Developing scientific data visualizations for non-specialist audiences

Jen Christiansen
jchristiansen@sciam.com
@ChristiansenJen

SCIENTIFIC AMERICAN

www.ScientificAmerican.com

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data visualization

Information (chiefly numerical), made visible.

data visualization

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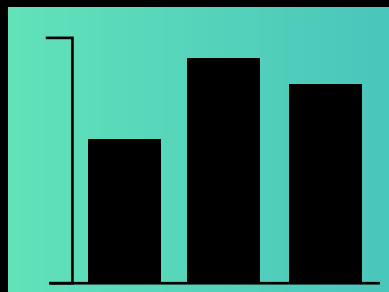
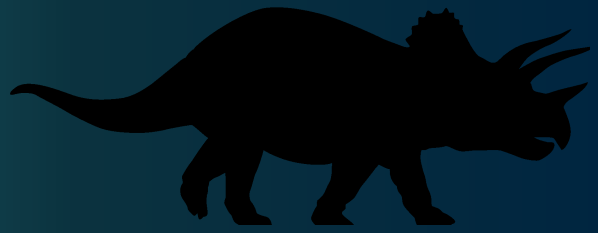
Information (chiefly numerical), made visible.



abstract representations



figurative illustrations

[content]

Information (chiefly numerical), made visible.

[content]

Information (chiefly numerical), made visible.

[context]

For whom and why?

[content]

[content]

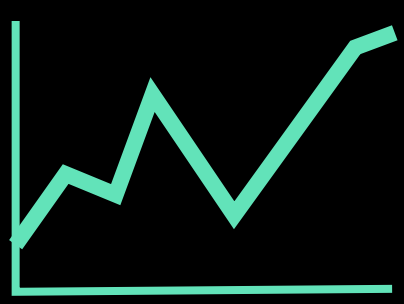
data / information

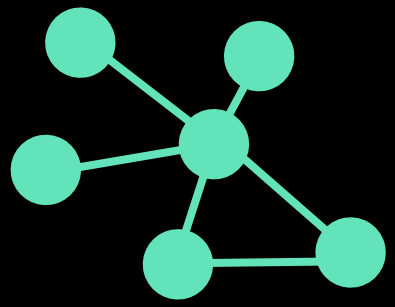
[content]

data / information

[content]

data / information





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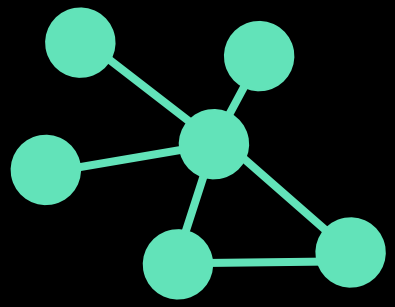
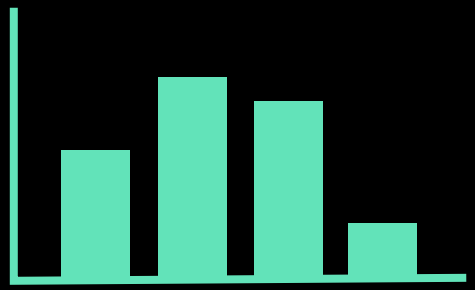
data / information





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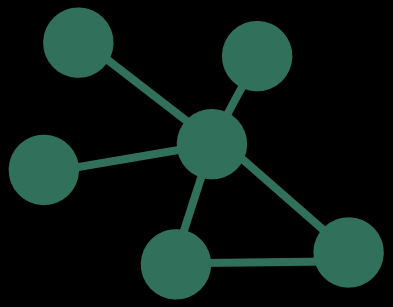
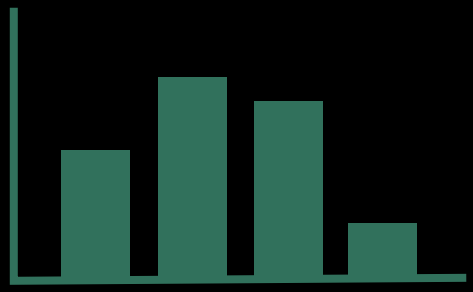
data / information

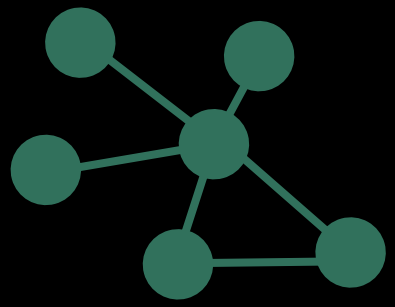


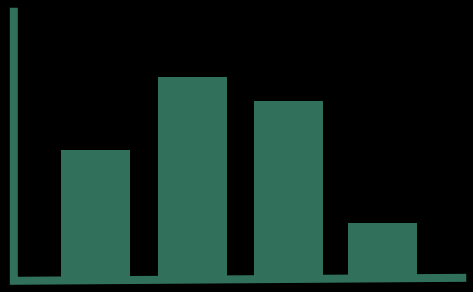


[context]

[content]

data / information





[context]

audience and purpose

Developing scientific data visualizations for non-specialist audiences

[content]

Developing scientific data visualizations for non-specialist audiences

[context]

organizing your [content]

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

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

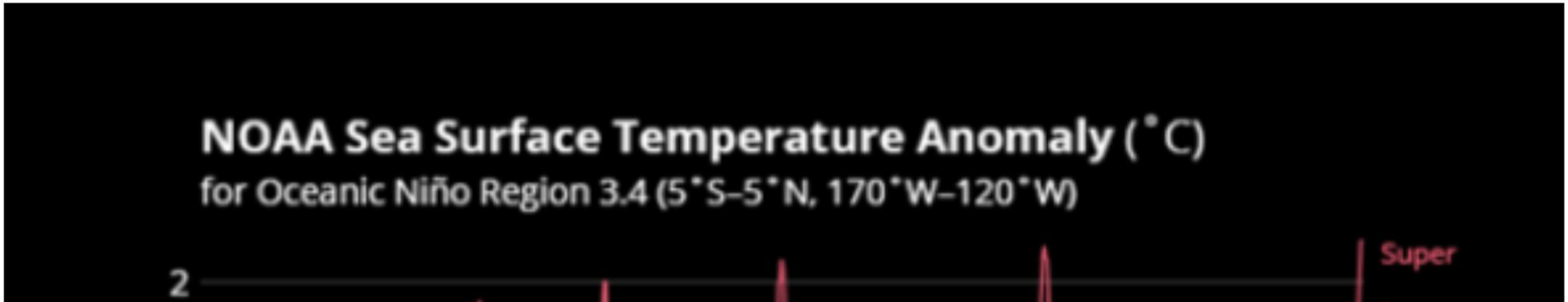
SA Visual

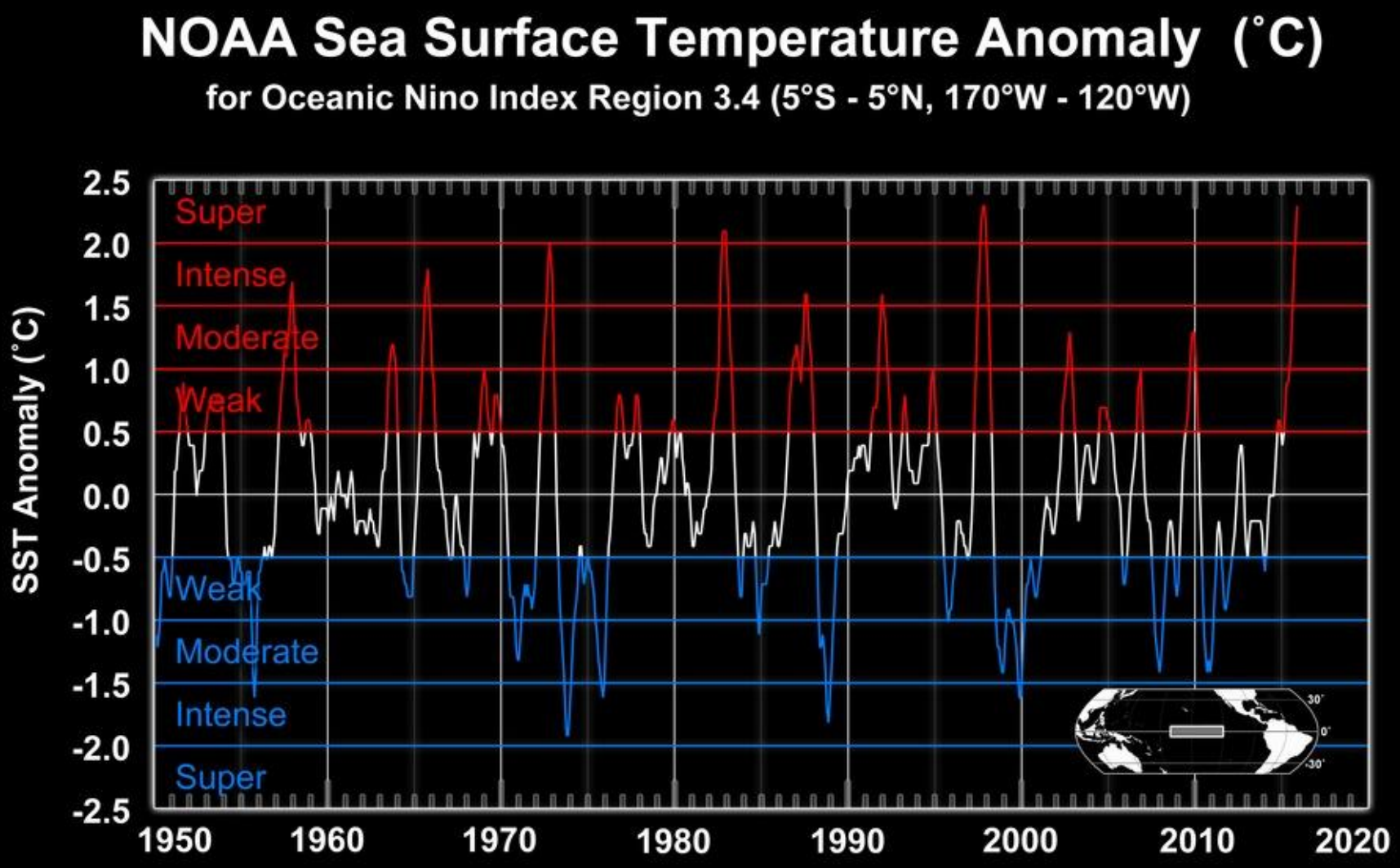
Data Visualization Advice for Scientists

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

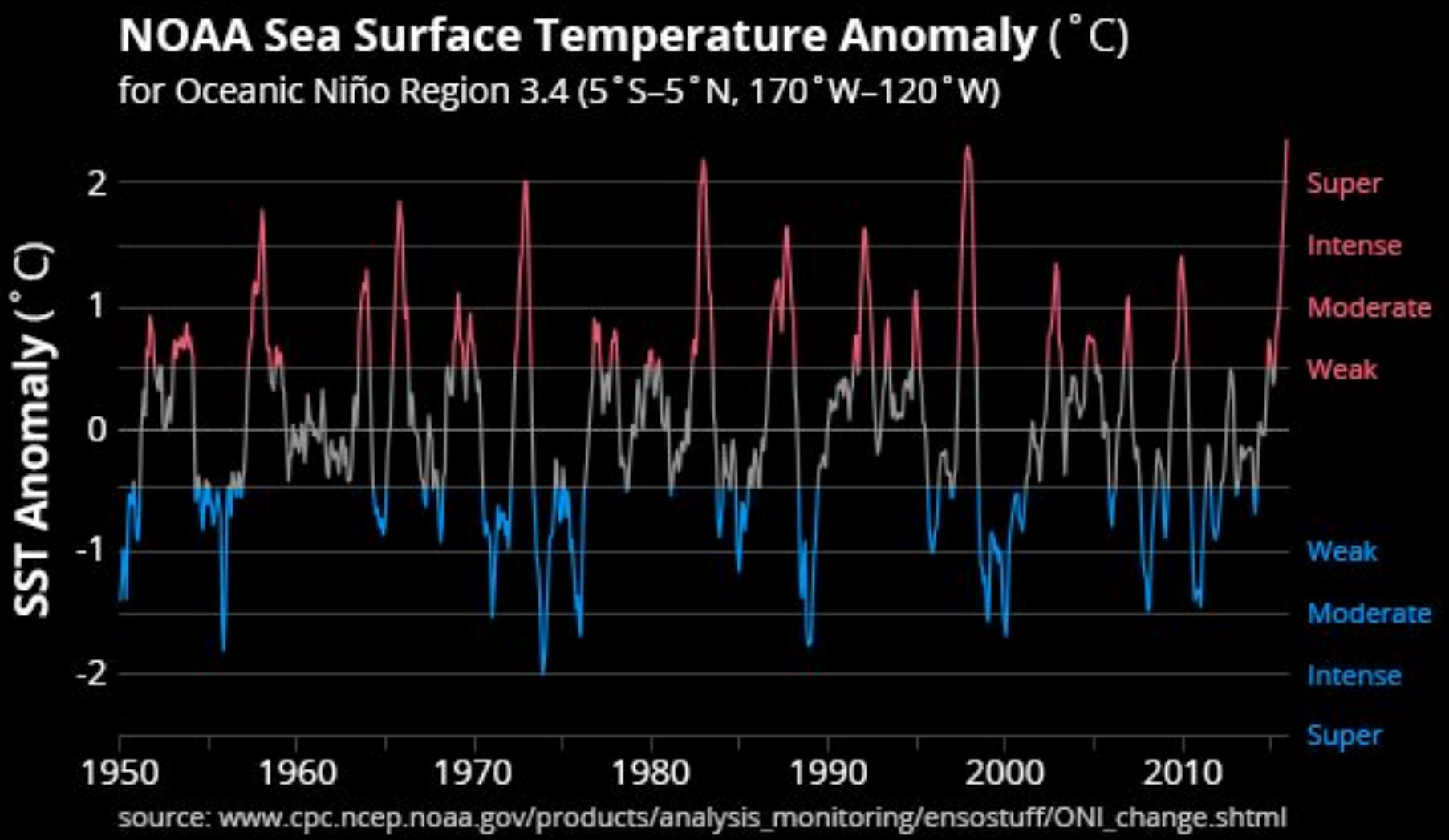
By Robert Simmon on February 19, 2016

http://bit.ly/SST_redesign



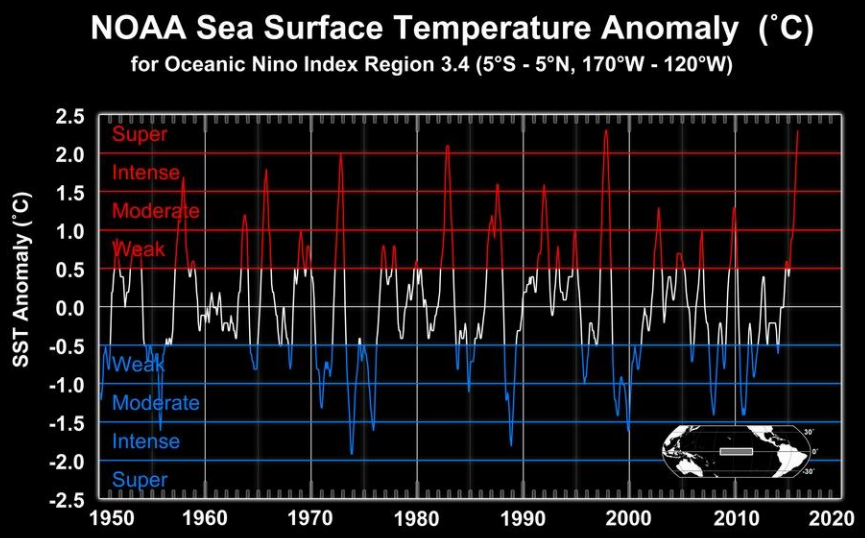


NASA's Scientific Visualization Studio

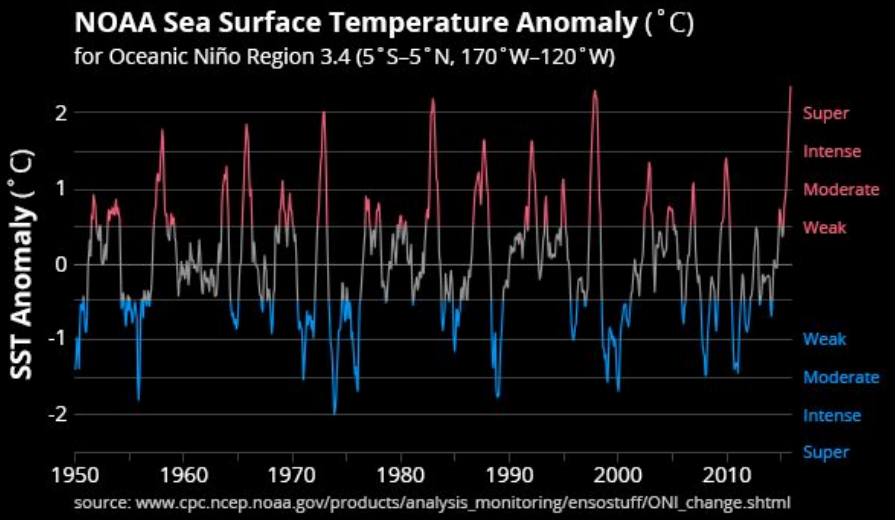


Robert Simmon

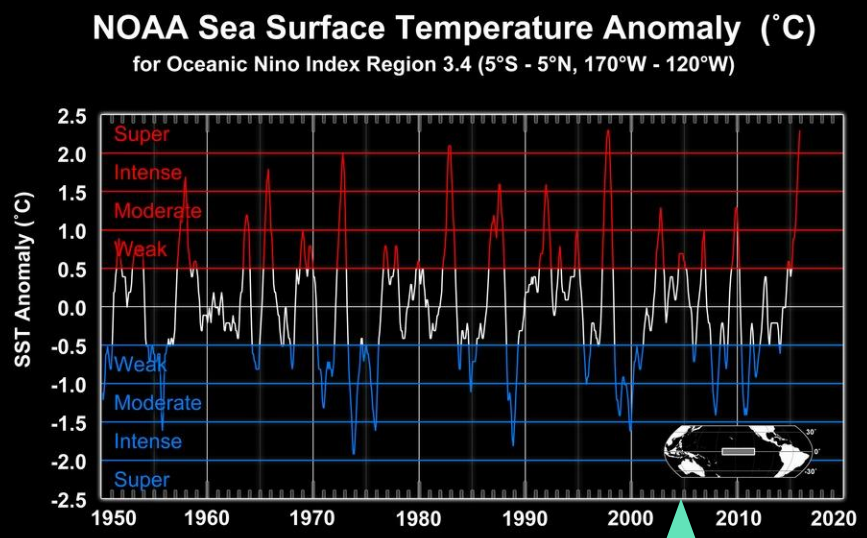
original



redesign

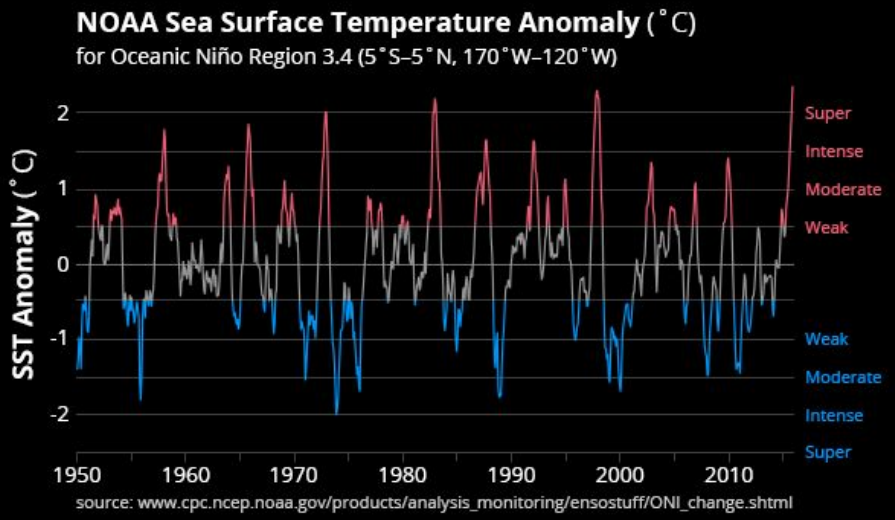


original



removed frame

redesign



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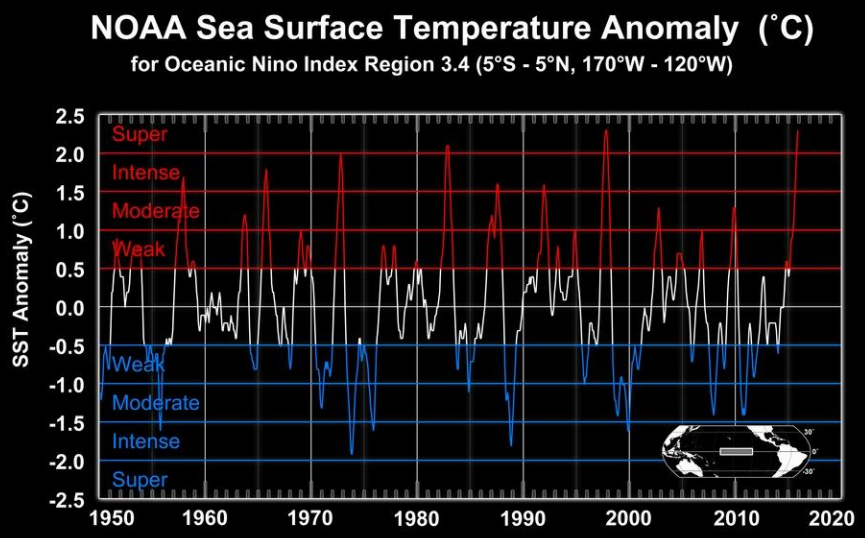
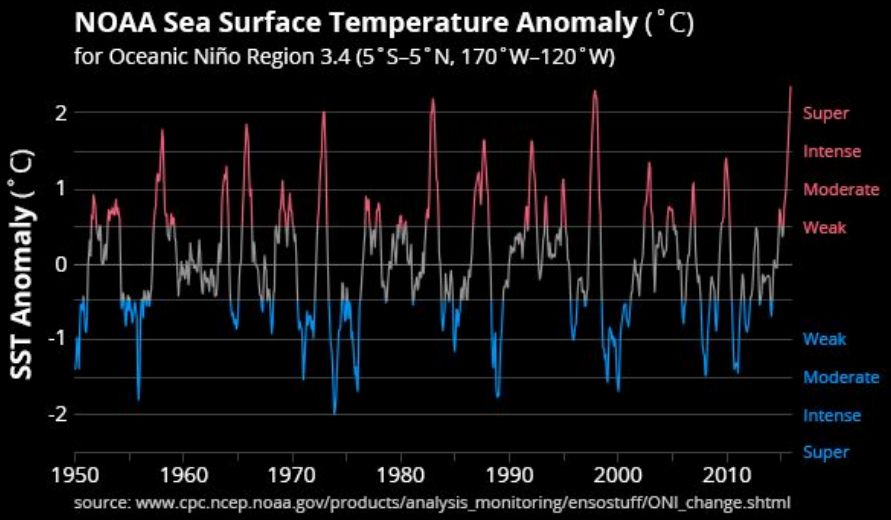
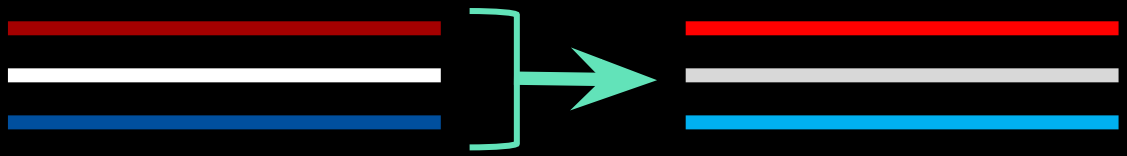


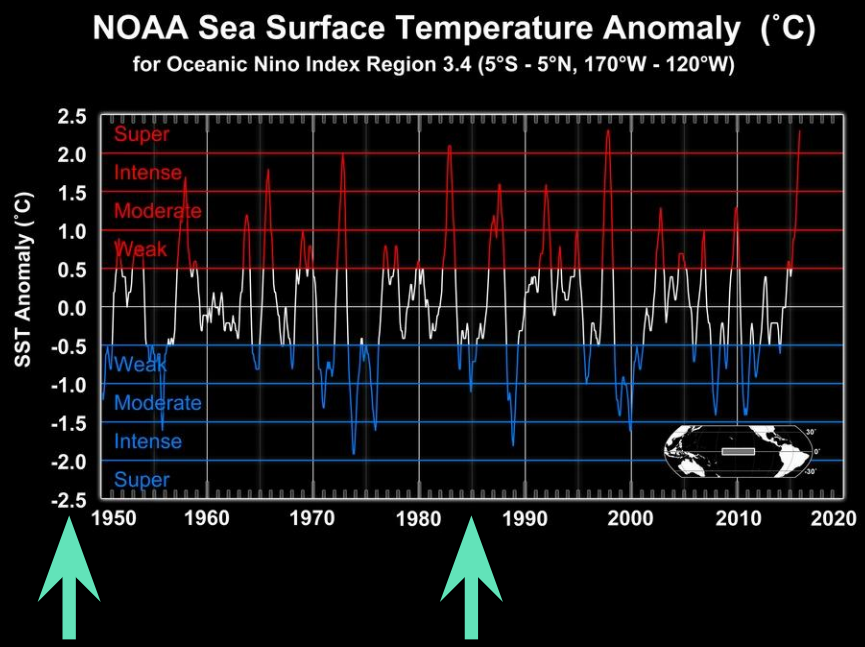
redesign



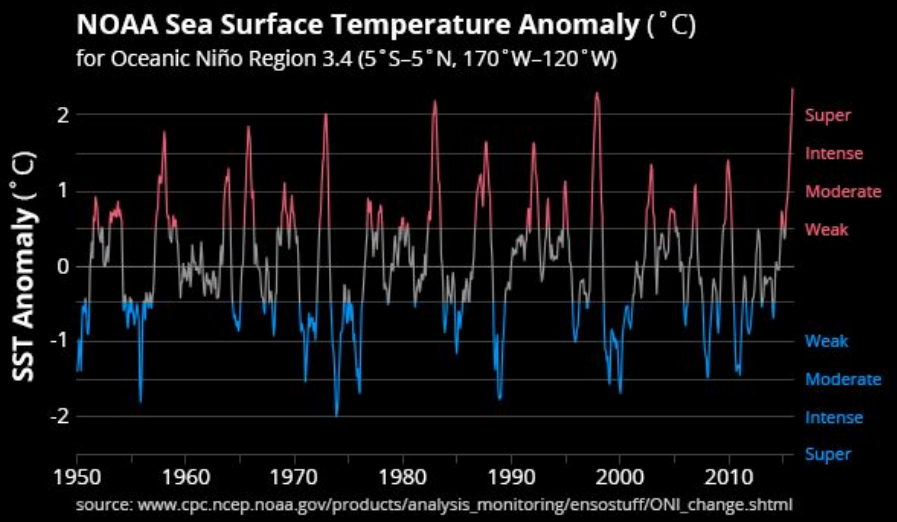
adjusted color for equal visual weight



original

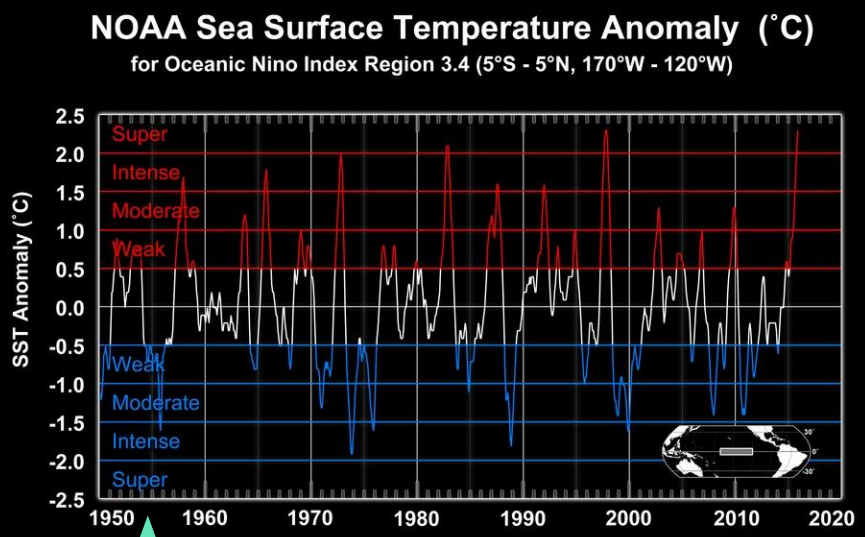


redesign

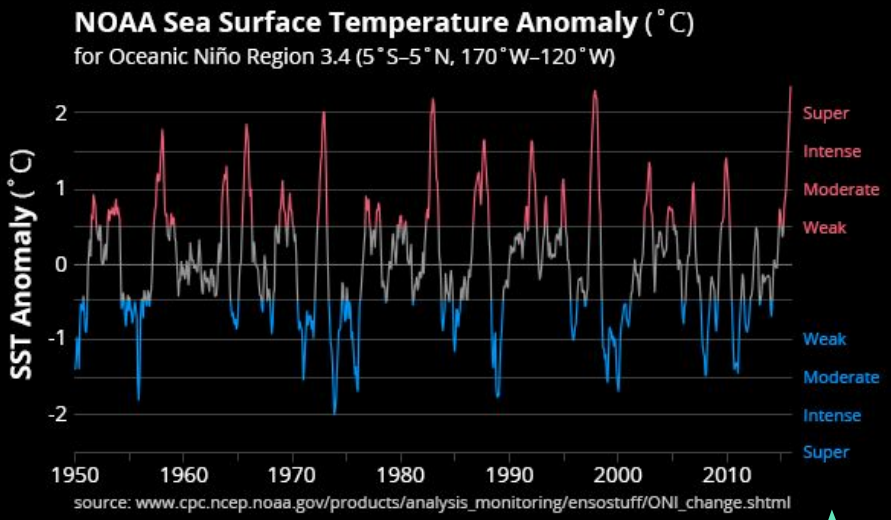


removed many tick marks, and some labels

original



redesign



moved labels into a more legible position

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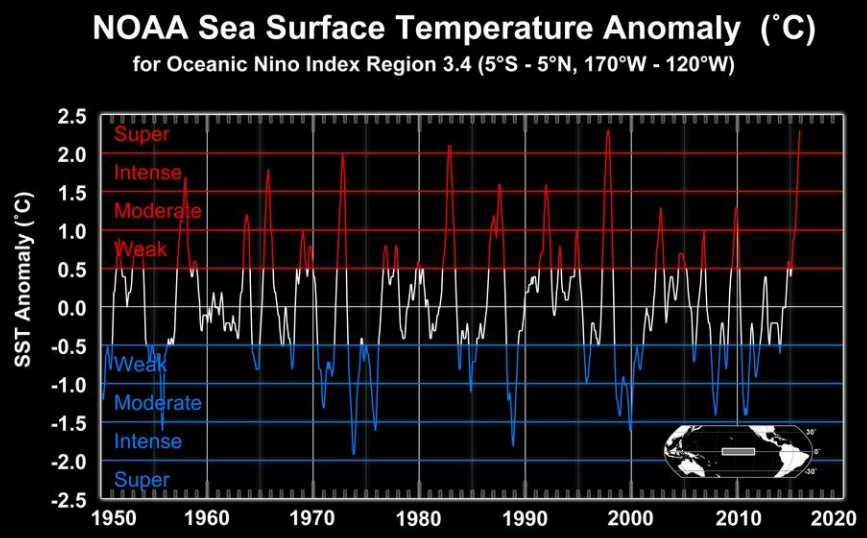
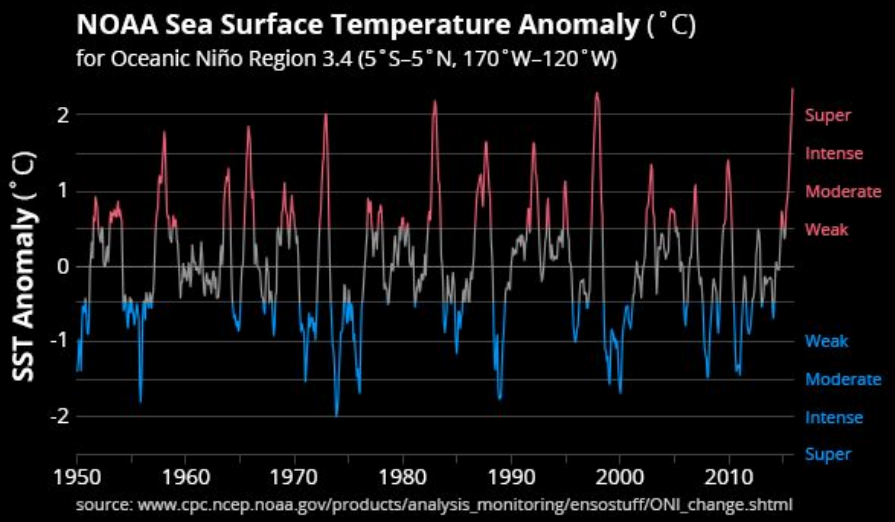
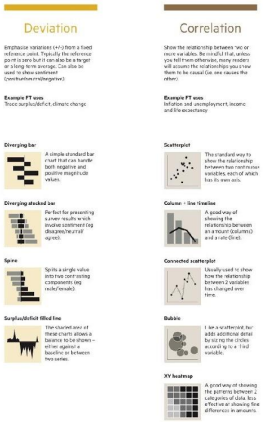


redesign



http://bit.ly/SST_redesign

chart choosers

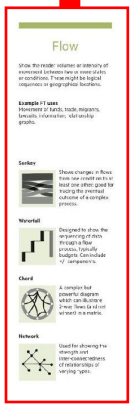


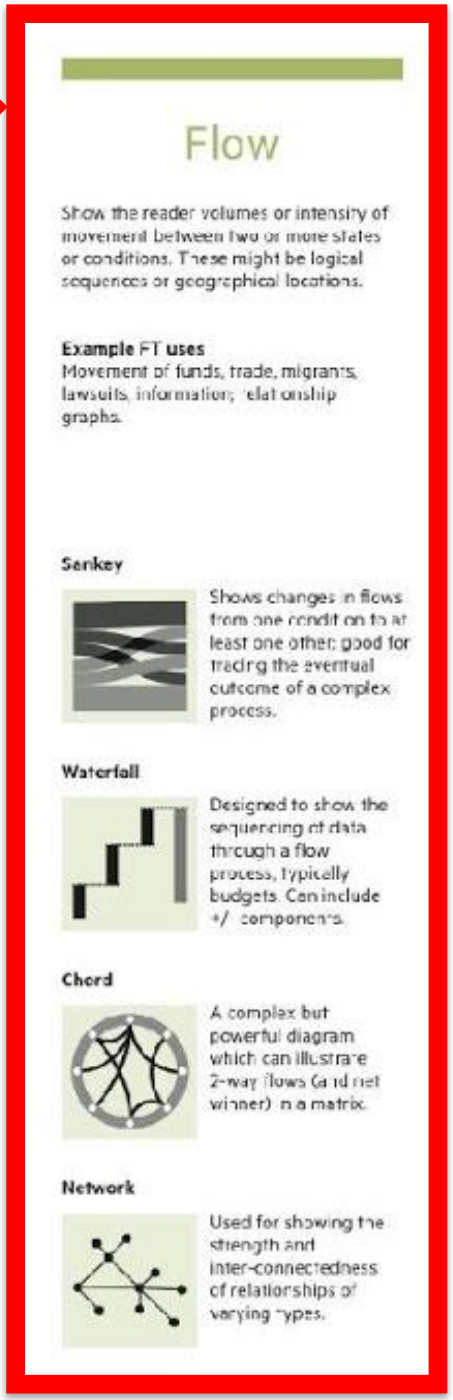
Visual vocabulary

Designing with data

There are so many ways to visualise data - how do we know which one to pick? Use the categories across the top to decide which data relationship is most important in your story, then look at the different types of chart within the category to form some initial ideas about what might work best. This list is not meant to be exhaustive, nor a wizard, but is a useful starting point for making informative and meaningful data visualisations.

ft.com/vocabulary

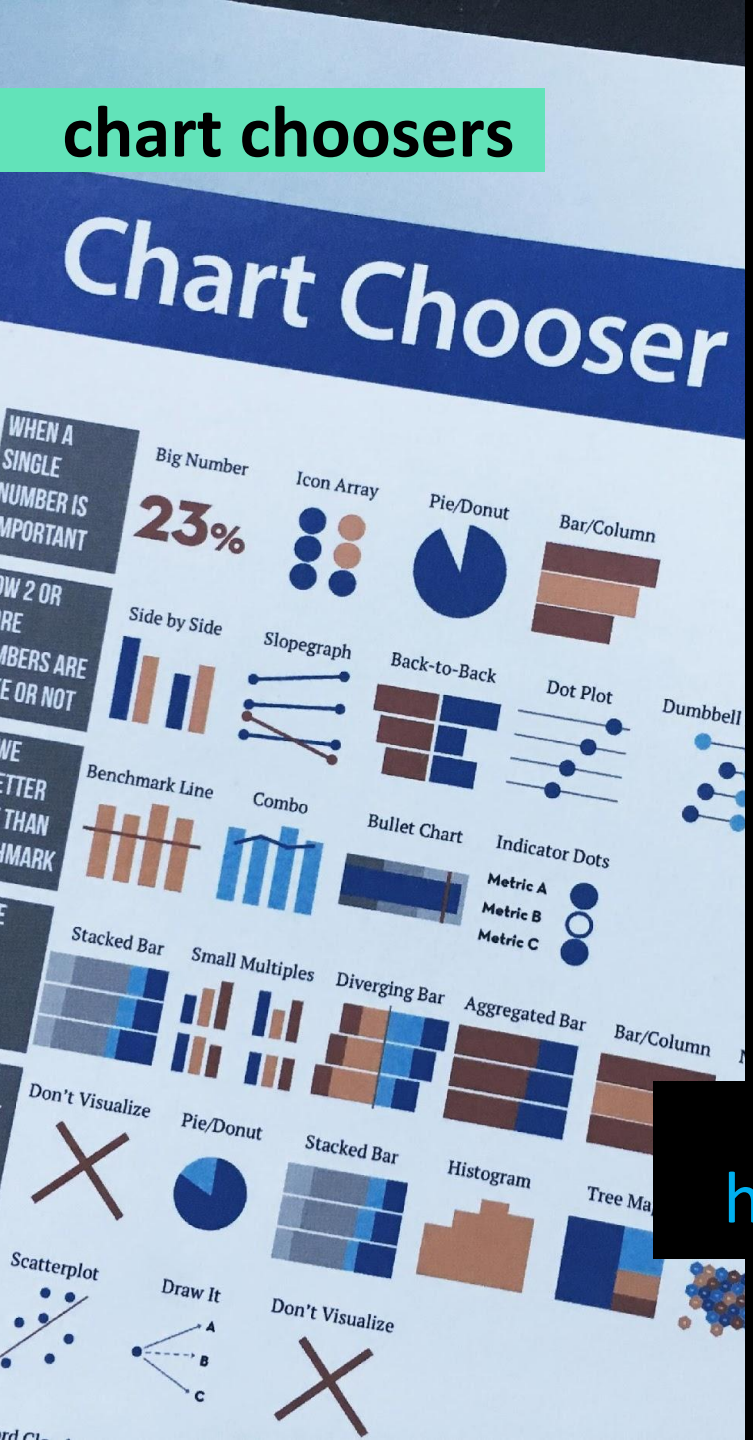




Financial Times

http://bit.ly/FT_chart_chooser

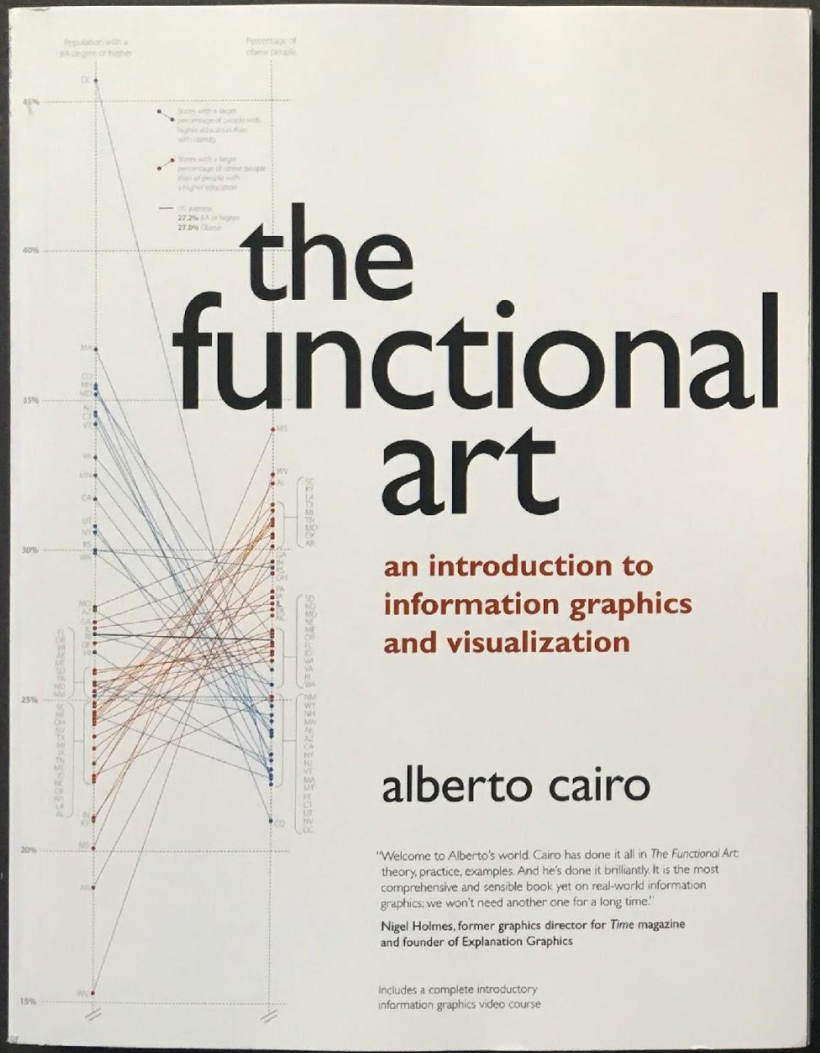
chart choosers

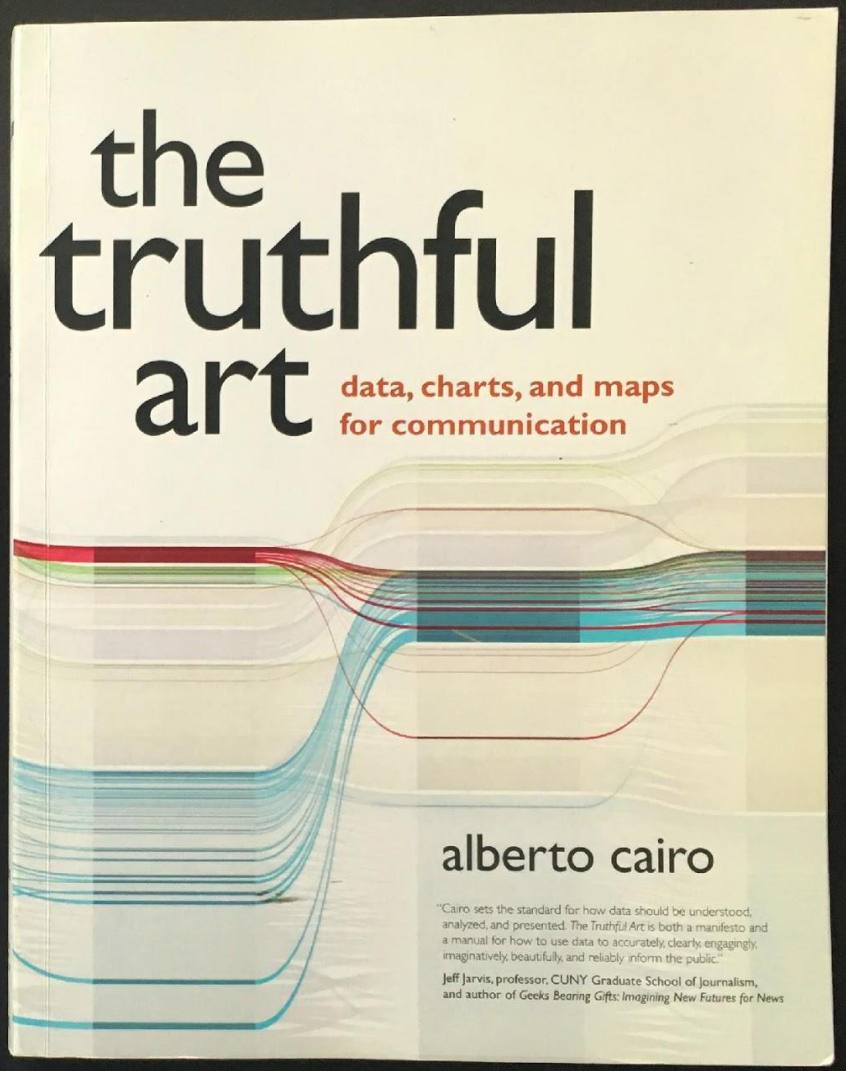


Stephanie Evergreen

http://bit.ly/Evergreen_chart_chooser

more resources

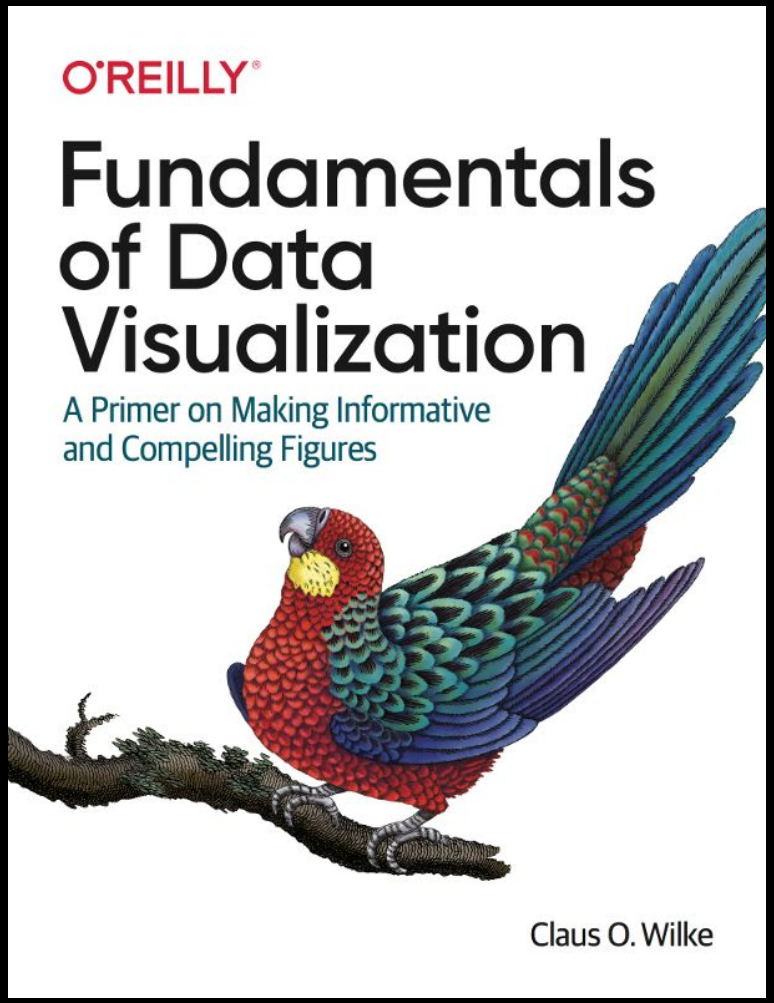




Alberto Cairo

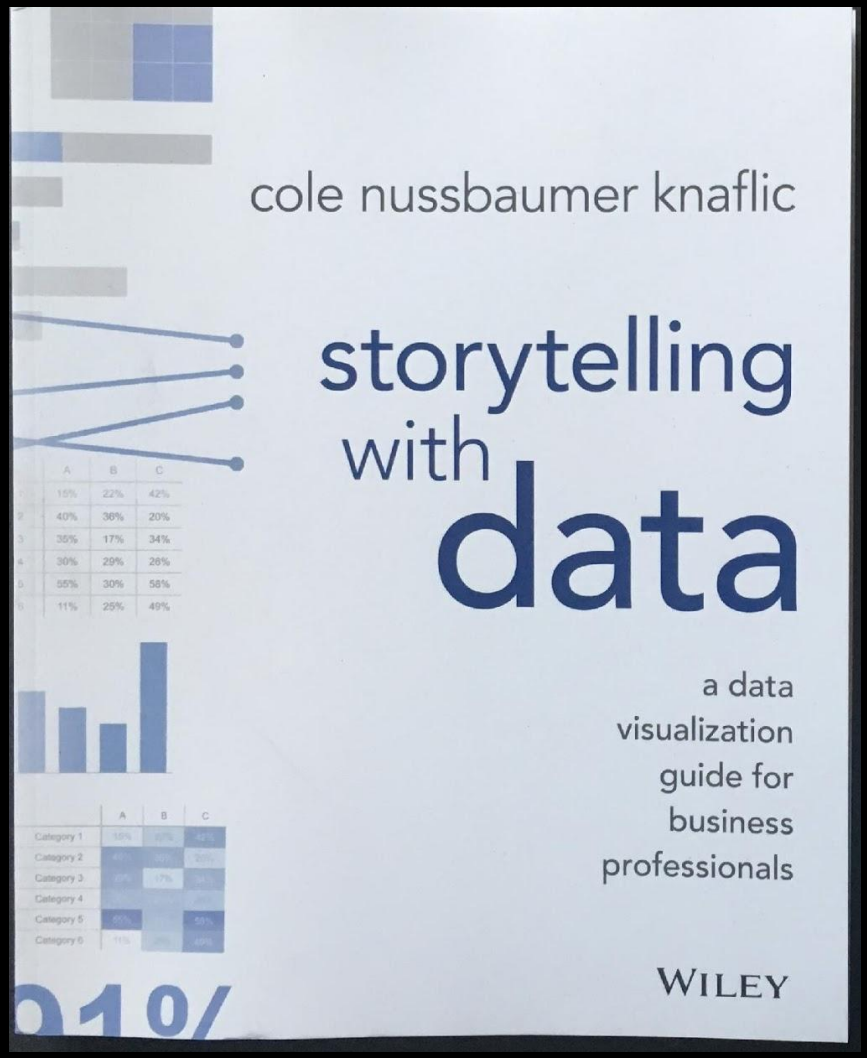
http://albertocairo.com/

more resources



Claus O. Wilke

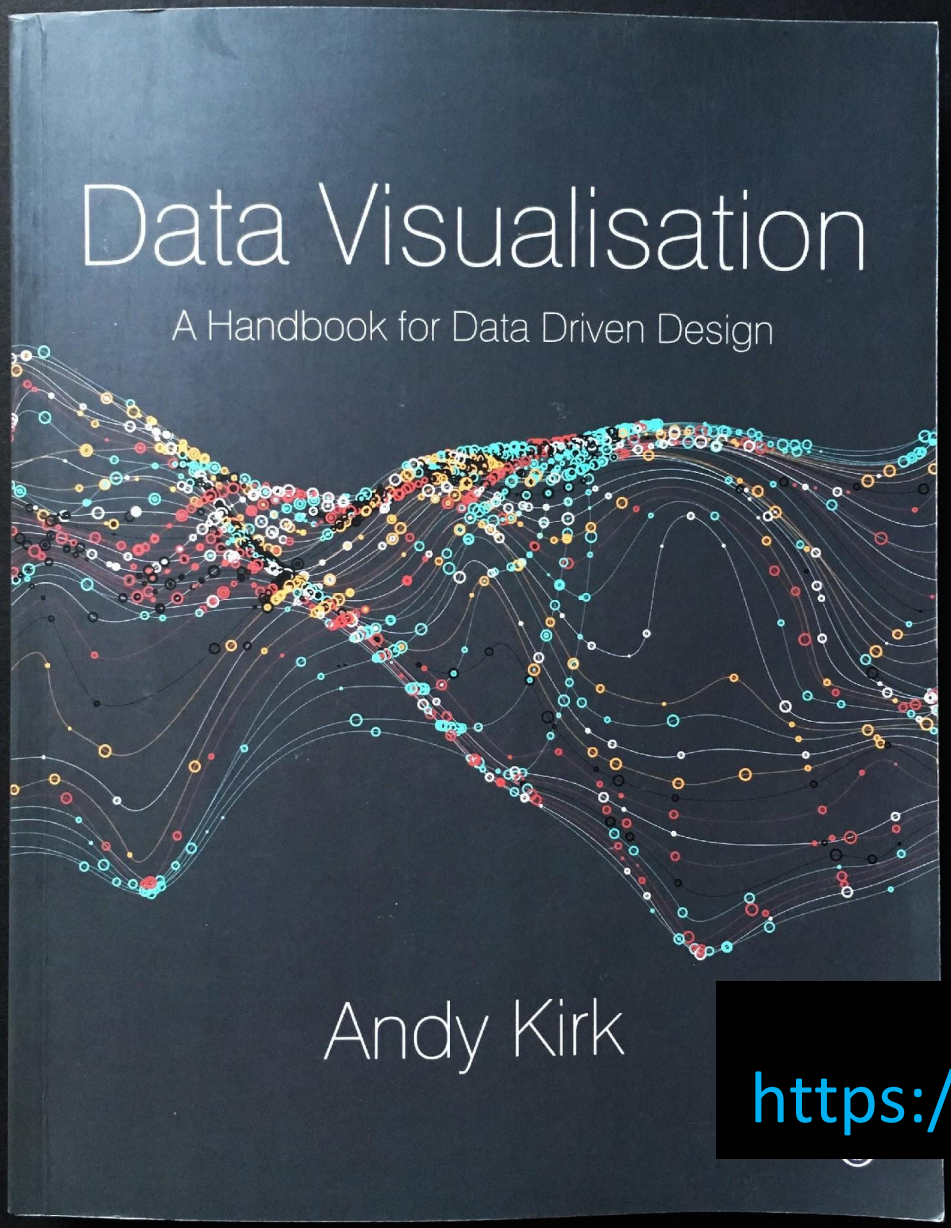
http://bit.ly/Wilke_fundamentals



Cole Nussbaumer Knaflic

http://bit.ly/Knaflic_books

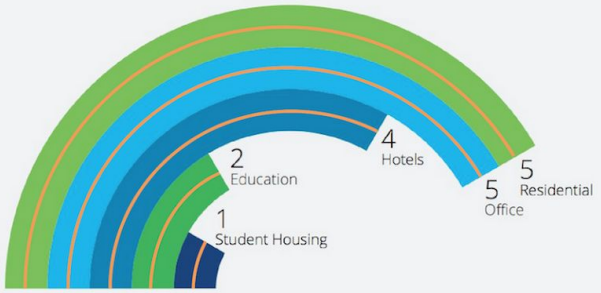
more resources



01 SEP THE PROBLEMS WITH B'ARC CHARTS

ORIGINAL B'ARC CHART

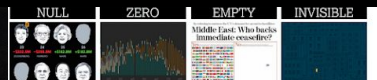
Which sectors are the most active? (Number of schemes under construction)



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

https://www.visualisingdata.com

more resources

CHARTABLE
A blog by Datawrapper

Home
Thoughts & How To's
About Us
Keep me updated
Datawrapper News
Weekly Chart
Changelog

Sep 4, 2020
by Lisa Charlotte Rost

Thoughts & How To's

How to pick more beautiful colors for your data visualizations

Common color mistakes and how to avoid them

Lisa Charlotte Rost
http://bit.ly/Rost_color

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

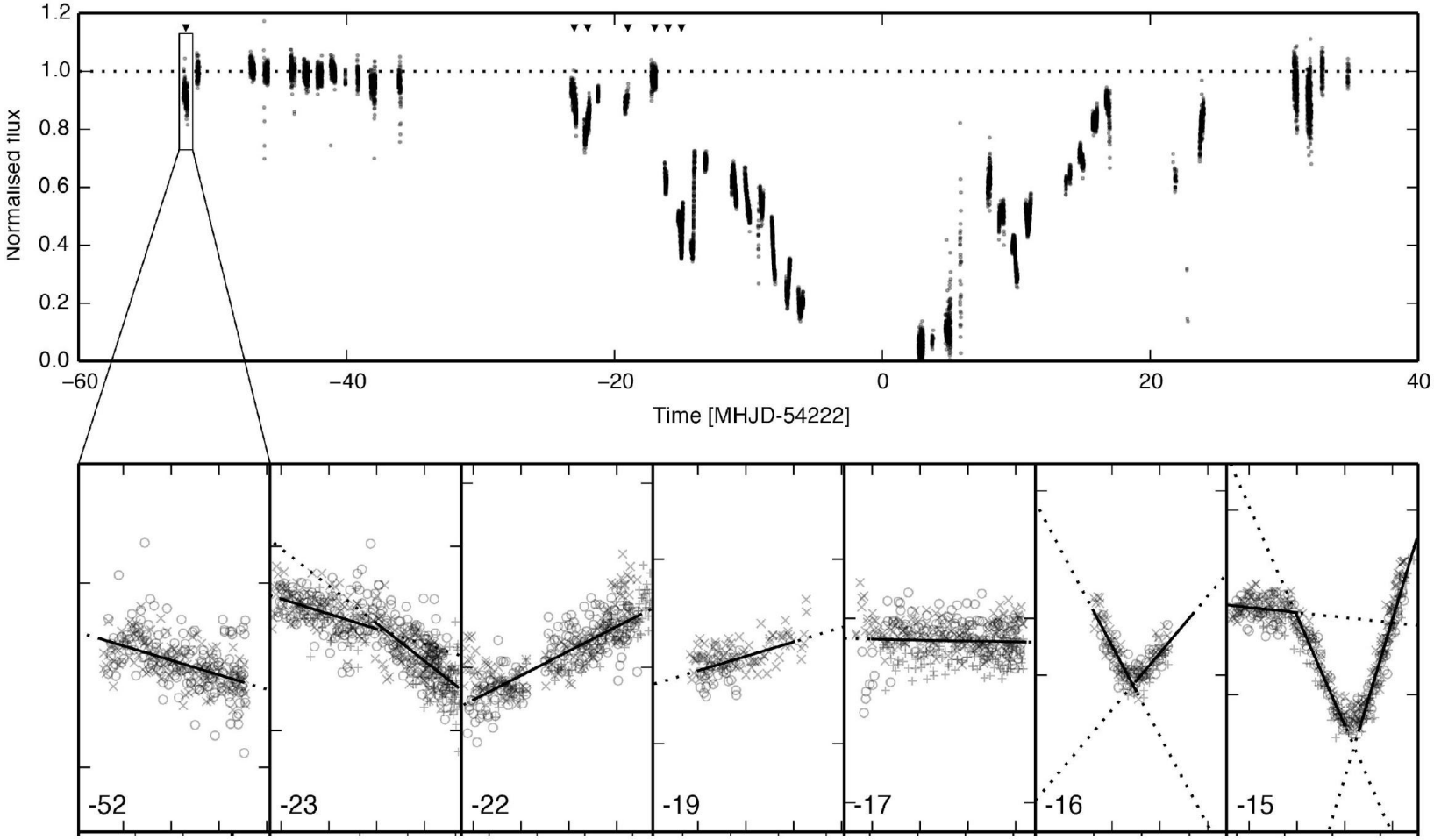


Figure 8. Detailed plot of the J1407 light curve during the eclipse. Top: overview of the light curve. Bottom: nightly light curve for 7 nights during the eclipse, indicated in the upper panel by triangles. The data from the different CCDs are plotted with different symbols, 221: ◯, 227: ×, and 228: +. 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"

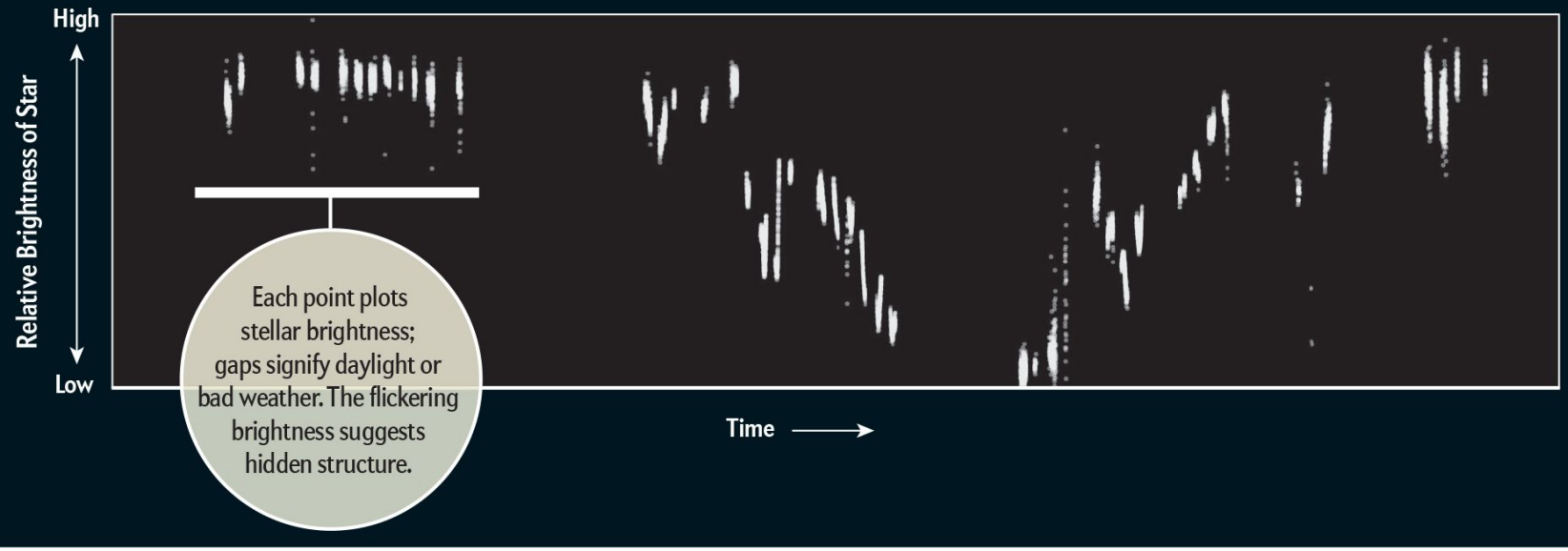
reframing

A MYSTERY OF LIGHT AND SHADOW

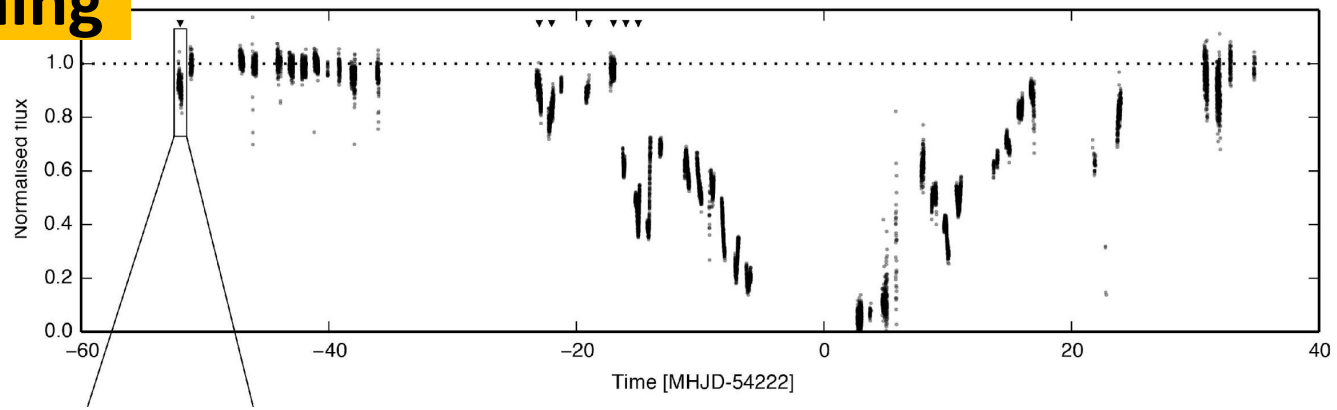
Perplexing Pattern

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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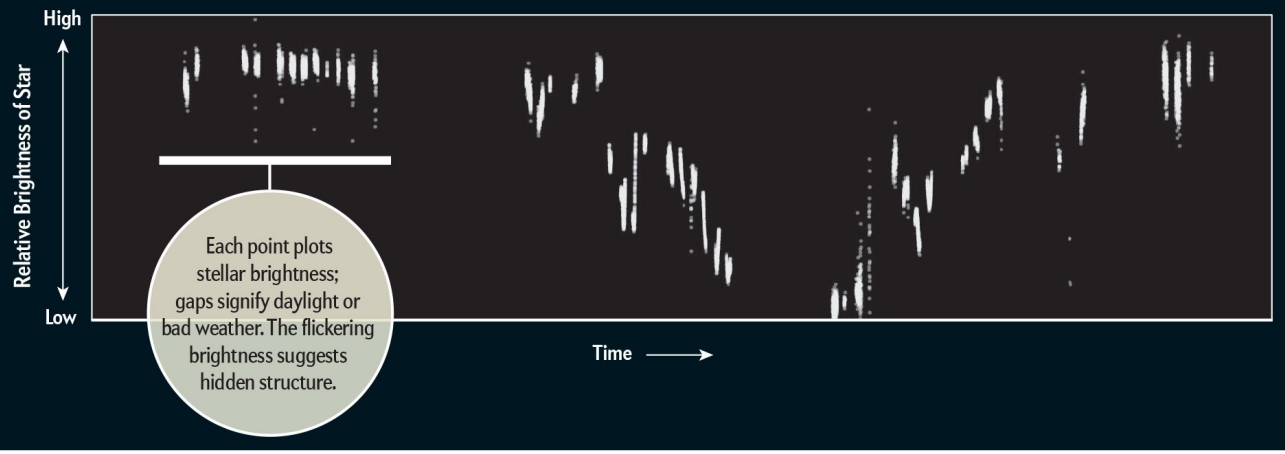

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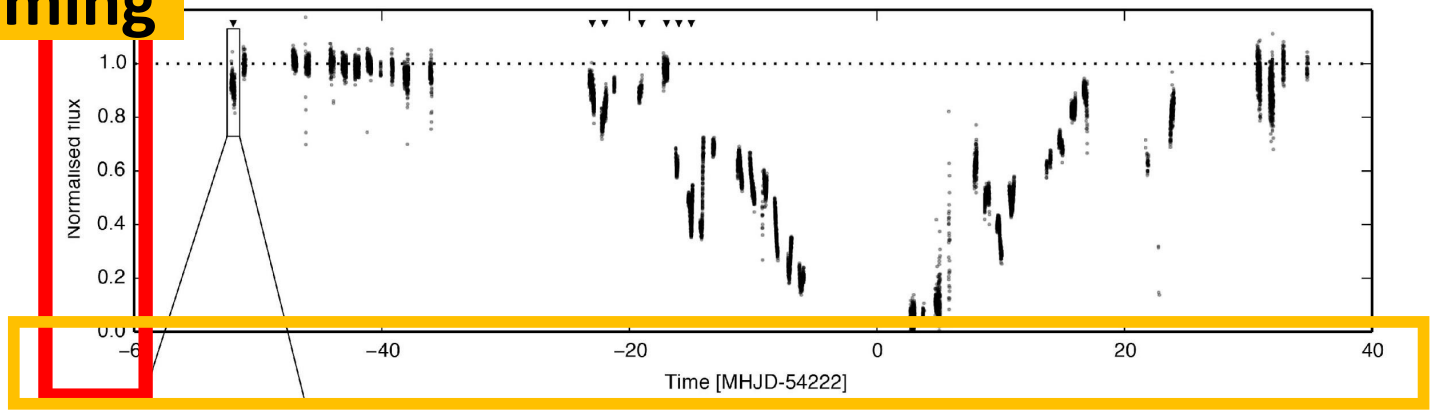

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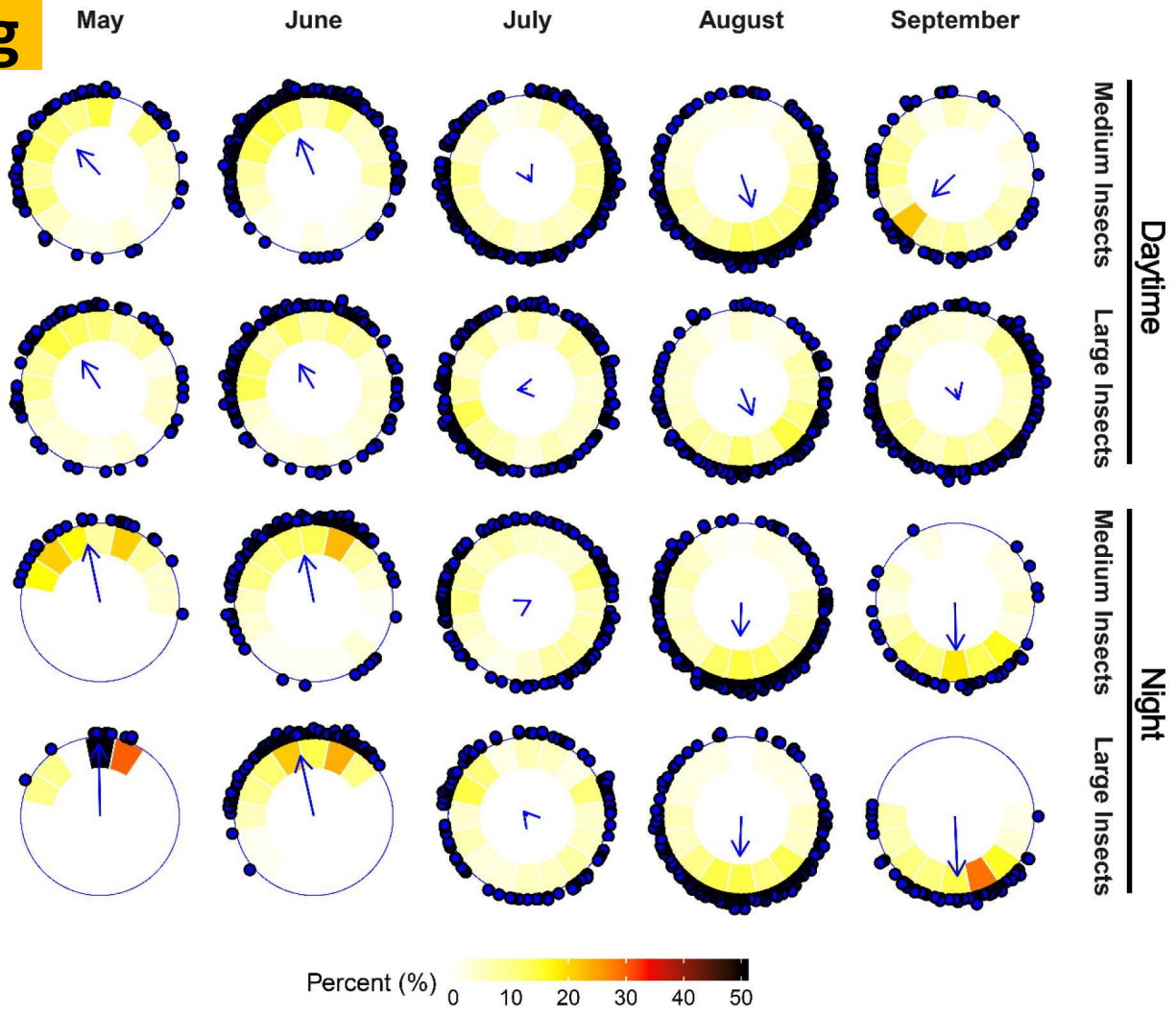


Fig. S2. Monthly track directions of larger insects migrating high above the southern United Kingdom. Migratory tracks of larger insects occurred predominantly in seasonally-beneficial directions in May and June, and in August and September, but were randomly directed in July. Small blue cir
migratio

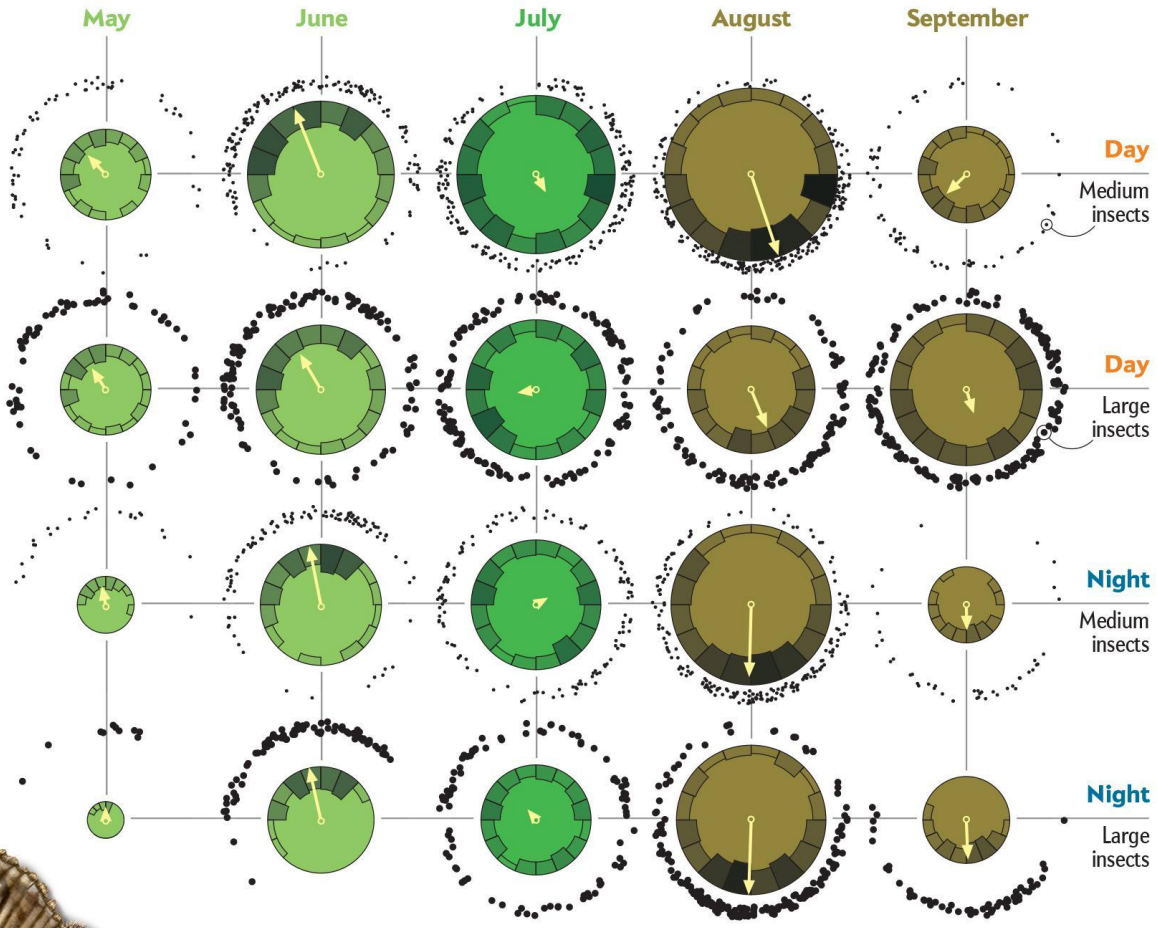
By Gao Hu et al., "Mass seasonal bioflows of high-flying insect migrants"

reframing

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

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.

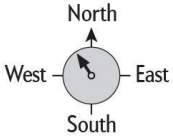


How to Read This Graphic

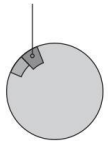
More than 70 percent of migrations occur during daytime (*top two rows*); fewer are at night (*bottom two rows*).

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.

Trillions of Insects Migrate

Surprising data show many species make annual treks

reframing

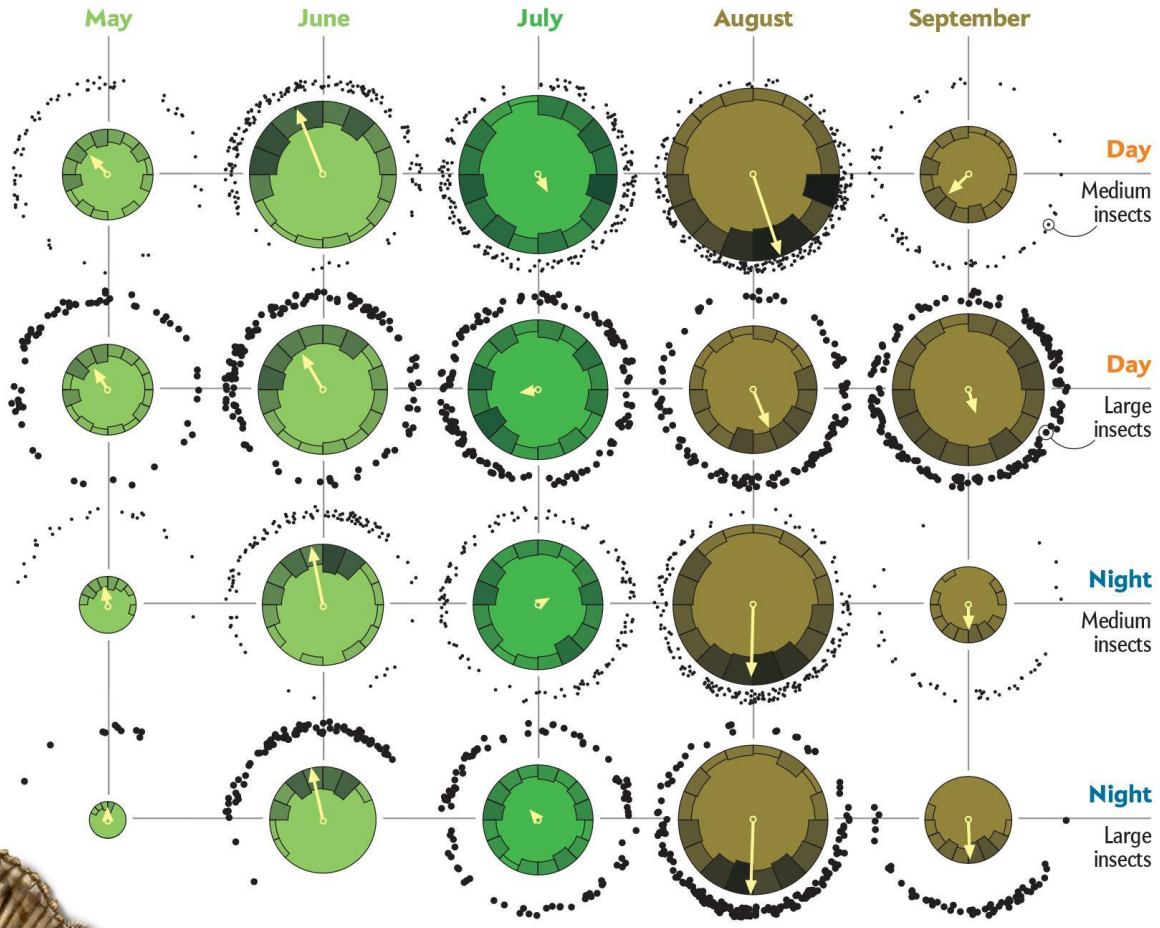
Jan Willem Tulp (charts) and Jessica Huppi (insects)

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.

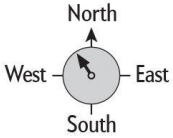


How to Read This Graphic

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.



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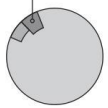

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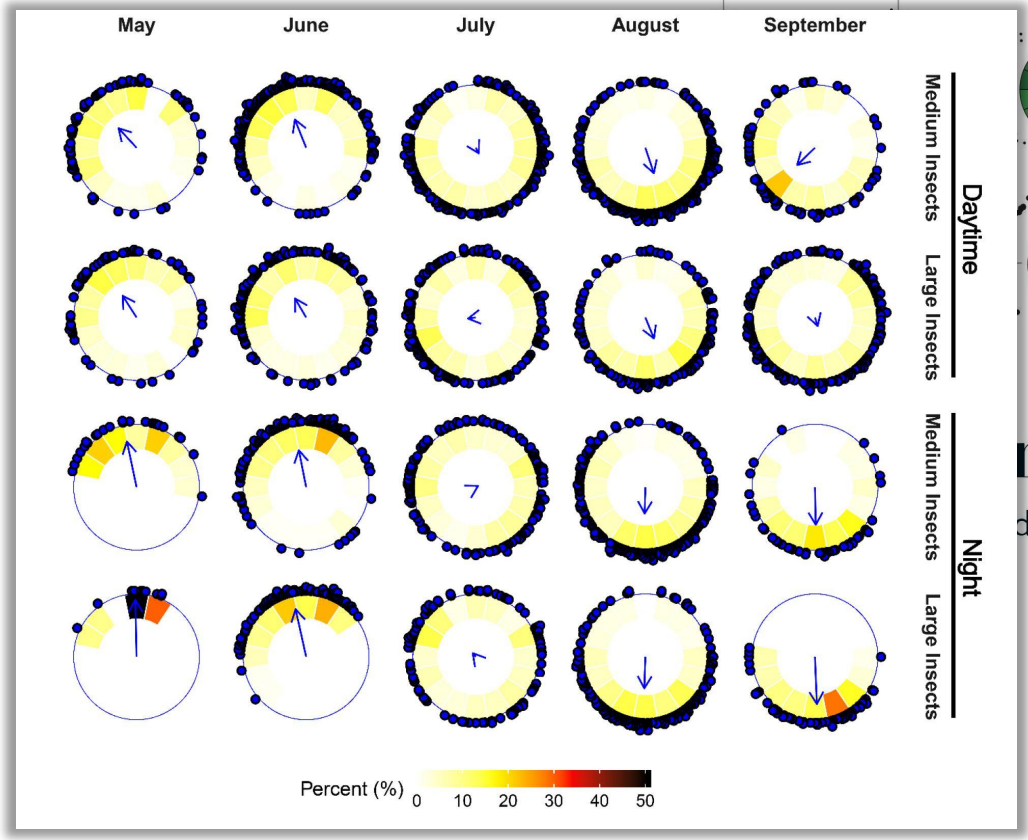

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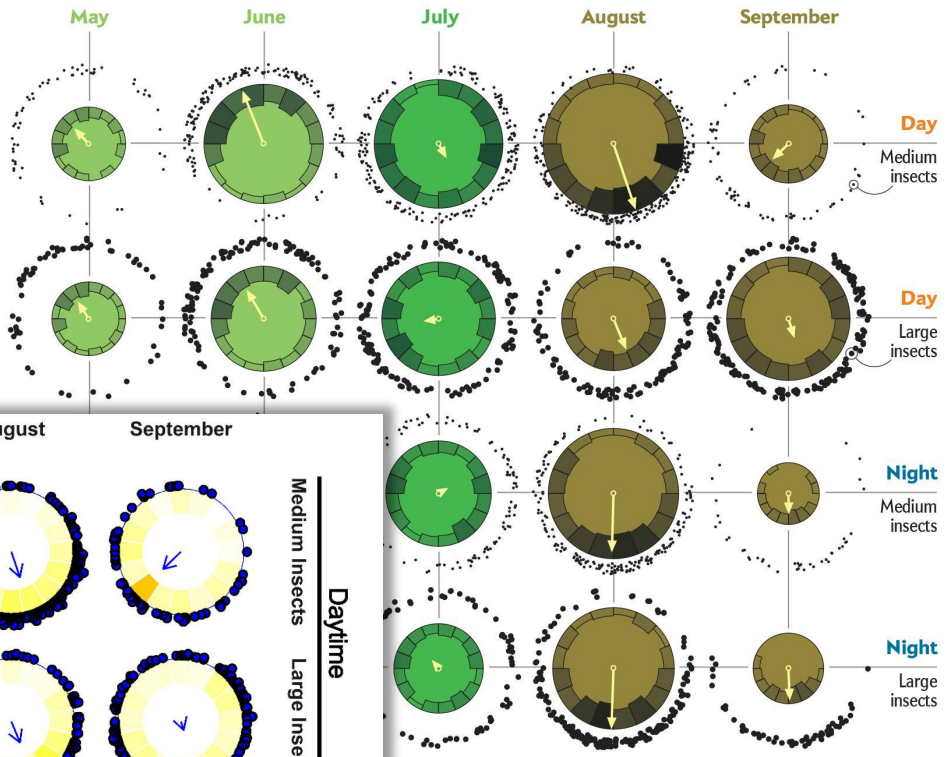

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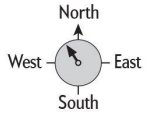

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rework

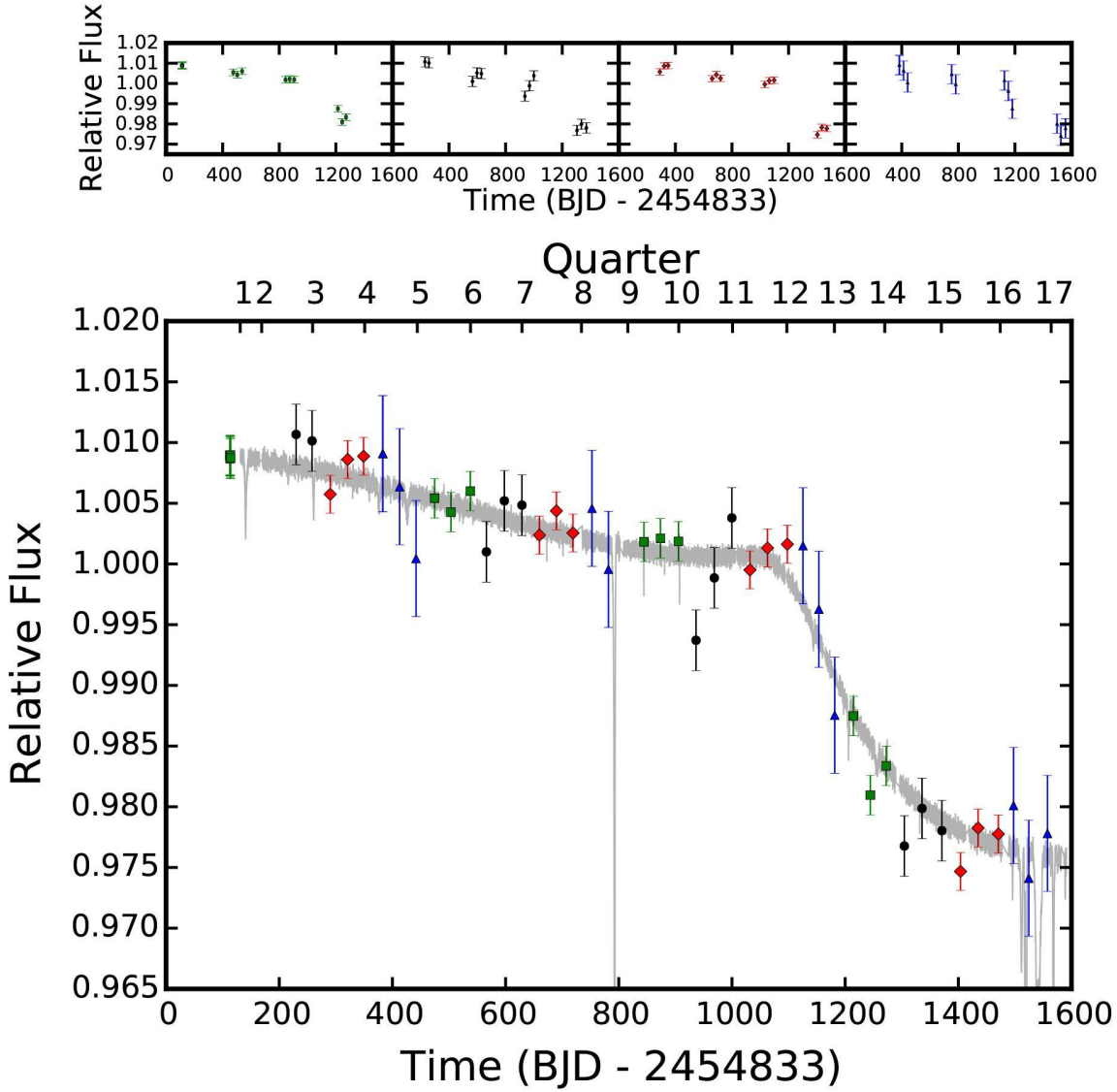


FIG. 3.— Photometry of KIC 8462852 as measured from the FFI data. The four colors and shapes (green squares, black circles, red diamonds, and blue triangles) represent measurements from the four separate channels the starlight reaches as the telescope rolls. The four subpanels show the flux measurements 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%, respectively, to match the red points' level. In all four channels, the photometry is consistent with a rapid decrease in flux of ≈ 2.5%. The light gray curve represents photometry created by fitting a spline to the FFI photometry. Individual data points are visible but narrow relative to the cadence of FFI observations. A machine-readable version of the data is available in the online version of the journal.

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

rework

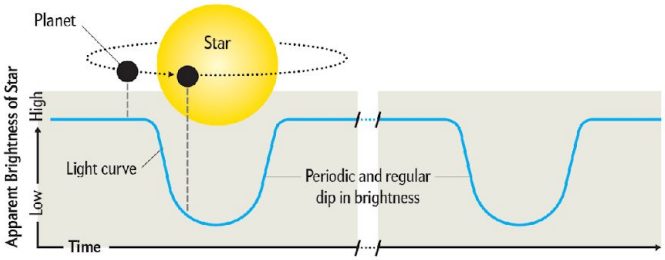
OBSERVATIONS

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.

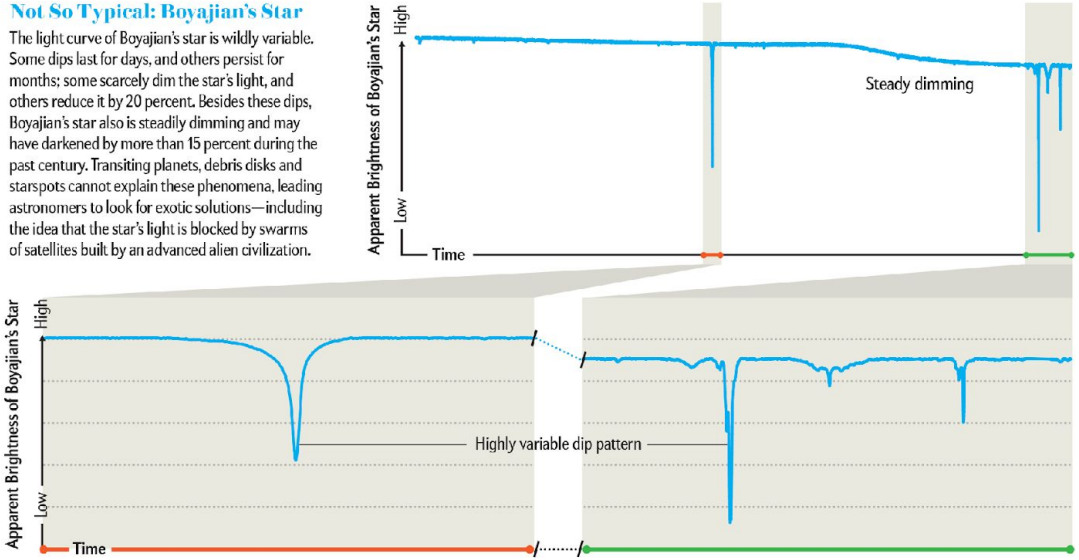
Typical Light Curve

A dimming star can be studied by its light curve—its brightness plotted over time. A planet or disk "transiting" across a star causes a dip in the curve; for planets, this dip recurs every orbital period. Starspots create patterns in light curves based on a star's rotation rate and activity cycle.



Not So Typical: Boyajian's Star

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

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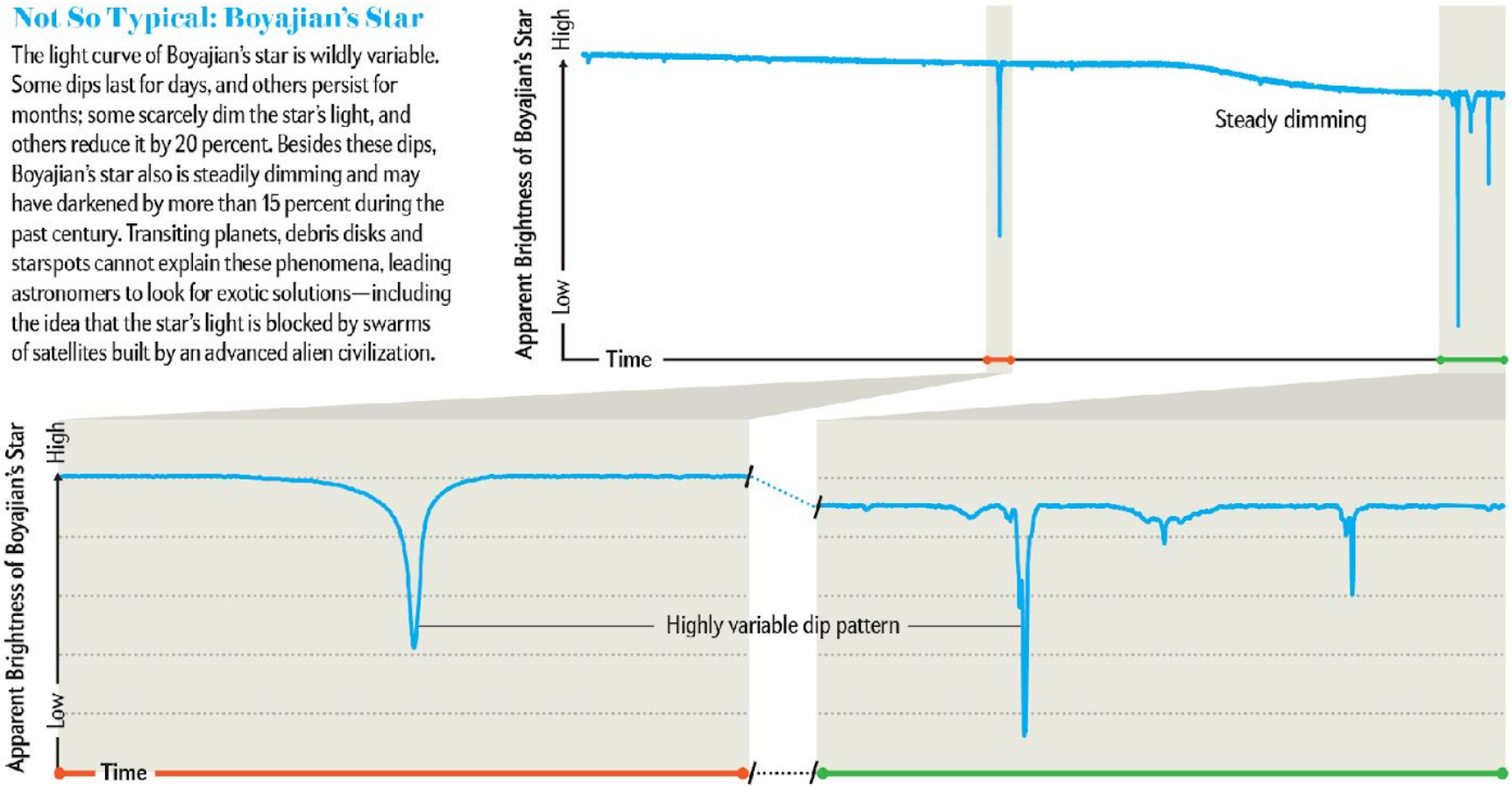

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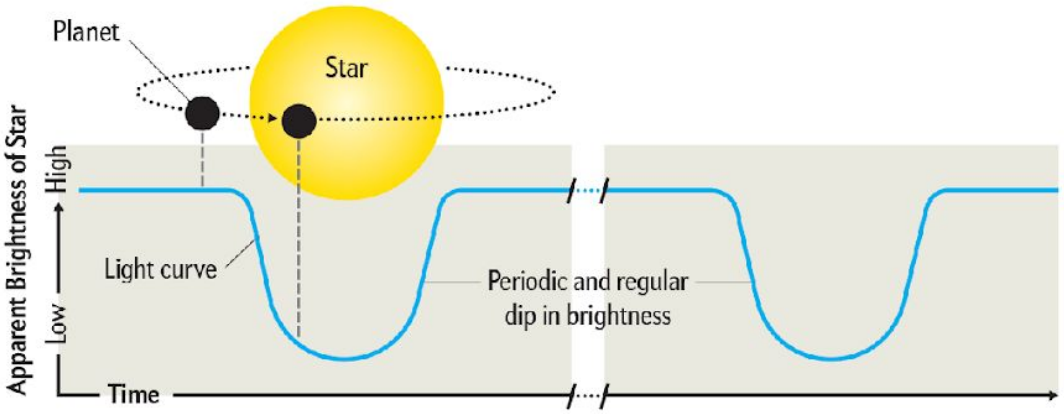

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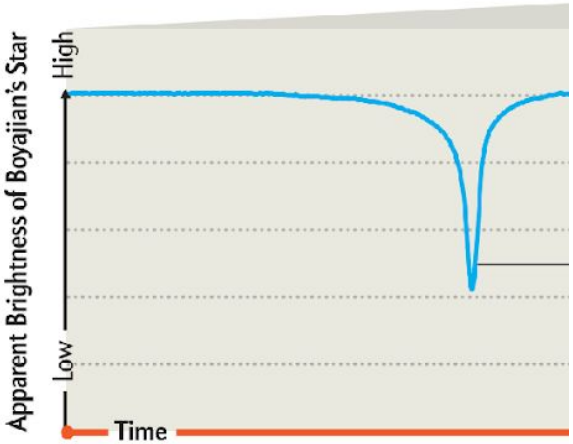

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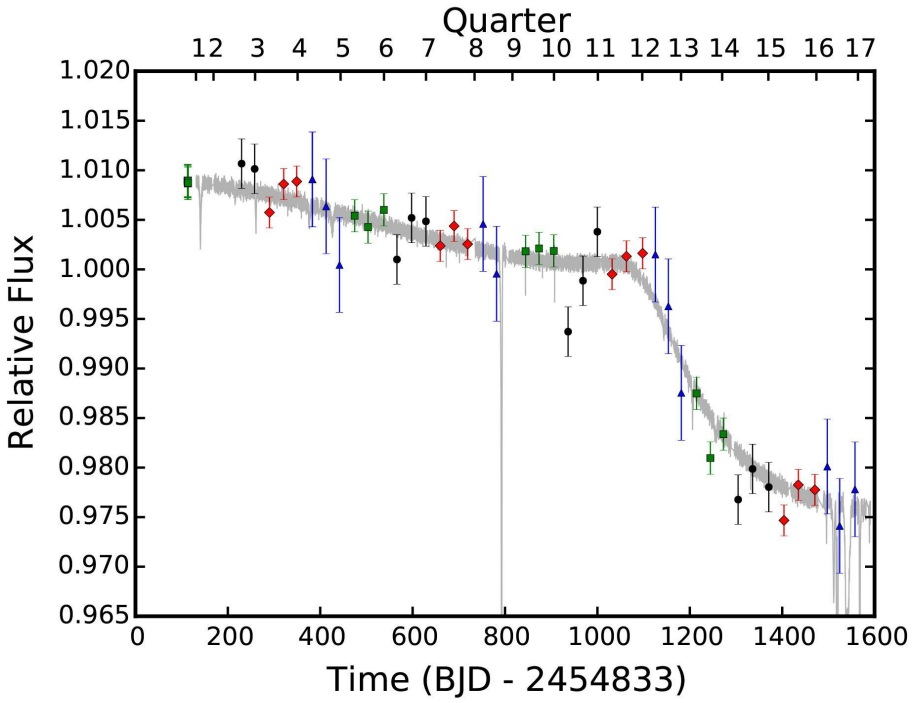

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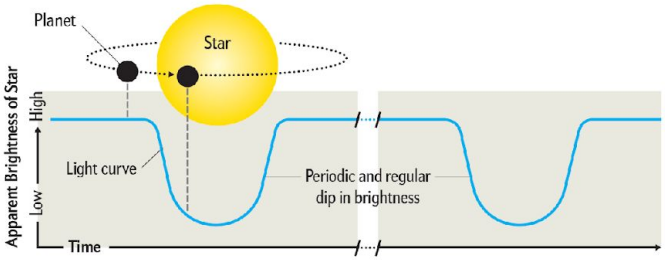

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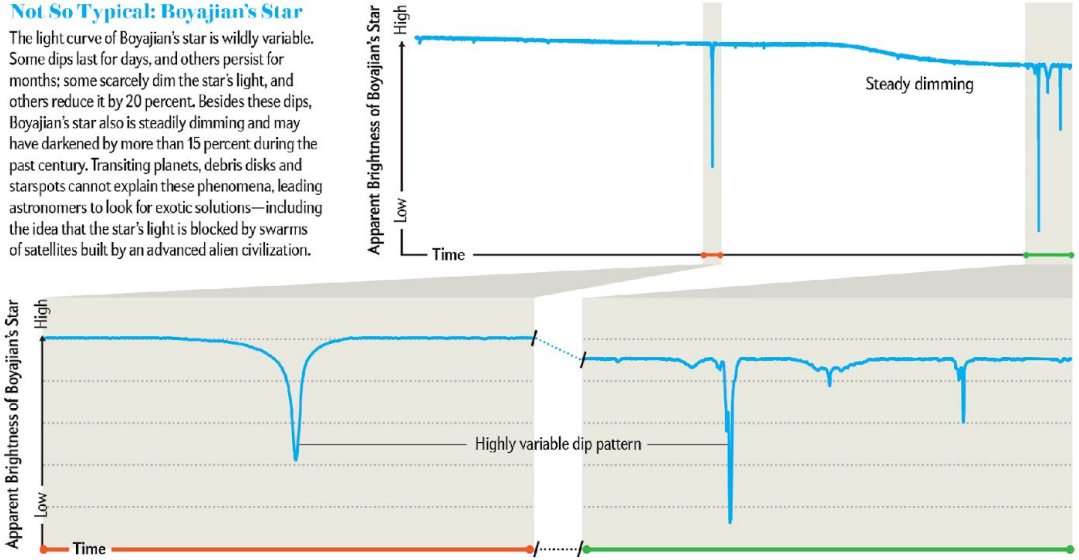

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custom

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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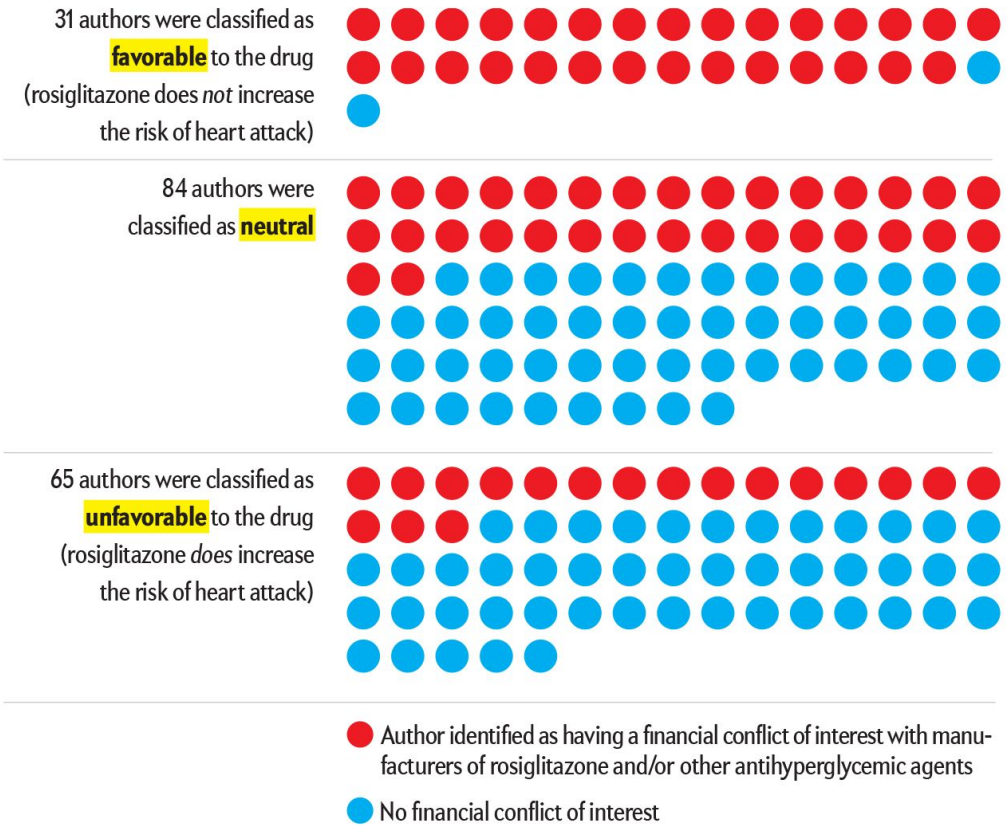
Case Study: Conflicting Interests

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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DRUG SAFETY

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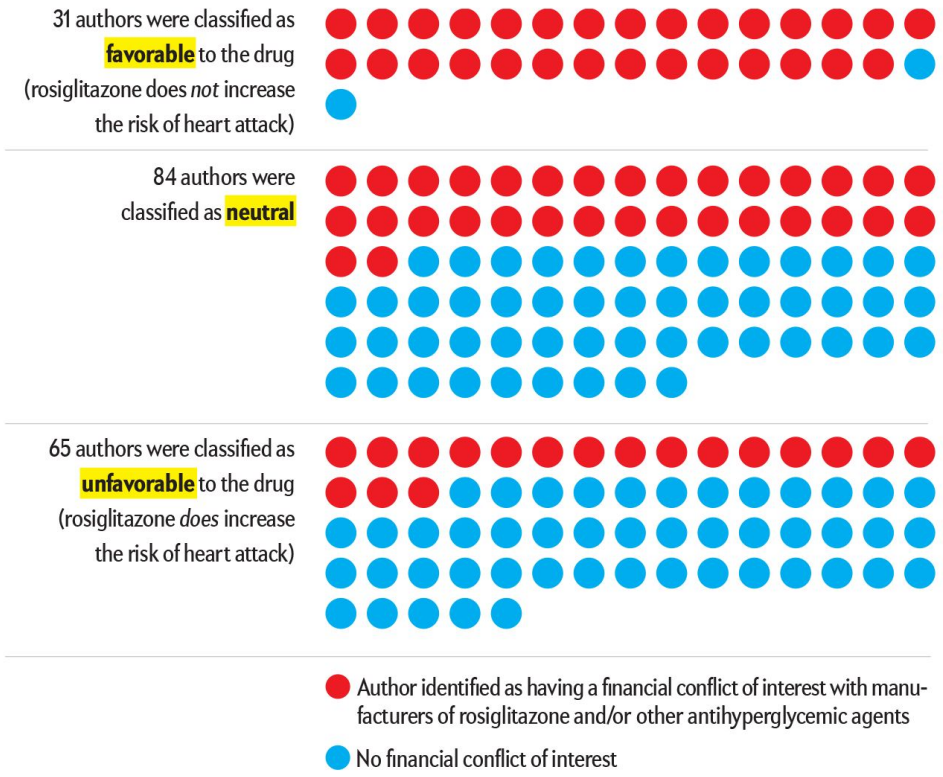


custom

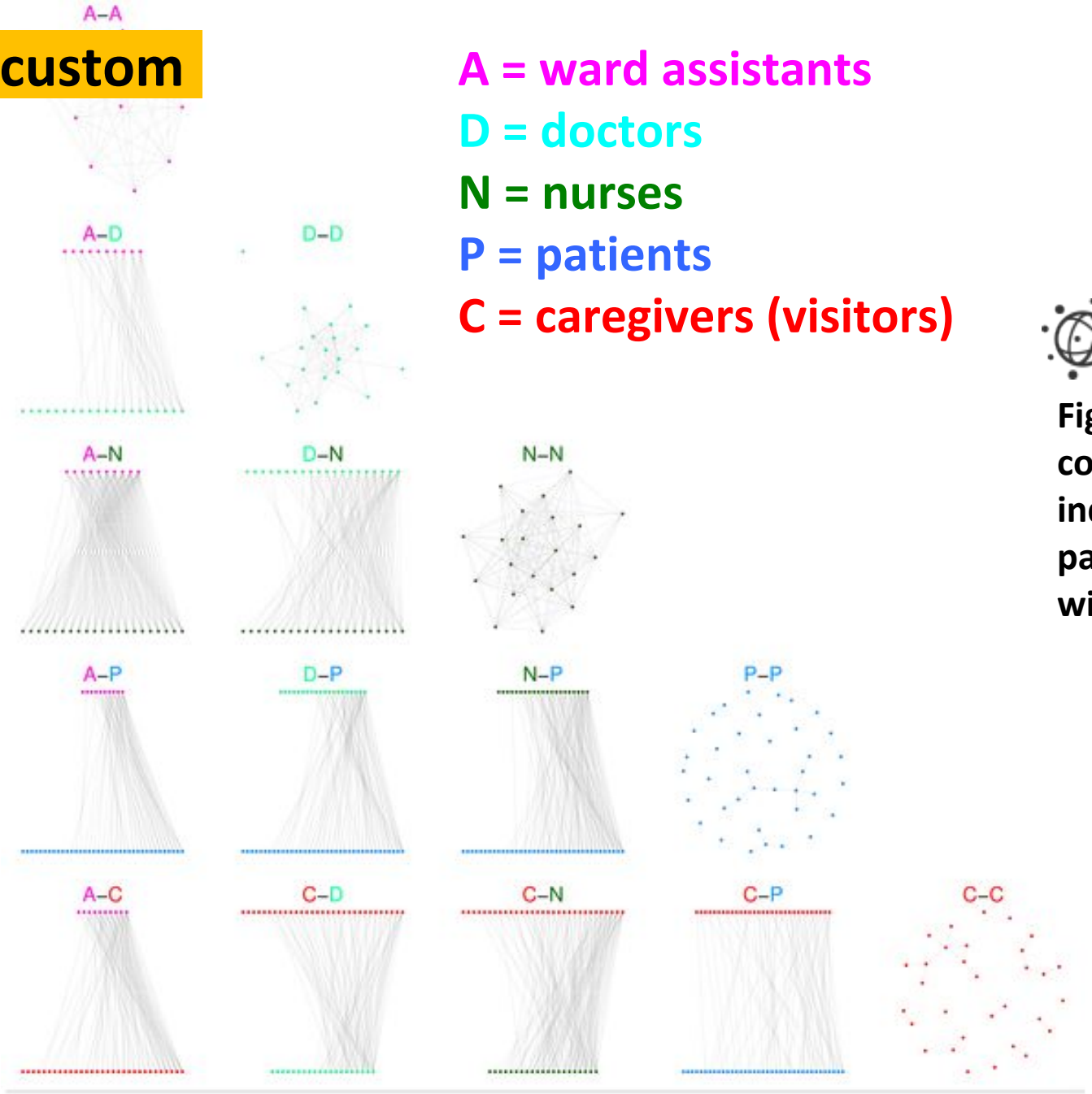
A = ward assistants

D = doctors

N = nurses

P = patients

C = caregivers (visitors)

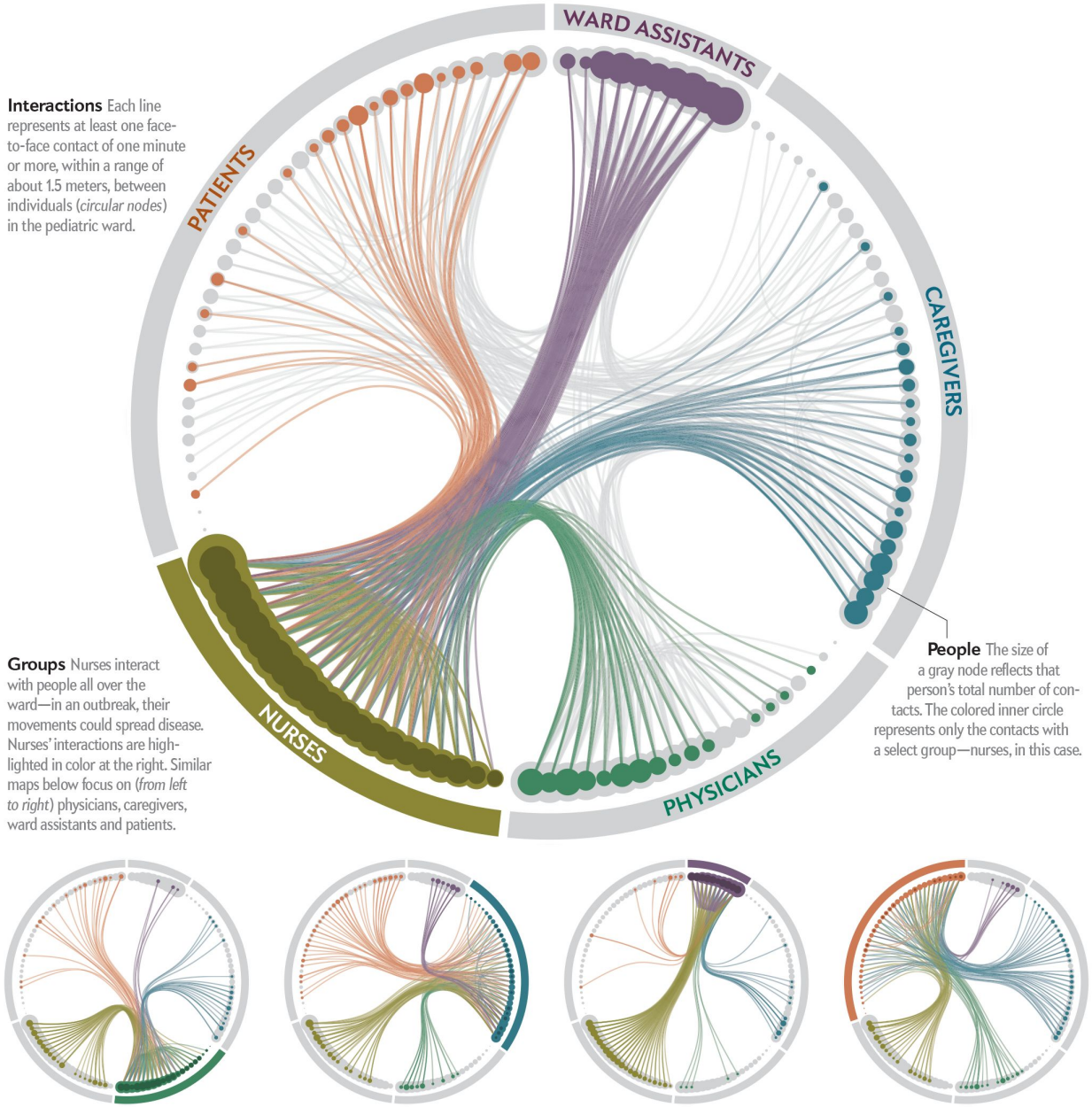


PLOS ONE

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

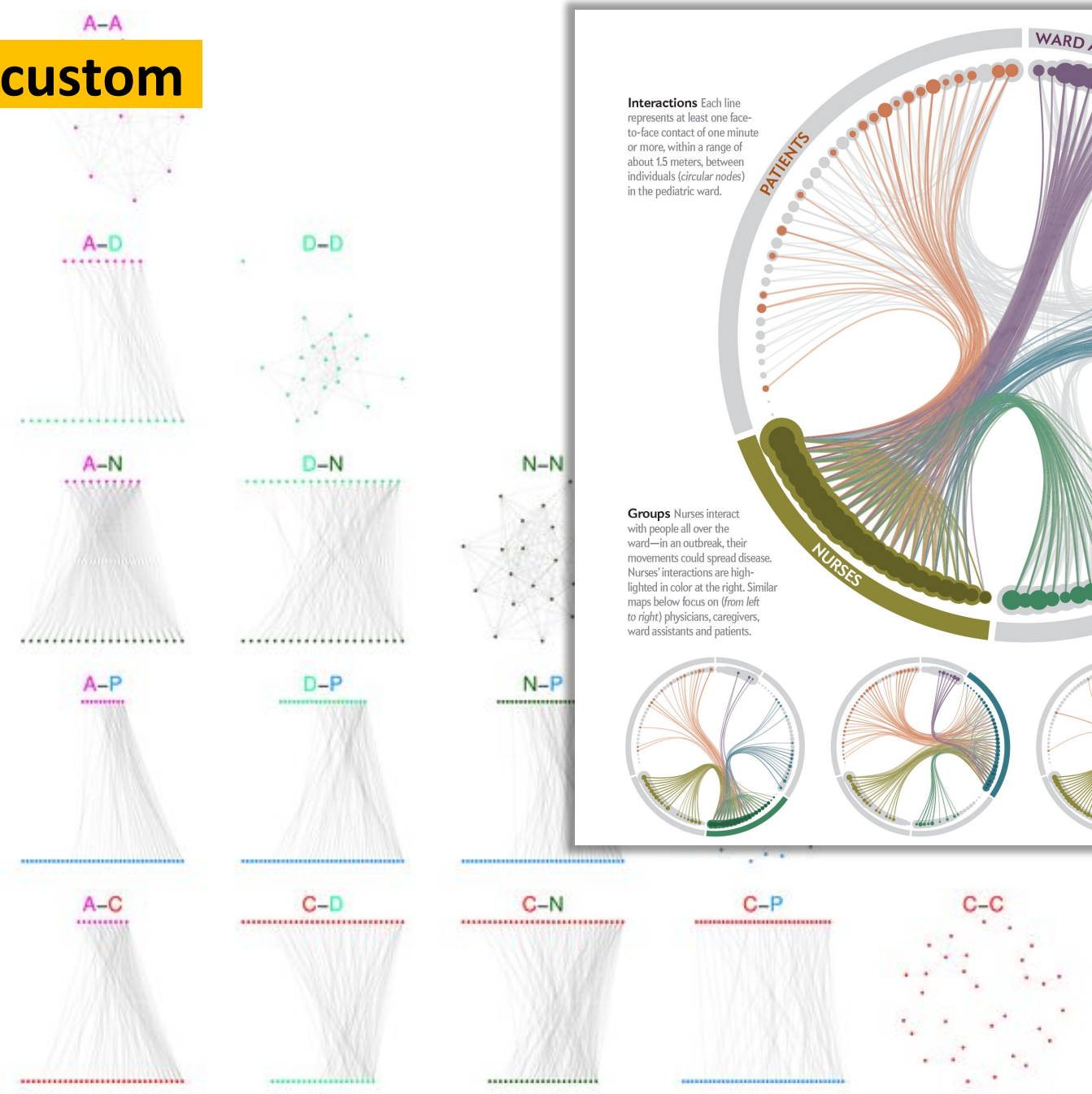


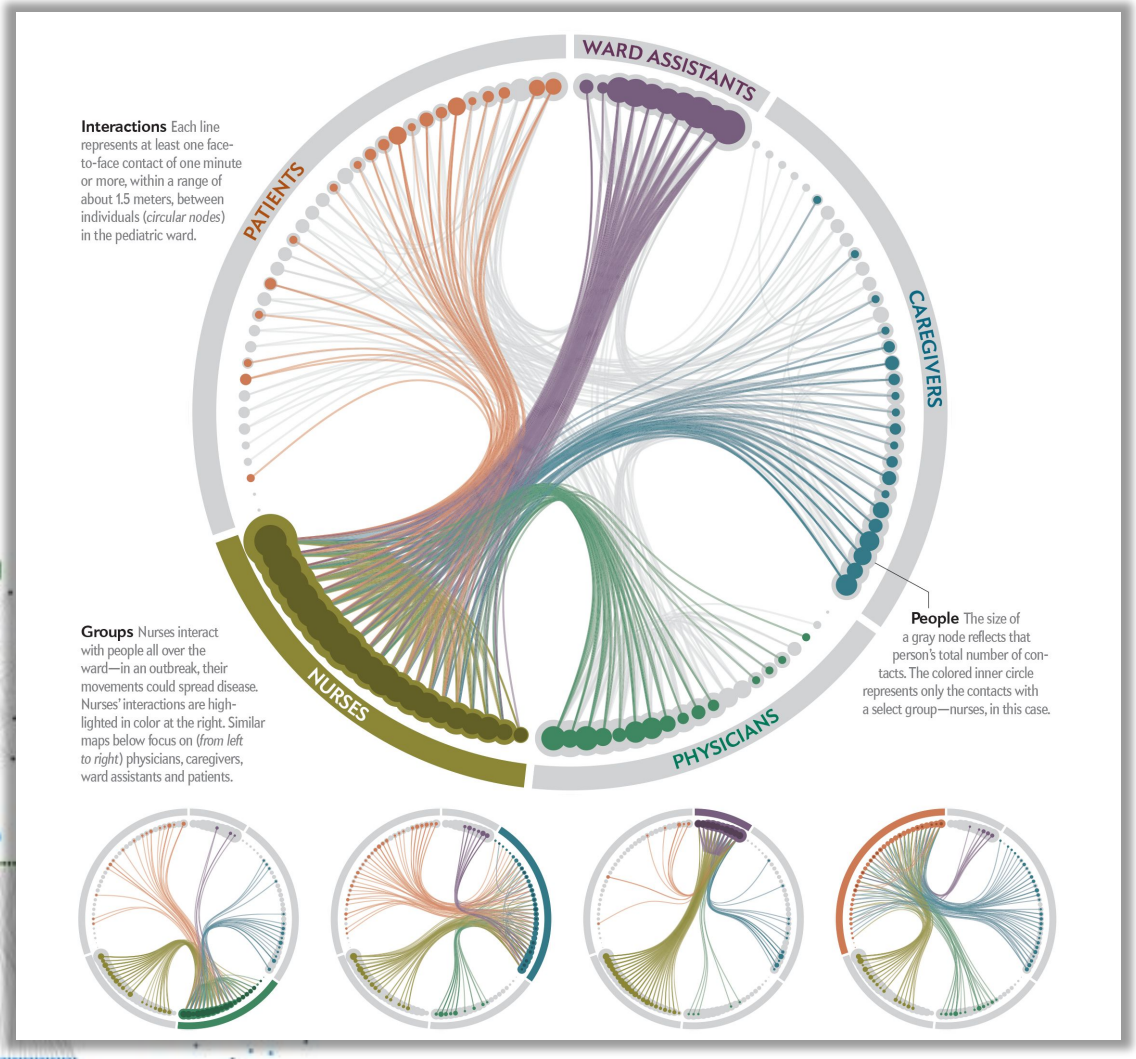
Tag—You're Sick

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
CAREGIVERS
PHYSICIANS
NURSES
PATIENTS
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]

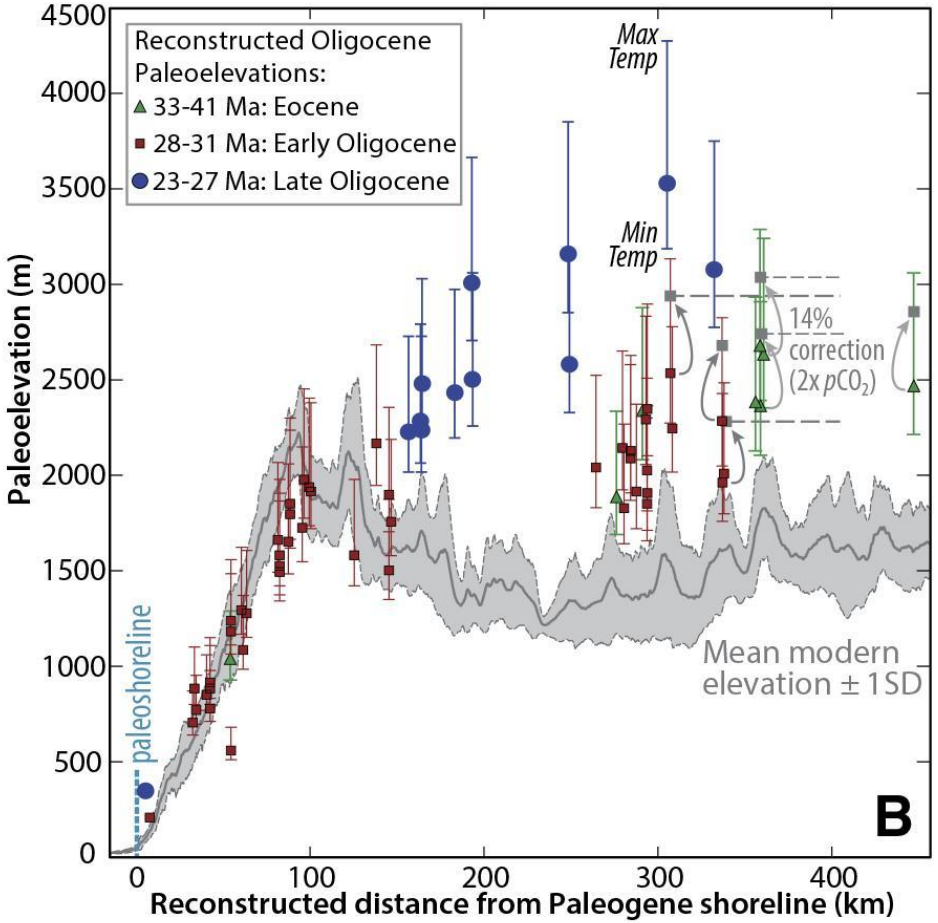
How to proceed?

customizing for a different [context]

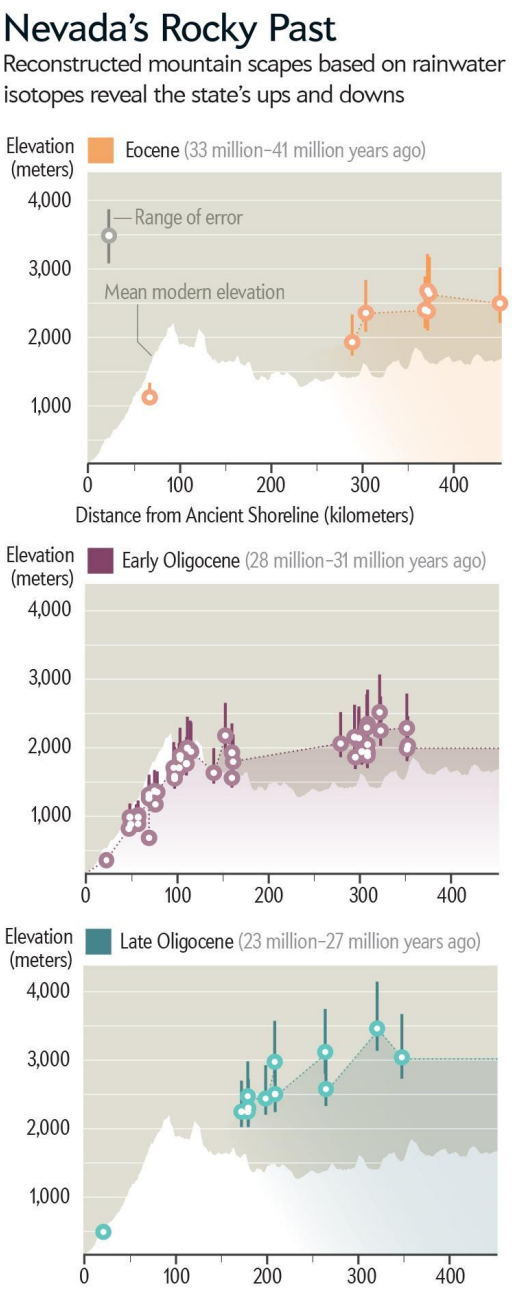
How to proceed?

- build in time for many iterations

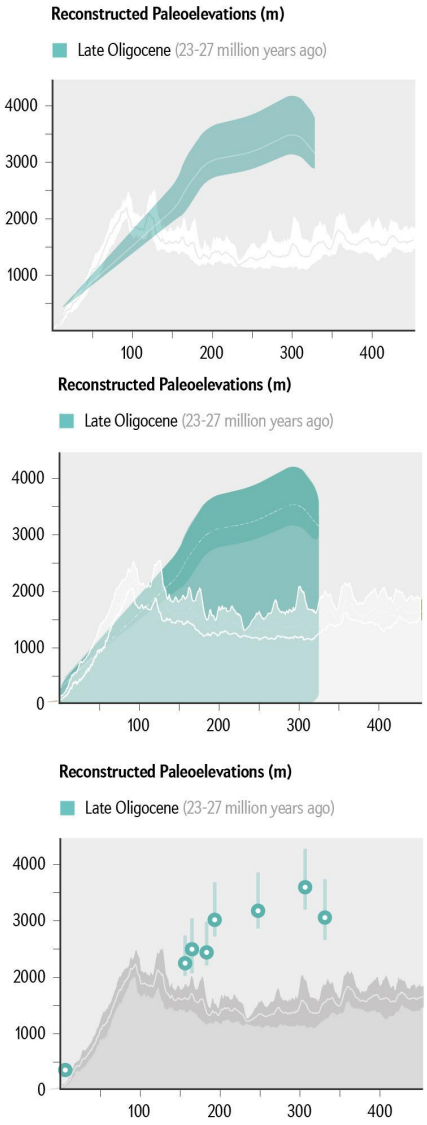
rework

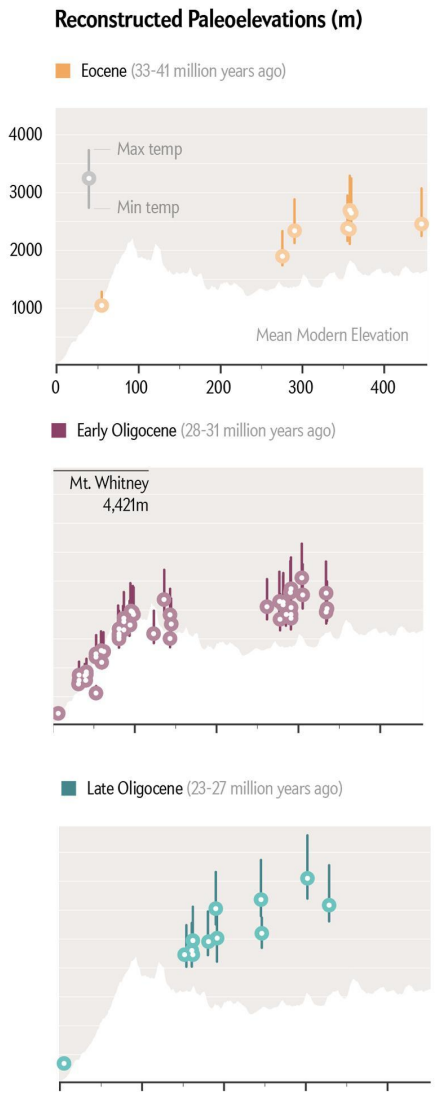


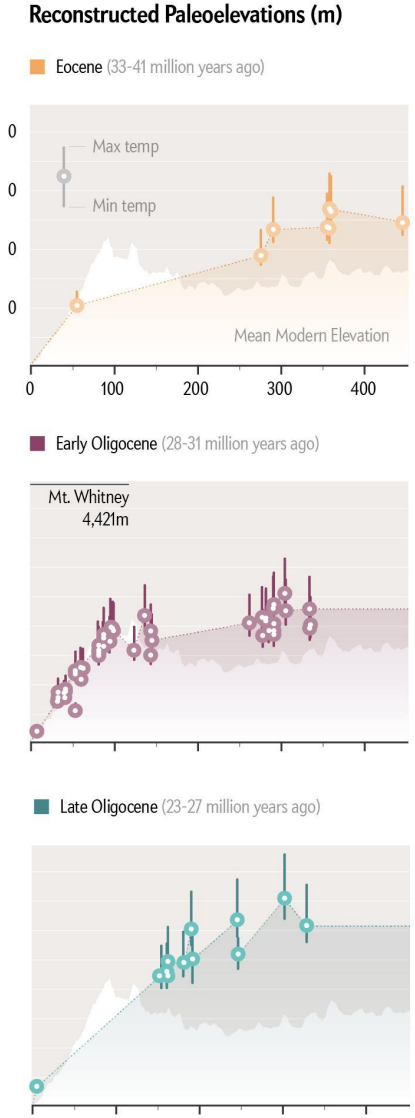
By Elizabeth J. Cassel et al., "Profile of a paleo-orogen: High topography across the present-day Basin and Range from 40 to 23 Ma"

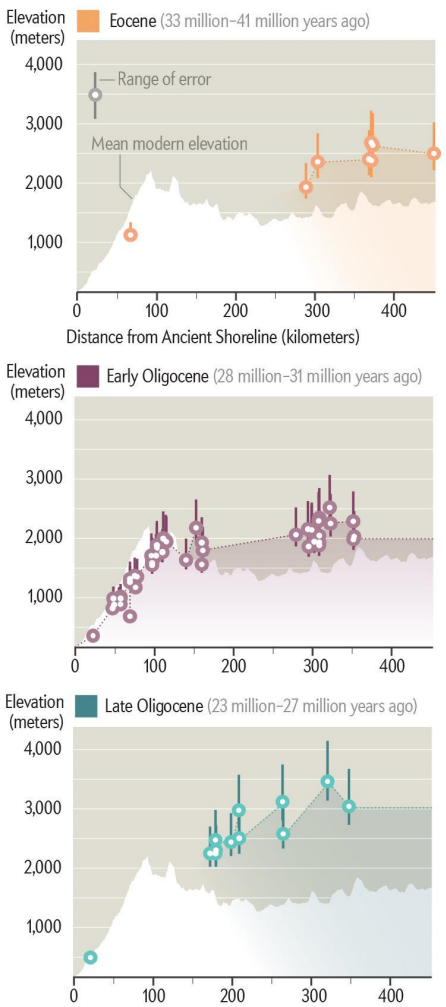


Tiffany Farrant-Gonzalez









Tiffany Farrant-Gonzalez

customizing for a different [context]

How to proceed?

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

continues. "To study a human disease, you have to start with the human body. In traditional Chinese medicine, there's never a lab animal. You never hear of a traditional Chinese doctor with 200 mice."

DR. JIA

Jia has no special affinity for cancer research. He's never lost a loved one to the disease and never thought about it more than anyone else until his research led him to believe he might be able to help create a better understanding of it.

China, he says, never had much of a cancer problem until recent decades, something he attributes to dietary, lifestyle and environmental changes.

"It's the only way to explain it," he says. "Prostate cancer was almost zero. The Chinese used to eat a lot of soybeans, which suppressed prostate cancer."

But the Westernization of the Chinese diet and lifestyle, as well as deteriorating environmental conditions, he says, have caused many cancer rates to "skyrocket."

Jia came to the States in the late 1980s to get his master's and doctoral degrees from the University of Missouri. He returned to China for 10 years and moved to North Carolina in 2008.

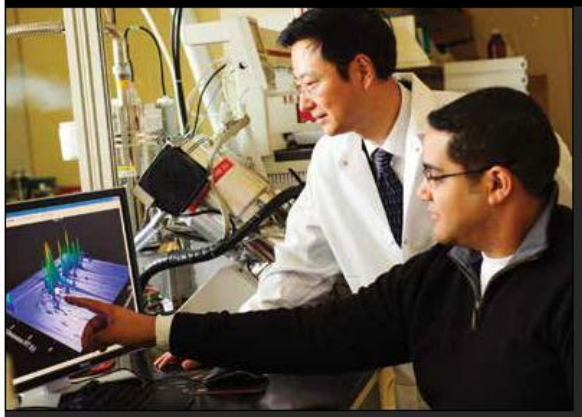
On a recent trip to his home city of Shanghai, he was struck not just by the differences between his home city, the largest in the world with 23 million people, and Kannapolis, where he now resides with about 42,000 others, but also the increasing ubiquity of the Western diet.

At a spring festival several years ago, he saw a queue nearly half a mile long outside an American fast-food restaurant.

"I was so impressed," he says. "Confused as well. There are long lines for Pizza Hut and KFC. You never see those long lines in front of a traditional Chinese restaurant."

THE CURE

Cancer affects this country like a plague. Last year, almost 1.6 million Americans were diagnosed with some form of the disease.



ABOVE, *Wei Jia looks over student's research. Jia is comparing the metabolites of healthy subjects against the ones with cancer. Such an approach – starting with humans – is different from what many researchers have done over the last 50 years.*

It claimed more than half a million American lives in 2011.

Jia and his team are not looking for a cure.

"Not yet," he says.

They are trying to understand cancer metabolism and what causes cancer to grow.

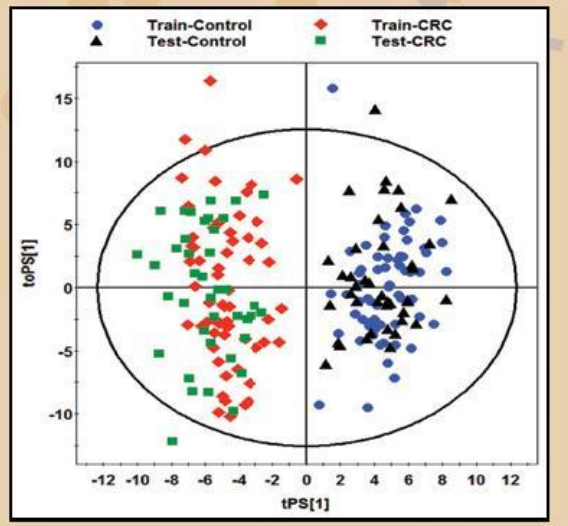
"We are looking for metabolic defects," he says. "The next step is to evaluate dietary influences, the effects of nutraceuticals and pharmaceuticals to correct these defects."

He's already identified several important biomarkers for colorectal cancer patients and filed patents for his – and, ultimately, the university's – discoveries. Breast cancer, which claimed 40,000 lives in the US last year, is in his sights.

"When we build a platform of technology, you always want to have an application. My goal is to make something usable in a clinic. I think I'm pretty close."

BELOW, *is an example of some of Jia's work on detecting colorectal cancer through a urine test. His research has found a panel of metabolite markers that make it possible to discriminate between those with colorectal cancer and those without.*

DISTINCT URINARY METABOLIC PROFILE OF HUMAN COLORECTAL CANCER



Urinary metabolomic study of CRC patients (n=101, Healthy control subjects n=103)

The scores plot of the OPLS-DA prediction model of colorectal cancer (CRC). An OPLS-DA model was constructed using data from 62 healthy controls (blue dots) and 61 CRC patients (red diamonds) (the "training set"); this model was then used to predict CRC of a further 81 samples including 41 healthy controls (black triangles) and 40 CRC patients (green boxes) that were not used in the construction of the model (the "testing set").

In *UNCG Research* (research magazine from The University of North Carolina at Greensboro); Representing the work of Yu Cheng et al., from "Distinct Urinary Metabolic Profile of Human Colorectal Cancer"

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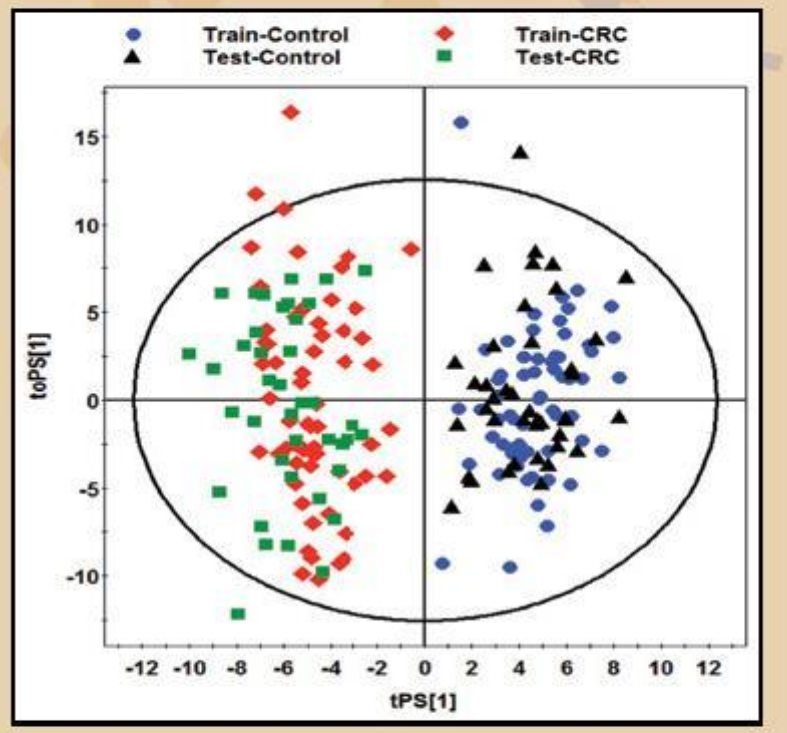

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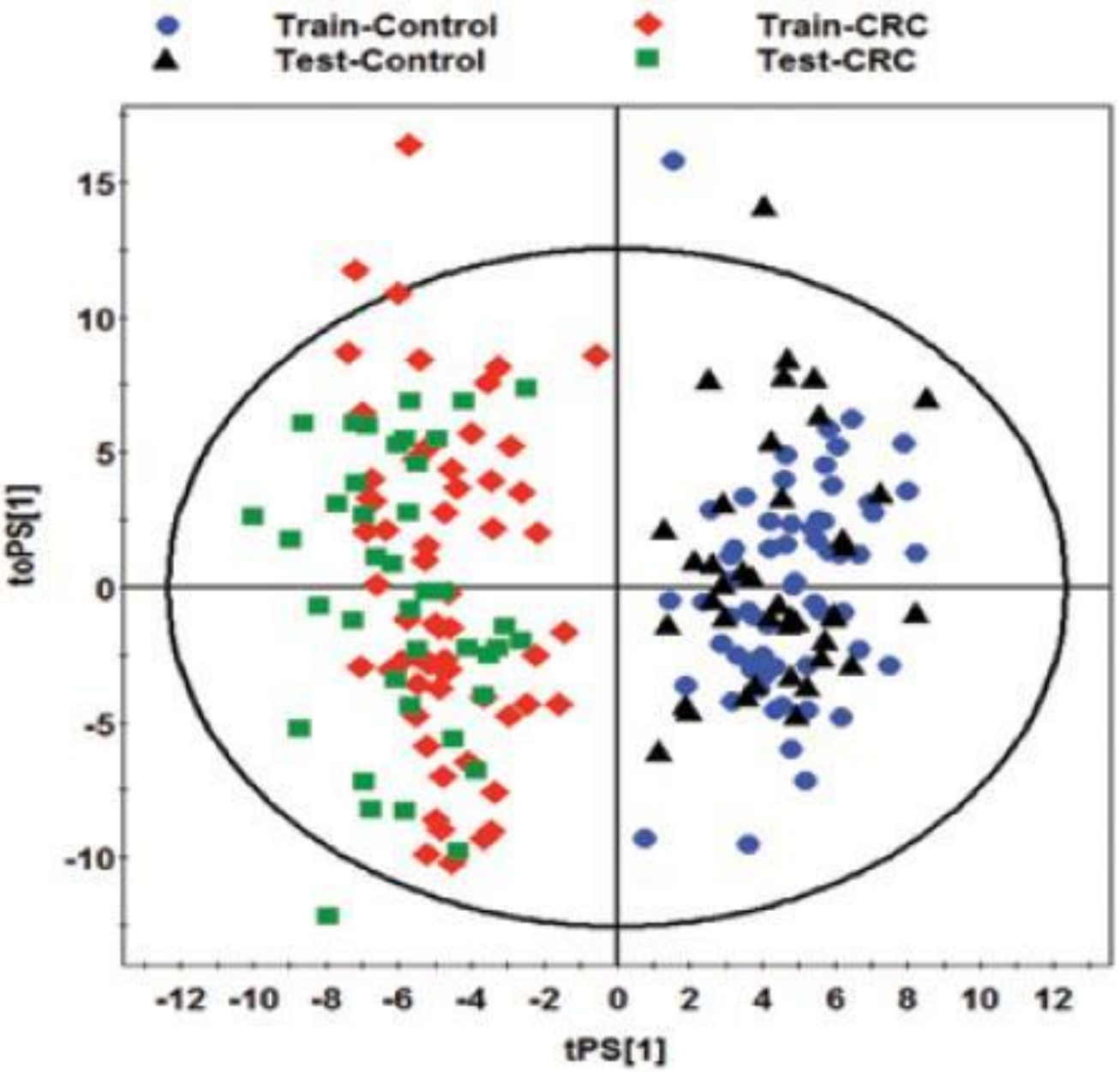

By Yu Cheng et al., “Distinct Urinary Metabolic Profile of Human Colorectal Cancer”

Detecting cancer through urine tests

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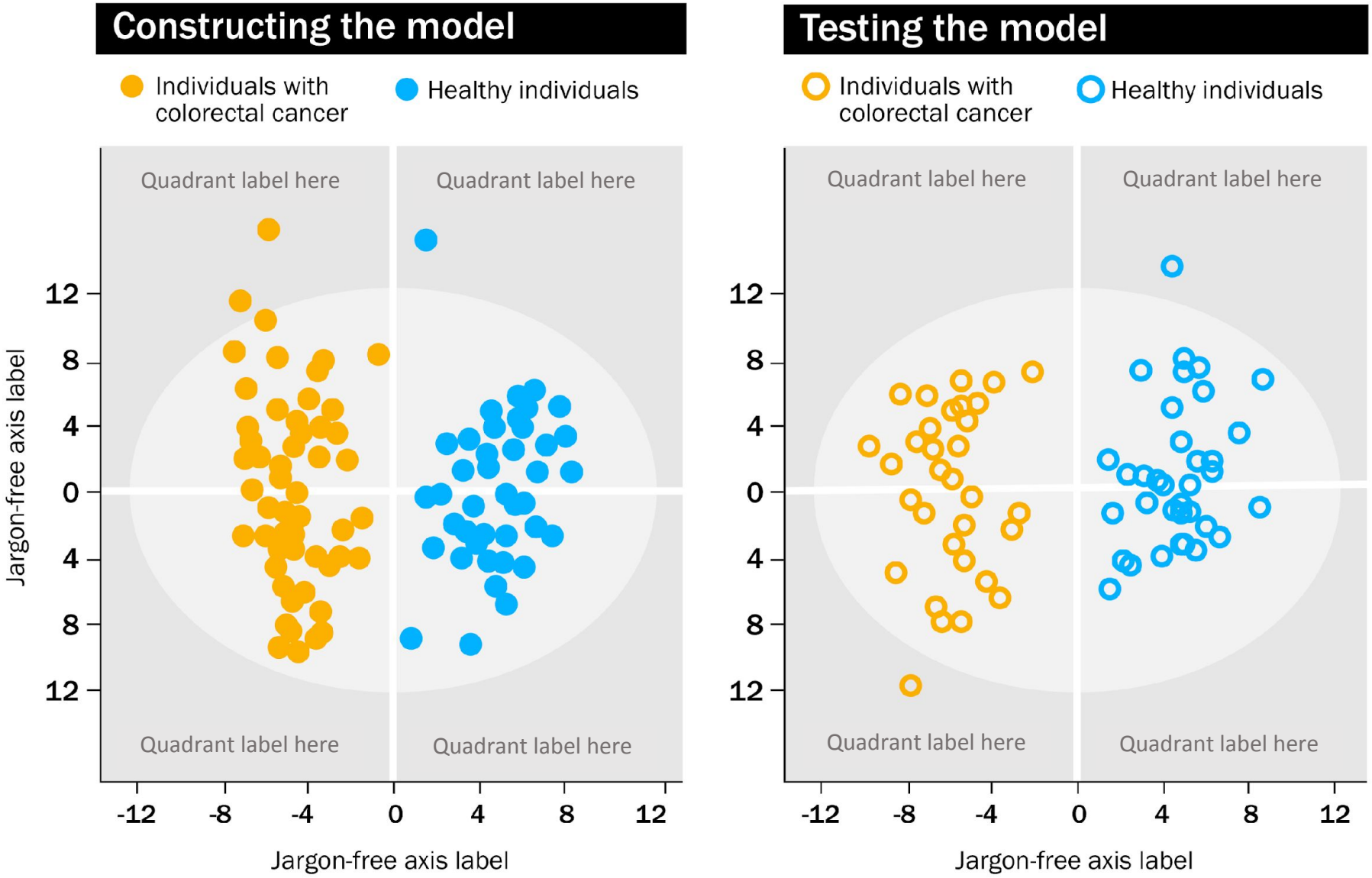

customizing for a different [context]

How to proceed?

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

“for whom and why?”

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