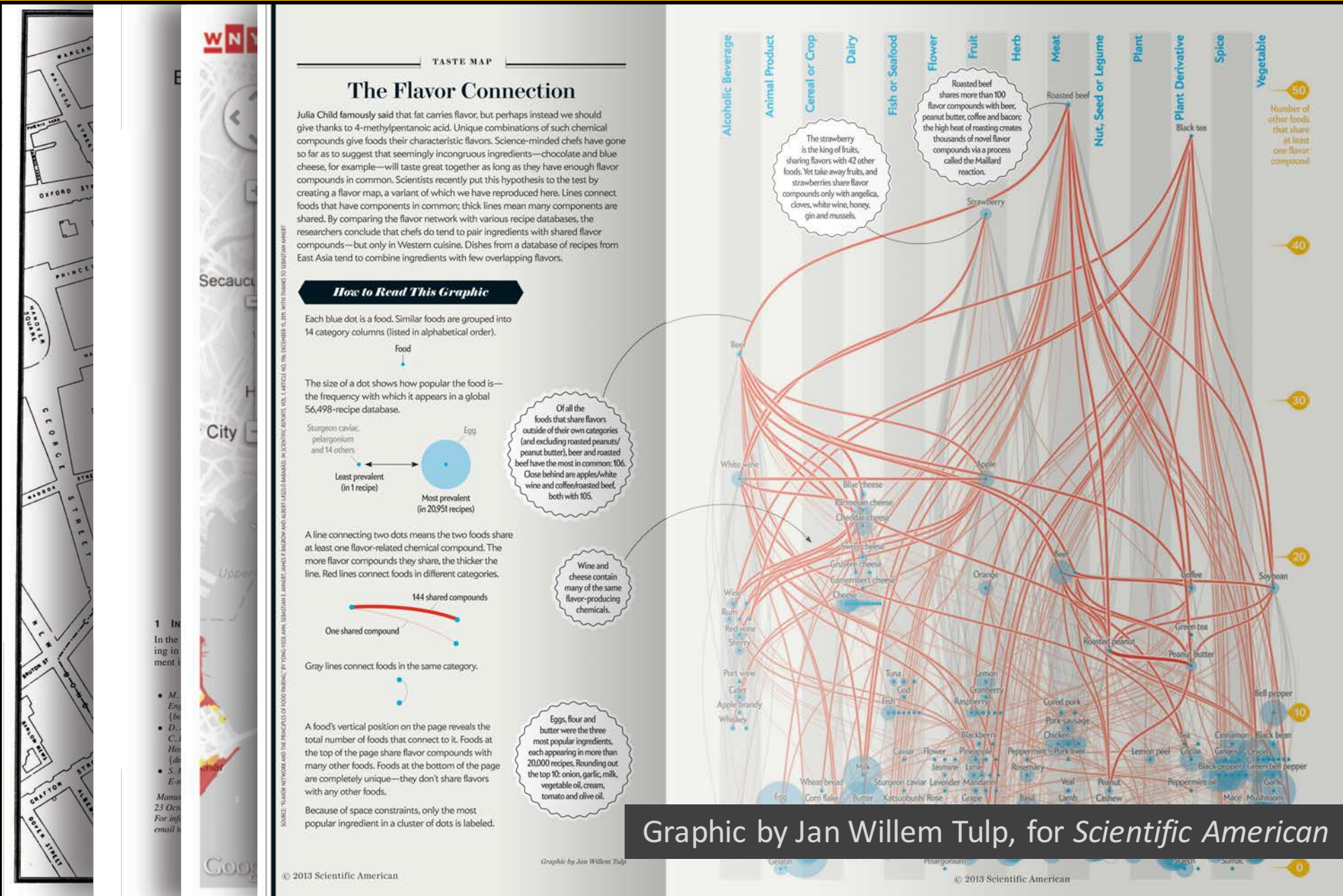
From Michelle Anne Borkin et al. 2011. "Evaluation of artery visualizations for heart disease diagnosis." *IEEE Transactions on Visualization and Computer Graphics* 17(12): 2479-2488

communicate breaking news to public



From WNYC

educate and inspire popular audiences



Graphic by Jan Willem Tulp, for *Scientific American*

communicate results to stakeholders

Figure 30: Distribution of Survey Responses

Economic | Environmental | Geopolitical | Societal | Technological

Chronic fiscal imbalances; Chronic labour market imbalances; Antibiotic-resistant bacteria; Failure of climate change adaptation; Critical fragile states; Diffusion of weapons of mass destruction; Backlash against globalization; Food shortage crises; Critical systems failure; Cyber attacks

Extreme volatility in energy and agriculture prices; Hard landing of an emerging economy; Irremediable pollution; Land and waterway use mismanagement; Entrenched organized crime; Failure of diplomatic conflict resolution; Ineffective illicit drug policies; Mismanagement of population ageing; Failure of intellectual property regime; Massive digital misinformation

Major systemic financial failure; Prolonged infrastructure neglect; Mismanaged urbanization; Persistent extreme weather; Global governance failure; Militarization of space; Rising rates of chronic disease; Rising religious fanaticism; Massive incident of data fraud/theft; Mineral resource supply vulnerability

Recurring liquidity crises; Severe income disparity; Rising greenhouse gas emissions; Species overexploitation; Pervasive entrenched corruption; Terrorism; Unmanaged migration; Unsustainable population growth; Proliferation of orbital debris; Unforeseen consequences of climate change mitigation

Unforeseen negative consequences of regulation; Unmanageable inflation or deflation; Unprecedented geophysical destruction; Vulnerability to geomagnetic storms; Unilateral resource nationalization; Widespread illicit trade; Vulnerability to pandemics; Water supply crises; Unforeseen consequences of nanotechnology; Unforeseen consequences of new life science technologies

Likelihood

NB: These diagrams show how individual survey responses are distributed across the different possible combinations of likelihood and impact scores, as measured, respectively, on the horizontal and vertical axes of the graphs. The darker the colour of the tile, the more often that particular combination was chosen by the experts who took the survey.

Source: World Economic Forum

Compared with Last Year

While there is some movement of individual dots, compared with last year's scatter plot, the general distribution of the risks on the risk landscape is, perhaps unsurprisingly, similar (see Figure 1). What is surprising, though, is that respondents this year see risks as more likely and as having a higher impact than respondents to the previous year's survey. The average likelihood score is 0.15 units higher (on a scale from 1 to 5), and the average impact score is 0.13 units higher.

Part of the increase in impact (about a quarter of the difference) can be explained by the fact that the average age of the survey sample has decreased, and as shown below, younger people tend to give higher answers when it comes to assessing a risk's impact. Nonetheless, even controlling for age and other different characteristics of the sample, the

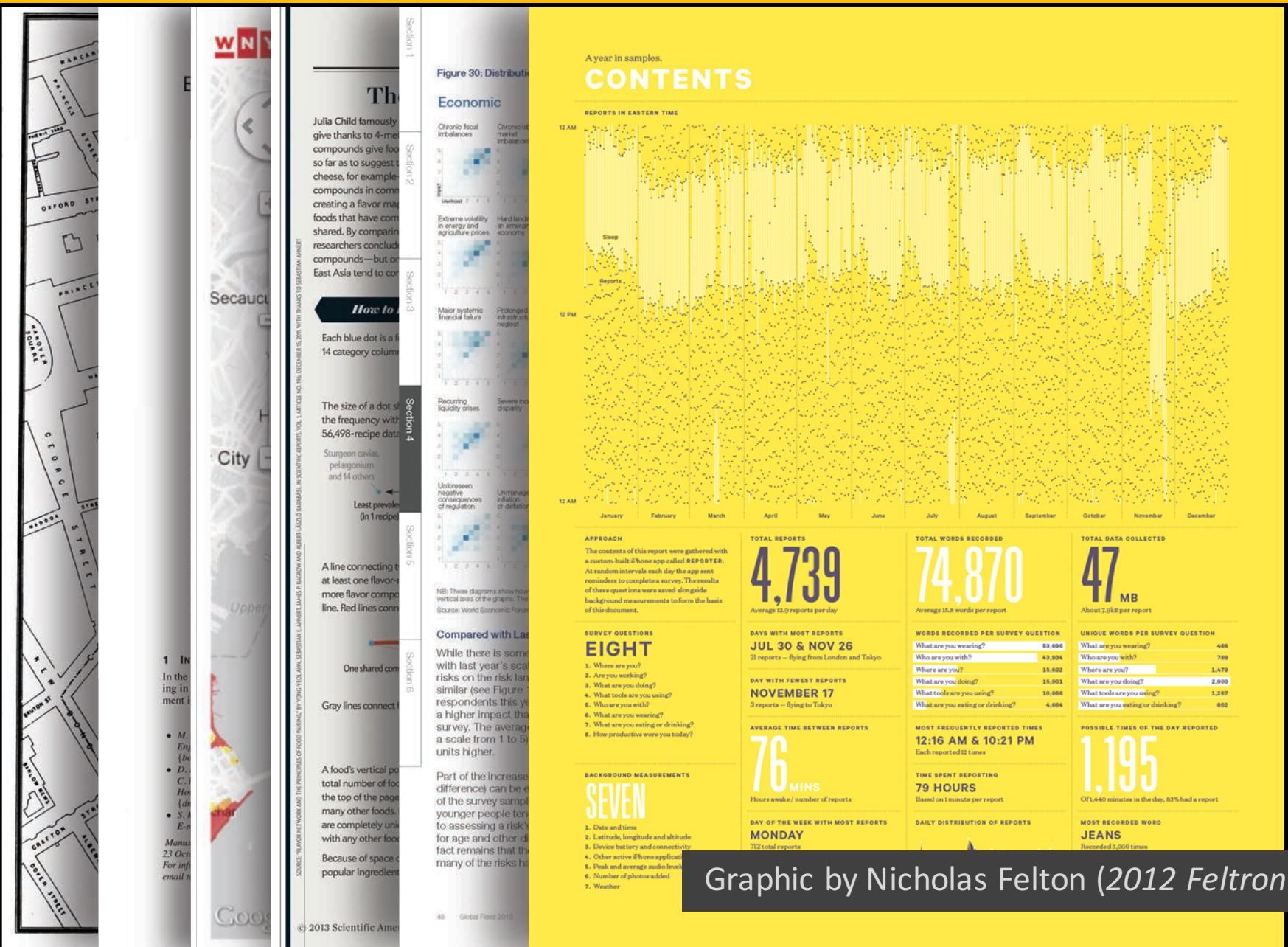
Particularly interesting cases which had big increases in both likelihood and impact scores are:

- the technological risks: *unforeseen consequences of new life science technologies* and *unforeseen consequences of climate change mitigation*;
- the economic risks: *unforeseen negative consequences of regulation*, *hard landing of an emerging economy* and *chronic labour market imbalances*;
- the two sides of global demographic imbalances: *unsustainable population growth* and *mismanagement of population ageing*; and
- the geopolitical risk: *unilateral resource nationalization*.

Only very few risks had their average scores decrease from last year. On the likelihood scale, these include *recurring liquidity crises*, *vulnerability to geomagnetic storms* and *proliferation of orbital debris*. The only risk where there was a statistically

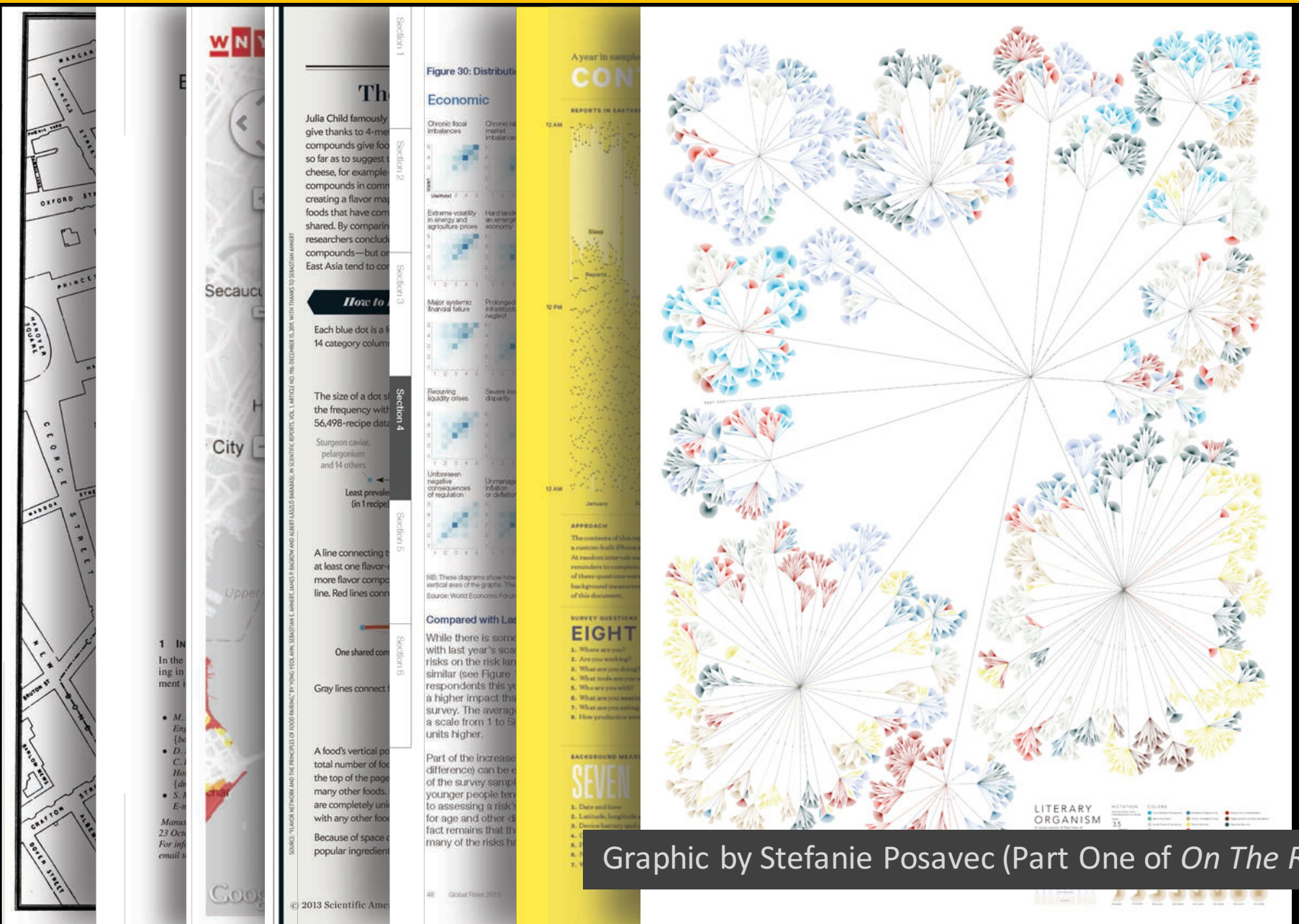
Graphic by Moritz Stefaner, From *World Economic Forum Global Risks Report, 2013*

nontraditional storytelling



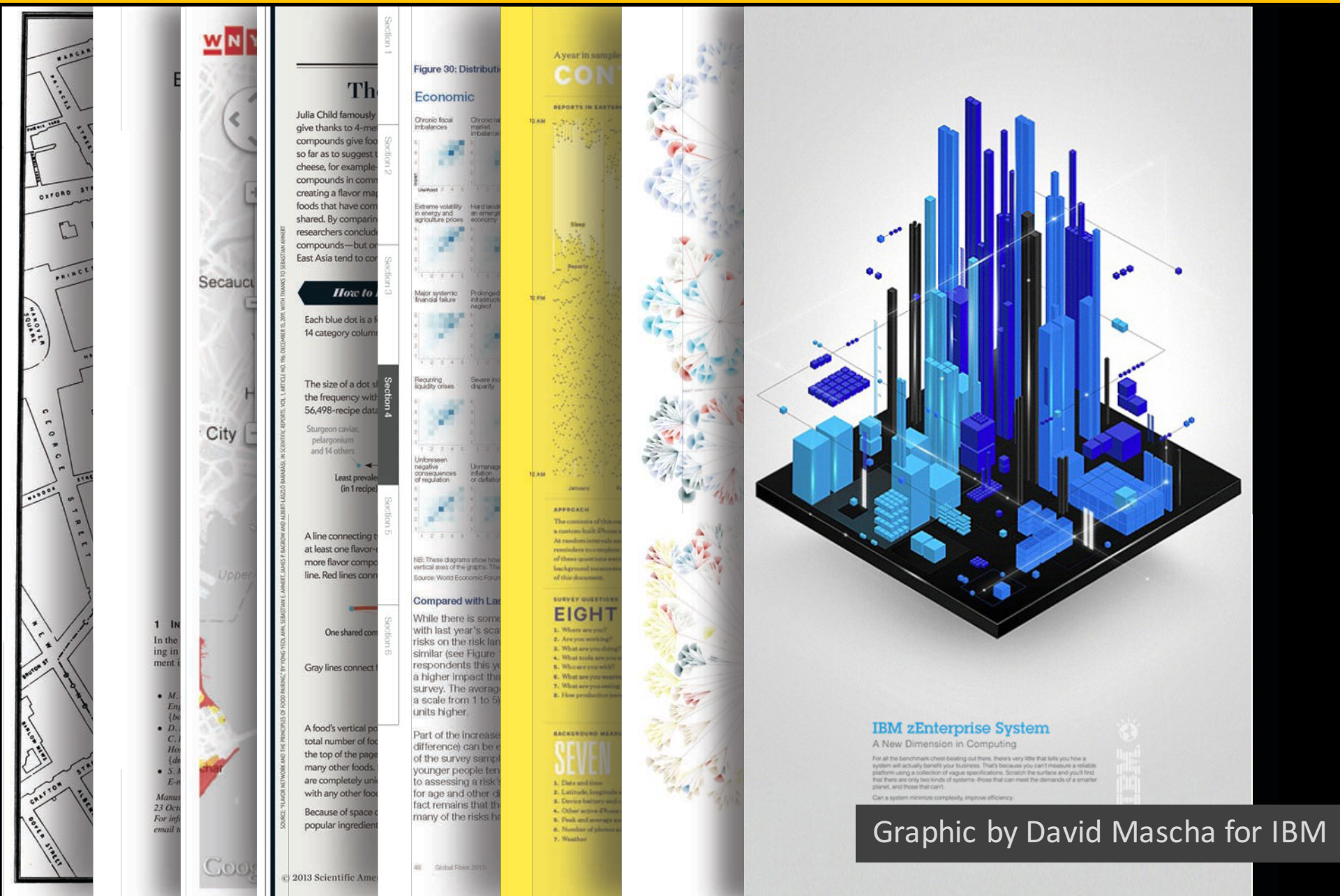
Graphic by Nicholas Felton (*2012 Feltron Report*)

artistic expression



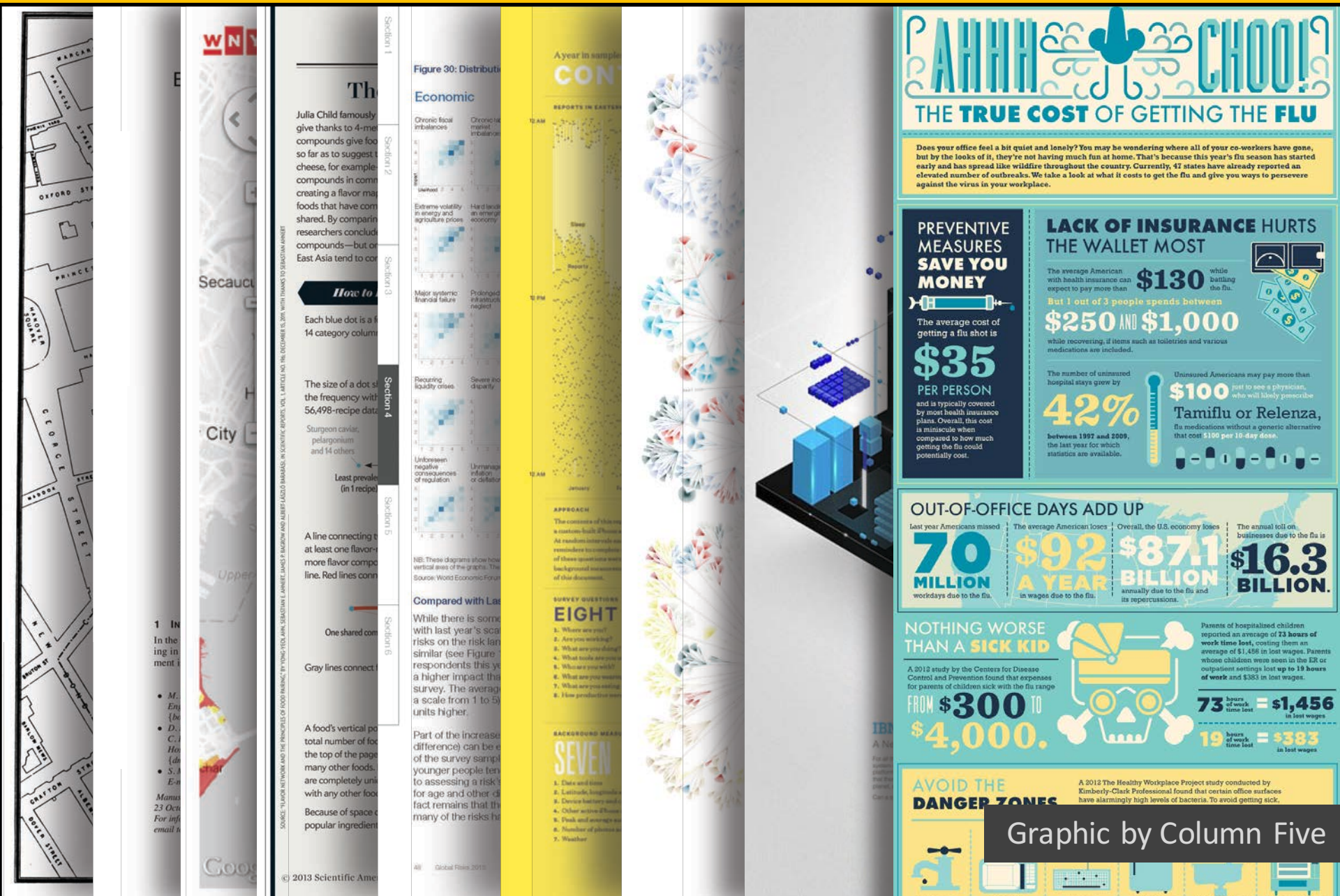
Graphic by Stefanie Posavec (Part One of *On The Road*)

advertising



Graphic by David Mascha for IBM

[infographic]



Graphic by Column Five

[content]

Developing scientific data visualizations for non-specialist audiences

[context]

organizing your [content]

- basic design tips
- choosing the right chart type
- more resources

customizing for a different [context]

- simple edits / reframing
- moderate reworks
- custom solutions

design tips

SA Visual

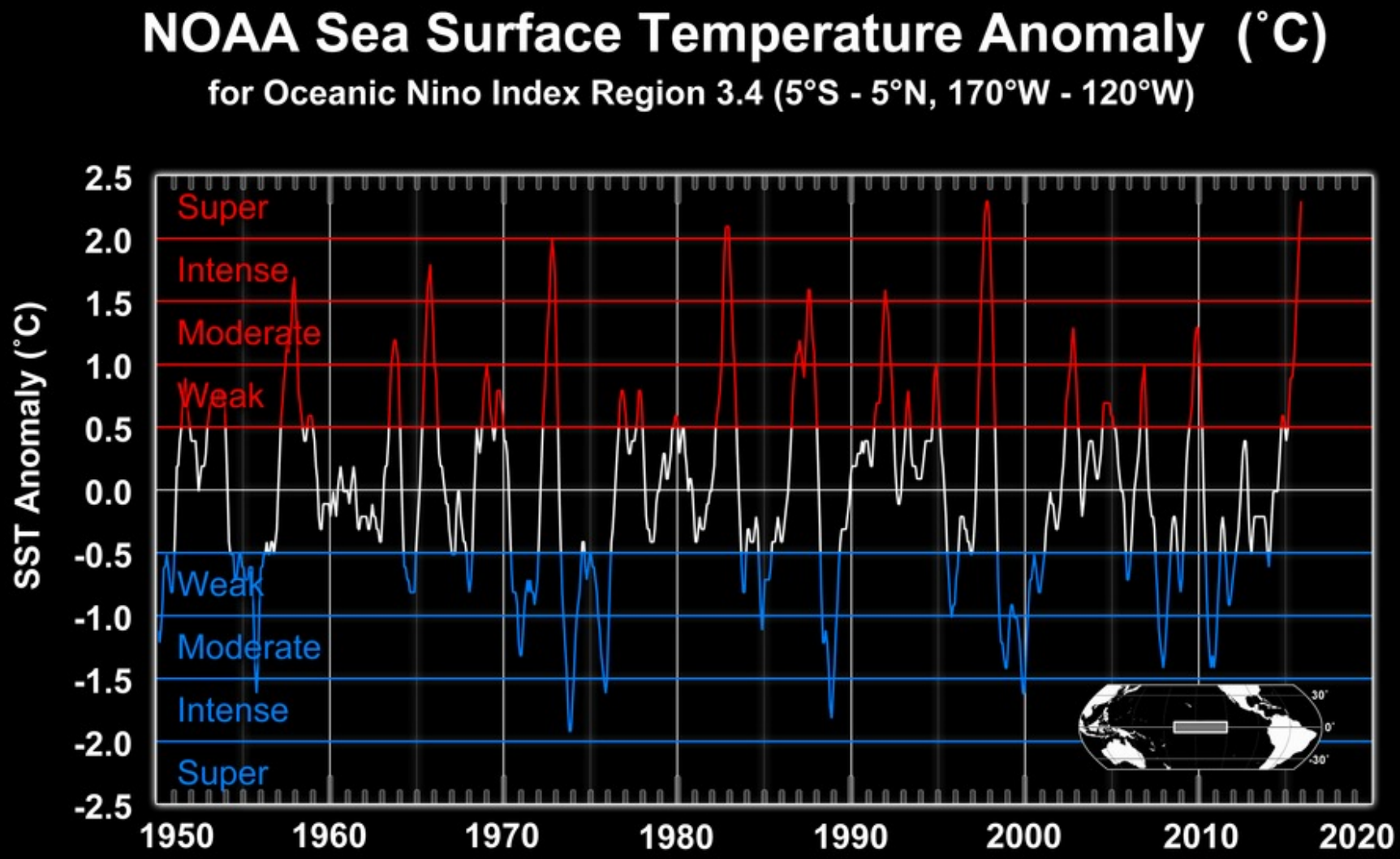
Data Visualization Advice for Scientists

Dataviz engineer Robert Simmon demonstrates how adhering to a few best-practice design principles can make graphics easier to read

By Robert Simmon on February 19, 2016

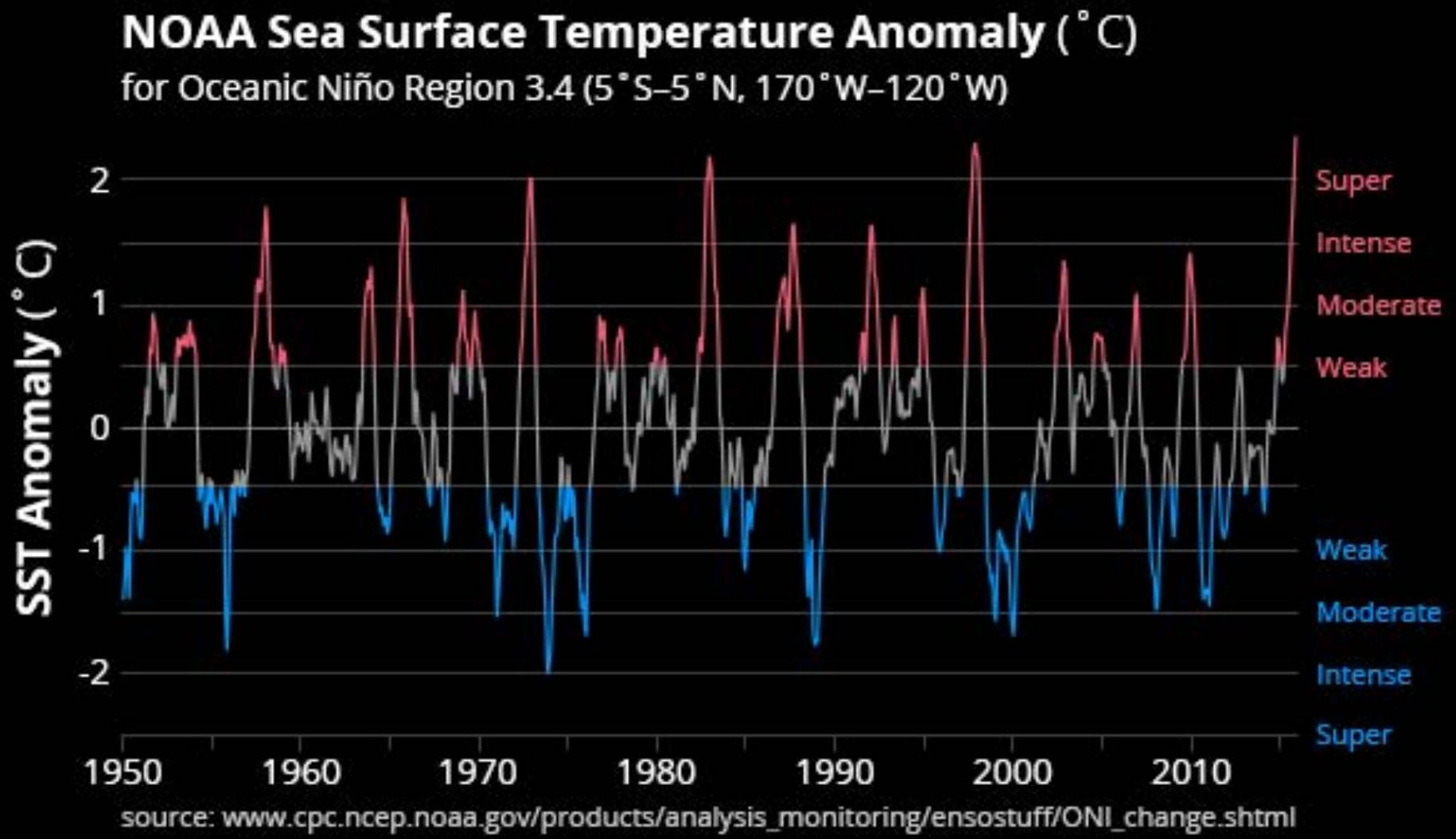
http://bit.ly/LSU_jc1

design tips



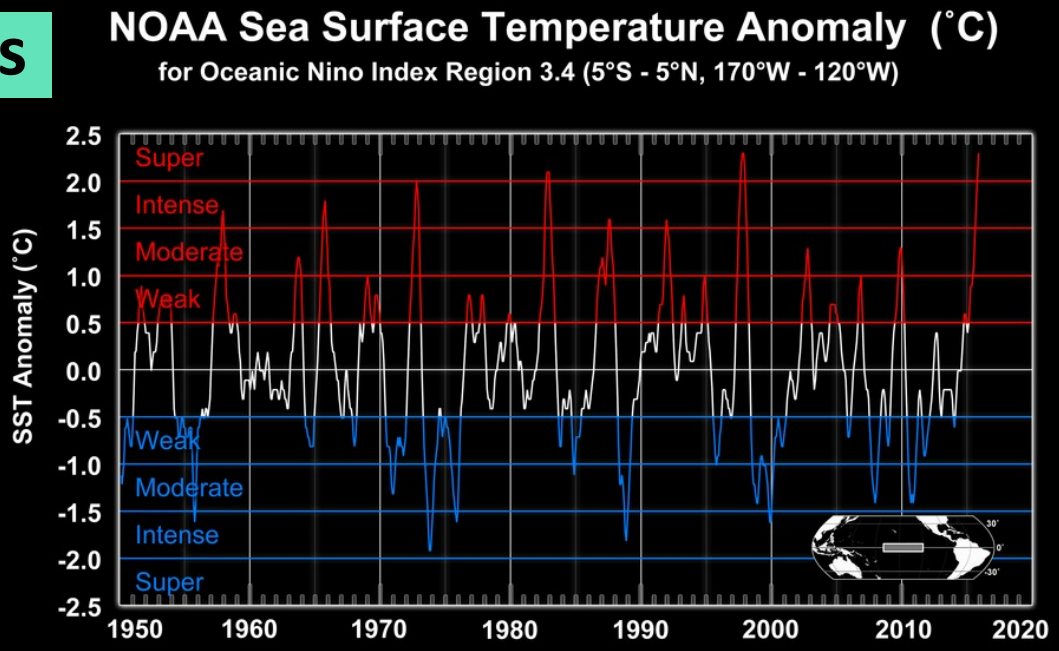
NASA's Scientific Visualization Studio

design tips



Robert Simmon

design tips


NOAA Sea Surface Temperature Anomaly (˚C)
for Oceanic Nino Index Region 3.4 (5°S - 5°N, 170°W - 120°W)
SST Anomaly (˚C)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
Super
Intense
Moderate
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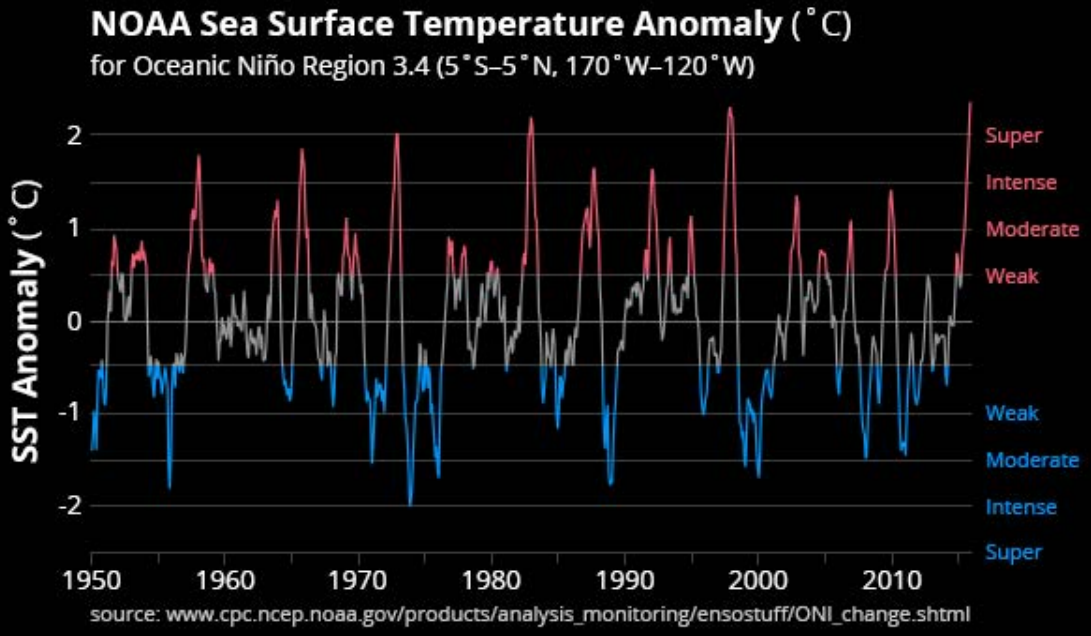
NOAA Sea Surface Temperature Anomaly (˚C)
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SST Anomaly (˚C)
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-2
Super
Intense
Moderate
Weak
Weak
Moderate
Intense
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1950
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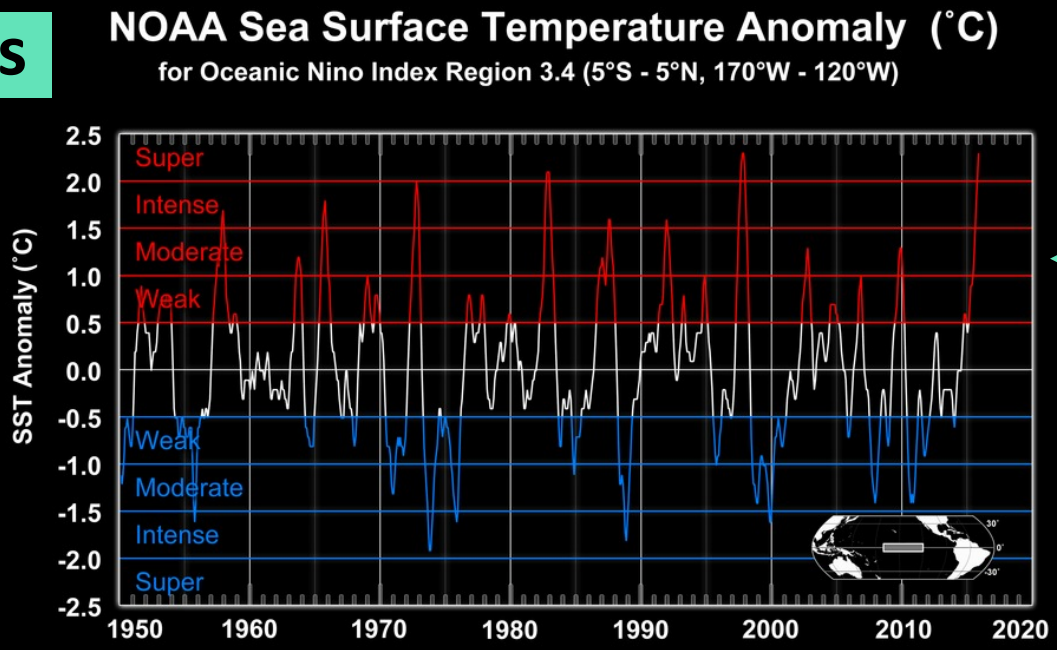
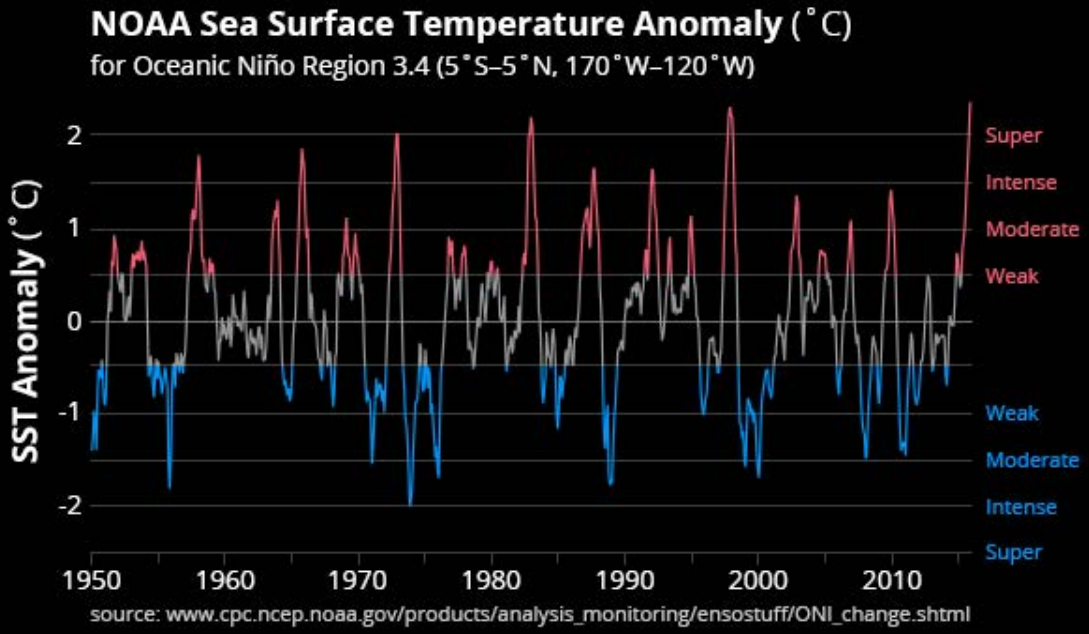
source: www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_change.shtml

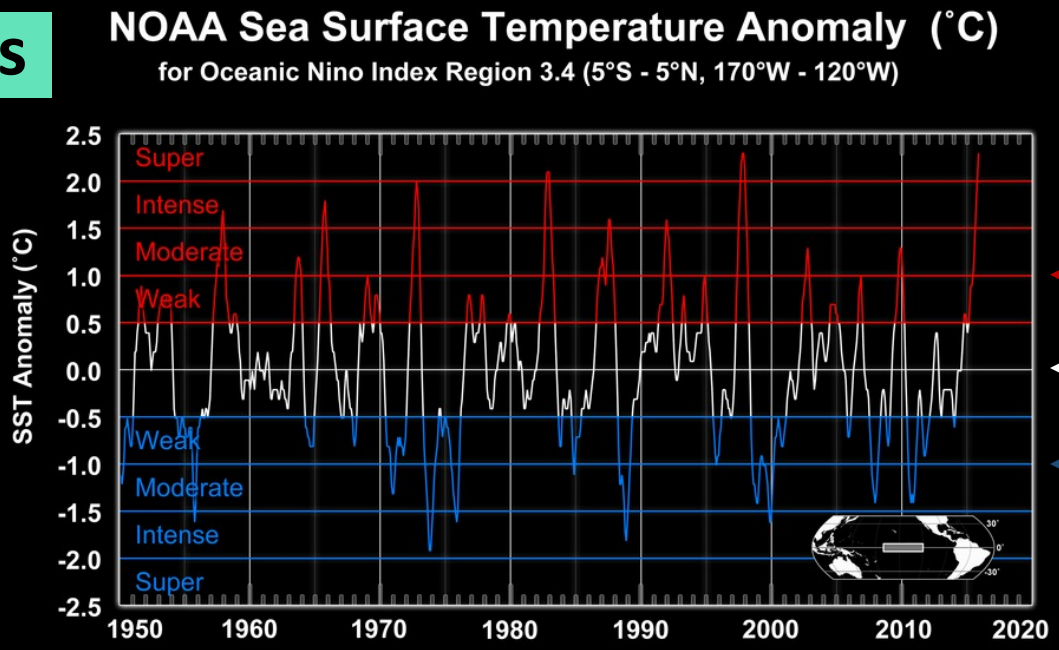
design tips



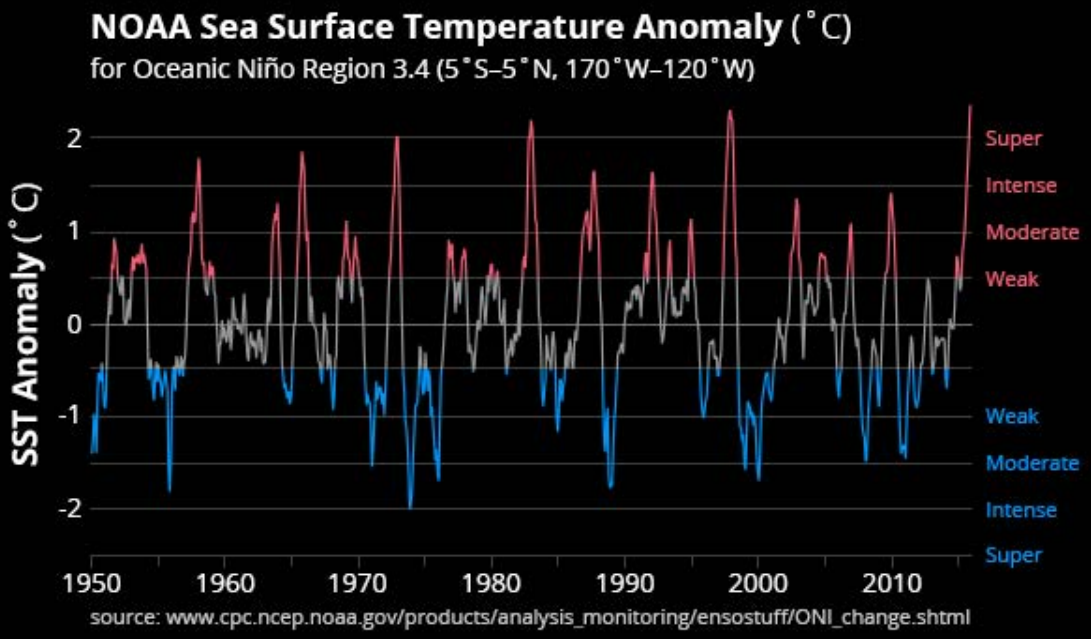
He removed the frame around the graph entirely—it flattens the graphic lessening the difference between foreground and background.



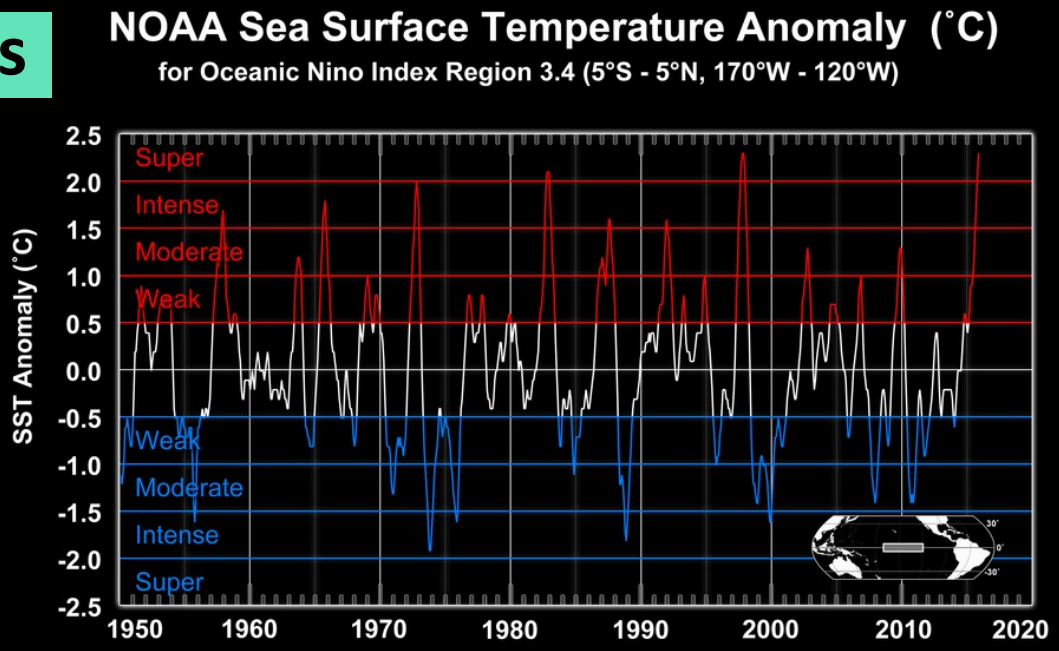
design tips



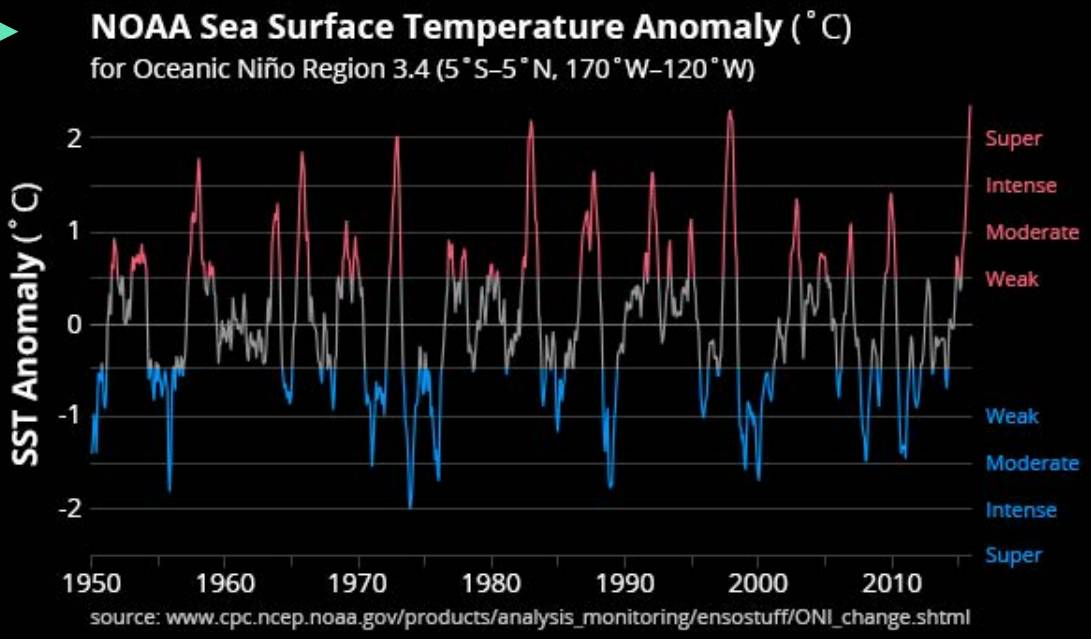
He adjusted the red, neutral, and blue colors so that they'd have equal visual weight.



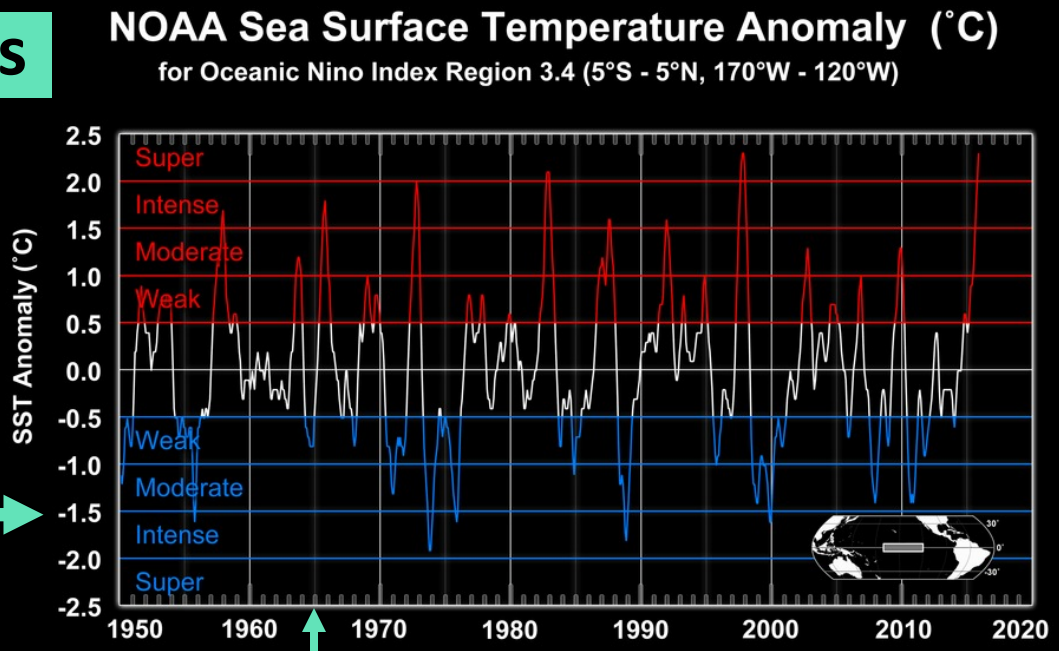
design tips



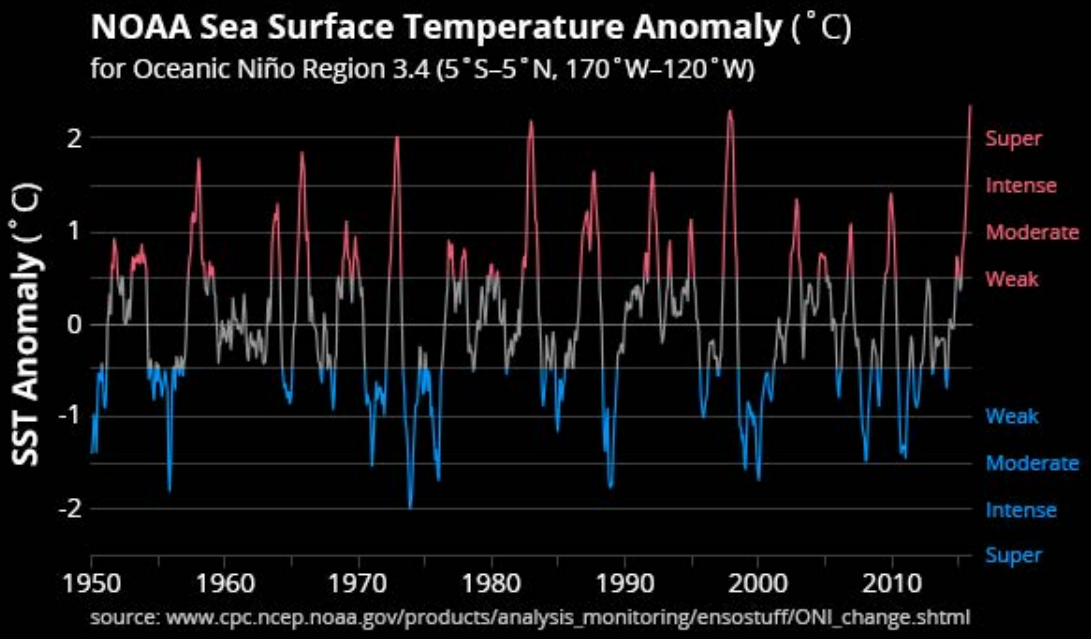
Moved title to the upper-left corner of the frame: where most western viewers will start reading.



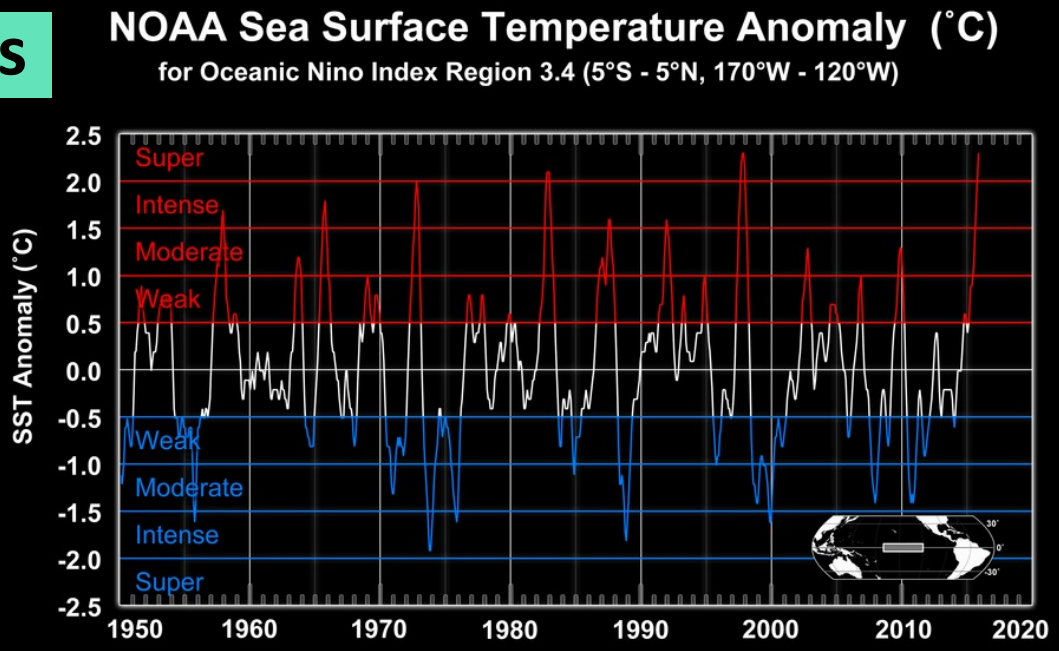
design tips



Removed intermediate tick marks and some labels, making the remaining labels easier to read



design tips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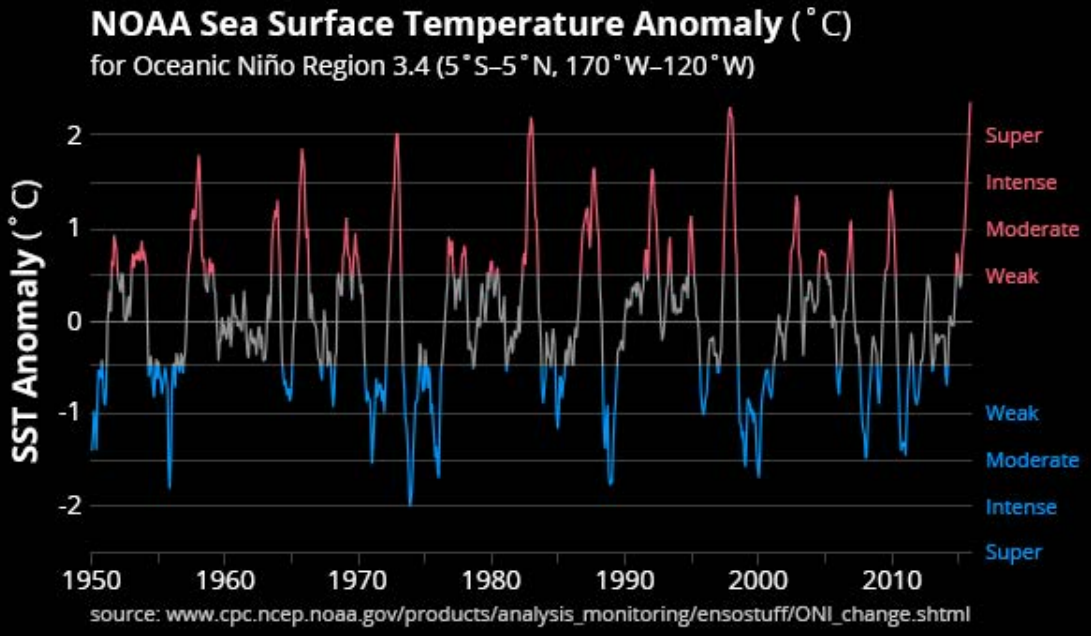
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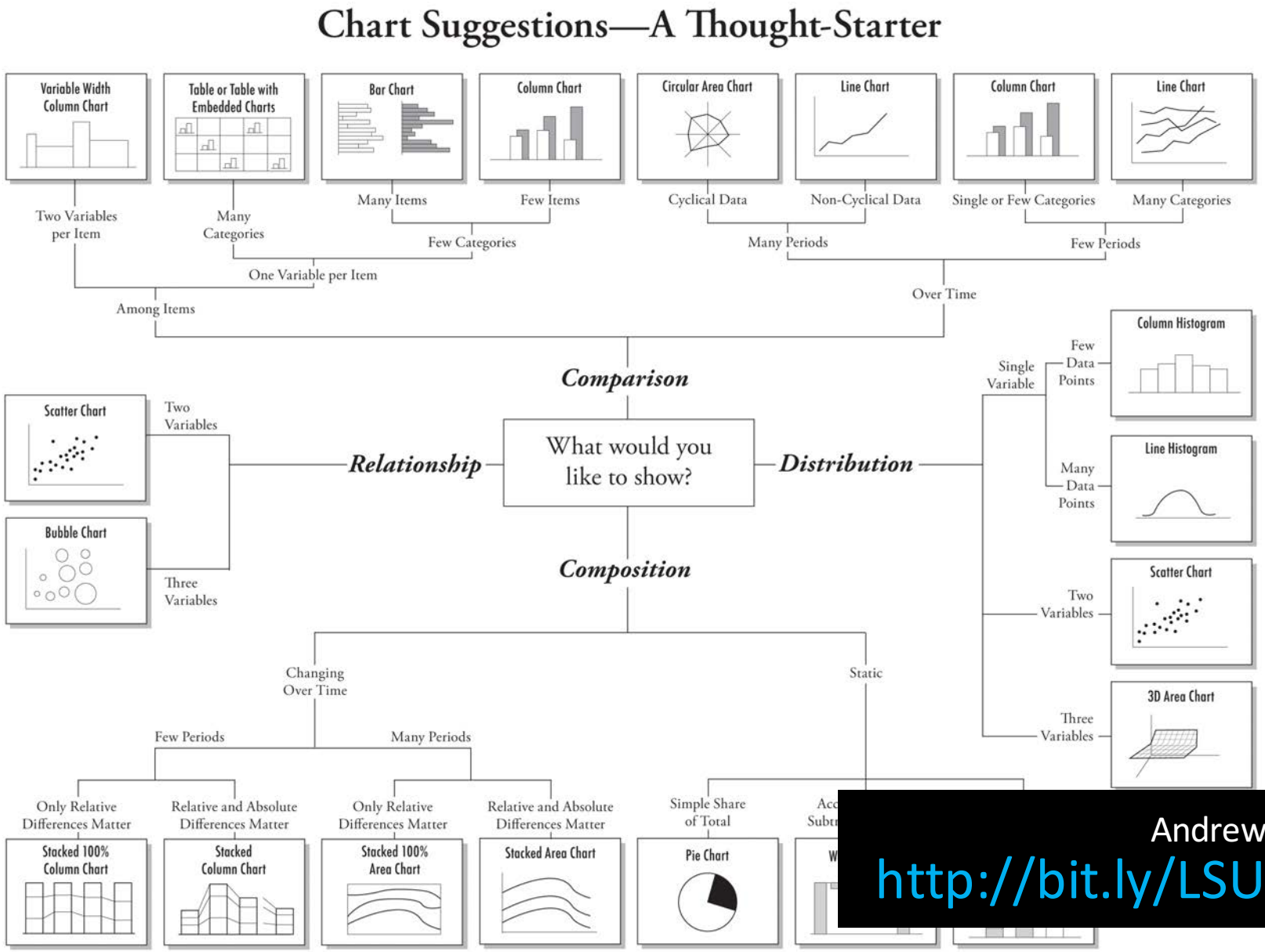
source: www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_change.shtml

chart choosers



Andrew Abela

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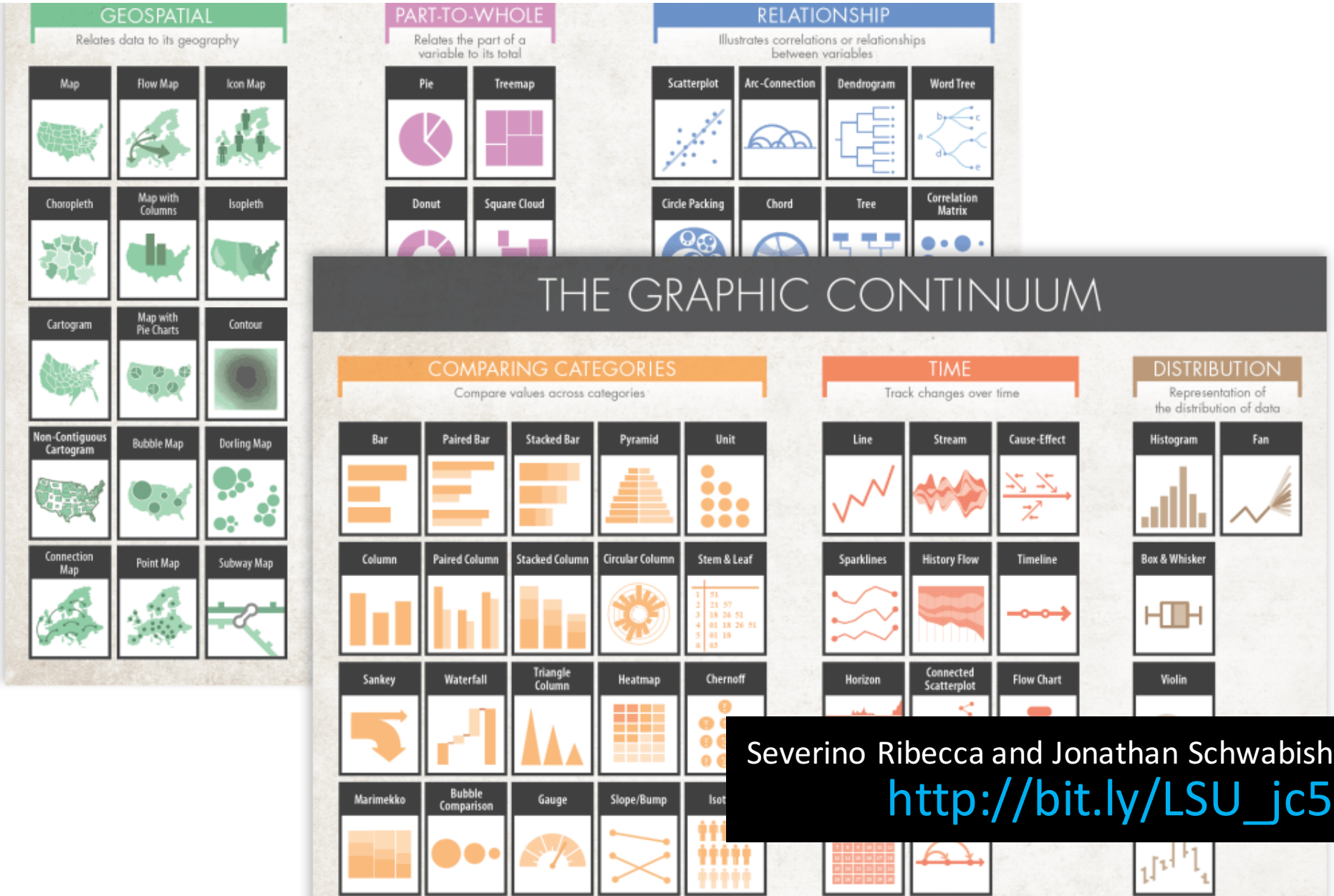

Severino Ribecca and Jonathan Schwabish

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Severino Ribecca

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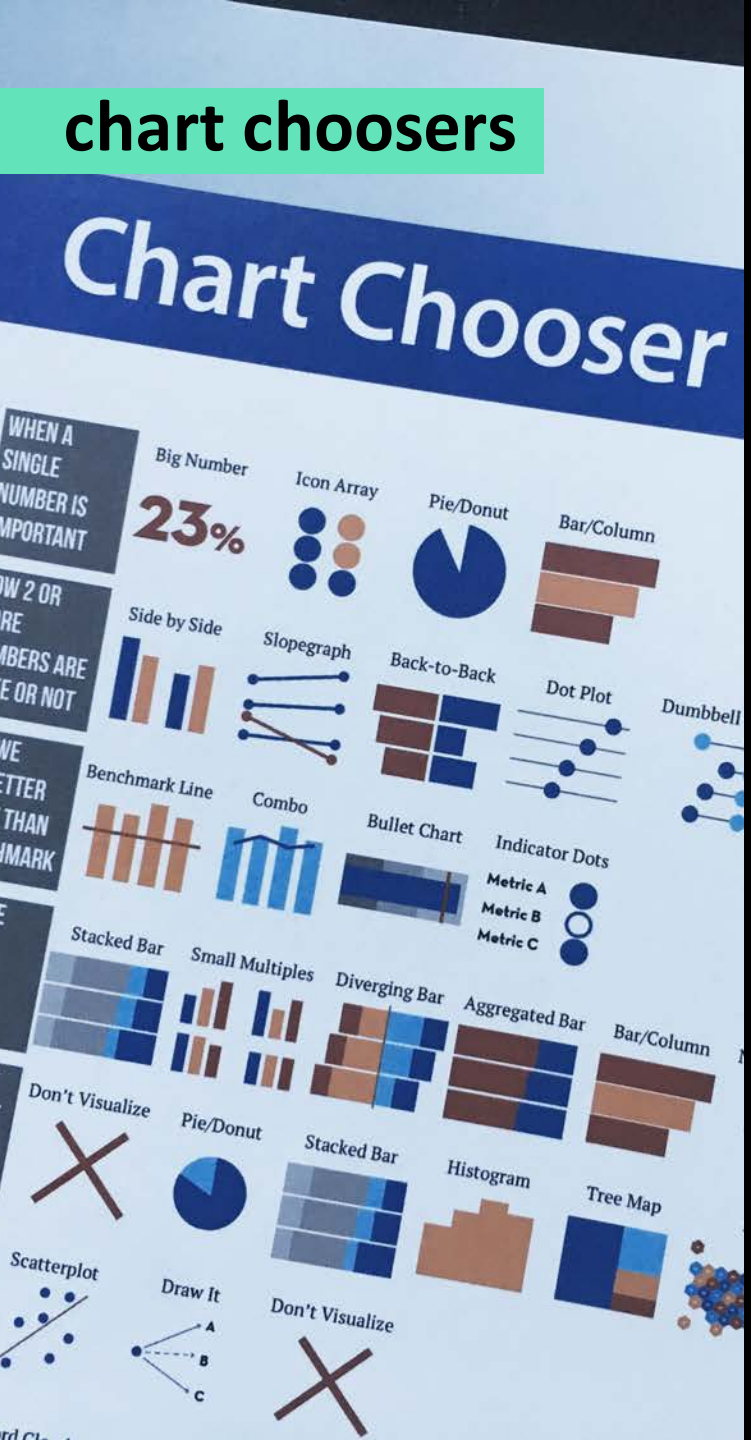
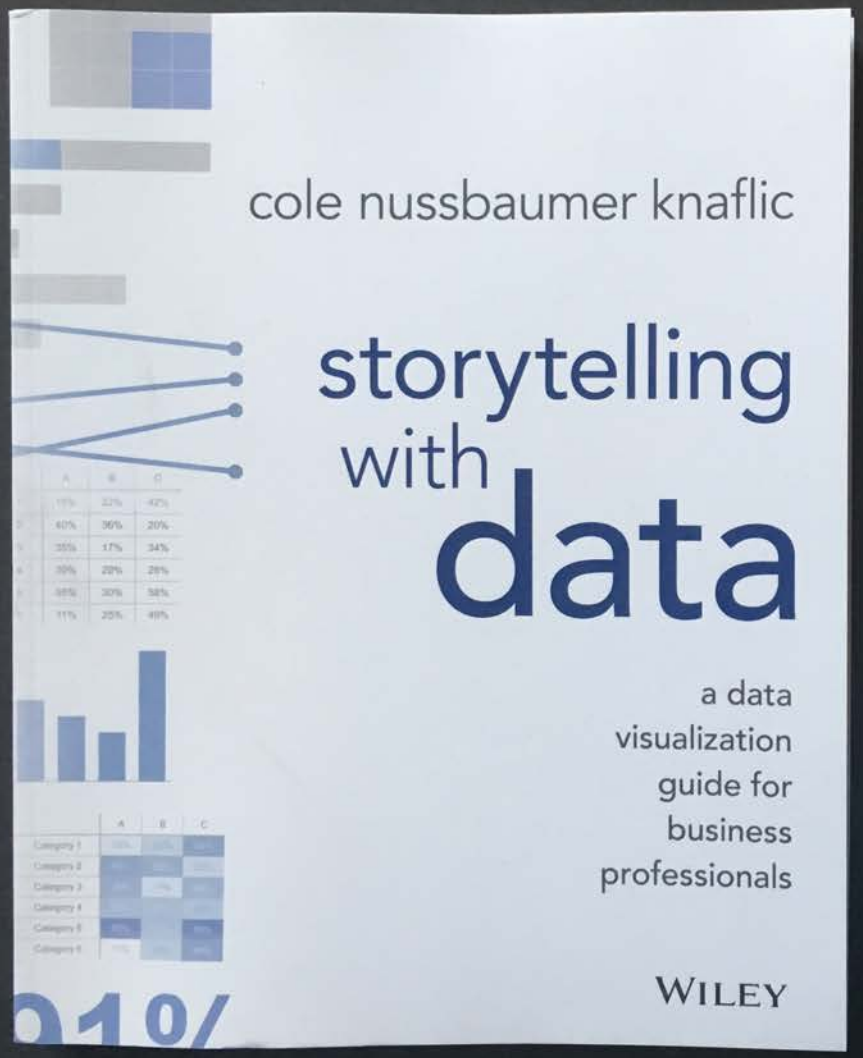
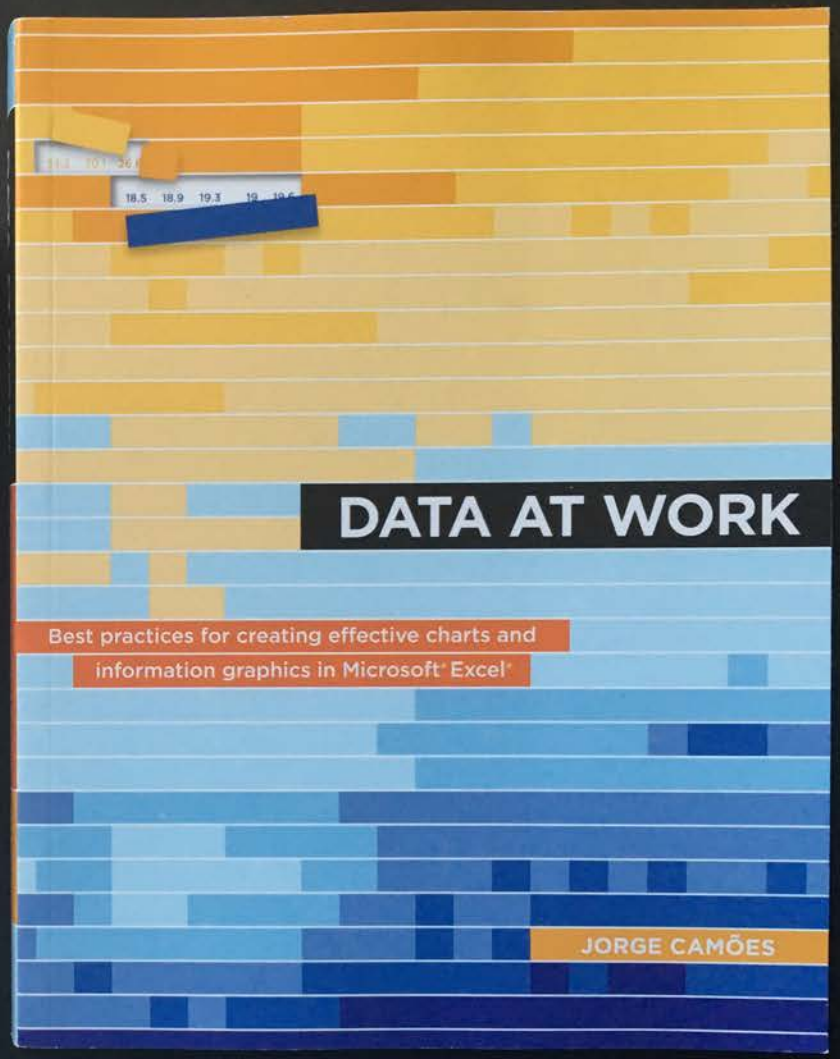
chart choosers



more resources

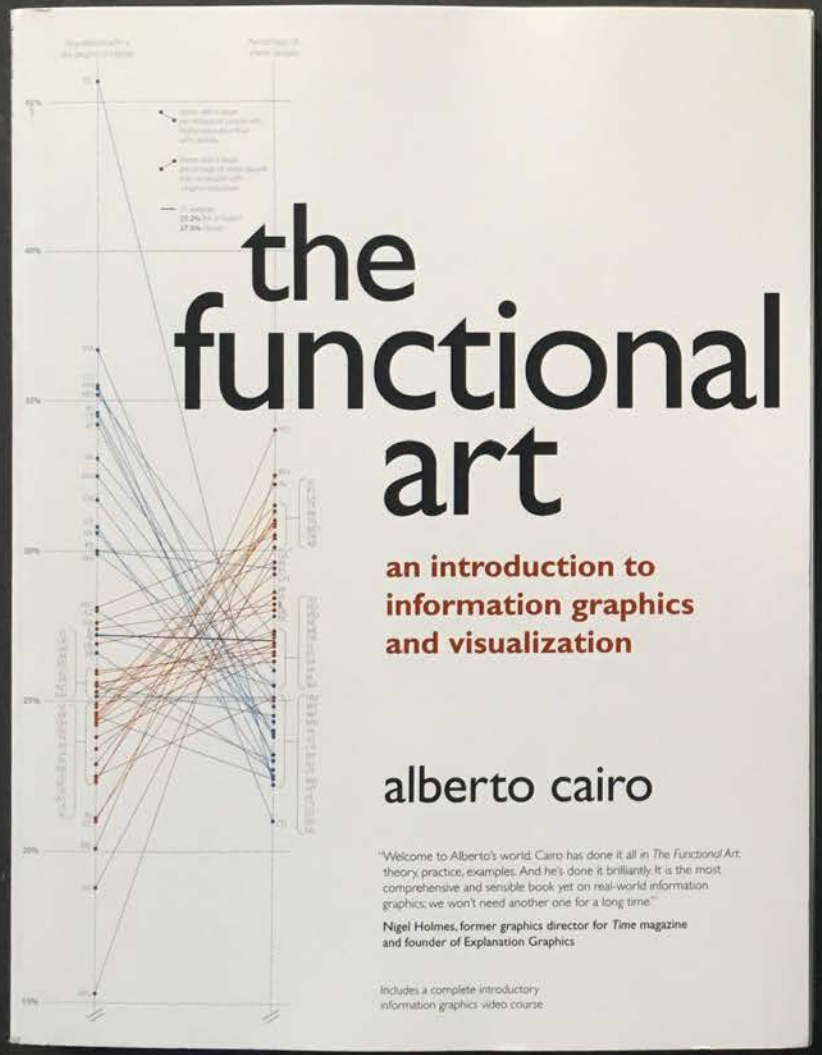


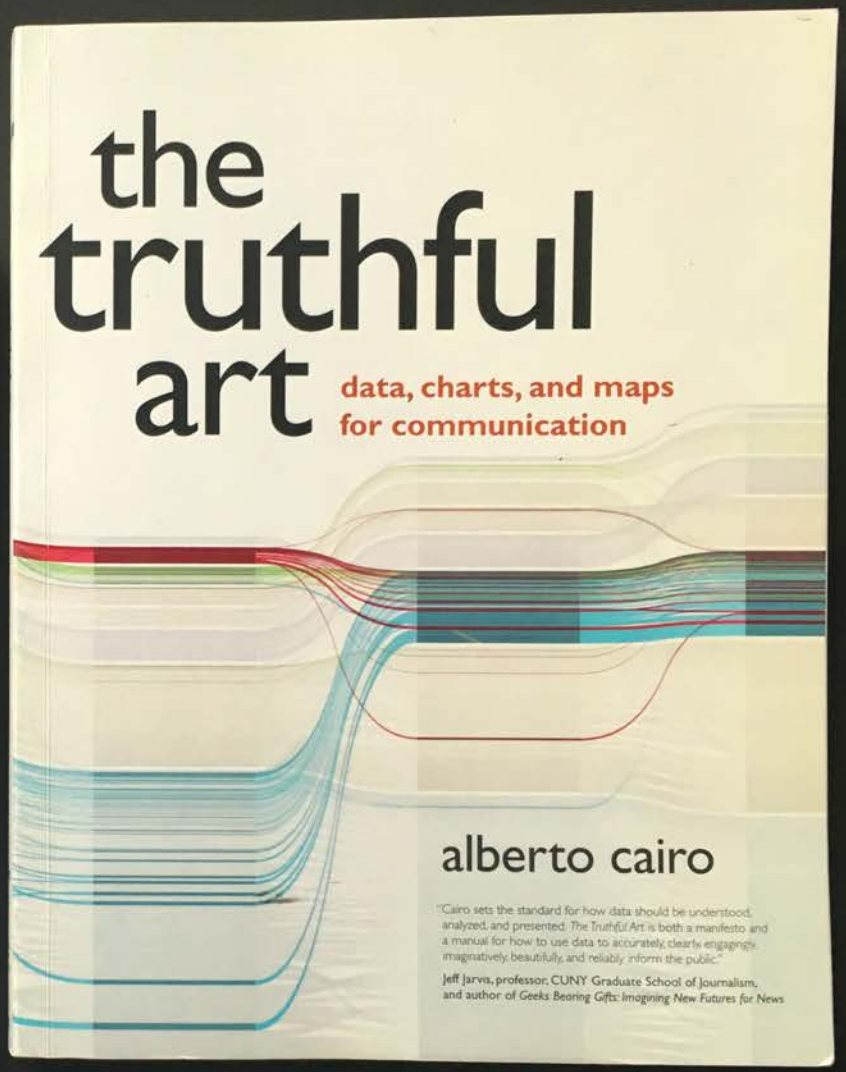
Cole Nussbaumer Knaflic http://bit.ly/LSU_jc8



Jorge Camões http://bit.ly/LSU_jc9

more resources

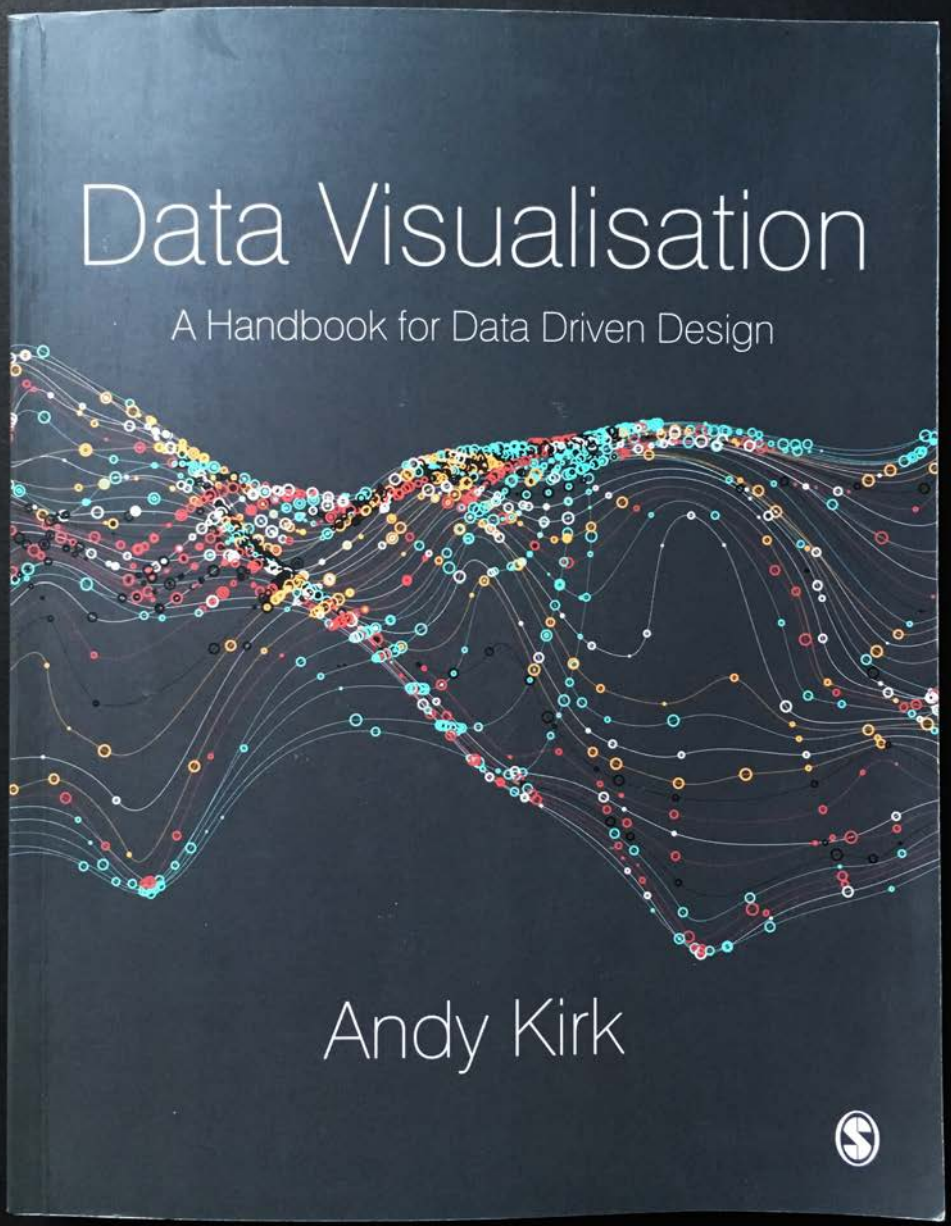




Alberto Cairo

http://bit.ly/LSU_jc10

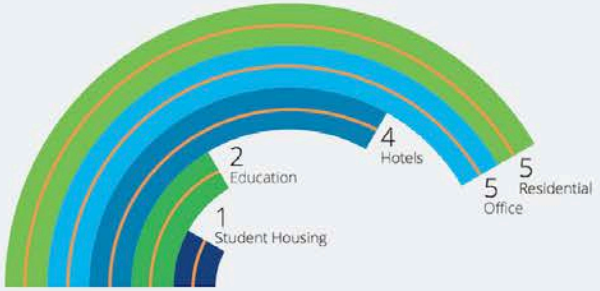
more resources



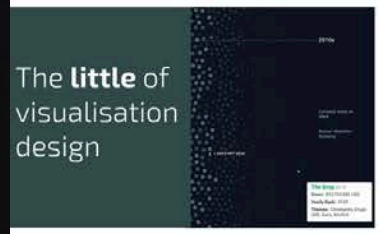
01 SEP THE PROBLEMS WITH B'ARC CHARTS

ORIGINAL B'ARC CHART

Which sectors are the most active? (Number of schemes under construction)



Almost one month ago I tweeted my contempt for radial bar charts, having come across a particularly egregious case. It seemed to gain a bit of traction on social media but was also met by genuine queries as to my reasoning for this disdain.



23 AUG THE LITTLE OF VISUALISATION DESIGN: PART 42

22 AUG ANOTHER UPDATE ABOUT THE CHARTMAKER DIRECTORY

WEBINAR

Andy Kirk

http://bit.ly/LSU_jc11

customizing for a different [context]

- simple edits / reframing
  - shake out label jargon
  - add framing text (focus attention)
  - add annotations
- moderate reworks
  - add audience-specific context
  - combine or divide elements
- custom solutions
  - create a new visualization from scratch

customizing for a different [context]

- simple edits / reframing
  - shake out label jargon
  - add framing text (focus attention)
  - add annotations

reframing

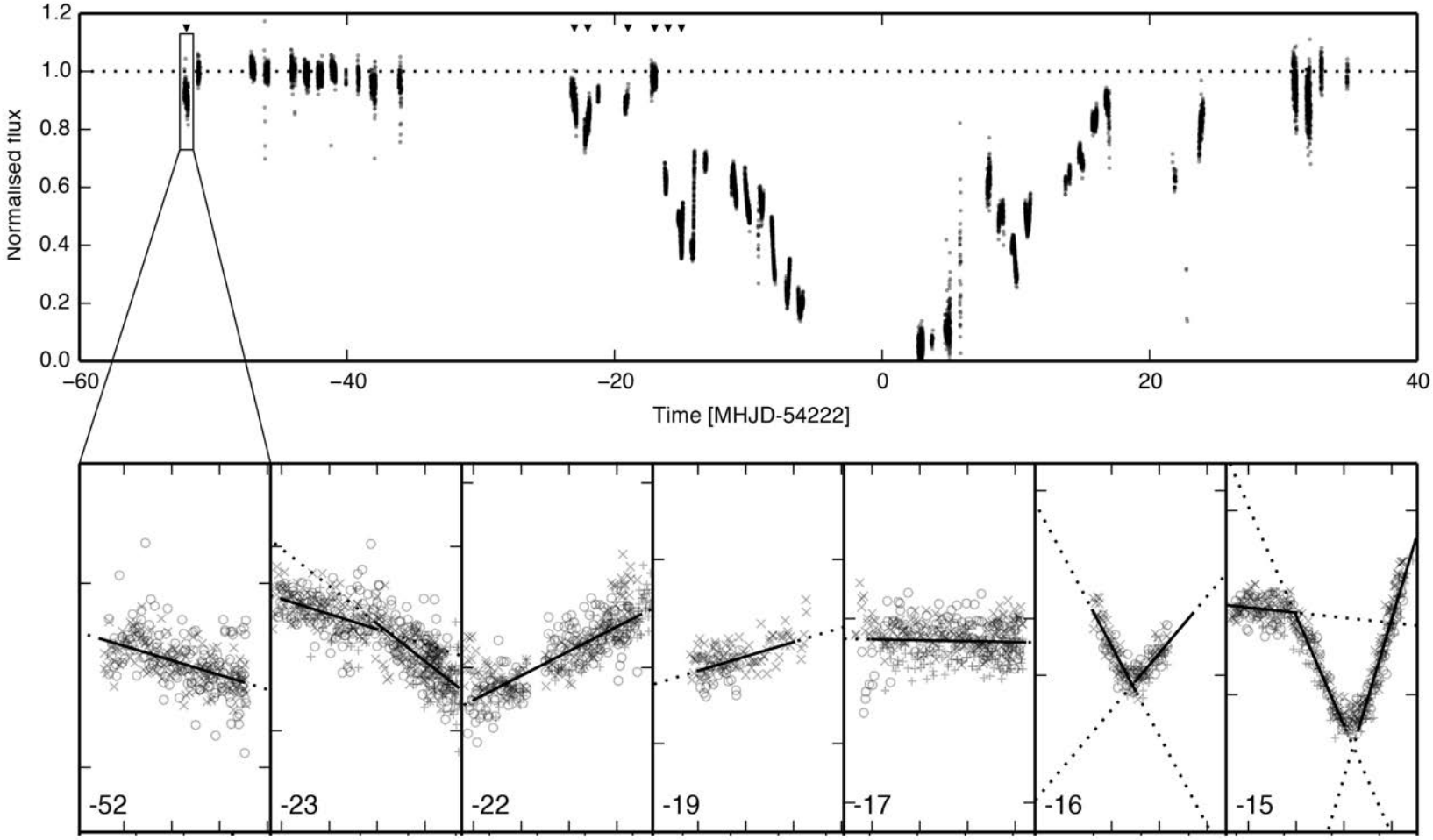


Figure 8. Detailed plot of the J1407 light curve during the eclipse. Top: overview of the light curve. Bottom: nightly light curve for 7 nights during the eclipse, indicated in the upper panel by triangles. The data from the different CCDs are plotted with different symbols, 221: ◯, 227: ×, and 228: +. The straight line fits are plotted over the data, solid lines are inside the window used for the fit, dotted line are extrapolated. The y-ticks are spaced at 0.2 au (as in the top panel) and x-ticks at 0.1 d.

By T. I. M. van Werkhoven *et al.*, "Analysis of 1SWASP J140747.93−394542.6 eclipse fine-structure: hints of exomoons"

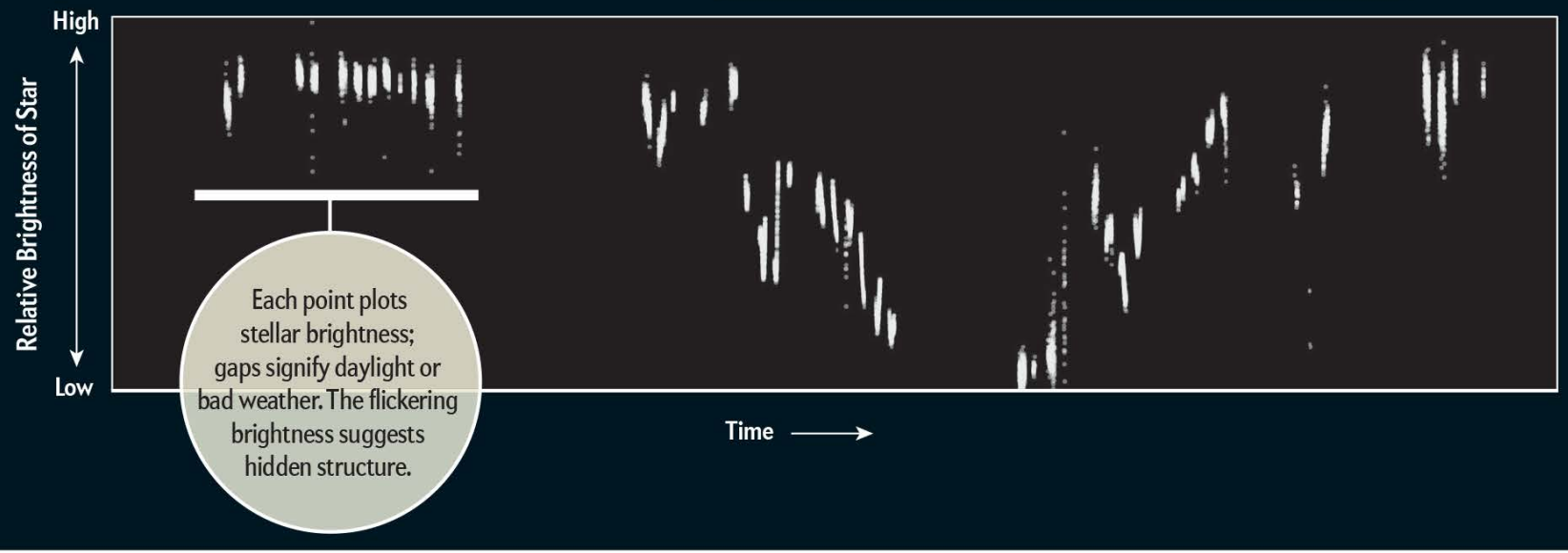
reframing

A MYSTERY OF LIGHT AND SHADOW

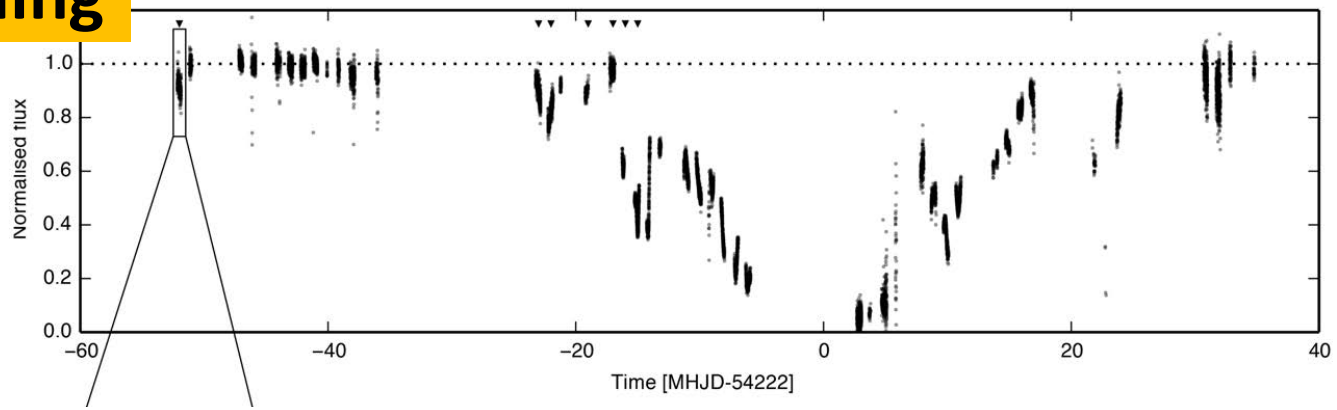
Perplexing Pattern

A light curve—an object's variance in brightness plotted over time—is a basic tool for studying stars. A brief boost in brightness can be caused by stellar flares, whereas momentary dips can signal star spots or the shadow of an orbiting planet. But the wildly fluctuating light curve of the star J1407 in 2007 (*below*) was unlike anything astronomers had ever seen. Something strange was making the star flicker and fade for months at a time.

J1407'S ODD LIGHT CURVE, DURING A 2007 ECLIPSE



reframing



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Between two periods of flickering, J1407's light dimmed for 56 days, suggesting the star was eclipsed by an object 180 million kilometers wide.

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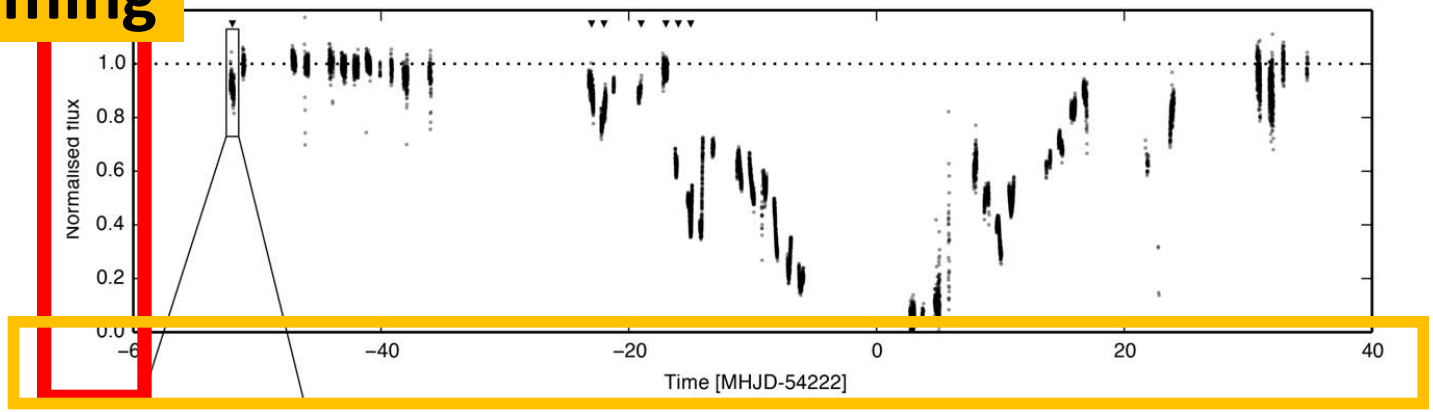
reframing



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reframing

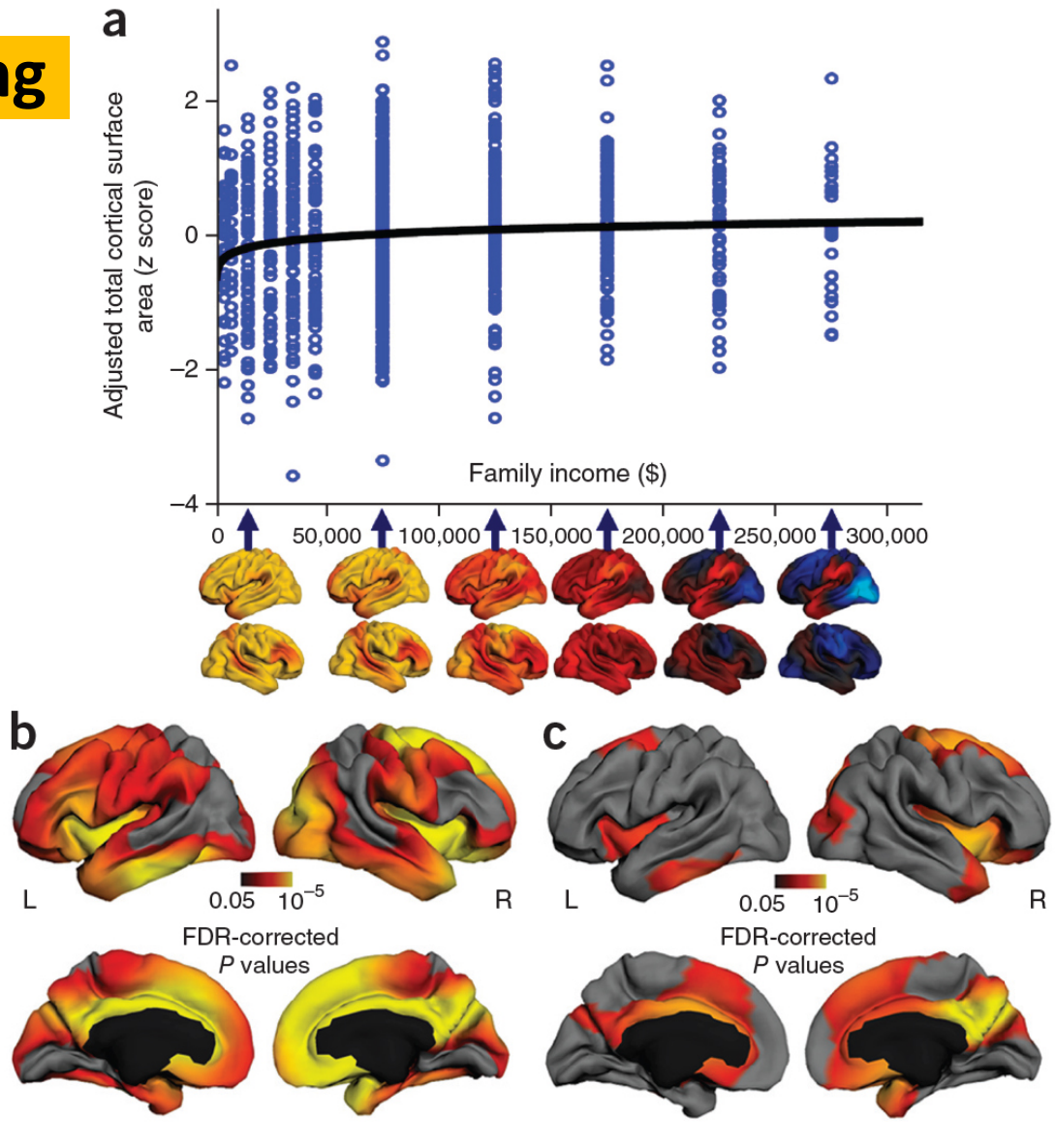
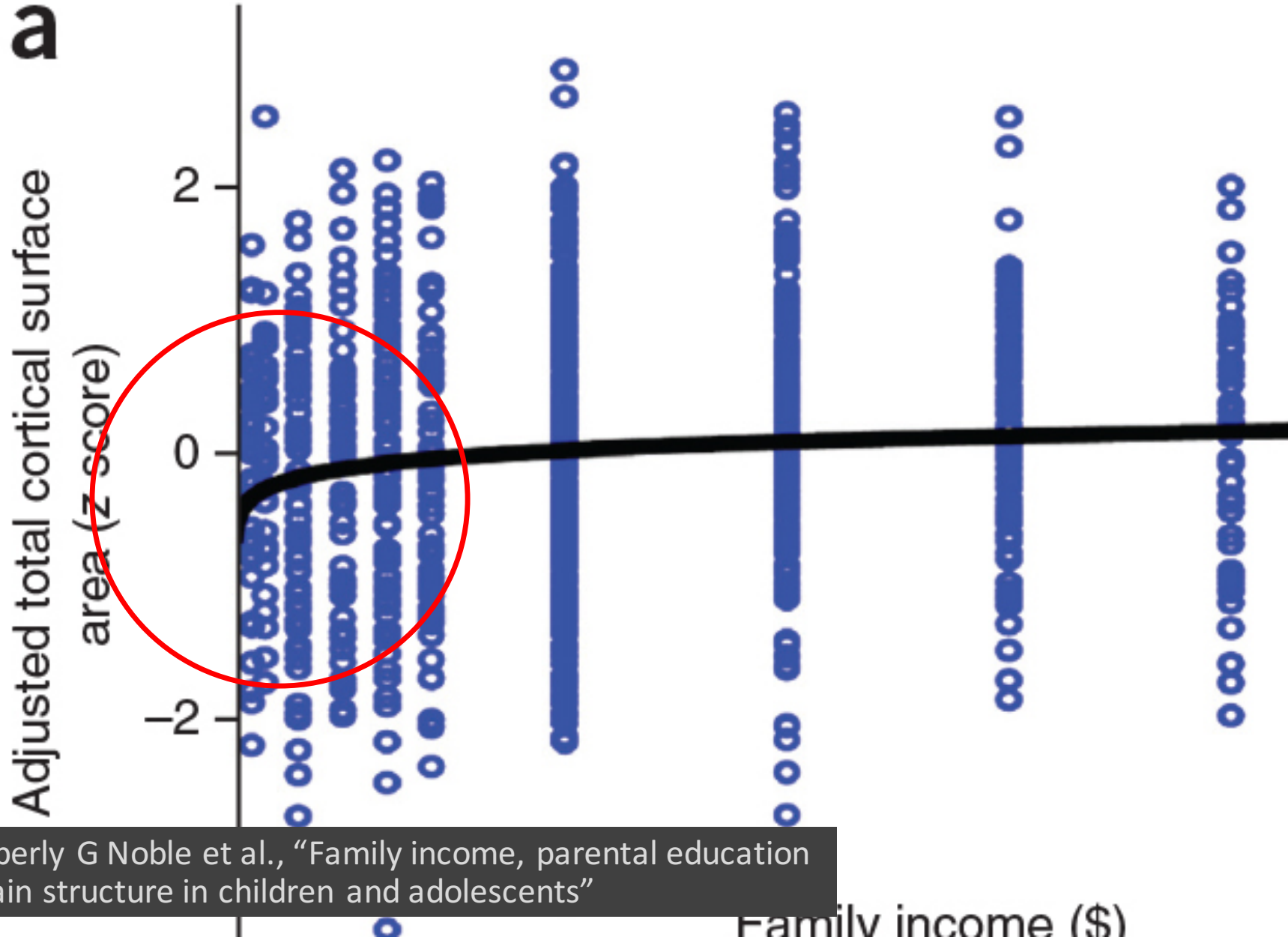


Figure 2 Family income is loga
($N = 1{,}099$). (**a**) Multiple regre
age^2, scanner, sex and genetic
logarithmically associated with
such that the steepest gradient
spectrum ($\beta = -0.19$, $P = 0.00$
untransformed scale, fitted wit
of this asymptotic relationship.
with the brain maps, where the
per unit income is visualized w
in cortical surface area per uni
(**b**) When adjusting for age, age
ln (family income) was significa
widespread regions of children's
Relationships were strongest in
frontal gyrus, and in the right oc
adjusting for age, age^2, scanner
ln (family income) was significa
number of regions including bil
inferior temporal regions, and in
Maps are thresholded at $P < 0.0$
thresholds of 0.01 and 0.001 ar

By Kimberly G Noble et al., "Family income, parental education and brain structure in children and adolescents"

reframing



By Kimberly G Noble et al., “Family income, parental education and brain structure in children and adolescents”

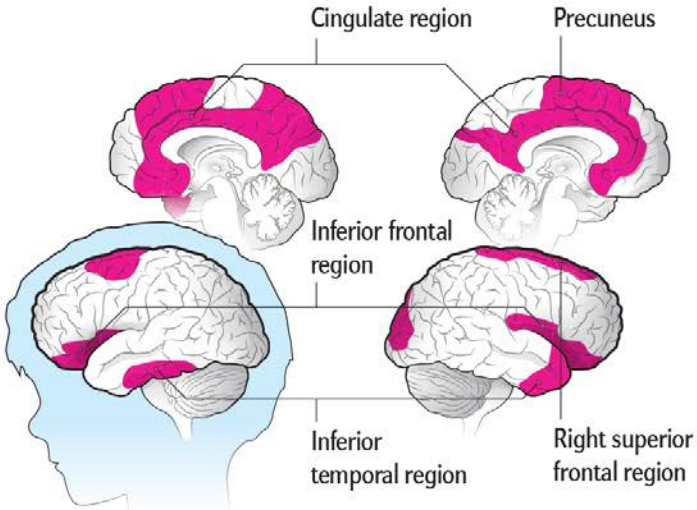
reframing

PHYSIOLOGY

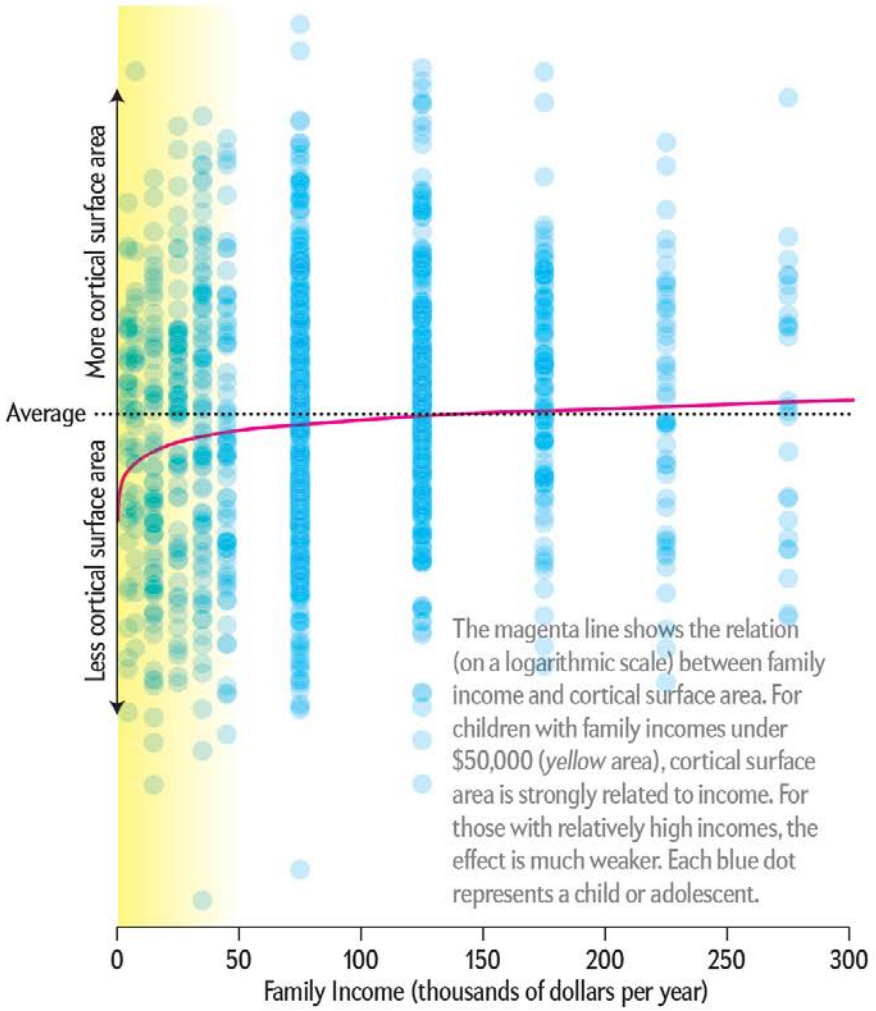
A Brain on Poverty

The travails of an impoverished upbringing reduce the surface area of some parts of the cortex more than others. The affected regions (*magenta*) participate in various forms of mental processing. The researchers demonstrated the connection by plotting collected measures of the affected regions (referred to as the cortical surface area) by socioeconomic status.

Areas of Vulnerability

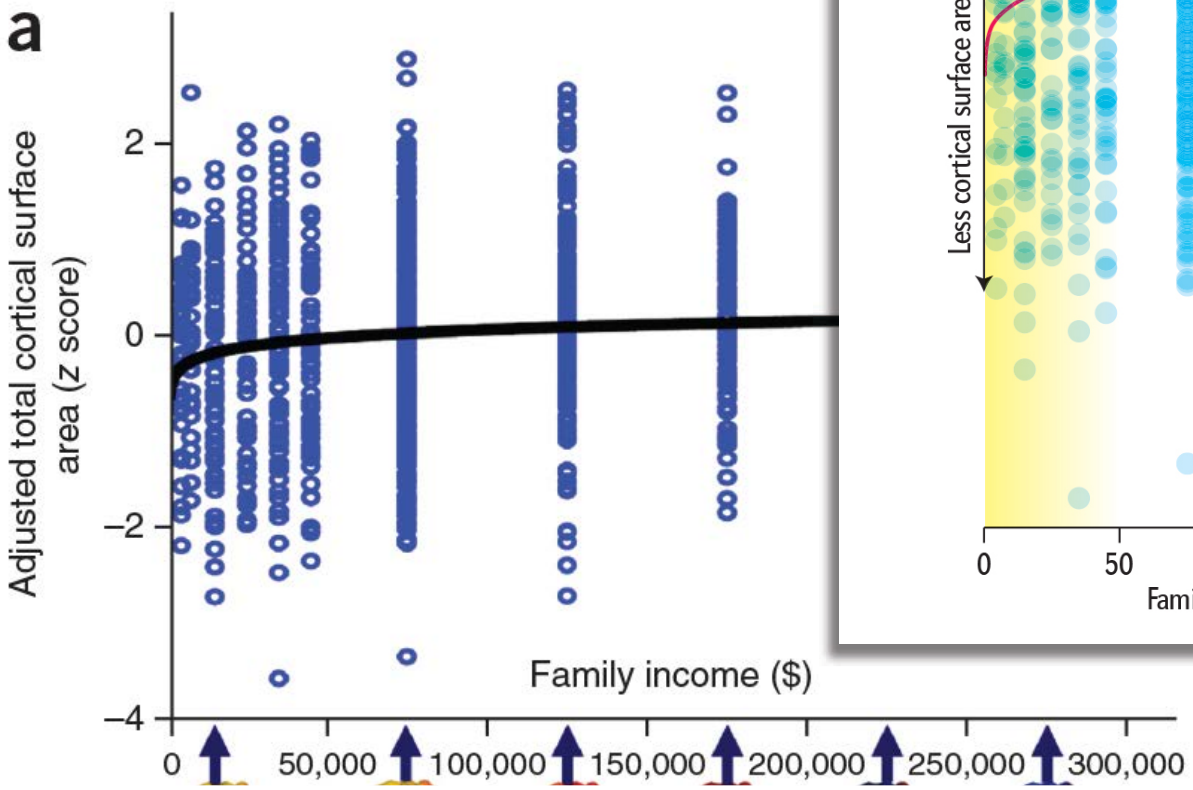


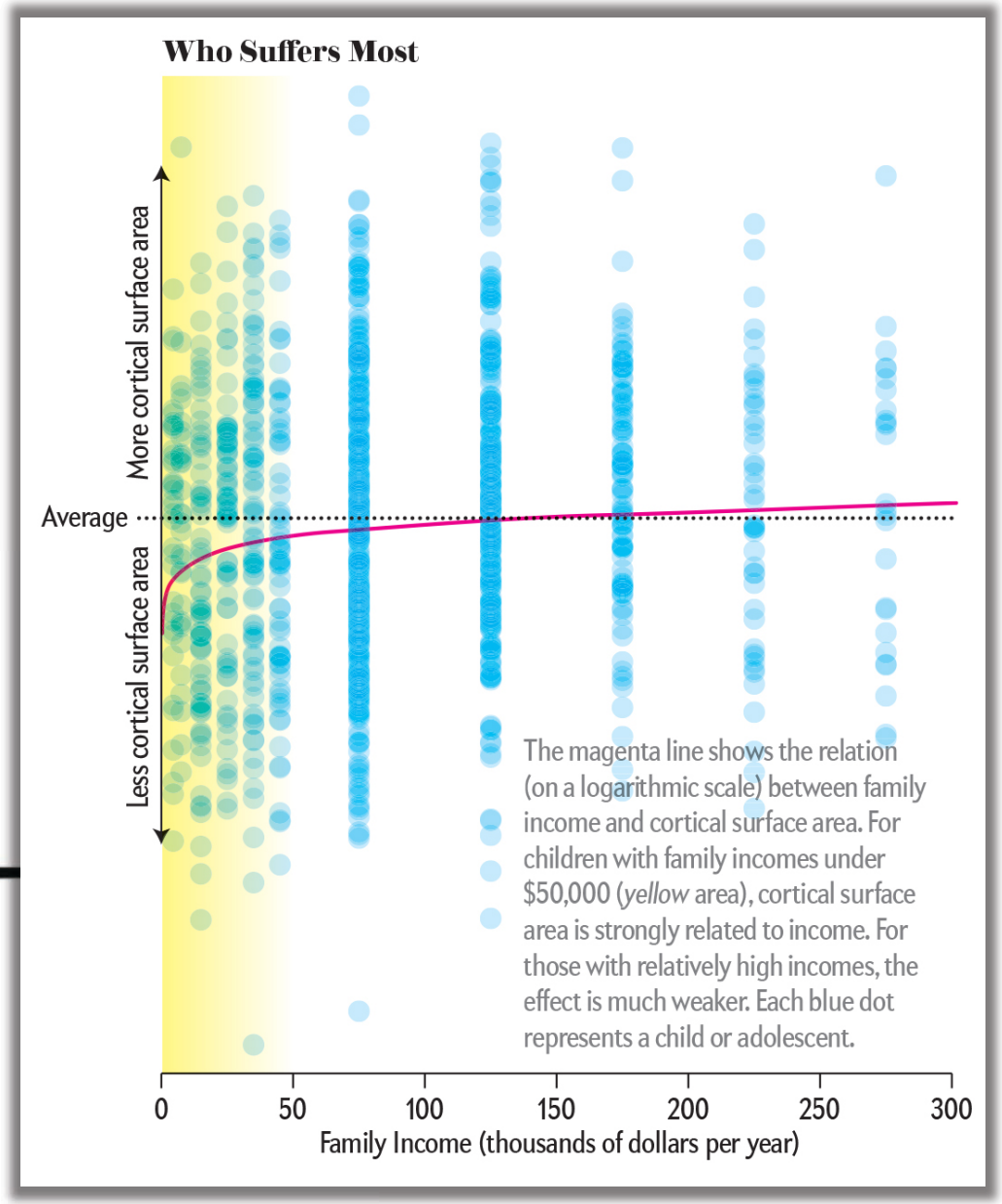
Who Suffers Most



By Tami Tolpa (brain illustrations) and Amanda Montañez (graph)

reframing


a
Adjusted total cortical surface area (z score)
2
0
−2
−4
Family income ($)
0
50,000
100,000
150,000
200,000
250,000
300,000


Who Suffers Most
More cortical surface area
Average
Less cortical surface area
The magenta line shows the relation (on a logarithmic scale) between family income and cortical surface area. For children with family incomes under $50,000 (*yellow* area), cortical surface area is strongly related to income. For those with relatively high incomes, the effect is much weaker. Each blue dot represents a child or adolescent.
0
50
100
150
200
250
300
Family Income (thousands of dollars per year)

reframing

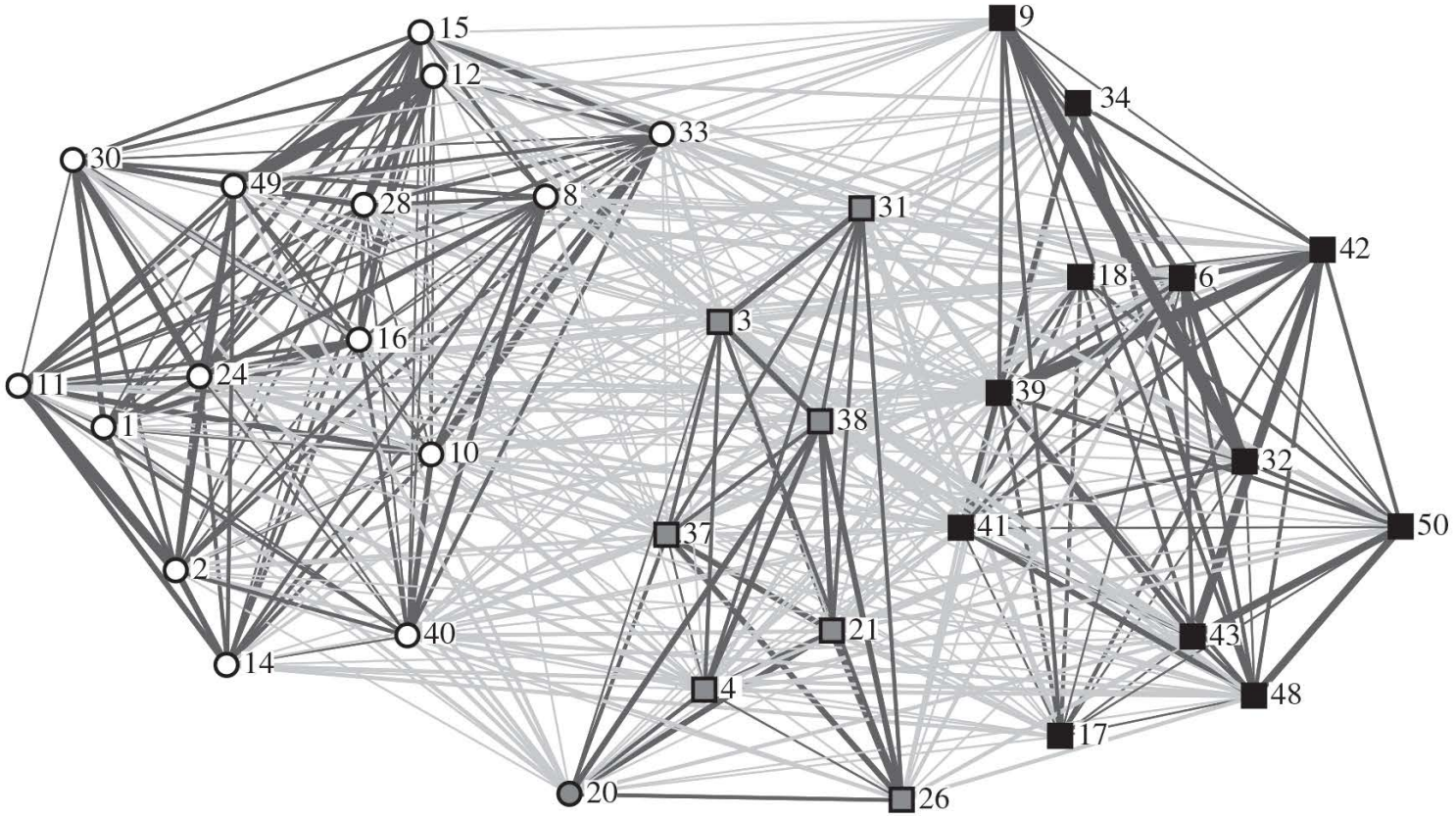


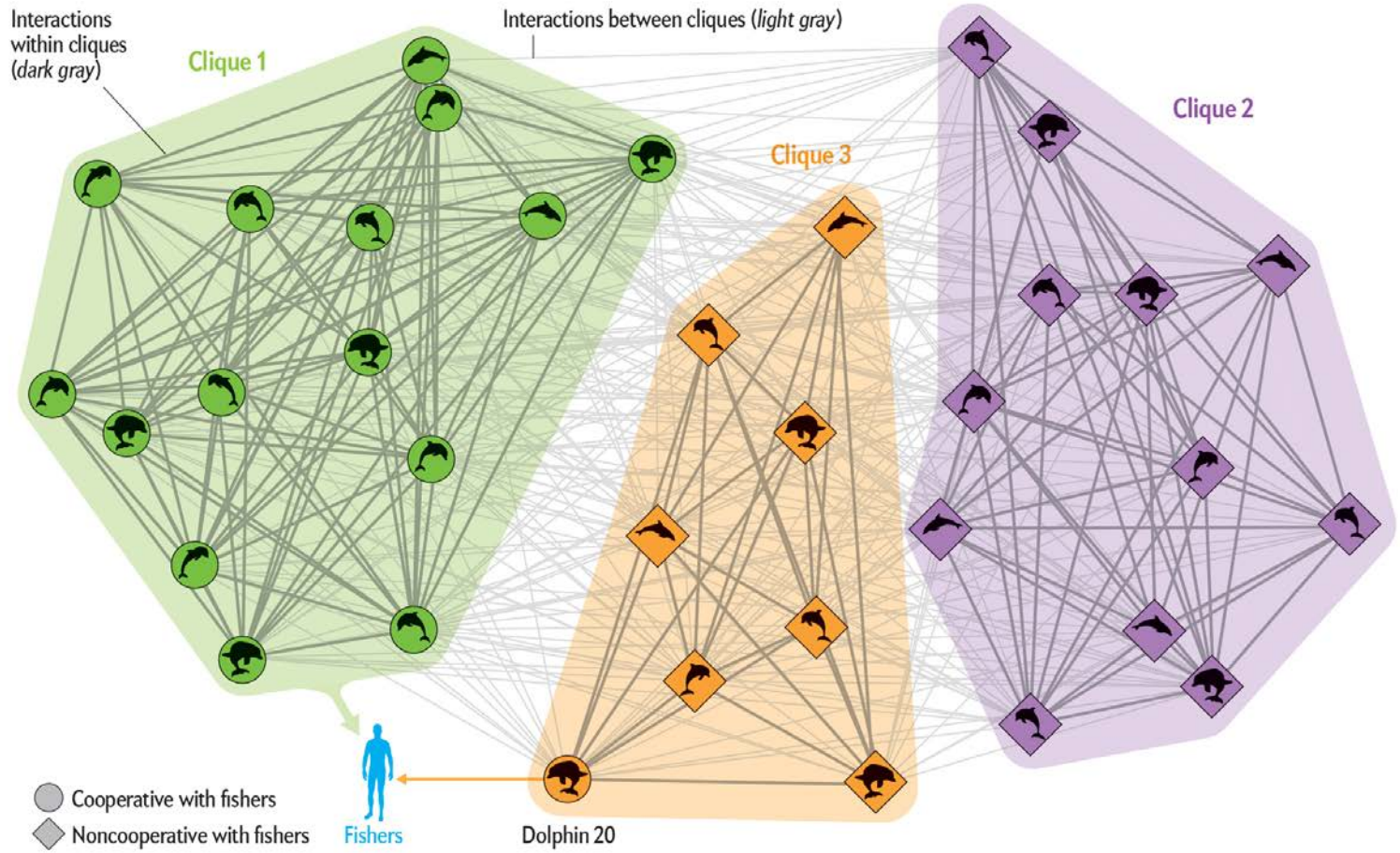
Figure 1. Social network of dolphins from Laguna with three modules defined by the foraging tactic of cooperation with artisanal fishermen. Module 1 (white nodes) comprises cooperative dolphins (circles), module 2 (grey nodes) almost entirely comprises non-cooperative dolphins (squares) (except for dolphin '20') and module 3 (black nodes) comprises only non-cooperative dolphins (squares).

By F. G. Daura-Jorge et al., "The structure of a bottlenose dolphin society is coupled to a unique foraging cooperation with artisanal fishermen."

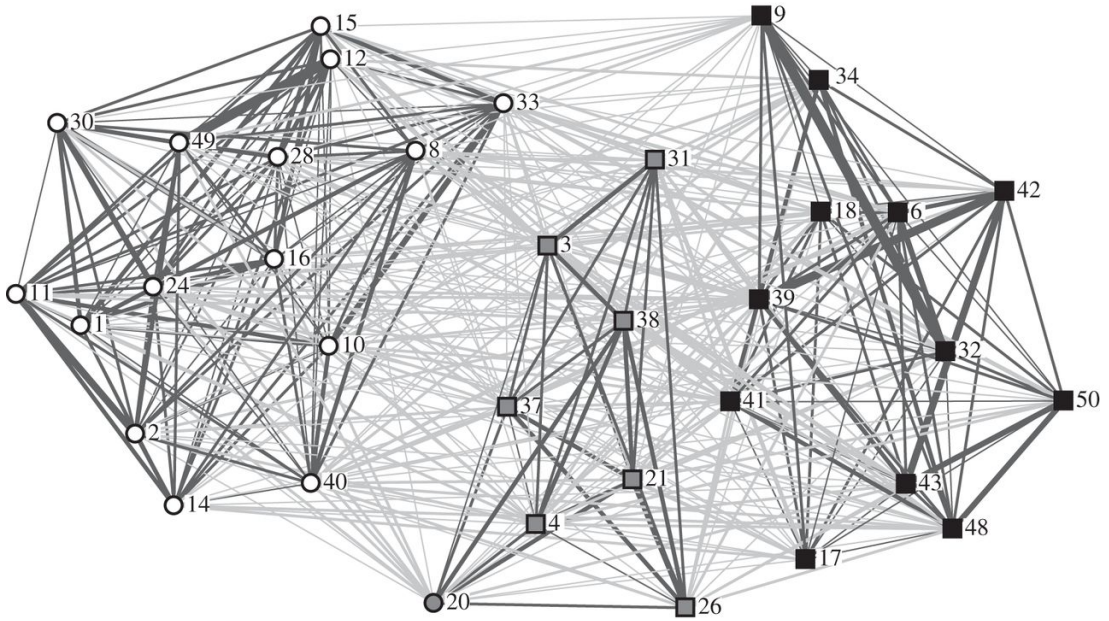
reframing

Dolphins and Humans Team Up to Bag Fish

Some—but only some—members of a community of dolphins in the Laguna region of southern Brazil formed a unique alliance with local artisanal fishers attempting to net mullet. The dolphins formed three cliques. All members of clique 1 (*green*) were cooperative (*indicated by circles*) with the fishers and highly interactive (*lines joining individuals*) with one another. Clique 2 (*purple*) members interacted less with one another than did clique 1 animals and had no contact with fishers (*indicated by squares*). Clique 3 (*orange*) dolphins were also uninterested in the fishers, with the notable exception of one member, known as dolphin "20" (*orange circle*). This individual aided the humans and liaised between its clique and the cooperative clique 1—and may yet teach clique 3 to work with humans. The collaboration of dolphins with fishers is known to enhance dolphin foraging success and human catch size.



reframing


15
12
33
30
49
28
8
9
34
31
42
18
6
3
16
24
11
1
39
38
10
32
37
41
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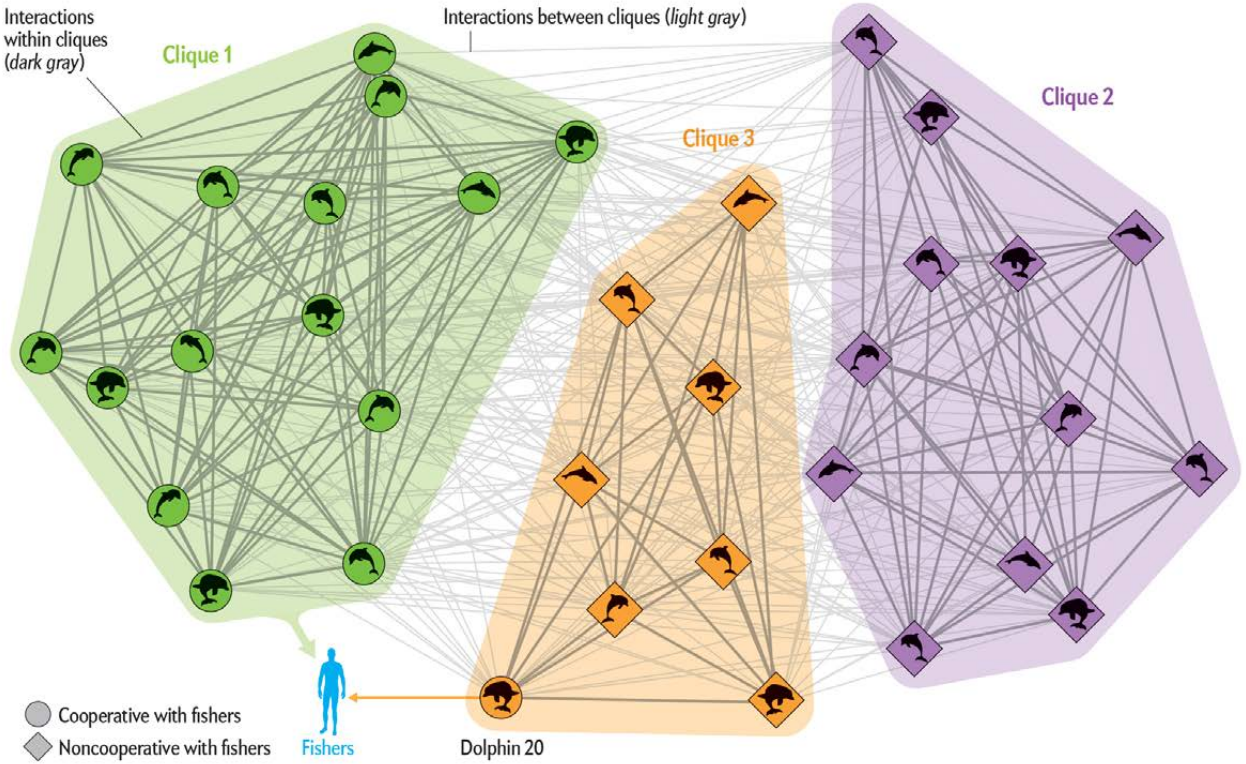
2
40
21
43
14
4
48
17
20
26


Interactions within cliques (dark gray)
Clique 1
Interactions between cliques (light gray)
Clique 2
Clique 3
Cooperative with fishers
Noncooperative with fishers
Fishers
Dolphin 20

reframing

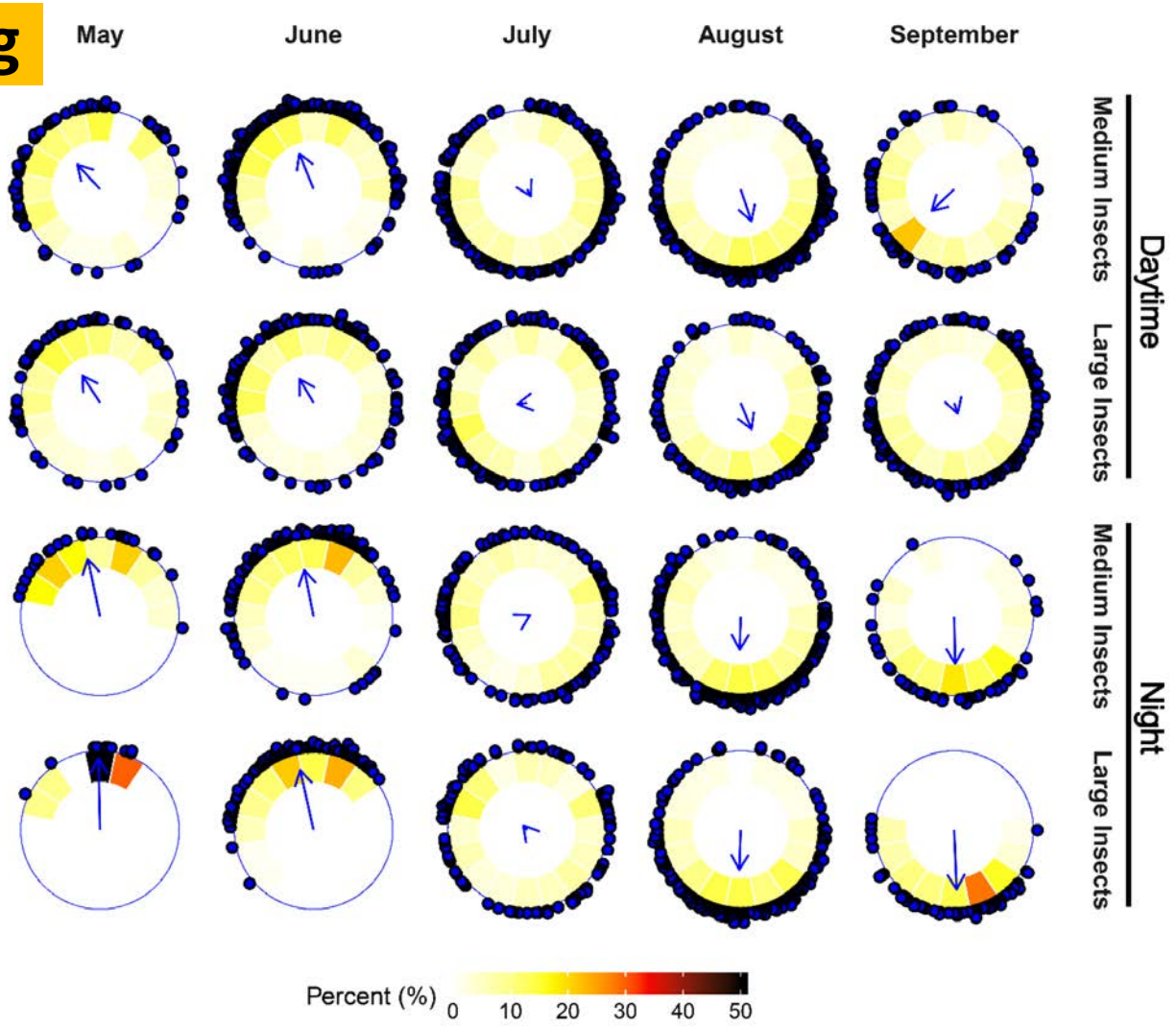


Fig. S2. Monthly track directions of larger insects migrating high above the southern United Kingdom. Migratory tracks of larger insects occurred predominantly in seasonally-beneficial directions in May and June, and in August and September, but were randomly directed in July. Small blue cir
migratio

By Gao Hu et al., "Mass seasonal bioflows of high-flying insect migrants"

reframing

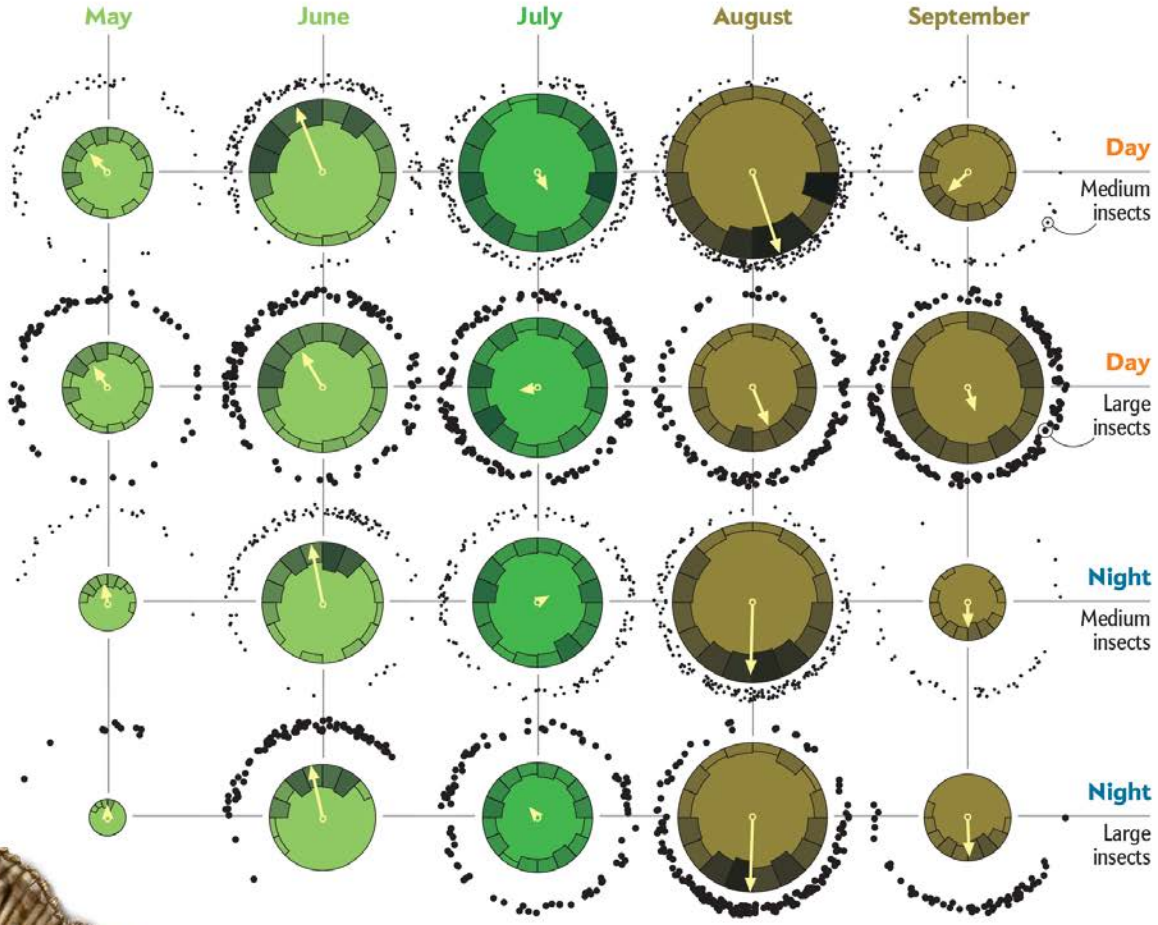
Jan Willem Tulp (charts) and Jessica Huppi (insects)

Trillions of Insects Migrate

Surprising data show many species make annual treks

Flight Patterns

Over southern Britain, the most bug movement occurs in late May and June toward the northwest and in late August and September toward the southeast (*arrows*). Many insects do not live long and struggle to survive the cold, so it may take up to six generations for one family, flying in slightly different directions from one breeding area to the next, to complete an annual migration.

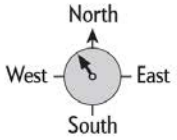


How to Read This Graphic

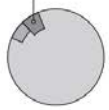
More than 70 percent of migrations occur during daytime (*top two rows*); fewer are at night (*bottom two rows*).

Migration Direction

Arrows depict the overall direction of insect flight. A longer arrow means more insects stick close to that path.



Darker, larger shapes inside a circle show the more heavily traveled directions.



Relative Number of Insects

Larger circle means more insects are airborne. Black dots indicate episodes when many insects are flying in a given direction.

reframing

Jan Willem Tulp (charts) and Jessica Huppi (insects)

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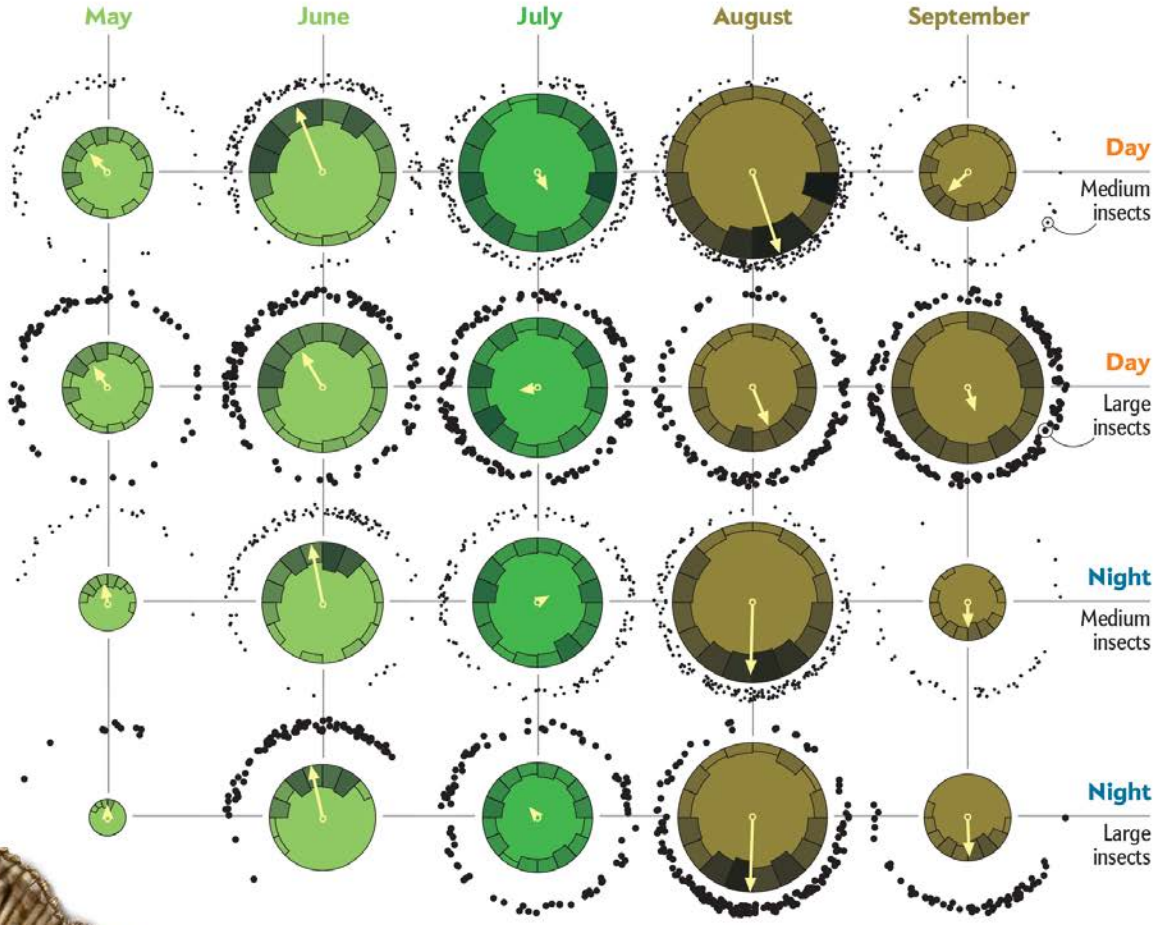

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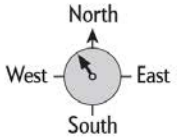

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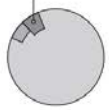

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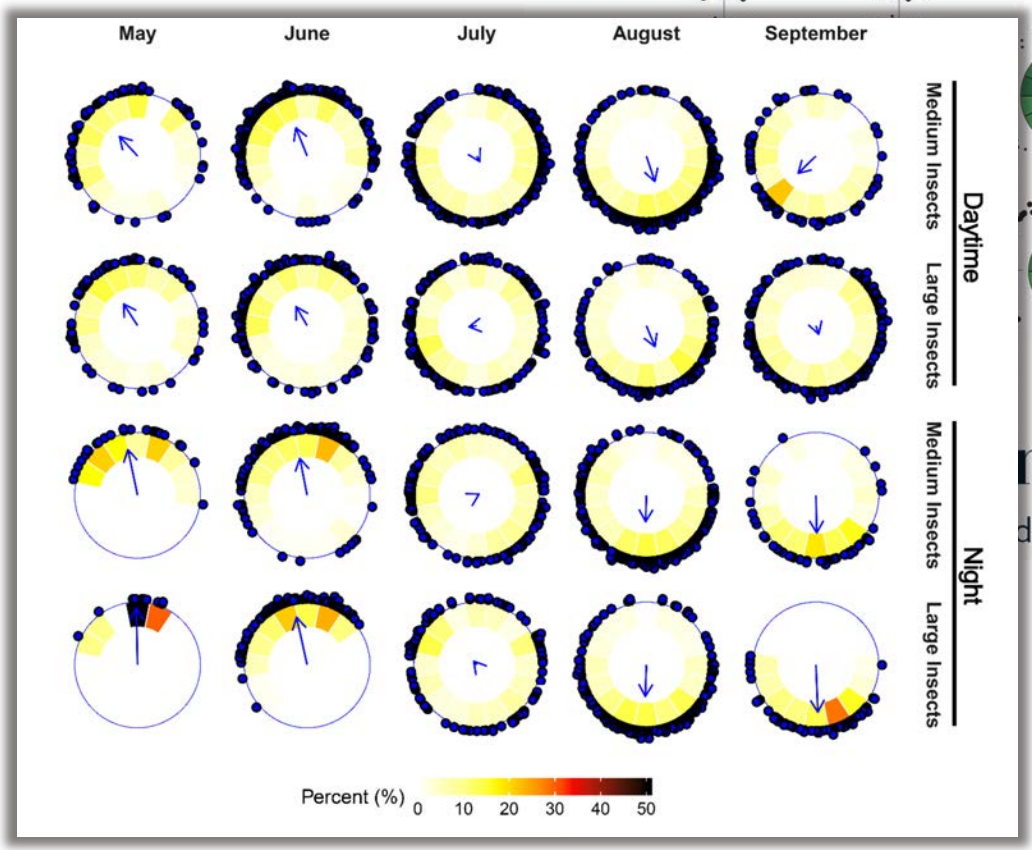
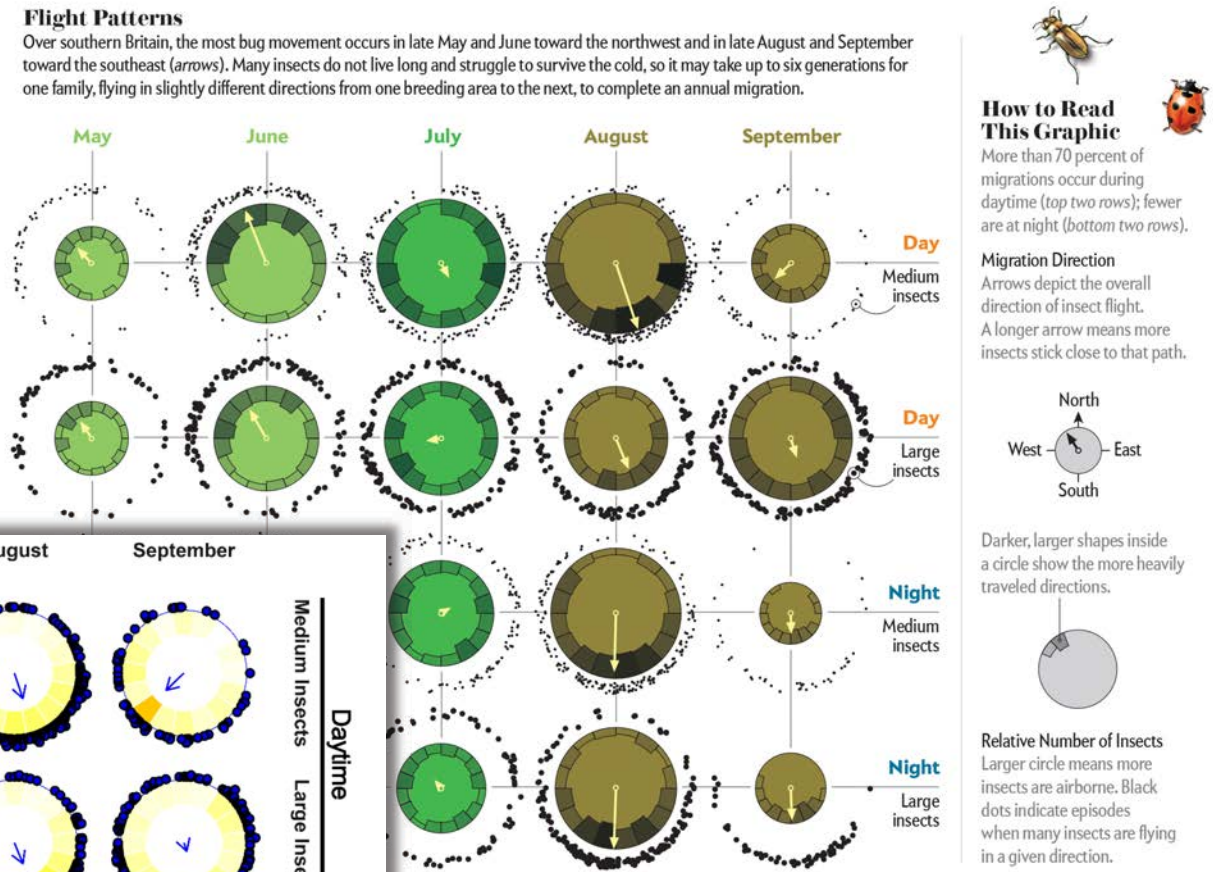
reframing





ns of Insects Migrate

data show many species make annual treks

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rework

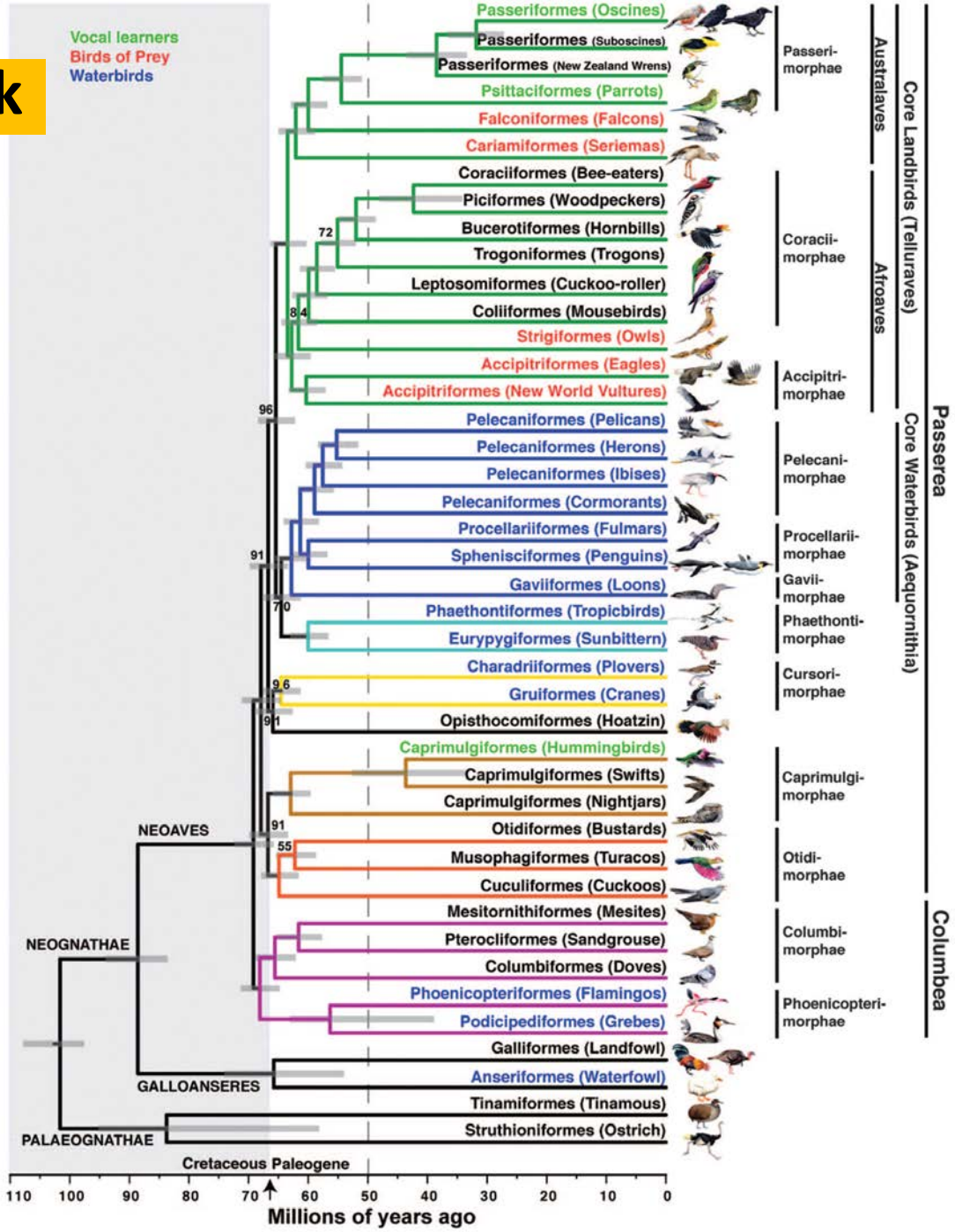


Fig. 1. Genome-scale phylogeny of birds. The dated TENT inferred with ExaML. Branch colors denote well-supported clades in this and other analyses. All BS values are 100% except where noted. Names on branches denote orders (-iformes) and English group terms (in parentheses); drawings are of the specific species sequenced (names in table S1 and fig. S1). Order names are according to (*36*, *37*) (SM6). To the right are superorder (-imorphae) and higher unranked names. In some groups, more than one species was sequenced, and these branches have been collapsed (noncollapsed version in fig. S1). Text color denotes groups of species with broadly shared traits, whether by homology or convergence. The arrow indicates the K-Pg boundary at 66 Ma, with the Cretaceous period shaded at left. The gray dashed line represents the approximate end time (50 Ma) by which nearly all neoavian orders diverged. Horizontal gray bars on each node indicate the 95% credible interval of divergence time in millions of years.

By Erich D. Jarvis et al., "Whole-genome analyses resolve early branches in the tree of life of modern birds"

rework

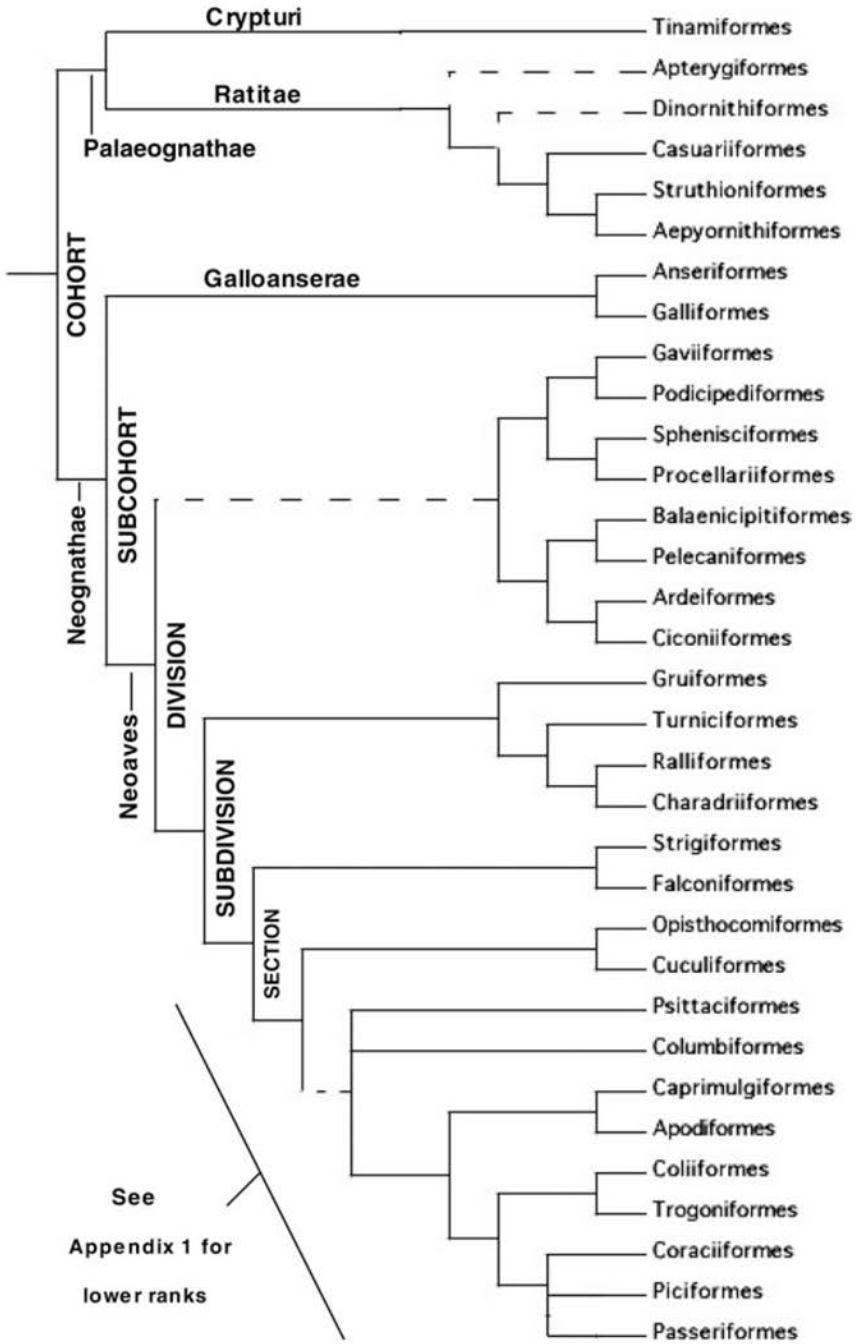
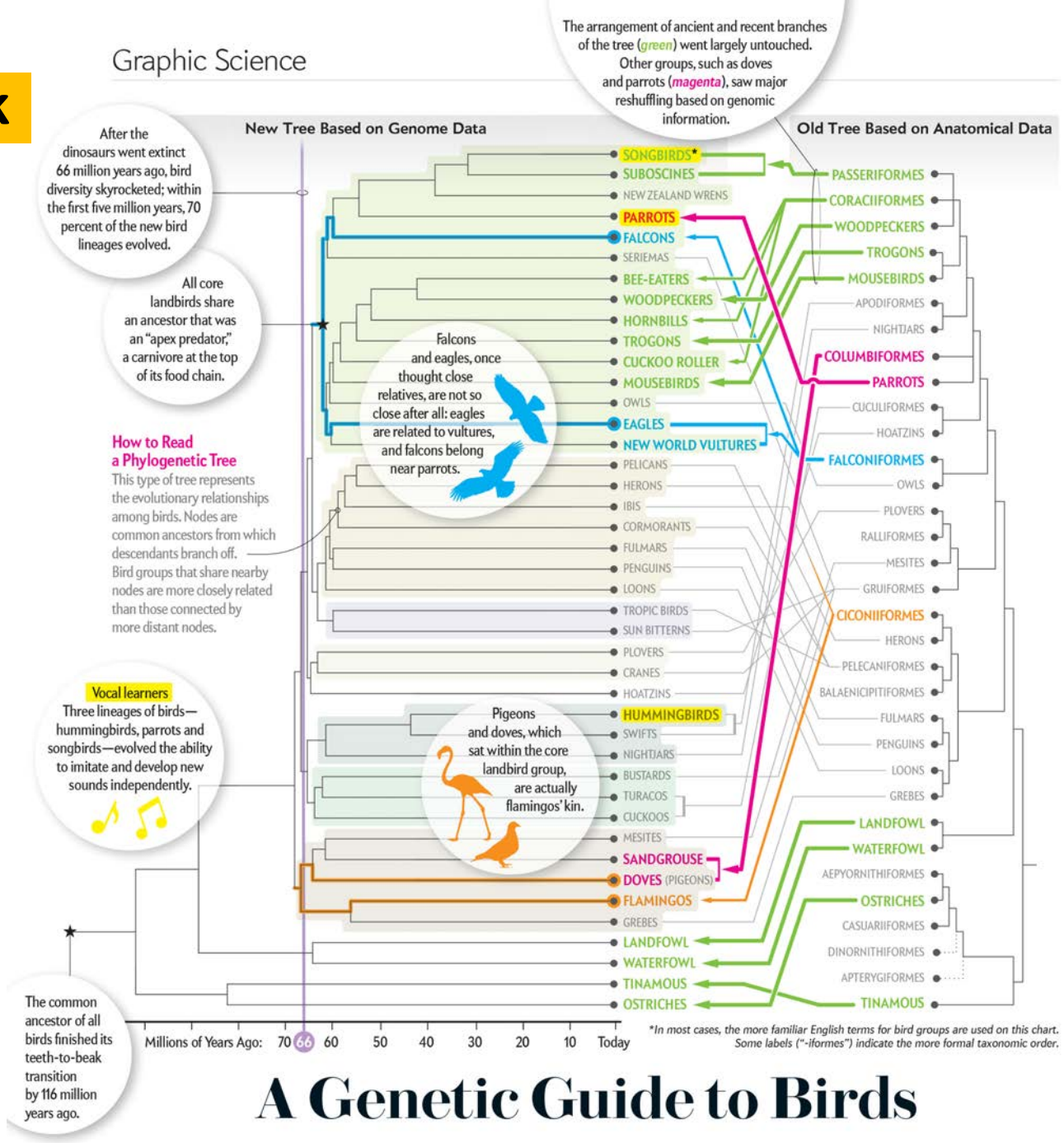


Figure 11. Simplified summary tree for uppermost, supraordinal ranks of avian classification. Dashed internodes correspond to marginally supported clades. For complete classification, see Appendix 1.

Bradley C. Livezey and Richard L. Zusi, "Higher-order phylogeny of modern birds (Theropoda, Aves: Neornithes) based on comparative anatomy. II. Analysis and discussion"

rework

Graphic Science

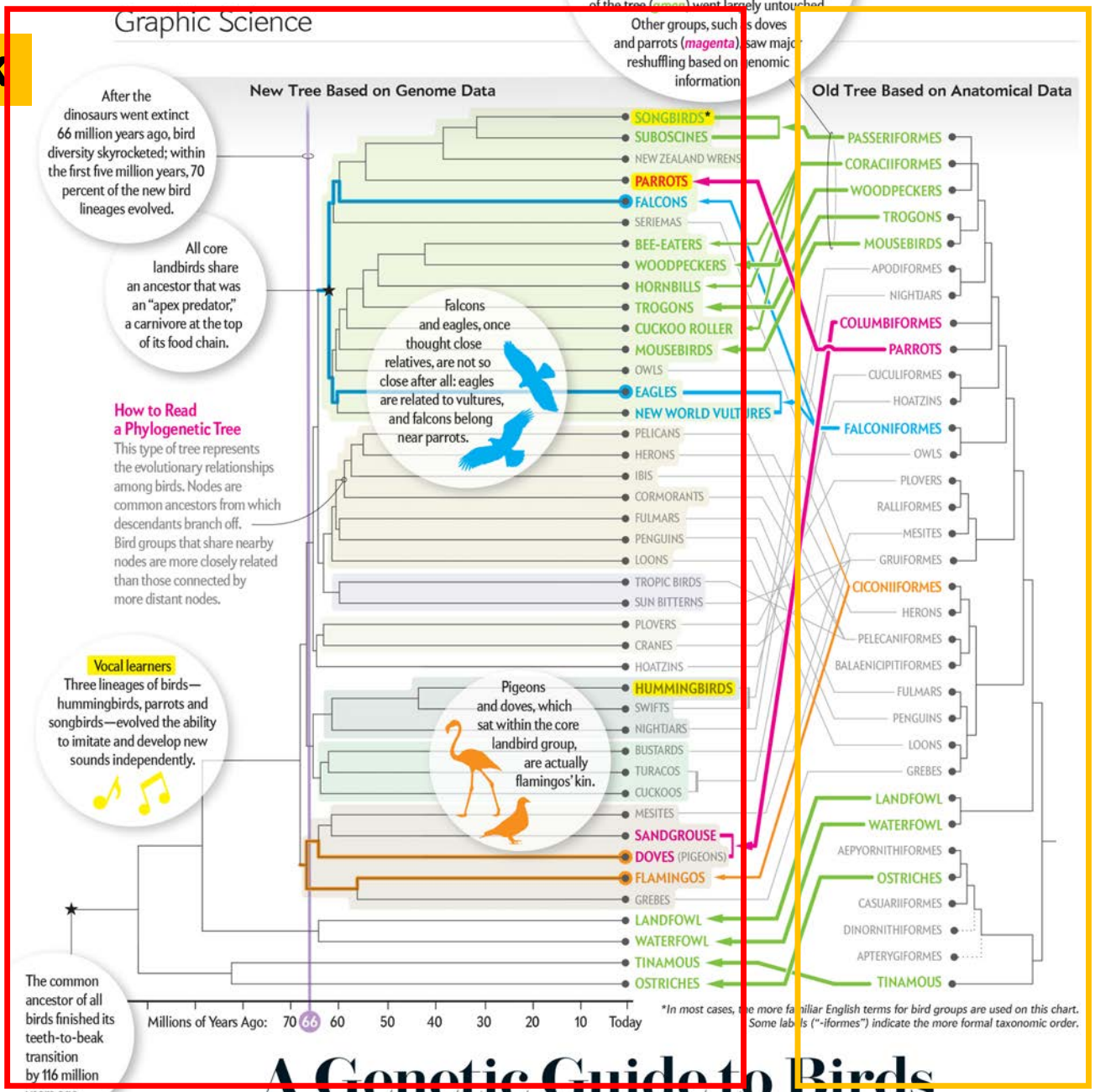


A Genetic Guide to Birds

The avian family tree gets a makeover

rework

Graphic Science



A Genetic Guide to Birds

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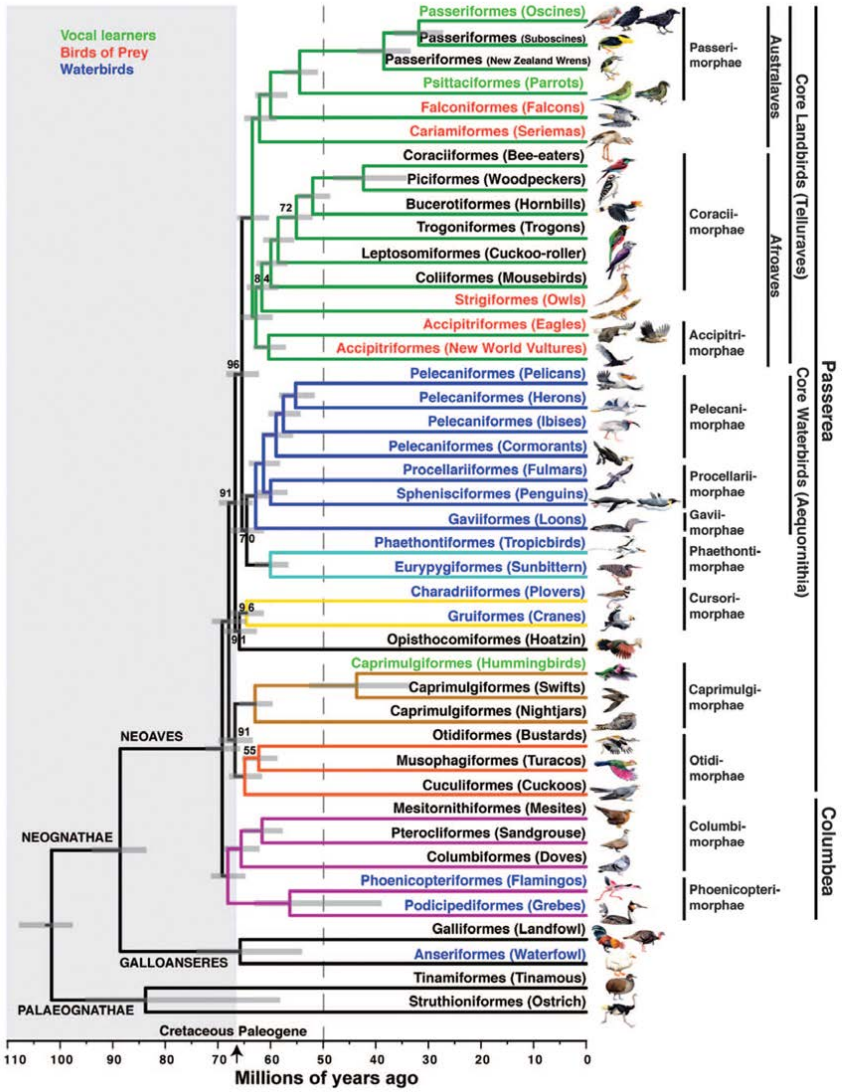


Graphic Science

The arrangement of ancient and recent branches of the tree (*green*) went largely untouched. Other groups, such as doves and parrots (*magenta*), saw major reshuffling based on genomic information.

After the dinosaurs went extinct 66 million years ago, bird diversity skyrocketed; within the first five million years, 70 percent of the new bird lineages evolved.

All core landbirds share an ancestor that was an "apex predator," a carnivore at the top of its food chain.

Falcons and eagles, once thought close relatives, are not so close after all: eagles are related to vultures, and falcons belong near parrots.

How to Read a Phylogenetic Tree

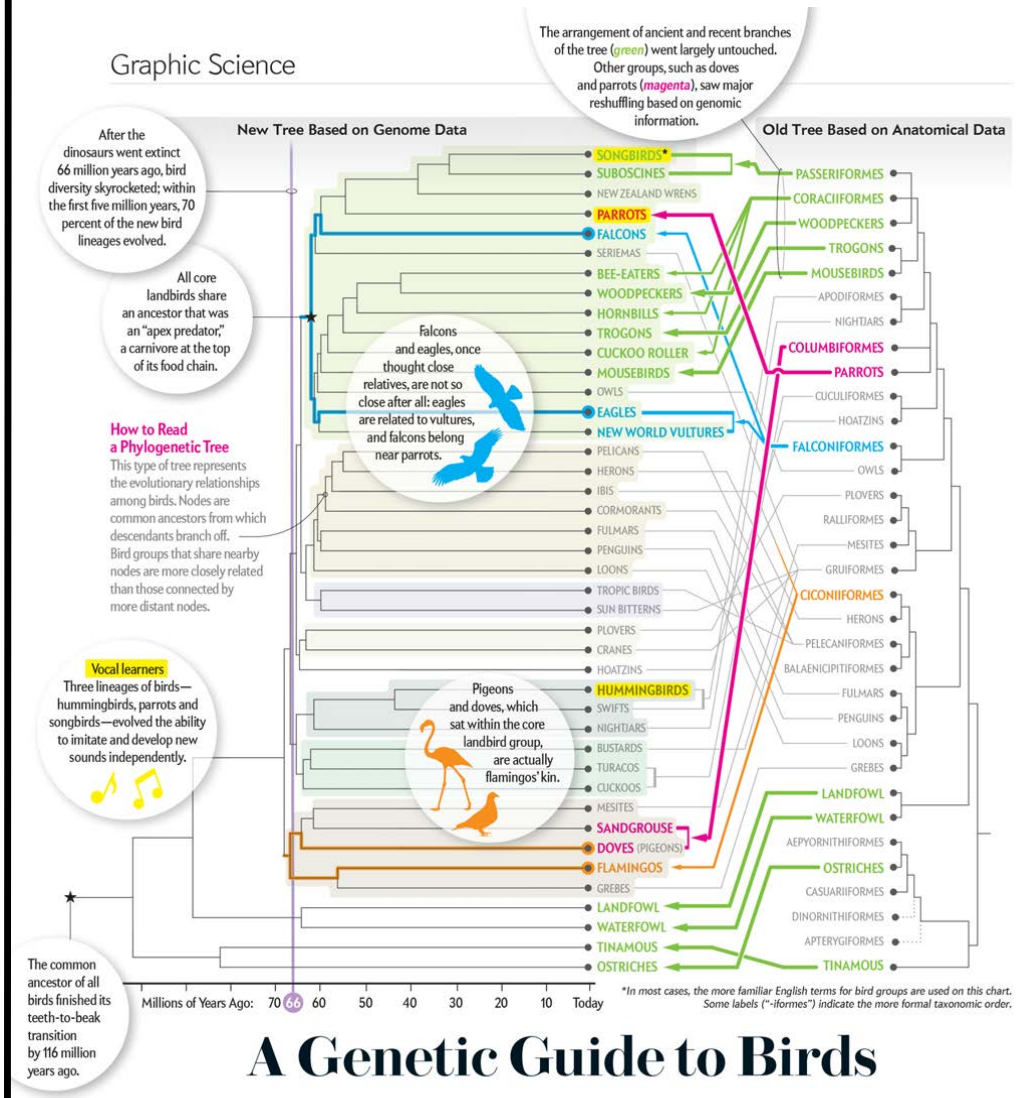
This type of tree represents the evolutionary relationships among birds. Nodes are common ancestors from which descendants branch off. Bird groups that share nearby nodes are more closely related than those connected by more distant nodes.

Vocal learners

Three lineages of birds—hummingbirds, parrots and songbirds—evolved the ability to imitate and develop new sounds independently.

Pigeons and doves, which sat within the core landbird group, are actually flamingos' kin.

The common ancestor of all birds finished its teeth-to-beak transition by 116 million years ago.



*In most cases, the more familiar English terms for bird groups are used on this chart. Some labels ("-iformes") indicate the more formal taxonomic order.

A Genetic Guide to Birds

The avian family tree gets a makeover

rework

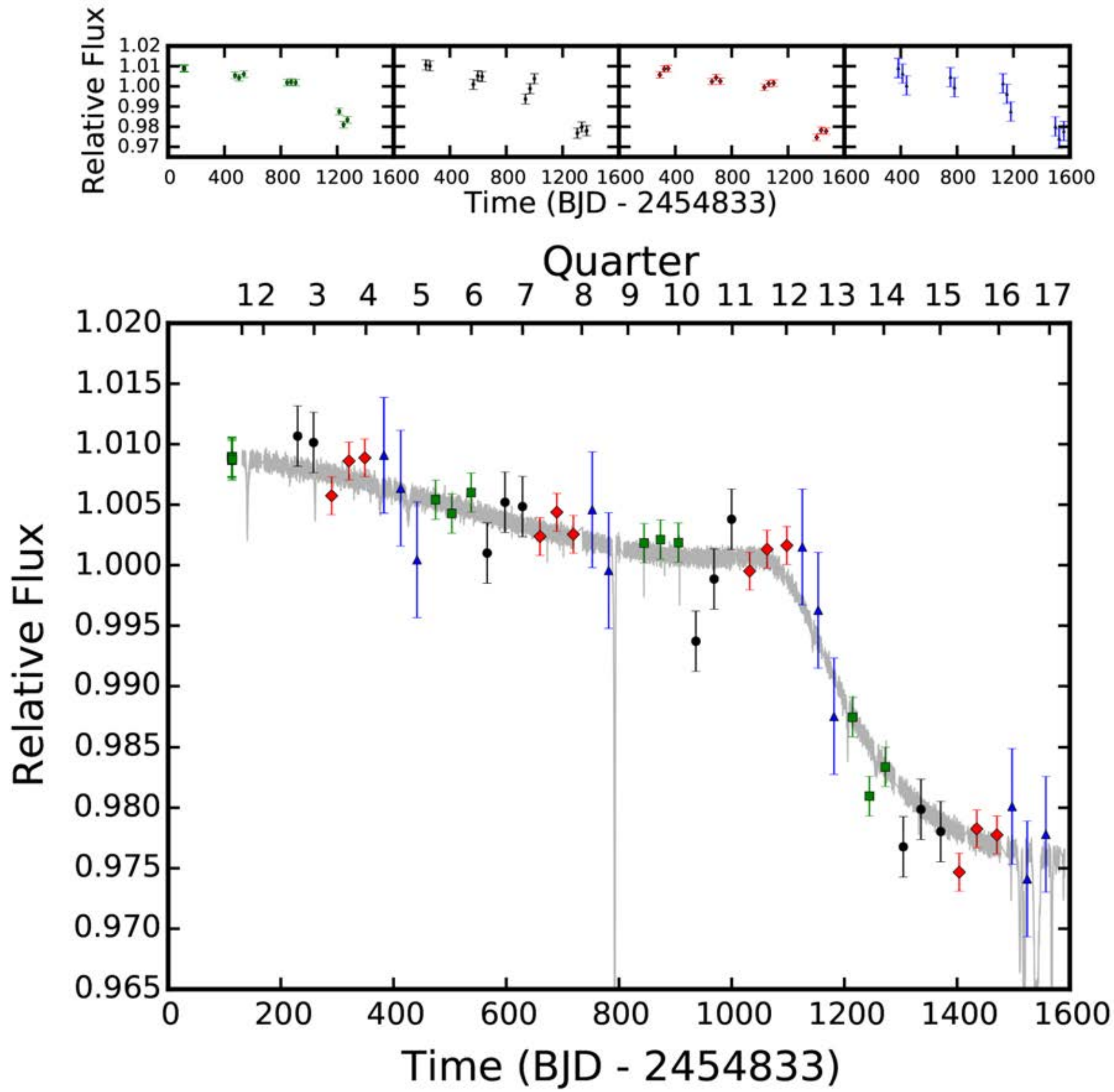


FIG. 3.— Photometry of KIC 8462852 as measured from the FFI data. The four colors and shapes (green squares, black circles, red diamonds, and blue triangles) represent measurements from the four separate channels the starlight reaches as the telescope rolls. The four subpanels show the flux measurements from each particular detector individually. The main figure combines all observations together. In the process of creating the fit, we allow a vertical offset between the data from each individual quarter to account for changes in the flat field with detector orientation. For the purposes of this figure, we plot the maximum likelihood values; the blue, green, and black points
have been shifted upward by 0.6%, 0.1%, and 0.2%, respectiv
level. In all four channels, the photometry is consistent with
a rapid decrease in flux of ≈ 2.5%. The light gray curve rep
photometry created by fitting a spline to the FFI photometry
are visible but narrow relative to the cadence of FFI observati
in the online version of the journal.

By Benjamin T. Montet and Joshua D. Simon, “KIC 8462852 Faded Throughout the Kepler Mission”

rework

OBSERVATIONS

Enigmatic Light Patterns

To astronomers, there is usually no mystery behind a star fading in the sky. Starspots as well as the shadows of planets or debris disks routinely dim the otherwise steady light from mature stars. But none of these explanations seems to apply for one mercurial middle-aged sun known as KIC 8462852—also called Boyajian's star.

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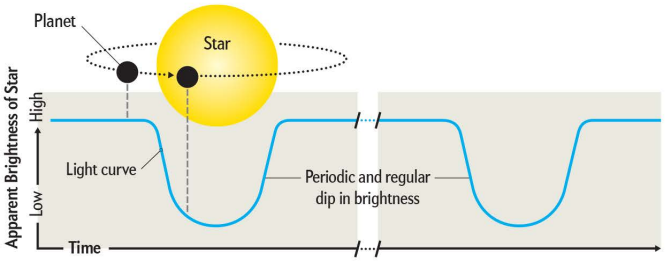

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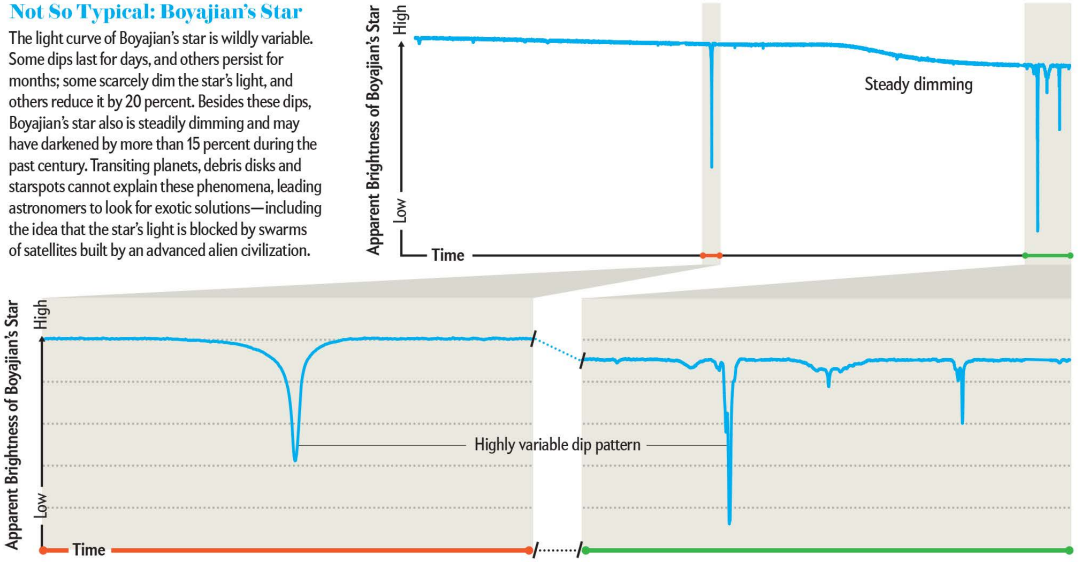
The light curve of Boyajian's star is wildly variable. Some dips last for days, and others persist for months; some scarcely dim the star's light, and others reduce it by 20 percent. Besides these dips, Boyajian's star also is steadily dimming and may have darkened by more than 15 percent during the past century. Transiting planets, debris disks and starspots cannot explain these phenomena, leading astronomers to look for exotic solutions—including the idea that the star's light is blocked by swarms of satellites built by an advanced alien civilization.



By Tiffany Farrant-Gonzalez, In "Strange News From Another Star," By Kimberly Cartier and Jason T. Wright

rework

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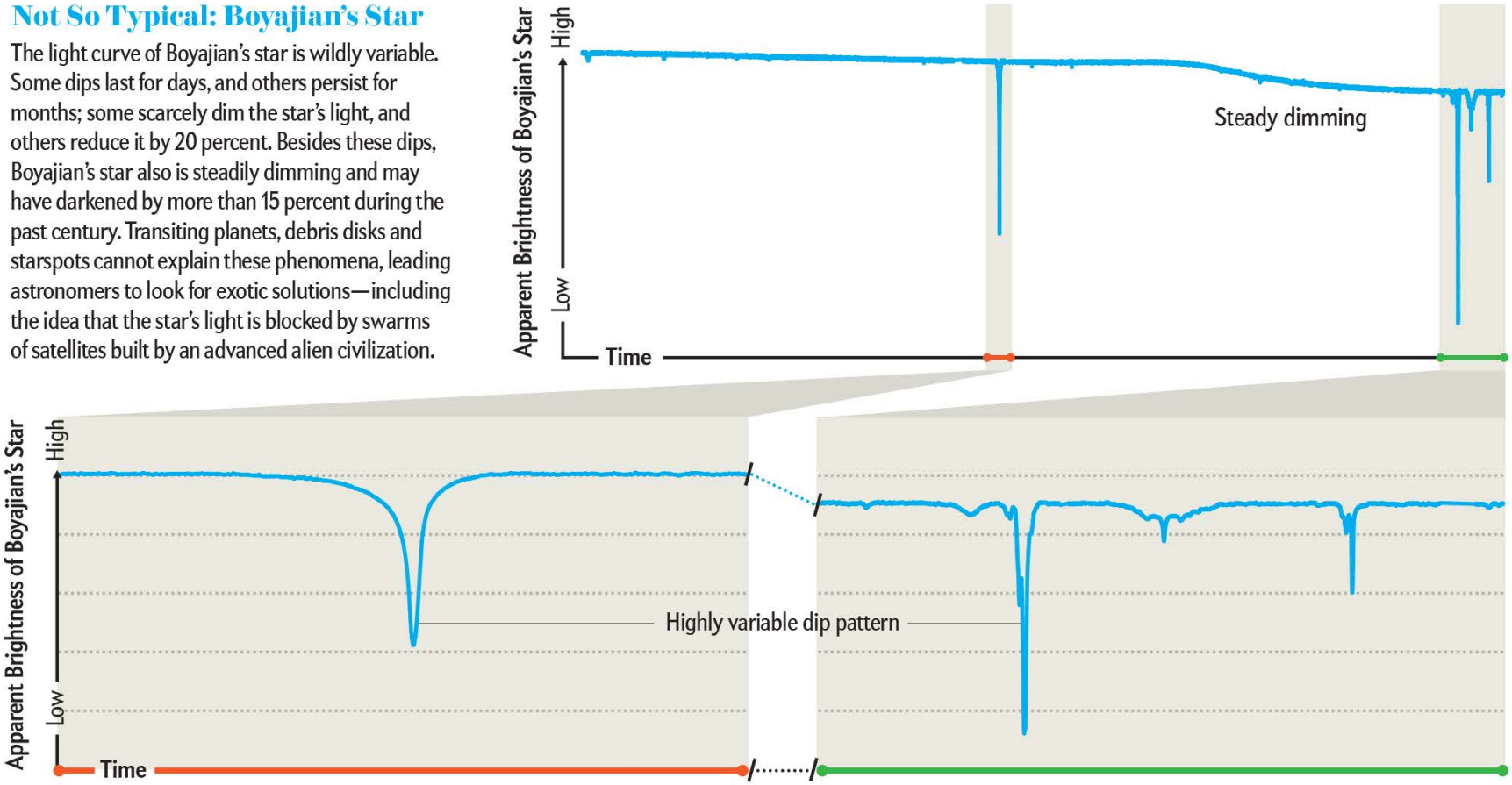

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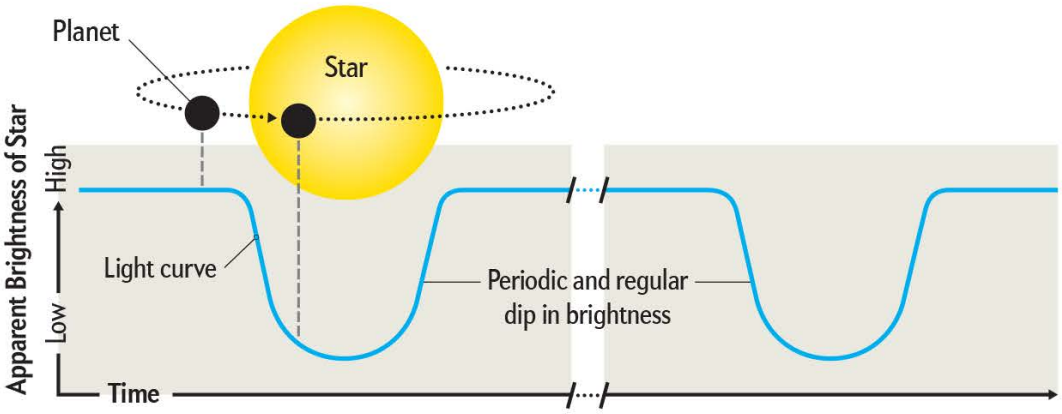

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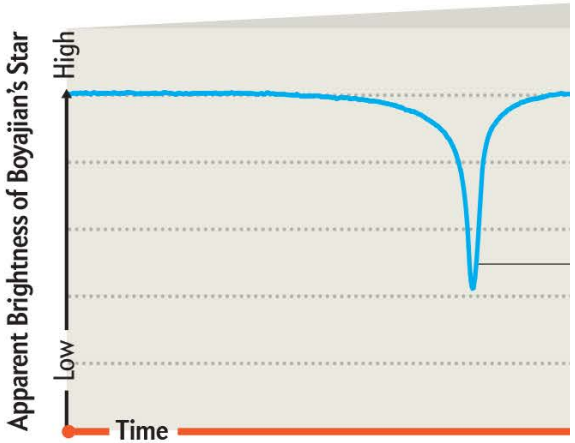

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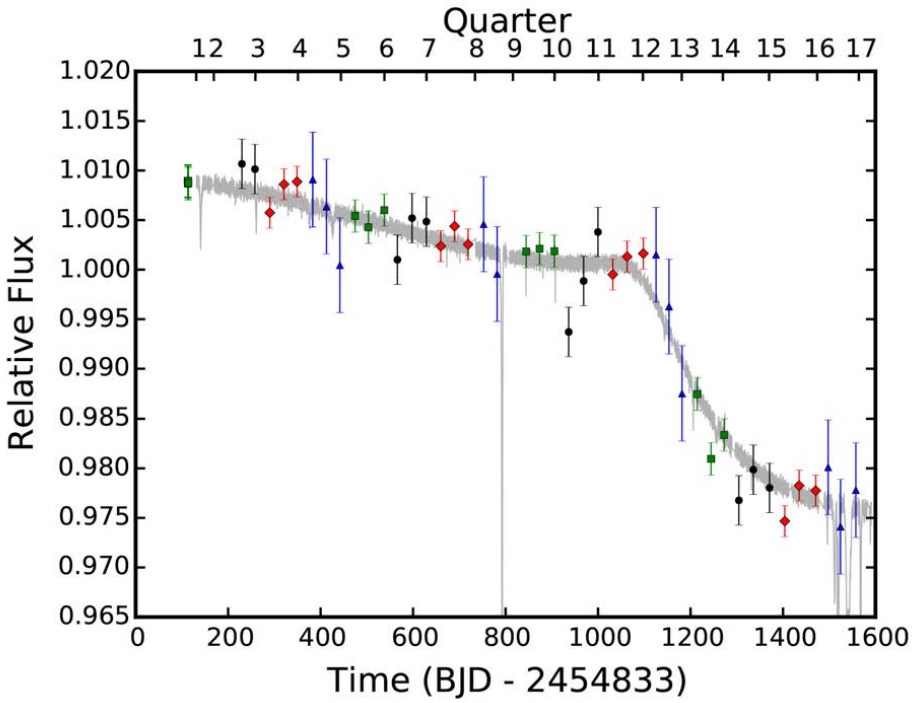
rework



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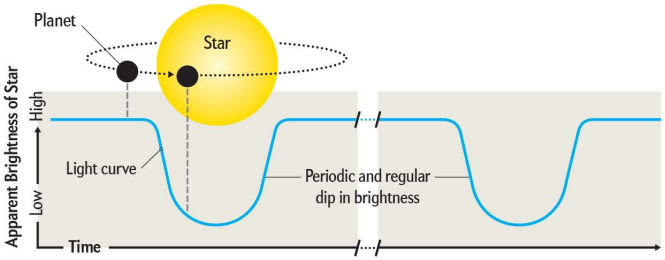

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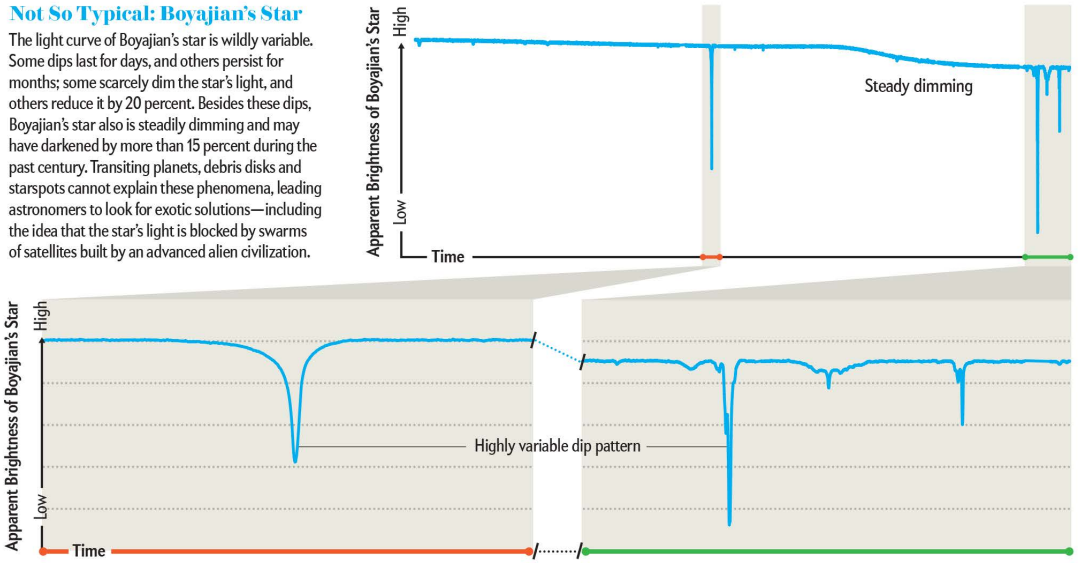
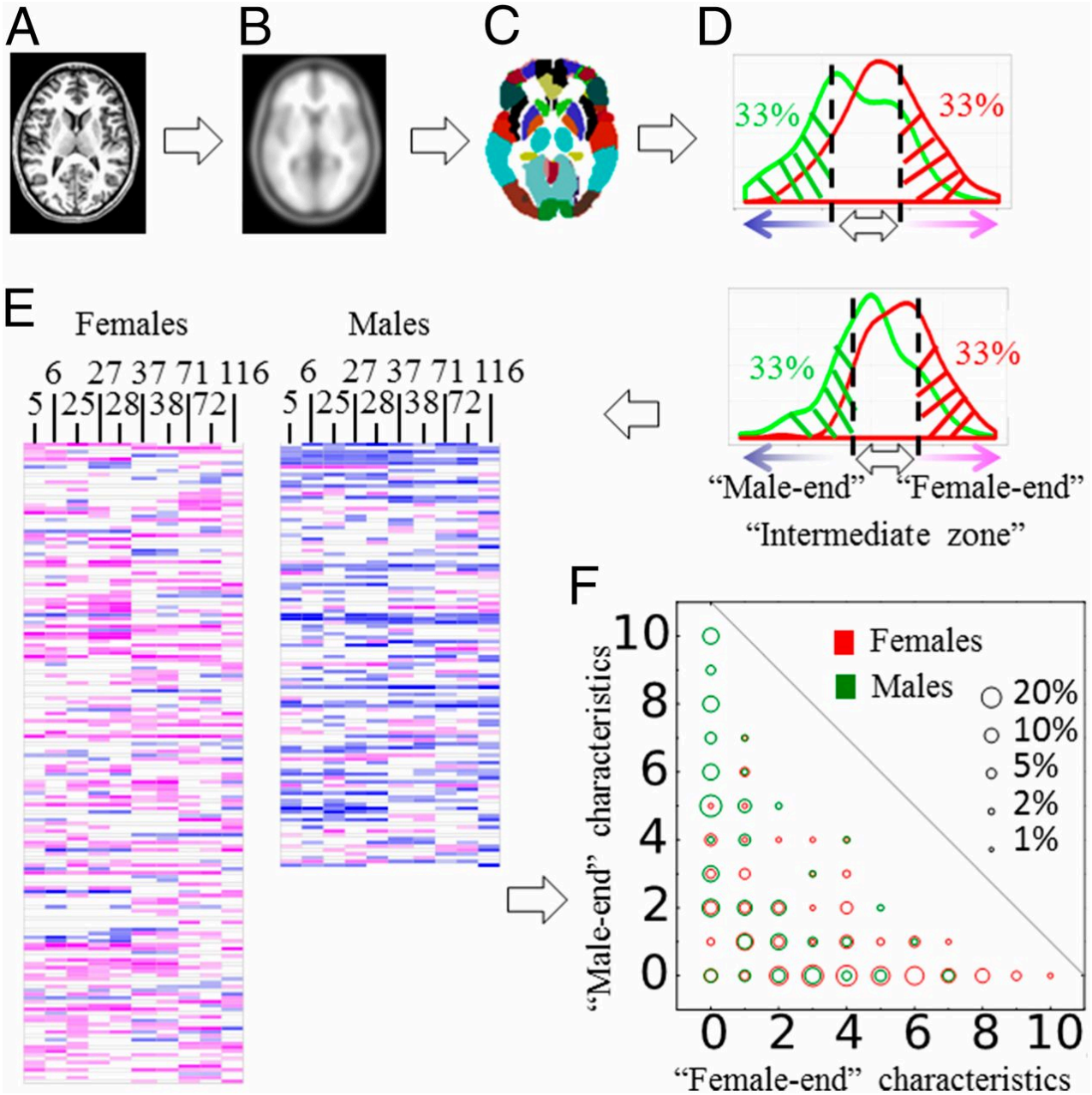


rework



By Daphna Joel et al., "Sex beyond the genitalia: The human brain mosaic"

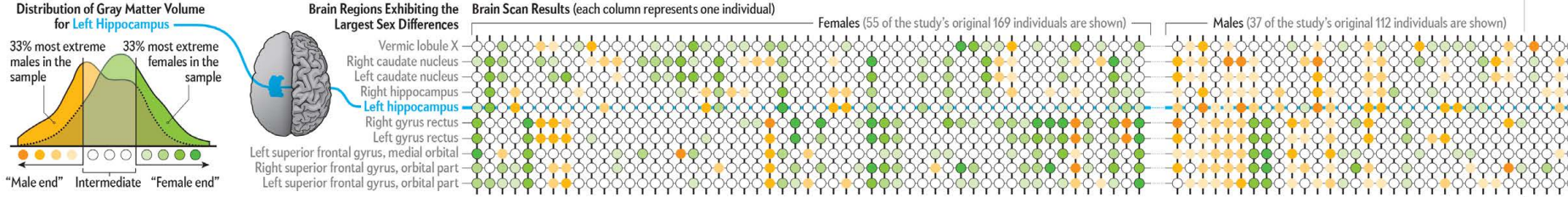
rework

The Mosaic Brain

Sex differences found in the human brain have led to the perception that brains are either male or female. A study by Daphna Joel of Tel Aviv University and her colleagues tells a different story. Joel's research found that the typical brain is a "mosaic," combining some features more common in males and some that appear more frequently in females, pointing to the conclusion that human brains do not belong to two distinct types categorized by sex.

NEURAL SIGNATURES OF THE SEXES

In her 2015 study, Joel examined MRIs of more than 1,400 brains and found significant overlap among the areas of neural tissue (gray matter) showing the largest differences between males and females. In brain scans of the left hippocampus, most females and males had a volume of gray matter toward the middle on a continuum of "maleness" or "femaleness" (*graph at left and white dots from a subset of the study data below*). In addition, about a third of individuals had features at both the maleness and femaleness extremes, shown below as green (femaleness) and orange (maleness) in dots of varying shades. Only 2.4 percent, meanwhile, had just features from one extreme. The trend was also reflected in the other data sets used by the researchers, and the findings were corroborated by a subsequent analysis of personality traits, attitudes and behaviors.



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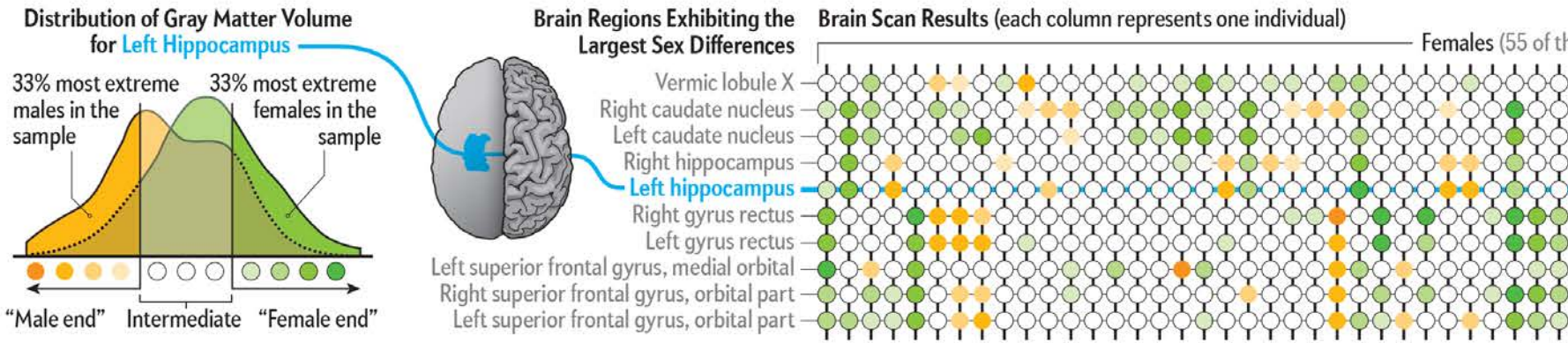
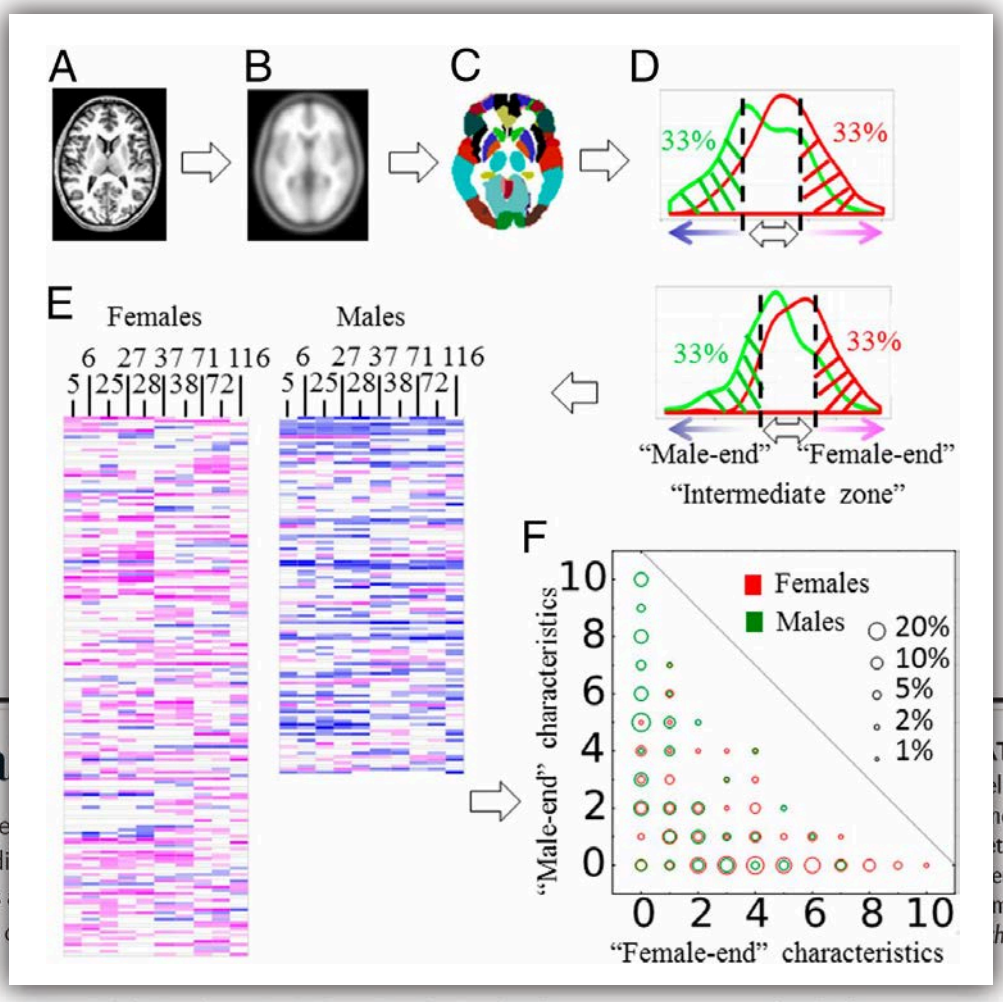


rework



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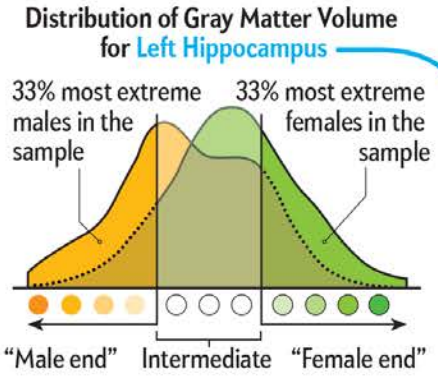

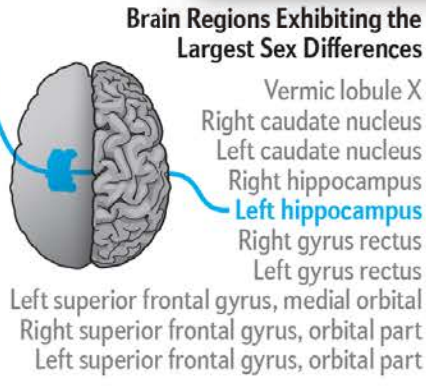

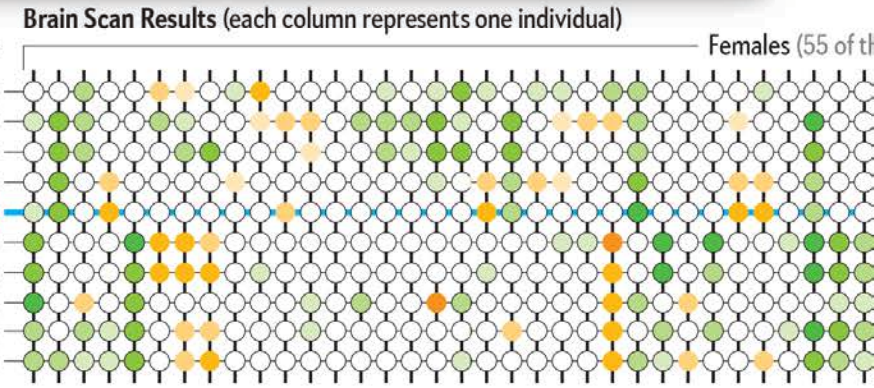

customizing for a different [context]

- simple edits / reframing
  - shake out label jargon
  - add framing text (focus attention)
  - add annotations
- moderate reworks
  - add audience-specific context
  - combine or divide elements
- custom solutions
  - create a new visualization from scratch

custom

Table 2 | Author position on rosiglitazone safety and financial conflicts of interest

	Risk of myocardial infarction with rosiglitazone				Use of rosiglitazone			
	Favourable (n=31)	Neutral (n=84)	Unfavourable (n=65)	Rate ratio (95% CI)*	Favourable (n=26)	Neutral (n=116)	Unfavourable (n=38)	Rate ratio (95% CI)*
Any manufacturer	29 (94)	32 (38)	18 (28)	3.38 (2.26 to 5.06)	23 (88)	46 (40)	10 (26)	3.36 (1.94 to 5.83)
Rosiglitazone manufacturer†	27 (87)	25 (24)	13 (20)	4.29 (2.63 to 7.02)	21 (81)	30 (26)	9 (24)	3.60 (2.00 to 6.48)
Pioglitazone manufacturer†	20 (65)	31 (30)	14 (22)	3.96 (2.45 to 6.39)	19 (73)	30 (26)	10 (26)	3.28 (1.88 to 5.73)
None	2 (6)	52 (62)	47 (72)	—	3 (12)	70 (60)	28 (74)	—

Values are numbers (percentages) unless otherwise indicated.
*Comparing favourable versus unfavourable views.
†Categories not mutually exclusive.

By Amy T Wang et al., "Association between industry affiliation and position on cardiovascular risk with rosiglitazone: cross sectional systematic review"

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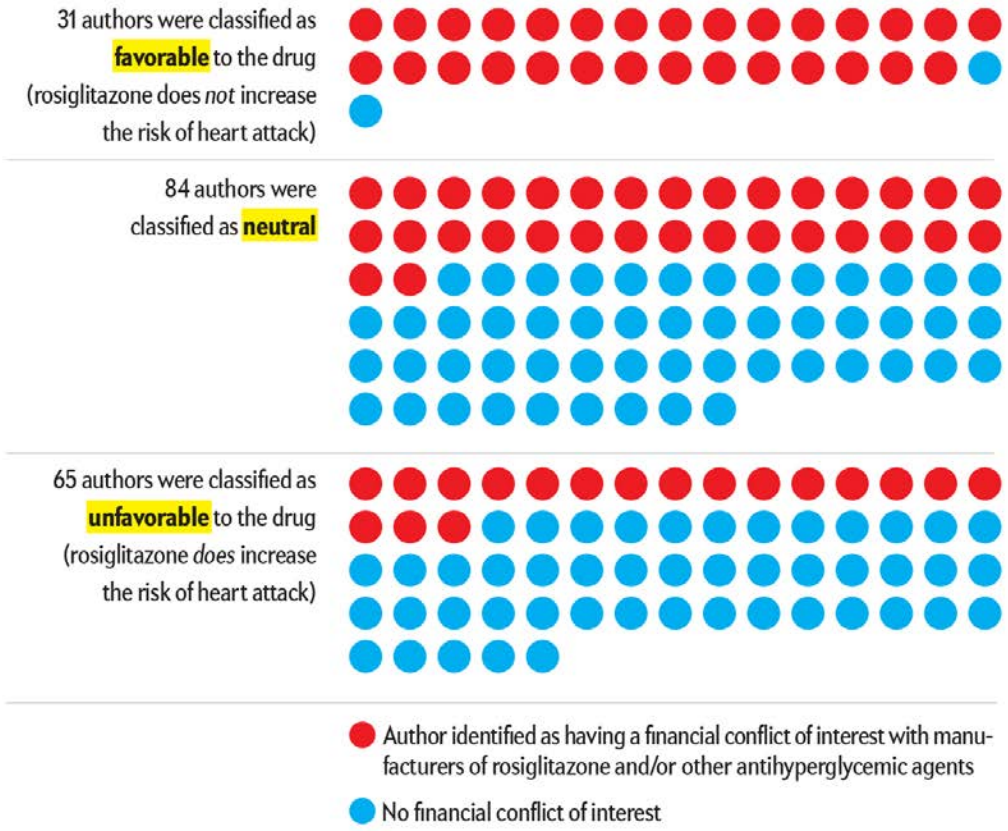
Case Study: Conflicting Interests

To what degree do financial entanglements influence the judgment of scientists? To find out, researchers at the Mayo Clinic in Rochester, Minn., focused on the diabetes drug rosiglitazone, which a meta-analysis had linked to increased risk of heart attacks. They examined articles that cited the meta-analysis or a subsequently released report on a large trial of rosiglitazone and found that scientists with a conflict of interest were more likely to view the drug favorably. "There was a clear and strong link between the orientation of authors' expressed views on the rosiglitazone controversy and their financial conflicts of interest with pharmaceutical companies," the report determined.



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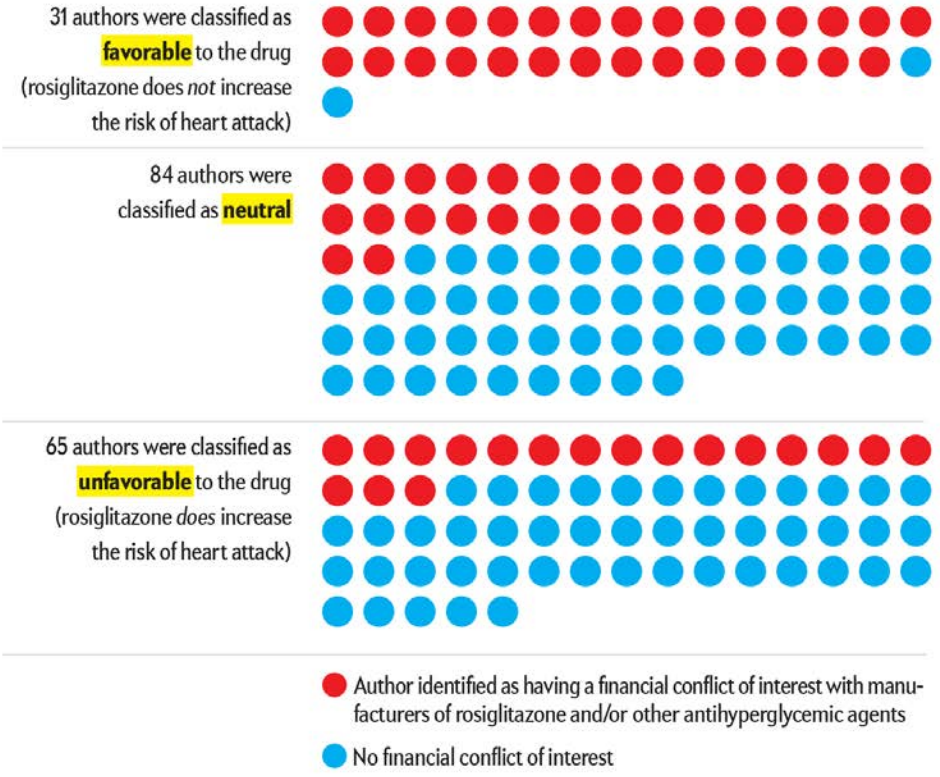


custom

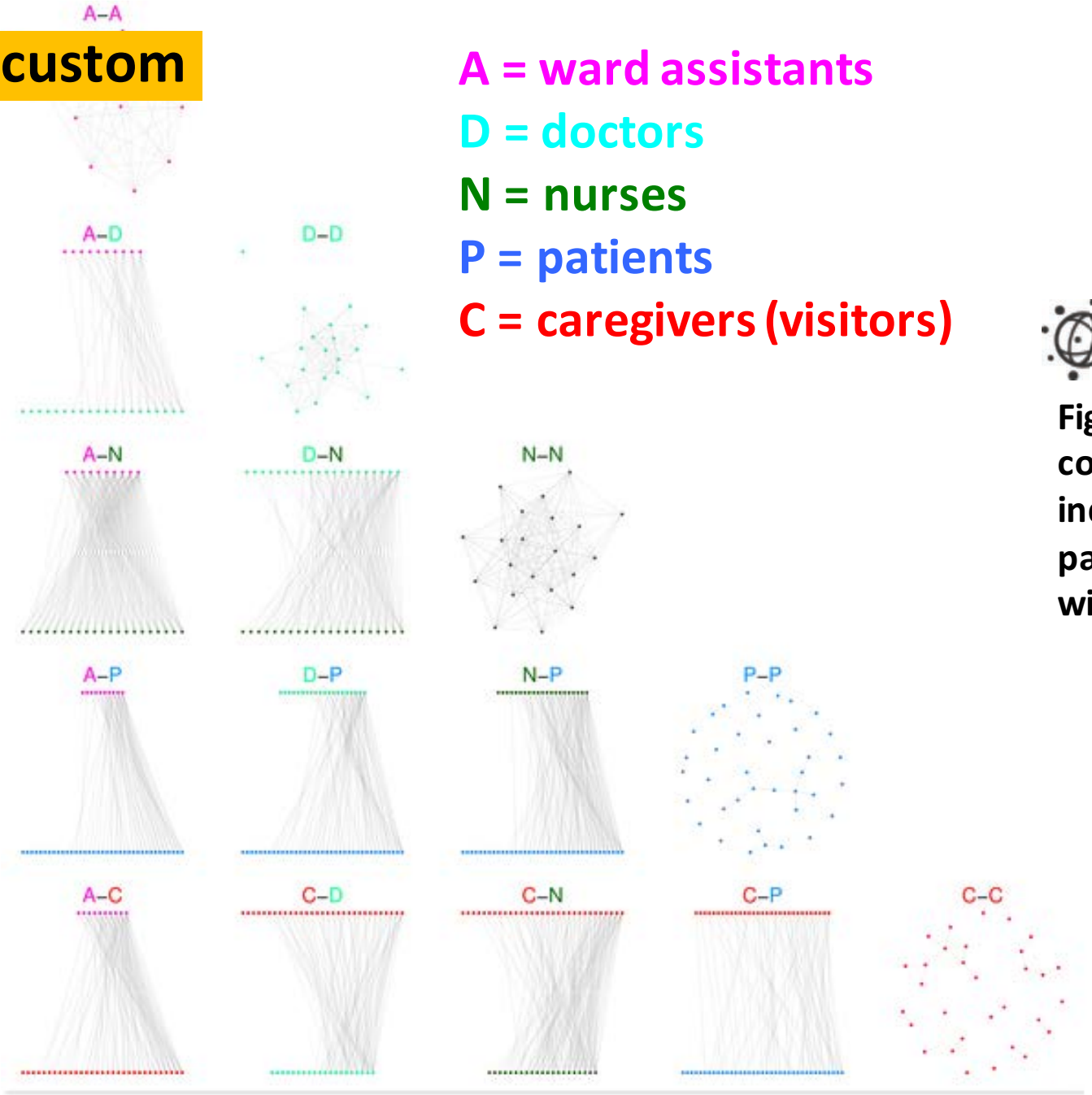
A = ward assistants

D = doctors

N = nurses

P = patients

C = caregivers (visitors)

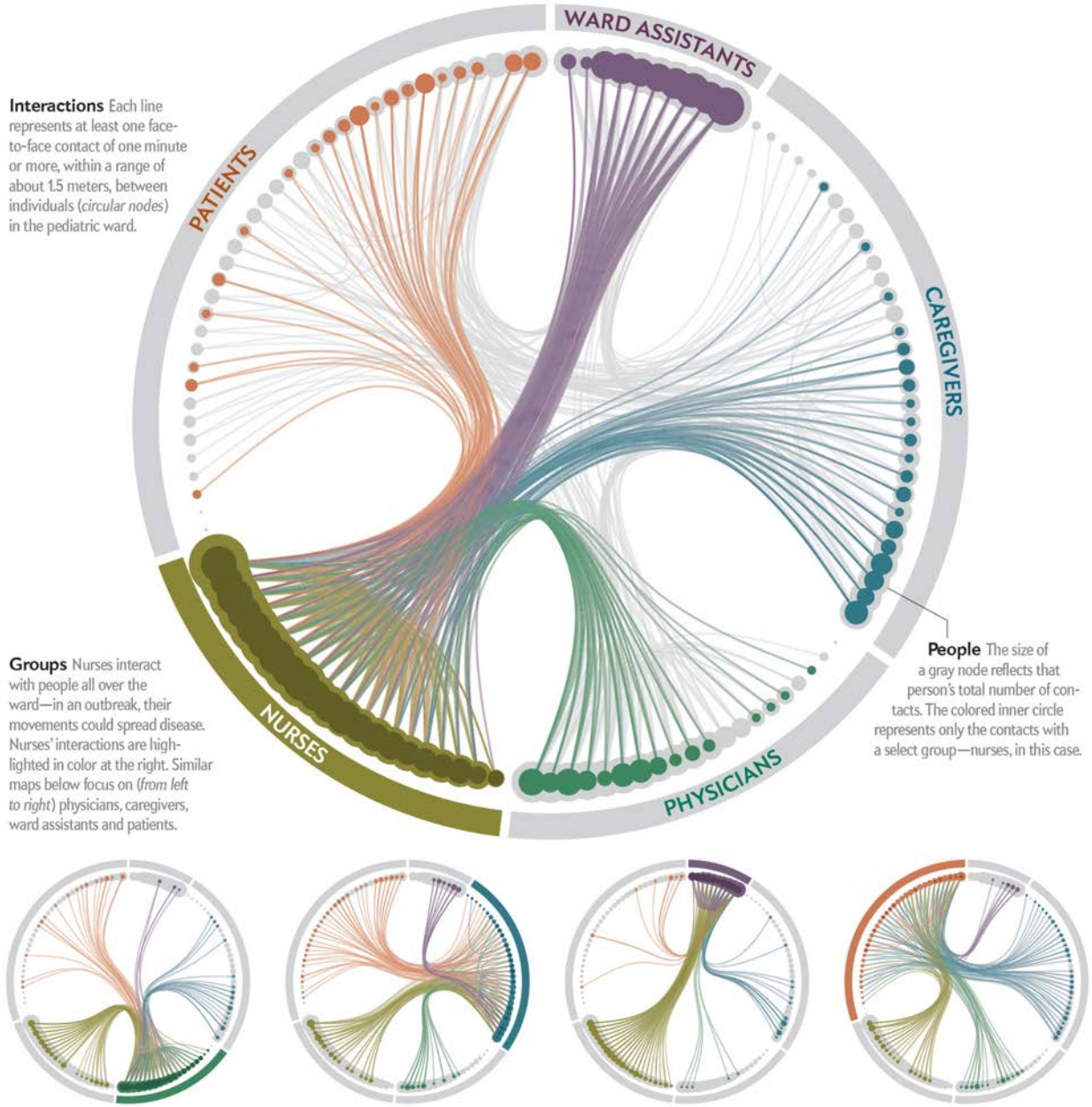


PLOS ONE

Figure 6. Cumulative contact networks of individuals, for all pairs of classes and within each class.

By L. Isella et al., "Close Encounters in a Pediatric Ward: Measuring Face-to-Face Proximity and Mixing Patterns with Wearable Sensors"

custom

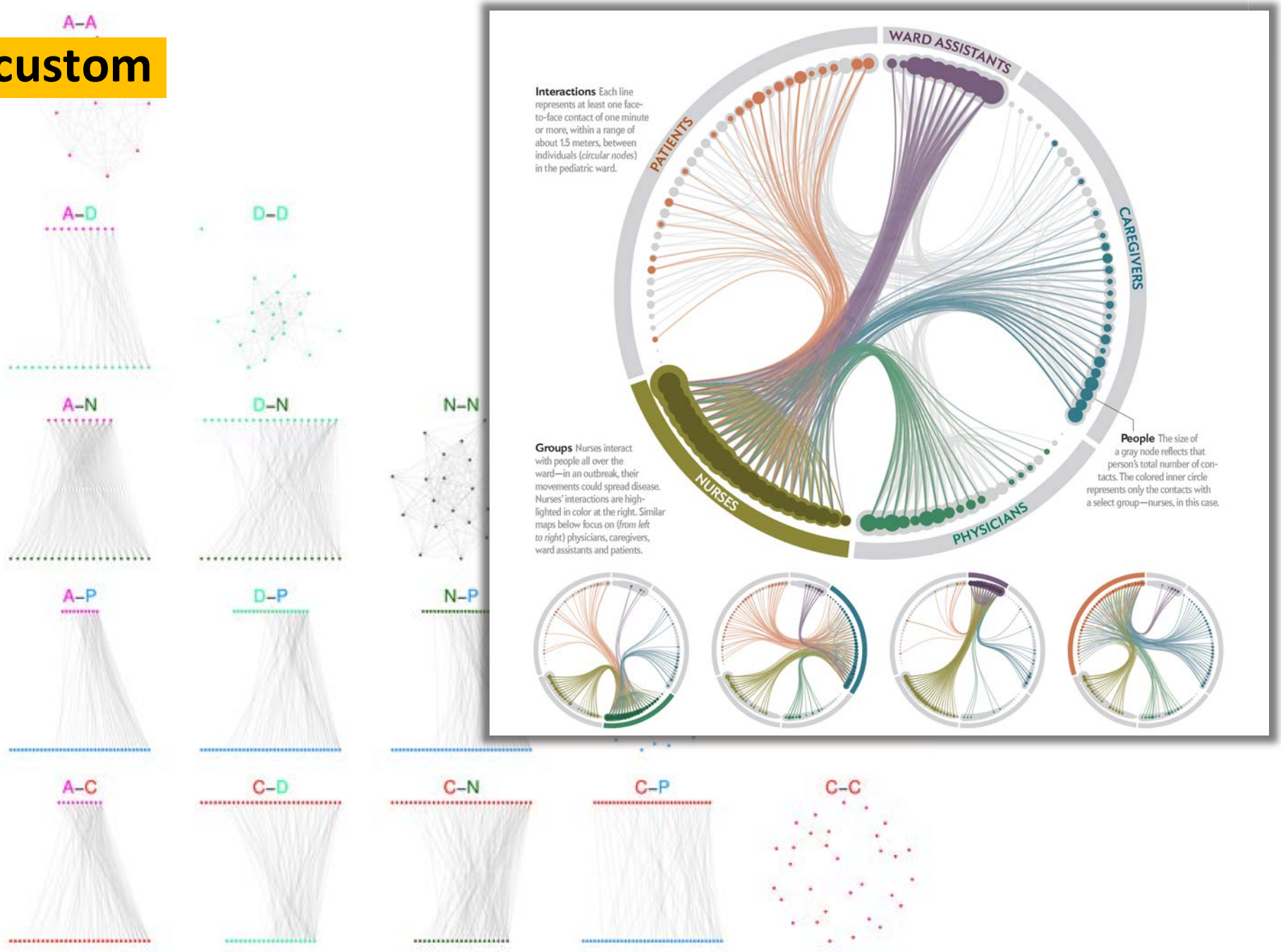


Tag—You're Sick

Patterns of personal contact in a hospital reveal true pathways of transmission

Jan Willem Tulp

custom


A–A
A–D
D–D
A–N
D–N
N–N
A–P
D–P
N–P
A–C
C–D
C–N
C–P
C–C
WARD ASSISTANTS
PATIENTS
CAREGIVERS
NURSES
PHYSICIANS
Interactions Each line represents at least one face-to-face contact of one minute or more, within a range of about 1.5 meters, between individuals (circular nodes) in the pediatric ward.
Groups Nurses interact with people all over the ward—in an outbreak, their movements could spread disease. Nurses' interactions are highlighted in color at the right. Similar maps below focus on (from left to right) physicians, caregivers, ward assistants and patients.
People The size of a gray node reflects that person's total number of contacts. The colored inner circle represents only the contacts with a select group—nurses, in this case.

customizing for a different [context]

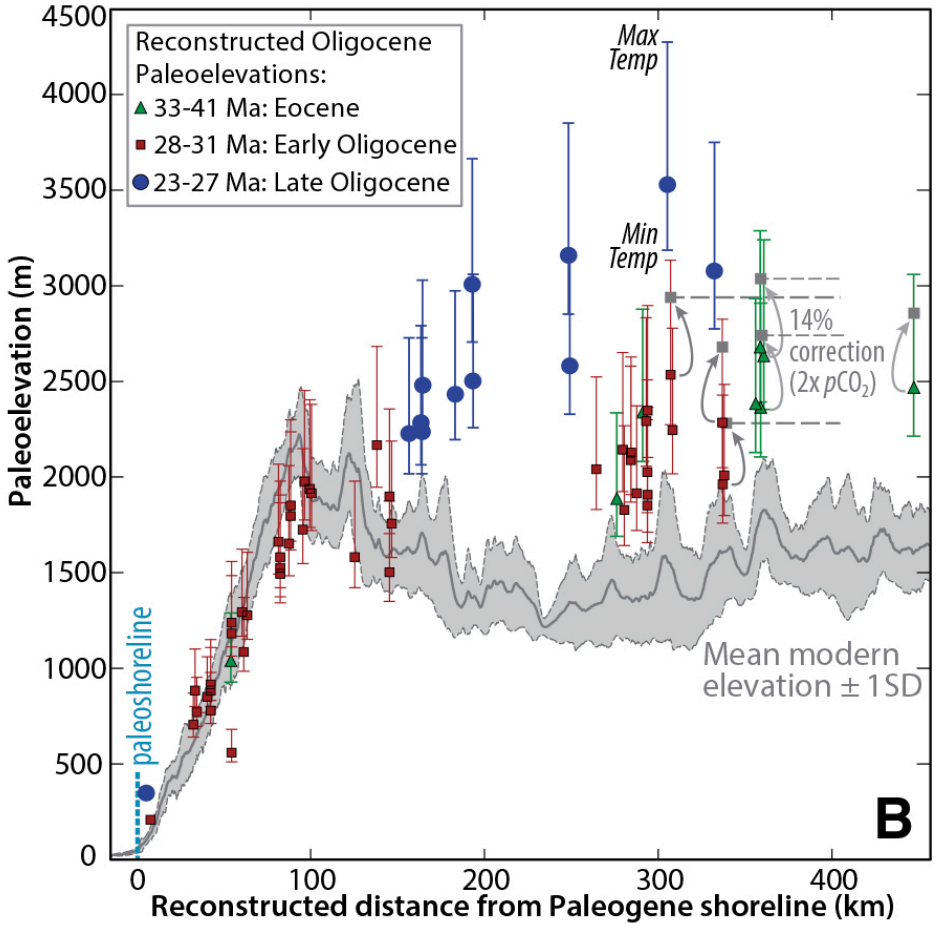
How to proceed?

customizing for a different [context]

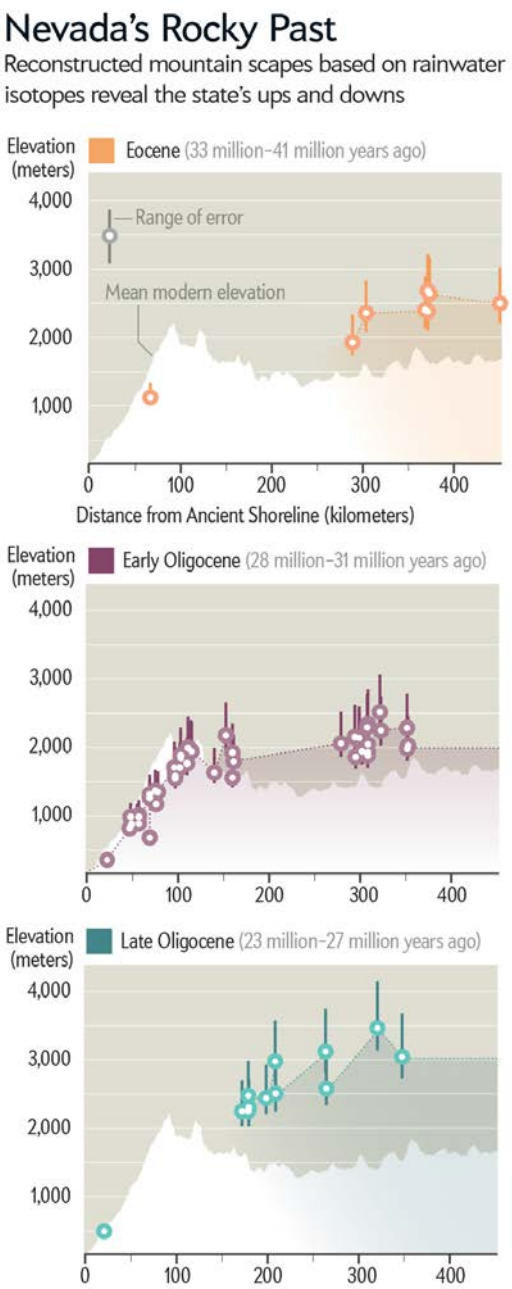
How to proceed?

- build in time for many iterations

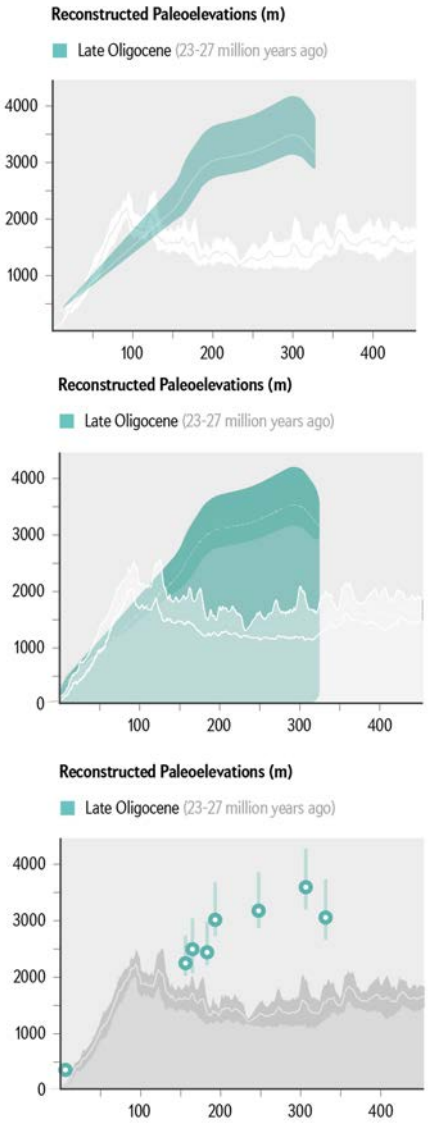
rework

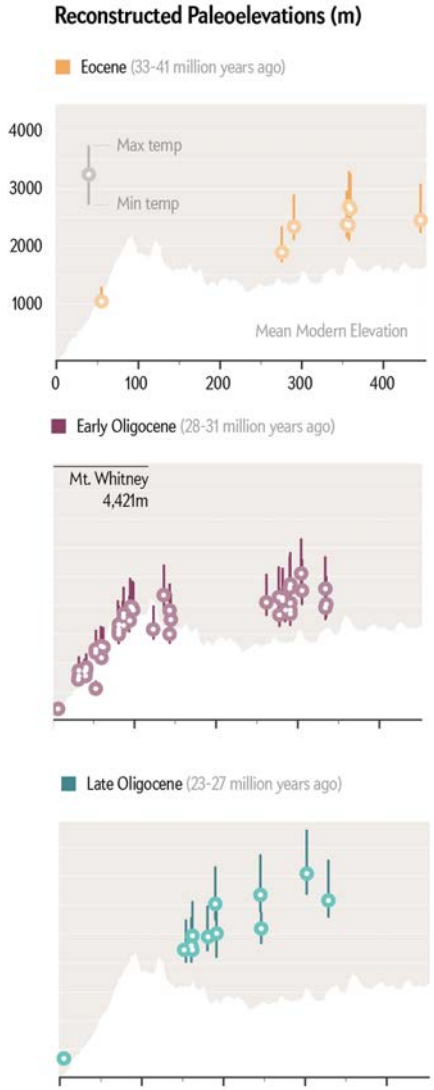


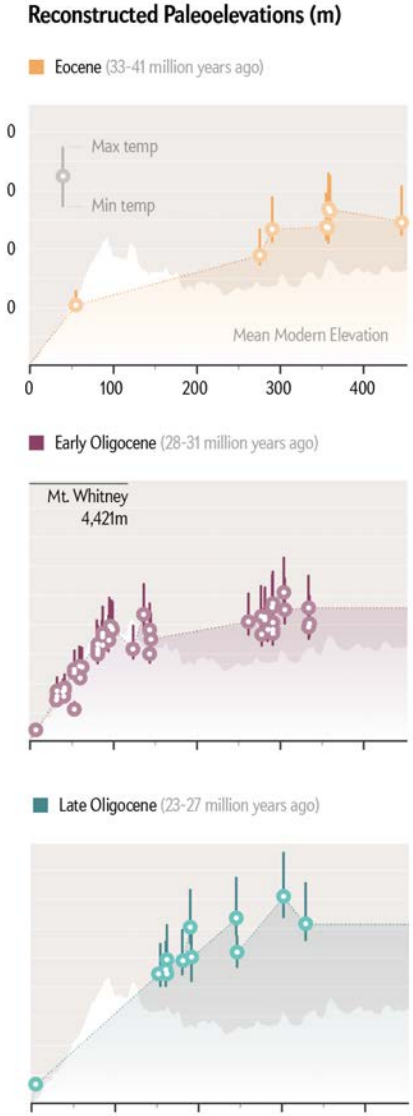
By Elizabeth J. Cassel et al., "Profile of a paleo-orogen: High topography across the present-day Basin and Range from 40 to 23 Ma"

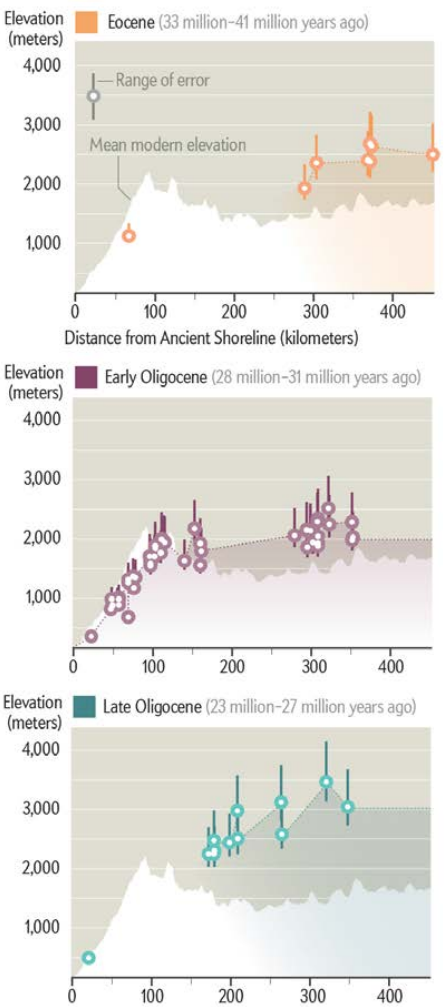


Tiffany Farrant-Gonzalez









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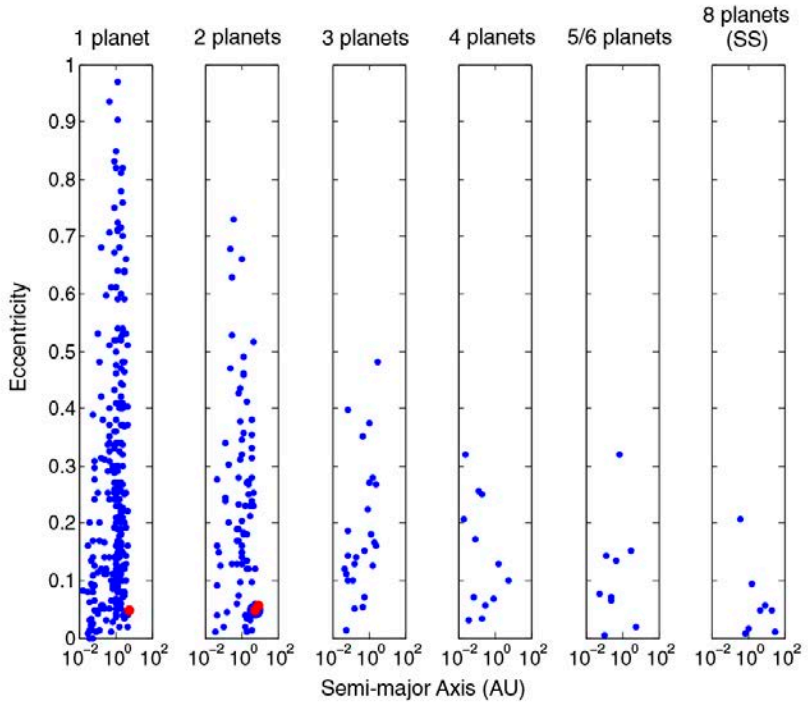
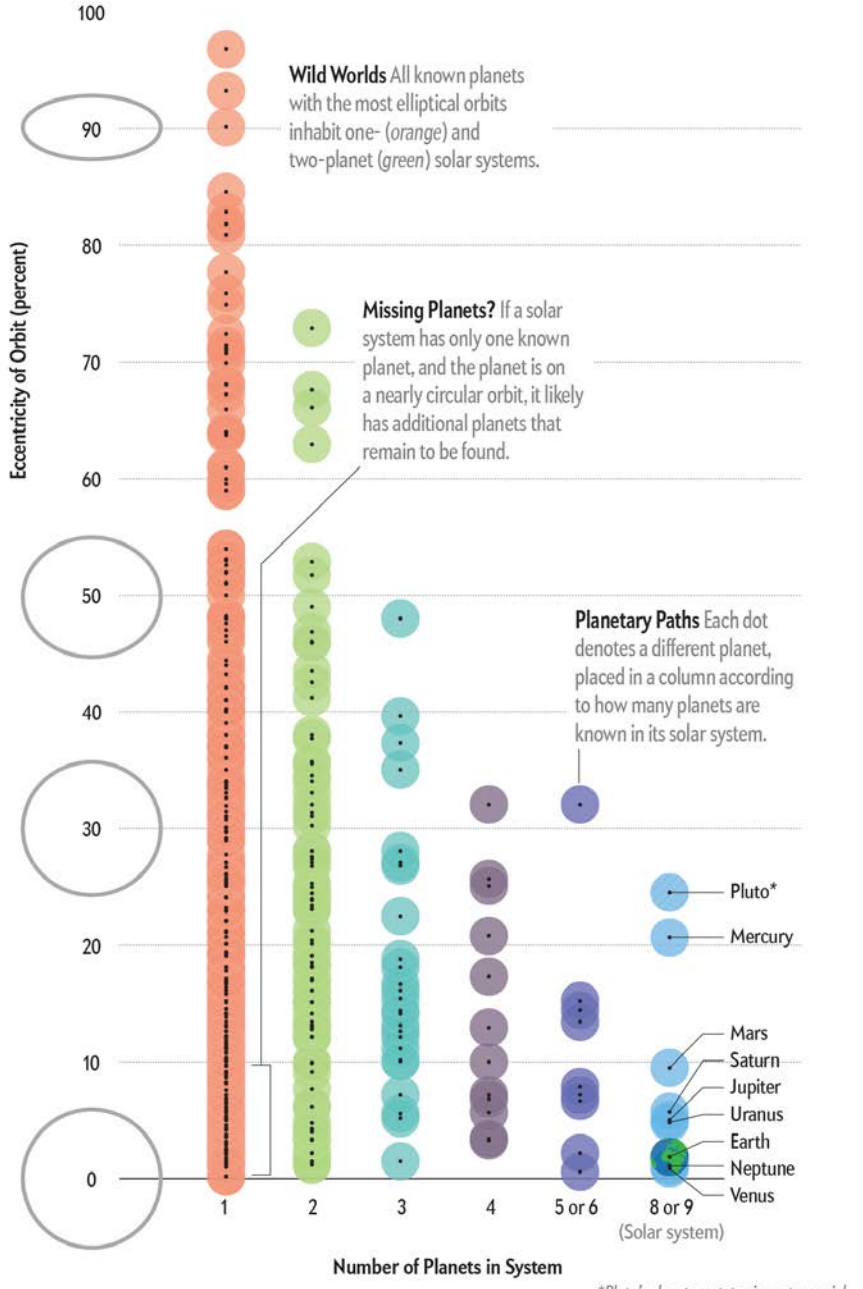


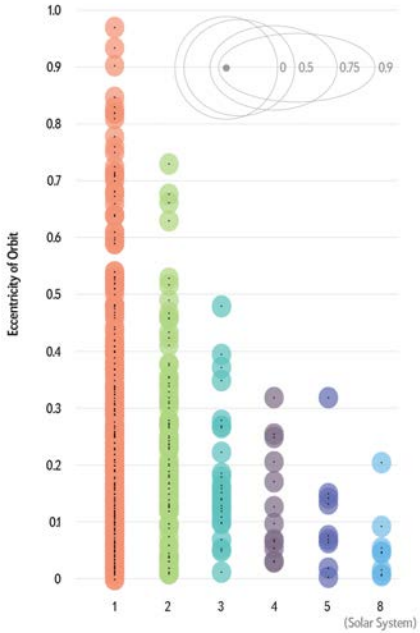
Fig. 2. Eccentricity versus semimajor axis going from low (left) to high multiplicity (right). A red dot is shown for where Jupiter would appear on the one- and two-planet distributions, and for Saturn on the two-planet distribution. This demonstrates that even if the Solar System were detected via RV as a one- or two-planet system, it would still be consistent with the data.

By Mary Anne Limbach and Edwin L. Turner, "Exoplanet Orbital Eccentricity: Multiplicity Relation and the Solar System"

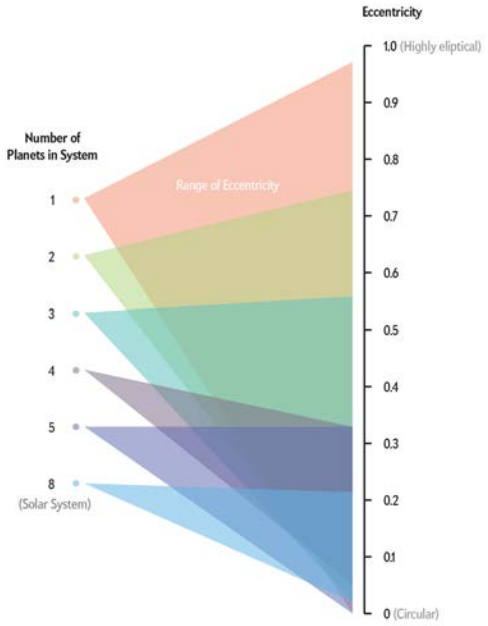


Tiffany Farrant-Gonzalez

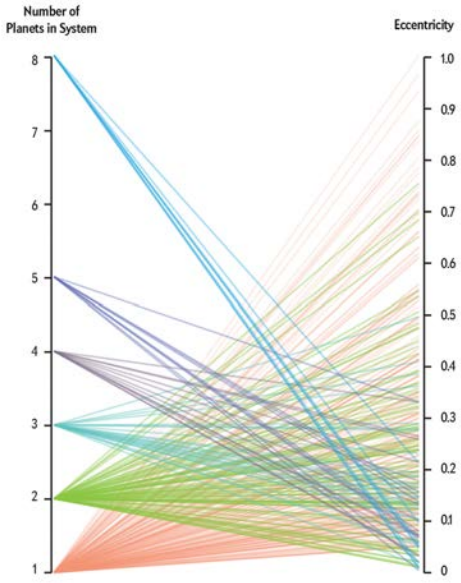
Mockup 1



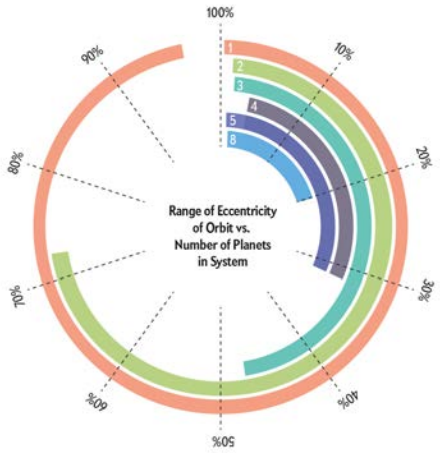
Mockup 2



Mockup 3



Mockup 4



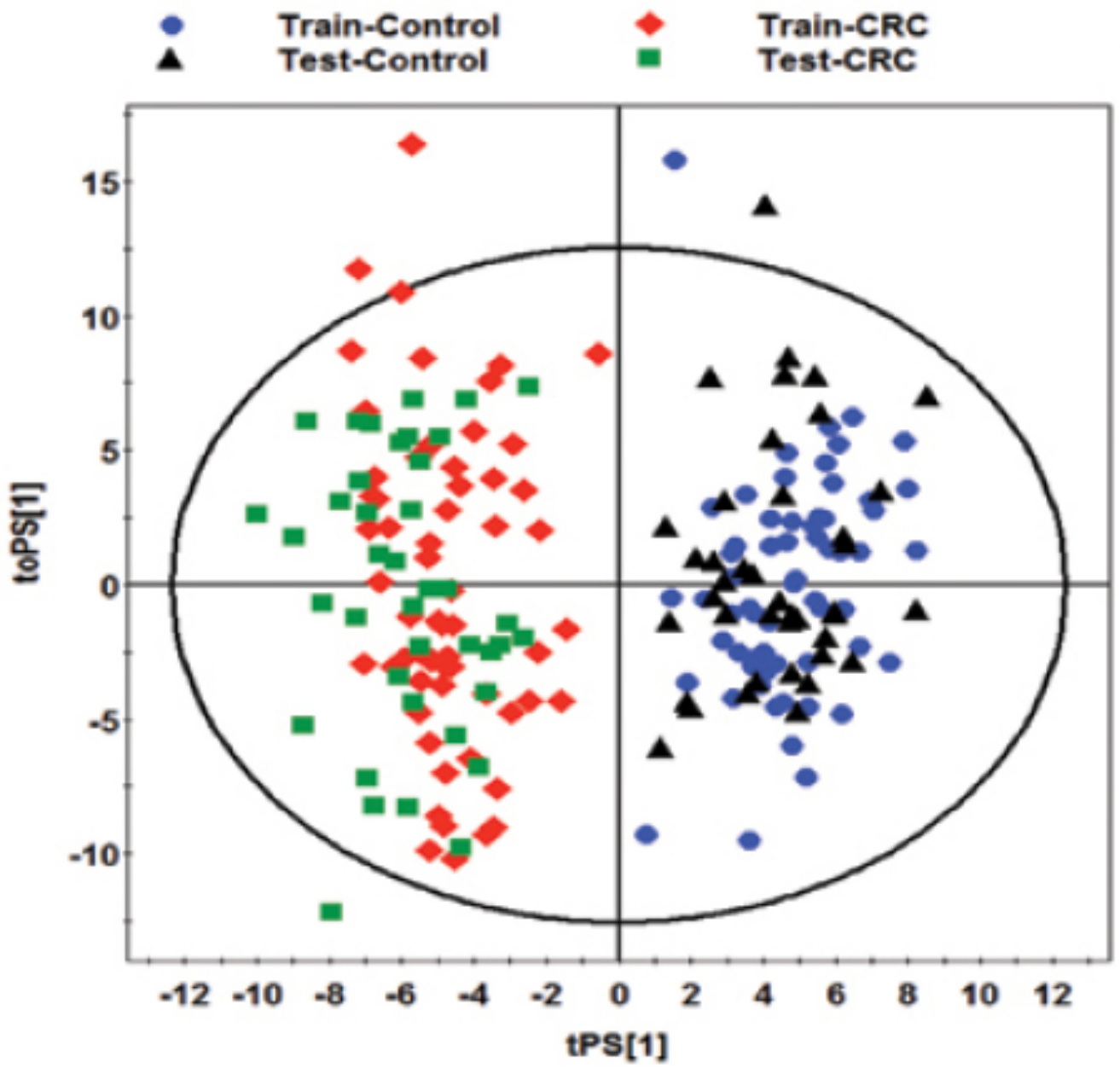
http://bit.ly/LSU_jc2

Tiffany Farrant-Gonzalez

customizing for a different [context]

How to proceed?

- build in time for many iterations
- look at your content with fresh eyes



By Yu Cheng et al., “Distinct Urinary Metabolic Profile of Human Colorectal Cancer”

Detecting cancer through urine tests

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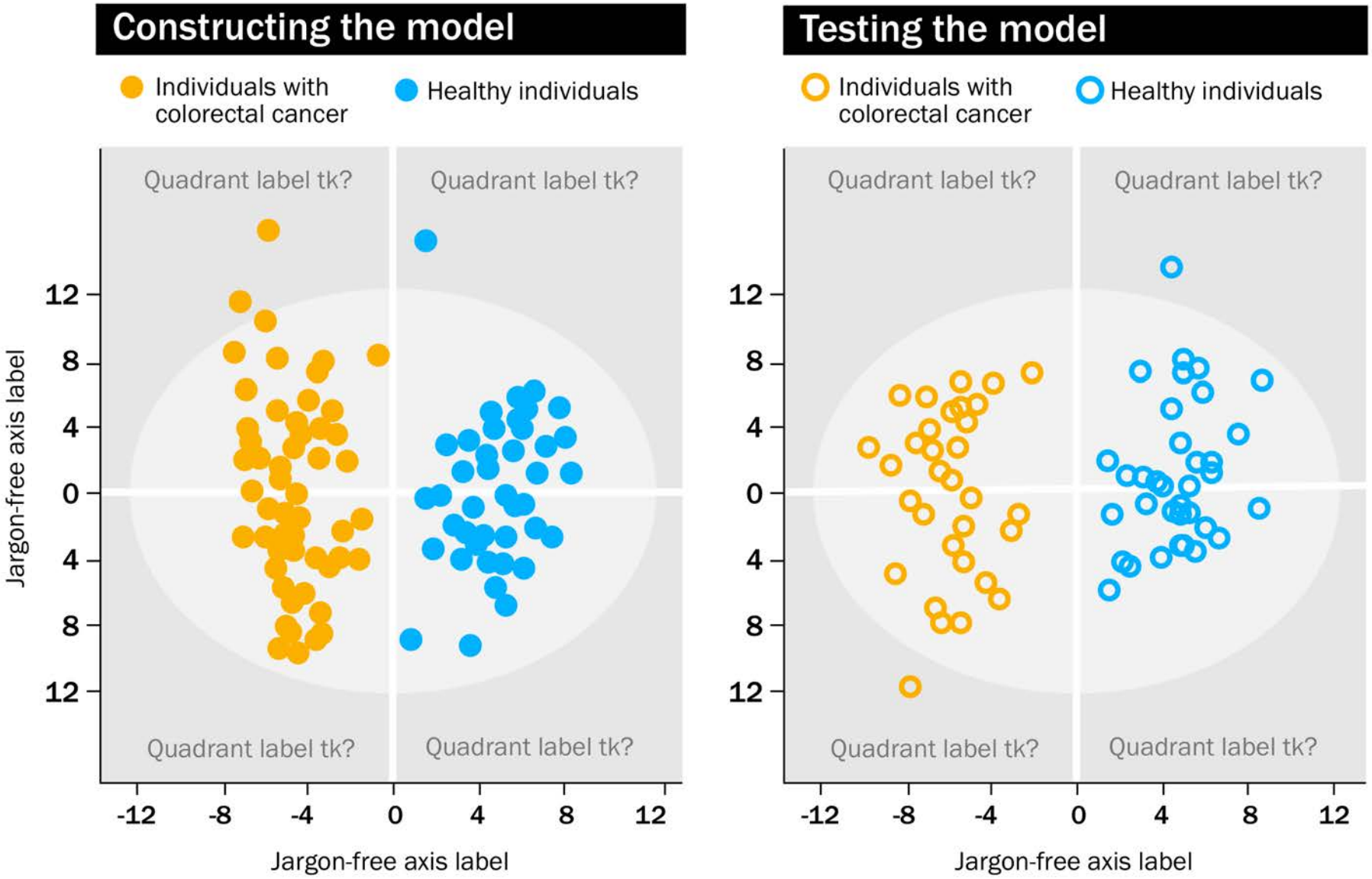

customizing for a different [context]

How to proceed?

- build in time for many iterations
- look at your content with fresh eyes
- remember to ask

“for whom and why?”

more resources

design-related SA blog posts

https://blogs.scientificamerican.com/sa-visual/data-visualization-advice-for-scientists/

https://blogs.scientificamerican.com/sa-visual/how-to-choose-the-form-of-an-infographic-it-s-all-about-context/

https://blogs.scientificamerican.com/sa-visual/

chart choosers

https://extremepresentation.com/design/7-charts/

https://policyviz.com/2014/11/11/graphic-continuum-desktop-version/

http://www.datavizcatalogue.com/index.html

http://stephanieevergreen.com/

Excel-centric books

http://www.storytellingwithdata.com/book/

https://excelcharts.com/

other great books/websites

http://www.thefunctionalart.com/

http://www.visualisingdata.com/

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