

Tracking how Covid-19 preprints spread across Twitter

*Finding the story: a process of data wrangling,
exploration, vetting, merging and visualization*

Aleszu Bajak
Science and data journalist
Northeastern University's School of Journalism
Twitter: @aleszubajak
aleszu.com

Opinion

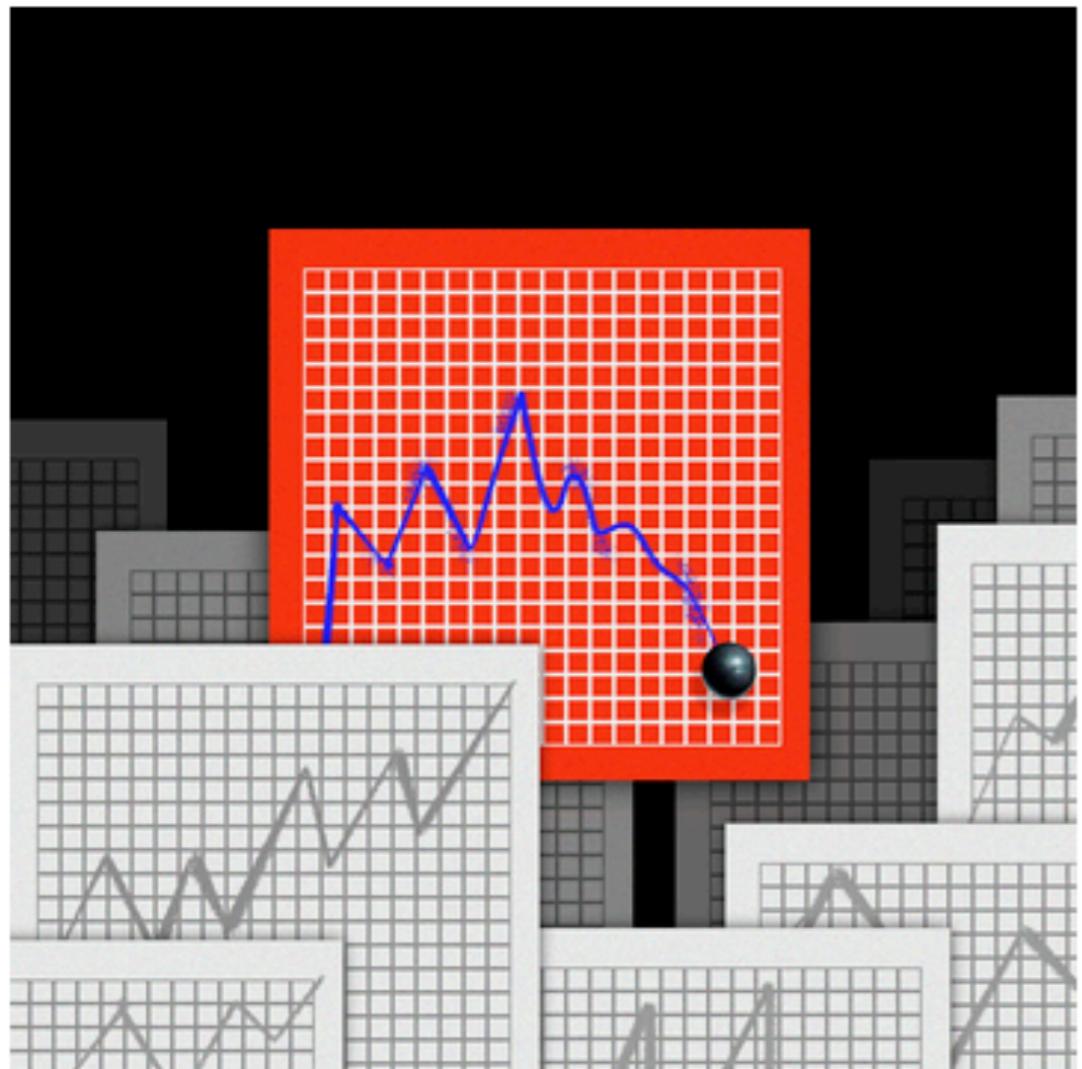
A Study Said Covid Wasn't That Deadly. The Right Seized It.

How coronavirus research is being weaponized.

By Aleszu Bajak and Jeff Howe

Mr. Bajak and Mr. Howe teach journalism at Northeastern University.

May 14, 2020



The New York Times

Last month, a group of Stanford University researchers released a remarkable study: Covid-19 infections in Santa Clara County, Calif., might well be 85 times higher than official estimates. The fatality rate for coronavirus might be as low as 0.12 percent, the researchers concluded, which would make Covid-19 only as deadly as the seasonal flu.

Within hours, the paper had been leveraged by conservative commentators and activists on social media, forged into ammunition to support the protests against lockdowns and other social mitigation efforts meant to contain the coronavirus and minimize deaths. The right-wing, prospecting for proof that the severity of the pandemic was overblown, had found their science, plain as day.

The study provoked a very different reaction from another realm of our increasingly Balkanized internet. As soon as the Stanford study went online, it began drawing intense criticism from other experts. Andrew Gelman, a professor of statistics and applied science at Columbia University, [suggested](#) that the authors issue an apology for wasting everyone's time — not so much because they made mistakes, but because “they’re the kind of screw-ups that happen if you want to leap out with an exciting finding.”

This paper, and thousands more like it, are the result of a publishing phenomenon called the “preprint” — articles published long before the traditional form of academic quality control, peer review, takes place. Preprints aren’t new, but they have flourished on the internet, especially during the pandemic.

Finding a story

“More than 10,000 academic works have been published about Covid-19 since January alone, 3,500 of them preprints. By comparison, only 29 studies were published before the 2003 SARS pandemic ended...

...The instant sharing of valuable data has accelerated our race for vaccines, antivirals, and better tests. But this welter of information, much of it conflicting, has sown confusion and discord with a general public not accustomed to the high level of uncertainty inherent in science.”

medRxiv

THE PREPRINT SERVER FOR HEALTH SCIENCES

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Caution: Preprints are preliminary reports of work that have not been certified by peer review. They should not be relied on to guide clinical practice or health-related behavior and should not be reported in news media as established information.

[COVID-19 SARS-CoV-2 preprints from medRxiv and bioRxiv](#)

Subject Areas

[All Articles](#)

[Addiction Medicine](#)

[Hematology](#)

[Pain Medicine](#)

```

library(medrxivr)
mx_results <- mx_search("COVID-19", from.date = 20200416,
                        to.date = 20200510)

mx_with_tweetsdata <- search_tweets2(mx_results, include_rts = FALSE)

mx_with_tweetsdata_topRTs <- mx_with_tweetsdata %>%
  group_by(pdf_name, title, query) %>%
  summarise(totalRTs = sum(retweet_count)) %>%
  arrange(desc(totalRTs)) %>%
  glimpse()

```

title	query	date	total_RT
COVID-19 Antibody Seroprevalence in Santa Clara County, California	https://www.medrxiv.org/ content/10.1101/2020.04.14. 20062463v1	2020-04-17	18528
Suppression of COVID-19 outbreak in the municipality of Vo, Italy	https://www.medrxiv.org/ content/10.1101/2020.04.17. 20053157v1	2020-04-18	3894
Chloroquine diphosphate in two different dosages as adjunctive therapy of hospitalized patients with severe respiratory syndrome in the context of coronavirus SARS-CoV-2 infection Preliminary safety results of a randomized, double-blinded, phase IIb clinical trial CloroCovid-19 Study	https://www.medrxiv.org/ content/10.1101/2020.04.07. 20056424v1	2020-04-11	2910
Hydroxychloroquine in patients with COVID-19 an open-label, randomized, controlled trial	https://www.medrxiv.org/ content/10.1101/2020.04.10. 20060558v1	2020-04-14	2729
No evidence of clinical efficacy of hydroxychloroquine in patients hospitalized for COVID-19 infection with oxygen requirement results of a study using routinely collected data to emulate a target trial	https://www.medrxiv.org/ content/10.1101/2020.04.10. 20060699v1	2020-04-14	1676
Indoor transmission of SARS-CoV-2	https://www.medrxiv.org/ content/10.1101/2020.04.04. 20053058v1	2020-04-07	1344

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```

Pull in preprints

Ping Twitter API

Calculate total retweets per study

title	query	date	total_RT
COVID-19 Antibody Seroprevalence in Santa Clara County, California	https://www.medrxiv.org/ content/10.1101/2020.04.14. 20062463v1	2020-04-17	18528
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Indoor transmission of SARS-CoV-2	https://www.medrxiv.org/ content/10.1101/2020.04.04. 20053058v1	2020-04-07	1344



```

library(rtweet)
study20062463v1_2 <- search_tweets2("https://www.medrxiv.org/content/10.1101/2020.04.14.20062463v1",
                                         n = 18000, include_rts = TRUE)
glimpse(study20062463v1_2)
saveRDS(study20062463v1_2, "study20062463v1_2.RDS")

```

created_at	screen_name	text	favorite	retweet_count	retweet_created_at	retweet_favorite_count	retweet_name	retweet_following	name	followers_count
2020-04-20 21:1	JulietteFrette	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Juliette Fretté	21334
2020-04-20 20:5	dad_liams	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Liams_Dad	945
2020-04-20 20:3	FreedomOU812	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Mr. Joe	1883
2020-04-20 19:4	JDocar	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Jessica Docar	199
2020-04-20 19:2	JenLynnO	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	JenniferLynn	78
2020-04-20 19:1	Daryl16519C	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Skeptical Russian False	1012
2020-04-20 19:1	AWeihs25	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	AWeihs25⭐⭐⭐	2852
2020-04-20 18:4	teenadee26	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Lovelee	339
2020-04-18 12:4	kreativekonnect	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264286	Karen K	3675
2020-04-20 18:2	Pamira_Bezmen	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Pamira Bezmen	134
2020-04-20 17:5	grgpetro	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	GR Gus 🇺🇸	3221
2020-04-20 17:4	JamesSt58926959	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	James Stephenson	279
2020-04-20 17:1	lisapamzaya	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Swan	261
2020-04-20 17:0	Roula1074	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Thalassa10	148
2020-04-20 16:5	irinabh	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	I r i n a	656
2020-04-20 16:4	goldenader	BREAKING: Coronavirus. #COVID-19 https://t.co/LV	0	7291	2020-04-17 15:46:14	12519	Lisa Boothe	264285	Marrano	120
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Lisa Boothe

@LisaMarieBoothe

BREAKING: Coronavirus random sampling study from Stanford. They found the infection is 50-85 x more common than previously thought & fatality rate accordingly 50-85 x lower than the crude numbers would suggest.

#COVID-19



COVID-19 Antibody Seroprevalence in Santa Clara County, ...
Background Addressing COVID-19 is a pressing health and social concern. To date, many epidemic projections and ...
[medrxiv.org](https://www.medrxiv.org)

11:46 AM · Apr 17, 2020 · Twitter for iPhone

8.1K Retweets 2.3K Likes



Lisa Boothe



Commentator

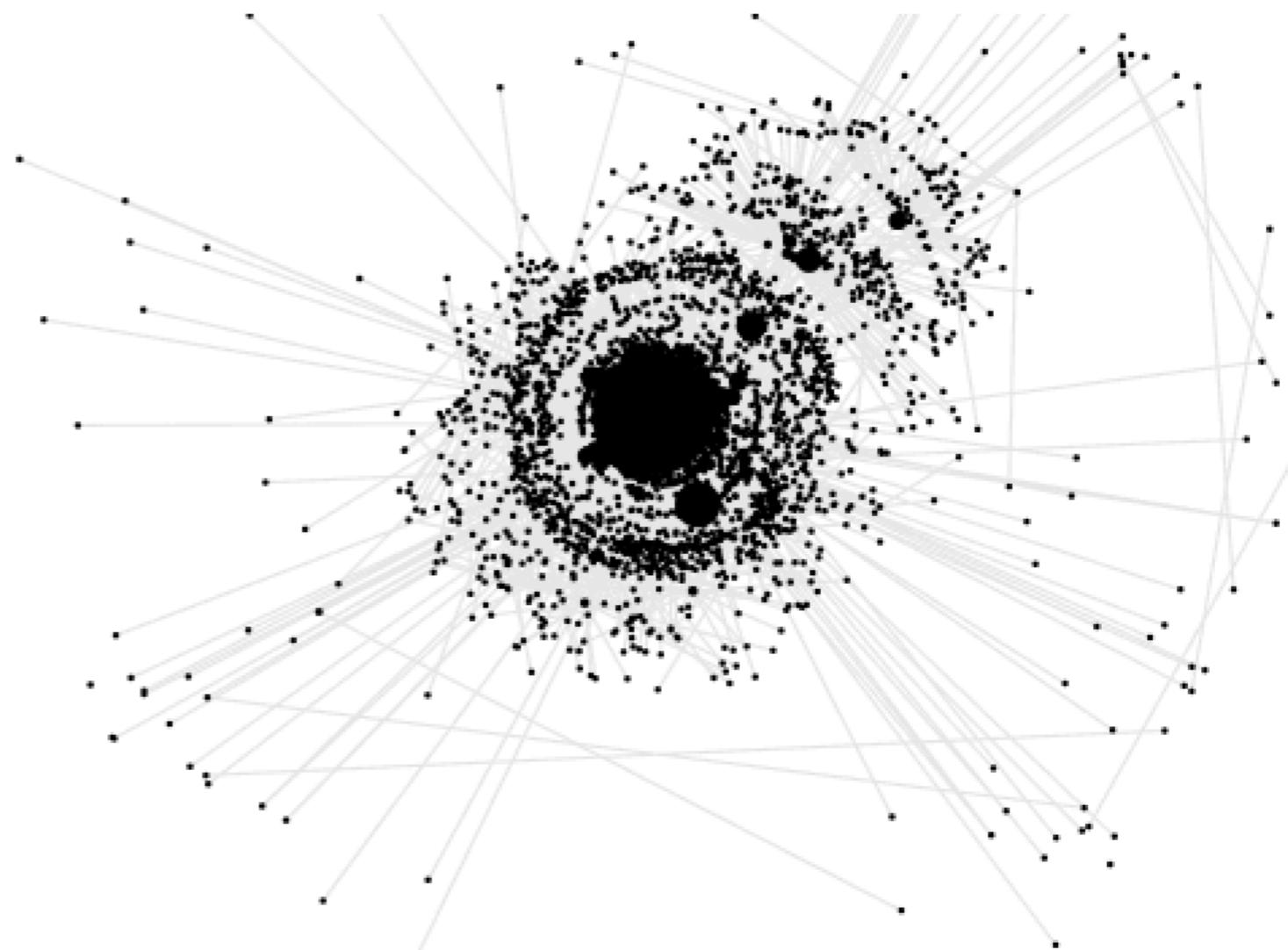
Lisa Marie Boothe is an American conservative political commentator working as a contributor for Fox News. She is a frequent co-host on *Outnumbered* and *The Five*, an occasional panelist on *Special Report*, and a guest on *The Story*, all on Fox News Channel.

[Wikipedia](#)

Born: February 3, 1985 (age 35 years), West Virginia

Education: University of Tennessee (2007)

```
library(twinetverse)
sigmajs() %>%
  sg_nodes(nodes_study20060699v1, id, size) %>%
  sg_edges(edges_study20060699v1, id, source, target) %>%
  sg_layout(layout = igraph::layout_with_kk) %>%
  sg_cluster(
    colors = c("#000000")
  ) %>%
  sg_export_svg() %>%
  sg_button("export_svg", "download") %>%
  sg_settings(
    minNodeSize = 3,
    maxNodeSize = 30,
    edgeColor = "default",
    defaultEdgeColor = "#E8E8E8"
  ) %>%
  sg_drag_nodes()
```





Ben Shapiro 
@benshapiro

New study: seroprevalence testing for coronavirus antibodies in Santa Clara county in CA (sample size: 3,300 people) finds prevalence 50 TO 85 TIMES the confirmed cases reported



COVID-19 Antibody Seroprevalence in Santa Clara County, ...
Background Addressing COVID-19 is a pressing health and social concern. To date, many epidemic projections and ...
 medrxiv.org

11:21 AM · Apr 17, 2020 · Twitter Web App

1.1K Retweets 2.5K Likes



Steve Deace 
@SteveDeaceShow

If your reaction to the Stanford antibody test, which shows **#coronavirus** is not as lethal as we feared, is "that's a long way from herd immunity," you're right. But you also just made the argument to end the lockdowns, because that's the only way we're getting to herd immunity.

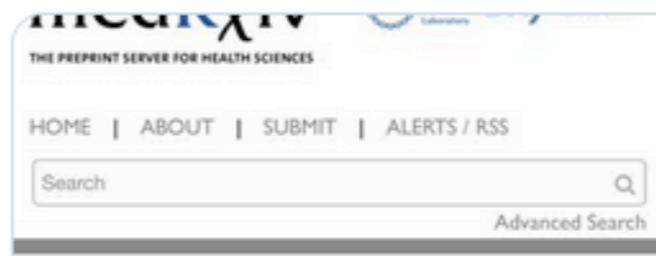
11:47 AM · Apr 17, 2020 · Twitter Web App

327 Retweets 940 Likes



Alex Berenson 
@AlexBerenson

The **@stanford** antibody testing is out - it estimates ~3% of people in Santa Clara County (CA) have been infected and recovered, 50-plus times the estimate of confirmed active cases. More evidence **#SARSCoV2** is far more widespread and thus less dangerous than expected.



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COVID-19 Antibody Seroprevalence in Santa Clara County, California

Eran Bendavid, Bianca Mulaney, Neeraj Sood, Soleil Shah, Emilia Ling, Rebecca Bromley-Dulciano, Cara Lai, Zoe Weissberg, Rodrigo Saavedra, James Tedrow, Dona Tversky, Andrew Bogan, Thomas Kupiec, Daniel Eichner, Ribhav Gupta, John Ioannidis, Jay Bhattacharya

doi: <https://doi.org/10.1101/2020.04.14.20062463>

This article is a preprint and has not been certified by peer review [what does this mean?]. It reports new medical research that has yet to

and policies addressing COVID-19 have been designed without seroprevalence data to inform epidemic parameters. We measured the seroprevalence of antibodies to SARS-CoV-2 in Santa Clara County. Methods On 4/3-4/4, 2020, we tested county residents for antibodies to SARS-CoV-2 using a lateral flow immunoassay. Participants were recruited using Facebook ads targeting a representative sample of the county by demographic and geographic characteristics. We report the prevalence of Funding Statement

We acknowledge many individual donors who generously supported this project with gift awards. The funders had no role in the design and conduct of the study, nor in the decision to prepare and submit the manuscript for publication.

Author Declarations

11:27 AM · Apr 17, 2020 · Twitter for iPhone

2.4K Retweets 3.5K Likes

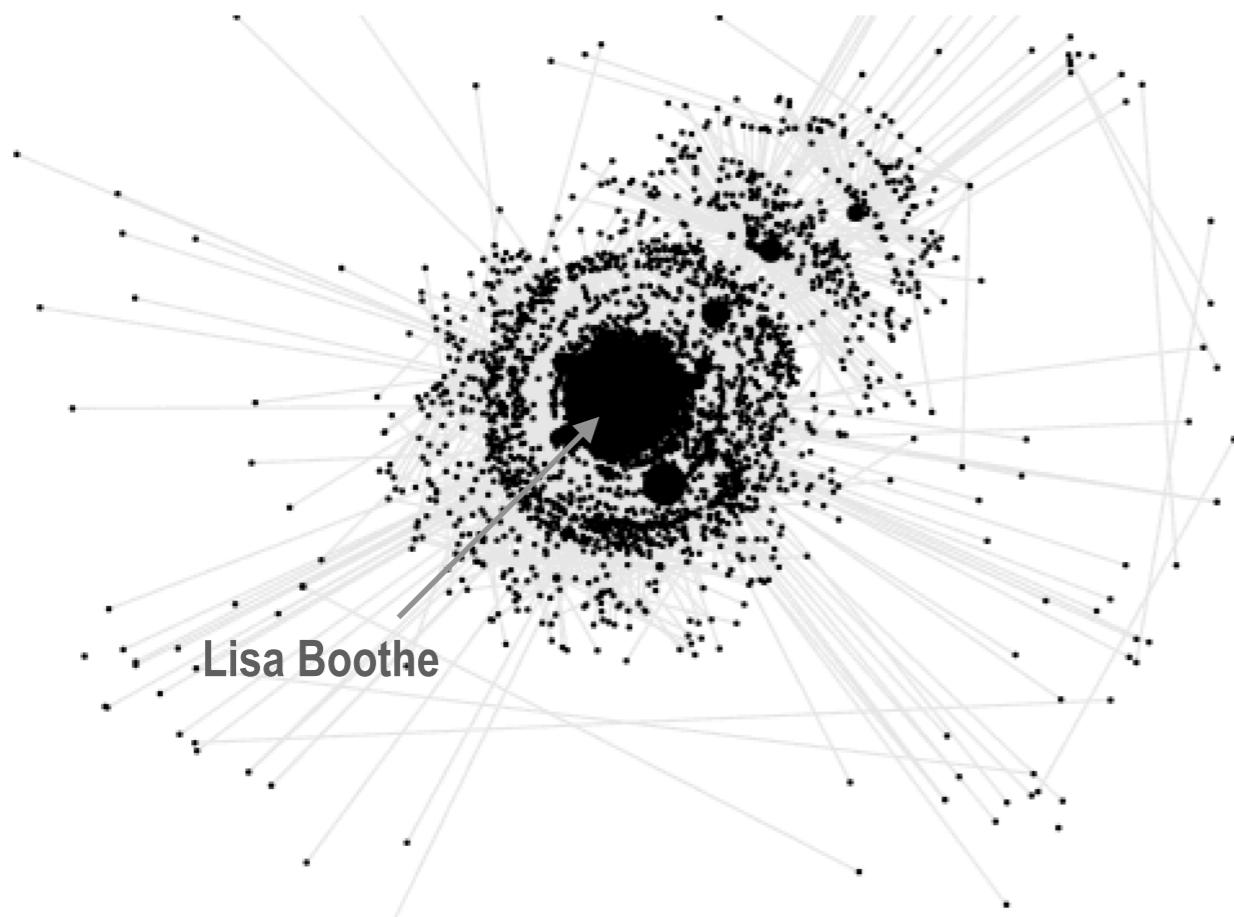


Jane L  
@SunnyJL52

The SCIENCE is NOT with you closing down Wisconsin @GovEvers  America is watching you and 'Sconnies will not be used to play election interference games on our backs. **#LiberateWisconsin**



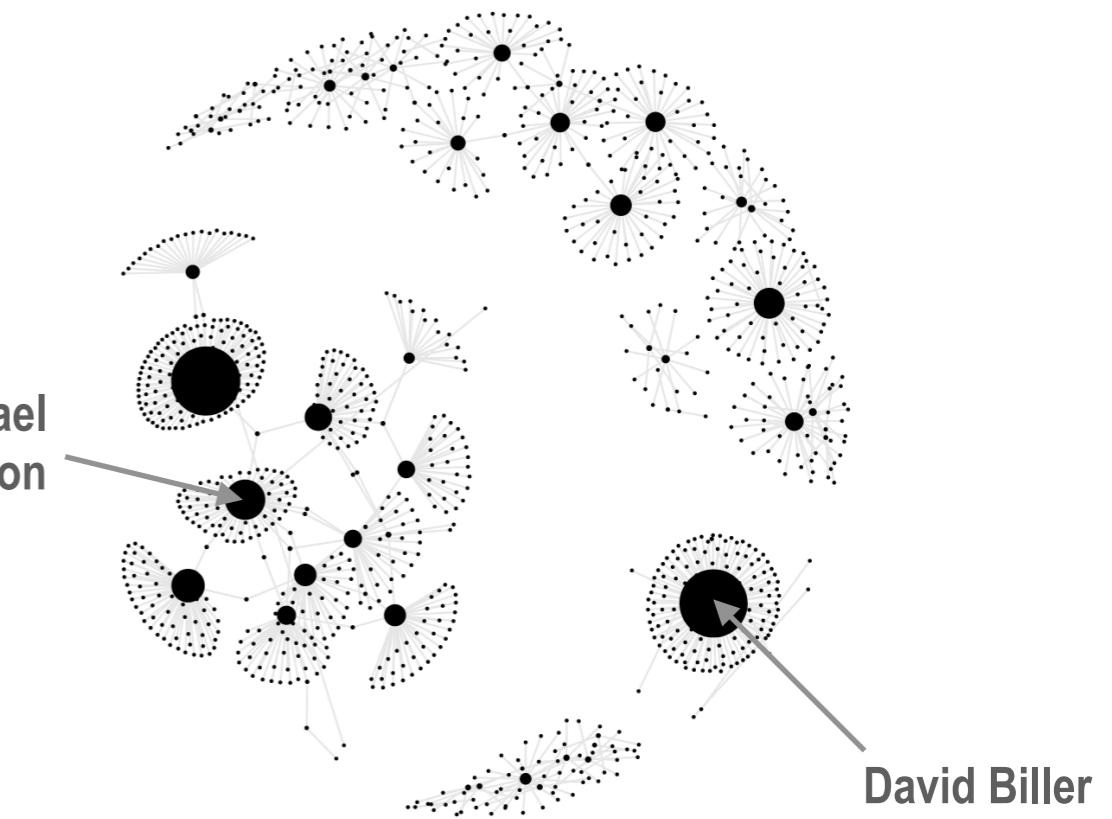
Alex Berenson 
@AlexBerenson · Apr 17



18,528 retweets

*COVID-19 Antibody Seroprevalence
in Santa Clara County, California*

C. Michael Gibson



2,910 retweets

*Chloroquine diphosphate in two
different dosages (CloroCovid study)*

“What this cascade of sharing behavior reveals, based on our analysis of nearly 900 Covid-19 preprints, is a tale of two internets: one largely ideological, in which science is leveraged as propaganda, and one that consists of the kind of discussion and debate vital for academia — and democracy.”

MENU ▾

We'd like to understand how you use our websites in order to improve them.

Letter | Published: 24 February 2020

Macroscopic patterns of interacting contagions are indistinguishable from social reinforcement

Laurent Hébert-Dufresne , Samuel V. Scarpino & Jean-Gabriel Young

Nature Physics 16, 426–431(2020) | Cite this article

2689 Accesses | 1 Citations | 238 Altme

Abstract

From ‘fake news’ to innovative technologies, complex contagions spread through multiple exposures via a process of social reinforcement. In contrast, multiple exposures are distinct from prior exposure to the same source¹. Contrarily, biological agents such as viruses spread through a single exposure to a source².

“In a world of pre-print science, we will need new methods to evaluate the firehose of information coming at us. This, which we've run past several network scientists, could be a valuable one.”

Science

Contents ▾ News ▾ Careers ▾ Journals ▾

SHARE RESEARCH ARTICLE

Fake news on Twitter during the 2016 U.S. presidential election

 Nir Grinberg^{1,2,*},  Kenneth Joseph^{3,*},  Lisa Friedland^{1,*},  Briony Swire-Thompson^{1,2},  David Lazer^{1,2,t}

* See all authors and affiliations

Science 25 Jan 2019:
Vol. 363, Issue 6425, pp. 374-378
DOI: 10.1126/science.aau2706

Article Figures & Data Info & Metrics eLetters PDF

Finding facts about fake news

There was a proliferation of fake news during the 2016 election cycle. Grinberg *et al.* analyzed Twitter data by matching Twitter accounts to specific voters to determine who was exposed to fake news, who spread fake news, and how fake news interacted with factual news (see the

Retweet

How do we wrap this in a compelling narrative?

Can we be methodical about how it was spread and what that tells us?

Yes! We can do a “tick tock” forensic analysis of how one preprint spread minute by minute.

Maybe plucking one piece of bad info and tracking its spread and the role certain people played in spreading it?

Yes! The Santa Clara study was the most popular in our initial data harvest. We can follow that.

Maybe even how that led to some real-world impact?

Yes! The study was cited across right-wing Twitter accounts and podcasts and shared on Facebook groups for anti-lockdown protests.

A timeline of how the Santa Clara study spread on social media

- April 17 11:21am Ben Shapiro, conservative radio host, [tweets](#) the study. Racks up more than **1,000 retweets** from [Mike Cernovich](#) (to his 576,000 followers), [The Daily Wire](#) (to its 406,000 followers), [Erielle Davidson](#) (to her 118,000 followers) and Daily Wire founder [Jeremy Boreing](#) to his 72,900 followers. "New study: seroprevalence testing for coronavirus antibodies in Santa Clara county in CA (sample size: 3,300 people) finds prevalence 50 TO 85 TIMES the confirmed cases reported." Shapiro replies to himself: "This is well in line with other studies from Denmark, Germany, etc. We know that most cases are asymptomatic. This means that case fatality rates are likely an order of magnitude off. And it also means that testing and contact tracing will be extremely difficult." and "All of which means that in getting back to work, social distancing combined with tranching populations by risk factor -- age, pre-existing conditions -- will be the vital component, not primarily widespread testing."
- April 17 11:27am [Alex Berenson](#) [tweets](#) screenshots of the study, racking up **2,200 retweets** from the likes of conservative talk radio host [Bill Mitchell](#), Fox News political analyst [Brit Hume](#), conservative podcaster [Daniel Horowitz](#), and Tea Party Patriots founder [Jenny Beth Martin](#).
- April 17 11:46am Last Friday, conservative commentator [Lisa Boothe](#) [tweeted](#) a Stanford study measuring Covid-19 antibody levels of people in Santa Clara County, California. The paper, she explained, [confirmed](#) an existing talking point – the COVID-19 mortality rate is actually far lower than Dr. Fauci would have you believe. It was retweeted more than **7,000 times**, including by [Andy McCarthy](#) of National Review and even [David Brooks](#) of the New York Times. What many of those who read the tweet probably didn't realize was that the study was published without having gone through science's traditional peer review process.
- April 17 11:47am Conservative media personality Steve Deace takes to Twitter to [make the case](#) to end lockdowns using the Stanford study: "If your reaction to the Stanford antibody test, which shows #coronavirus is not as lethal as we feared, is "that's a long way from herd immunity," you're right. But you also just made the argument to end the lockdowns, because that's the only way we're getting to herd immunity."
- April 17 3:27pm Jane L (@SunnyJL52) [quotes Alex Berenson's tweet](#) to Wisconsin Governor Tony Evers, "The SCIENCE is NOT with you closing down Wisconsin @GovEvers  America is watching you and 'Sconnies will not be used to play election interference games on our backs.' #LiberateWisconsin." Jane L was not the only one citing the study as evidence that America should reopen. By that evening, conservative Twitter was abuzz with the study, sharing it with hashtags like #ReopenAmerica, #FactsNotFear, #LiberateWisconsin, #endthelockdown and #BackToWork. Meanwhile, it was making its way onto Facebook pages, too.
- April 17 2:06pm That afternoon, the Facebook page [Health Freedom Louisiana](#), with more than 3,700 subscribers, shared the study link writing, "Approximately 50-85 times the number of confirmed cases have antibodies to SARS-COVID-2. Can we go back to normal life now, while protecting those who are susceptible to adverse outcomes, and provide effective therapies to those who do experience illness severity?" with the hashtags #LaLege #LaGov #ReOpenLA #ReOpenLouisiana #Time2Geaux. It was then shared by the [Reopen Louisiana](#) page.
- April 17 4:52pm Boothe's tweet, citing the Stanford seroprevalence study, is posted by Elizabeth Bricken Wilson on the [#FreeTN Facebook page](#), which has almost **8,000 members**. "More good news!" Wilson writes.
- Two days later, people in Tennesseeans left their houses to [protest](#) social distancing orders. The next #FreeTN rally [is set](#) for Monday April 27th at the state capitol in Nashville.
- April 17 5:13pm Steve Deace [publishes a tweet](#) linking to his BlazeTV segment, since viewed more than **165,000 times**, walking through the study and concluding "Stanford's data confirms we must end these lockdowns immediately."

reddit

Search

| ↑ 36 ↓ | ⌂ Stanford study suggests coronavirus is more widespread than realized

Fri Apr 17 2020 13:51:09 GMT-0400 (Eastern Daylight Time)

Posted by u/CherryCokeNixon Buckleyite Conservative 25 days ago

Stanford study suggests coronavirus is more widespread than realized

spectator.us/stanfo... ↗

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Health Freedom Louisiana April 17 at 2:06 PM ·

Approximately 50-85 times the number of confirmed cases have antibodies to SARS-COVID-2.

Can we go back to normal life now, while protecting those who are susceptible to adverse outcomes, and provide effective therapies to those who do experience illness severity?

Results... See More

Results

The unadjusted prevalence of antibodies to SARS-CoV-2 in Santa Clara County was 1.5% (exact binomial 95%CI 1.11-1.97%), and the population-weighted prevalence was 2.81% (95%CI 2.24-3.37%). Under the three scenarios for test performance characteristics, the population prevalence of COVID-19 in Santa Clara ranged from 2.49% (95%CI 1.80-3.17%) to 4.16% (2.58-5.70%). These prevalence estimates represent a range between 48,000 and 81,000 people infected in Santa Clara County by early April, 50-85-fold more than the number of confirmed cases.

Conclusions

The population prevalence of SARS-CoV-2 antibodies in Santa Clara County implies that the infection is much more widespread than indicated by the number of confirmed cases. Population prevalence estimates can now be used to calibrate epidemic and mortality projections.

13 10 Shares

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Write a comment...

DISQUS

OK Back 2 Work April 18 at 9:11 AM ·

You don't say...

#OKBack2Work #ReopenOK
#ReopenAmerica
#LibertyisEssential

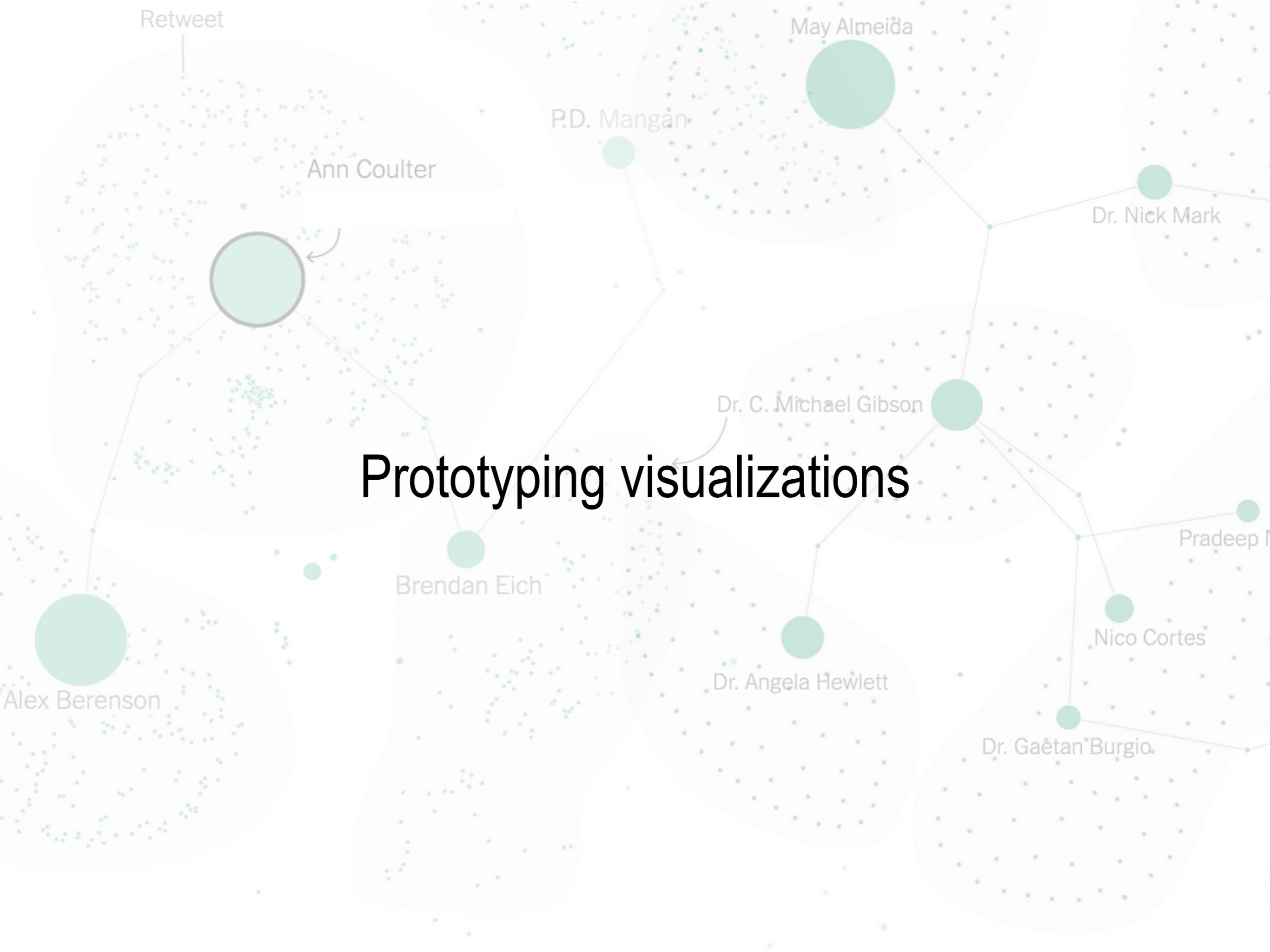
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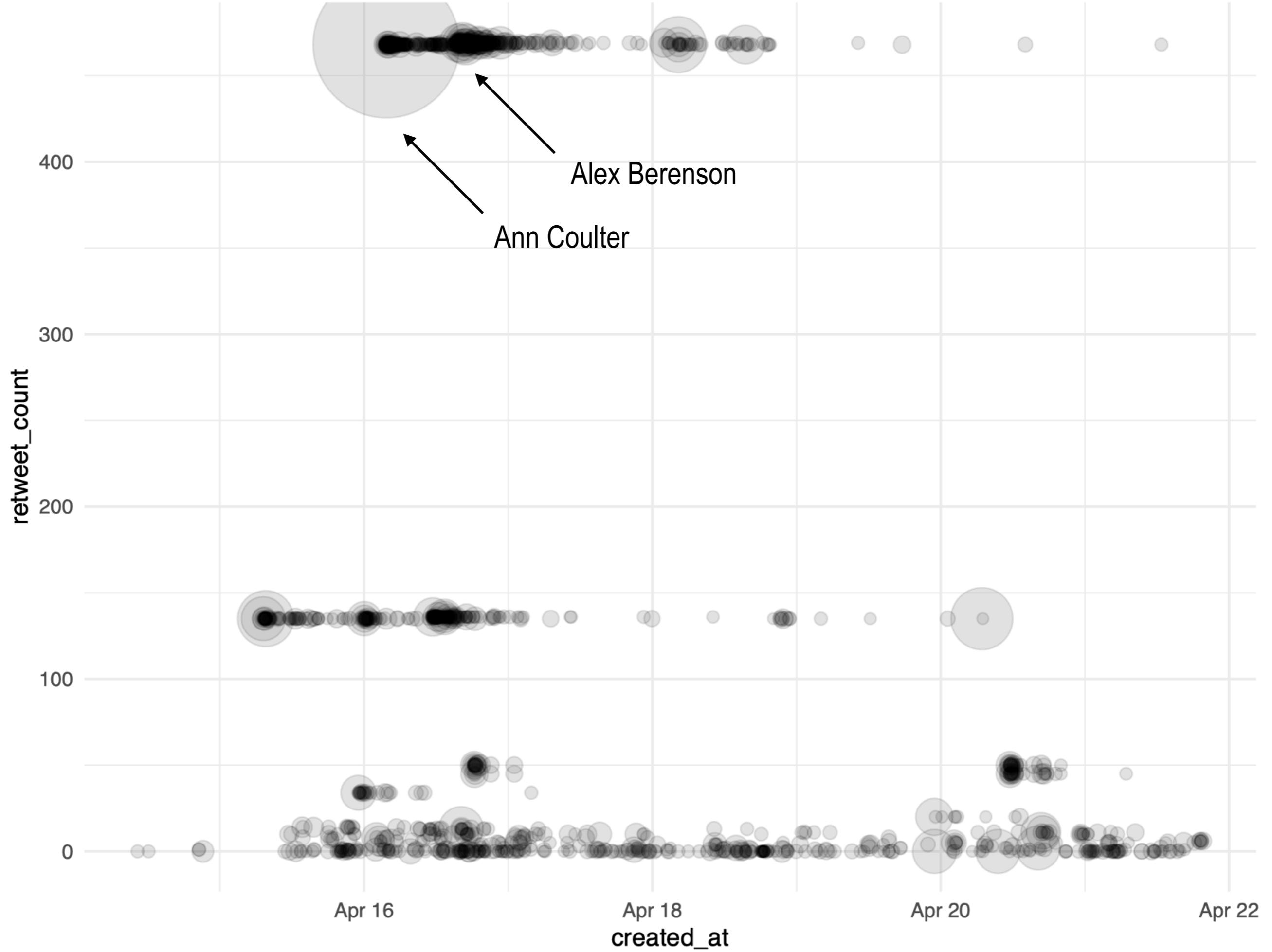
Random sampling test shows coronavirus more widespread and less deadly than previously thought: Study

34 4 Comments 8 Shares

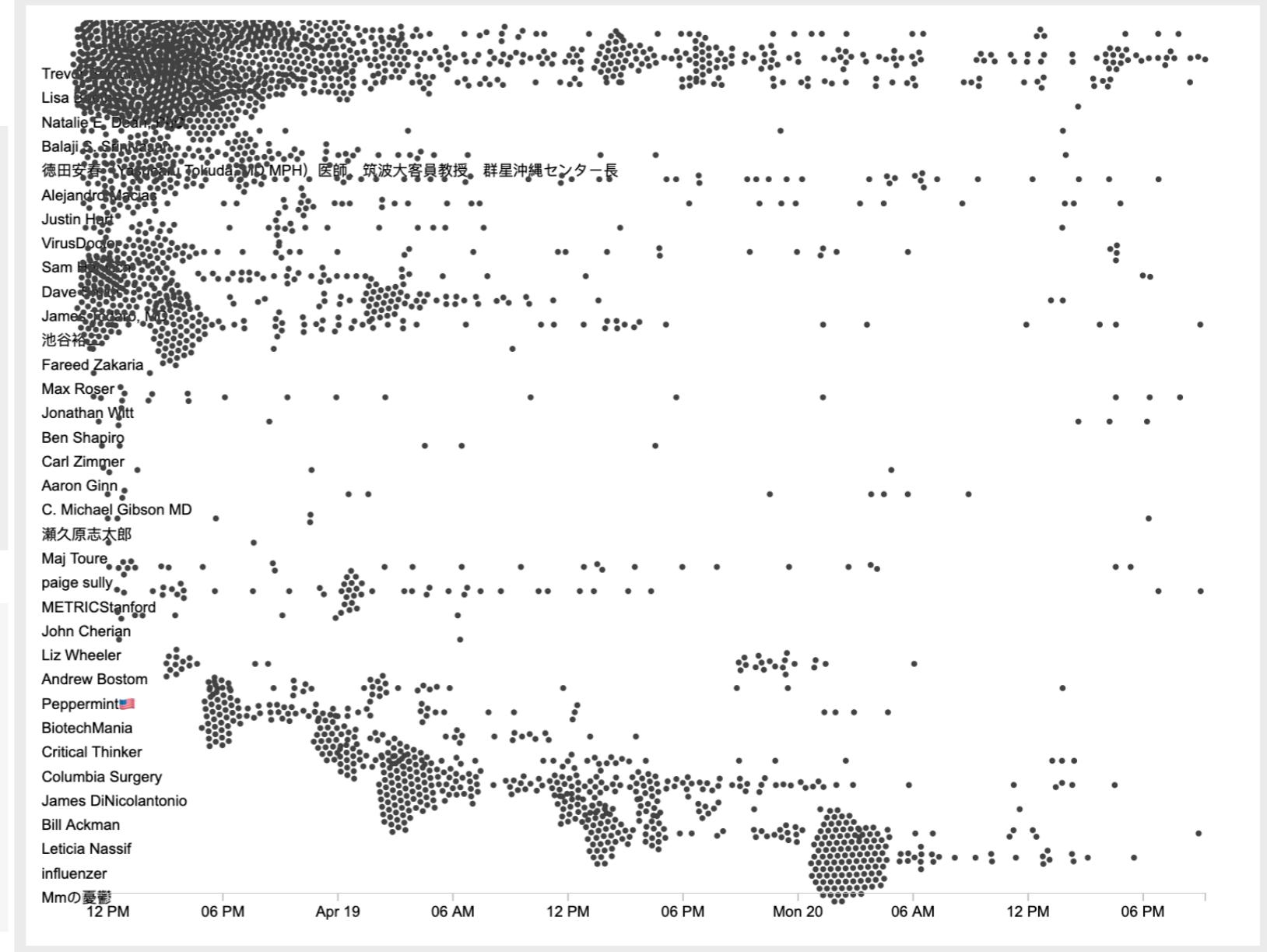
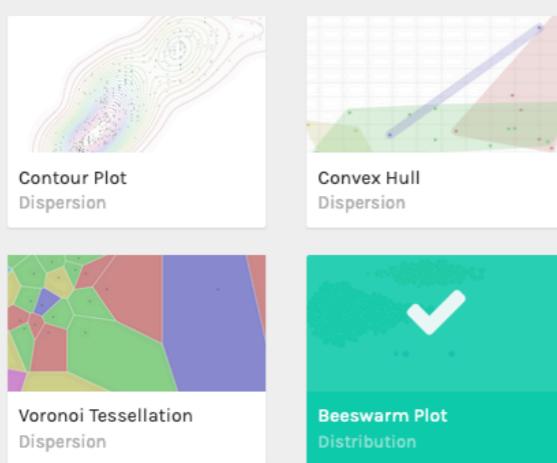
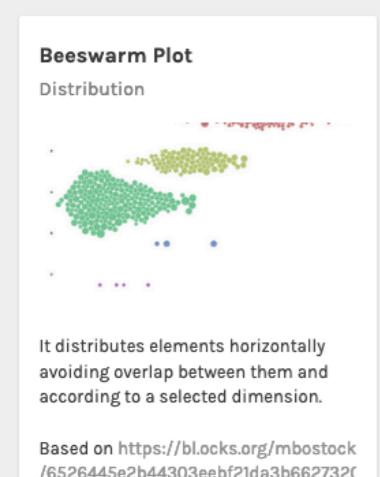
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Choose a Chart

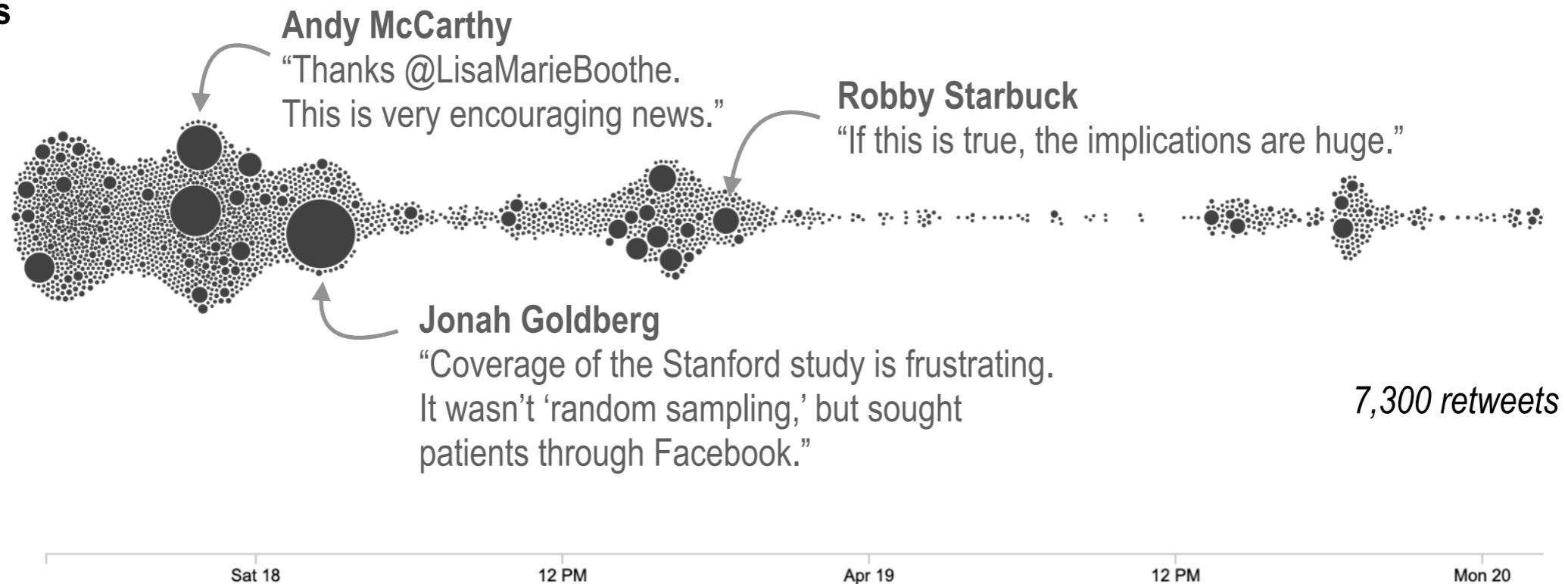


Map your Dimensions

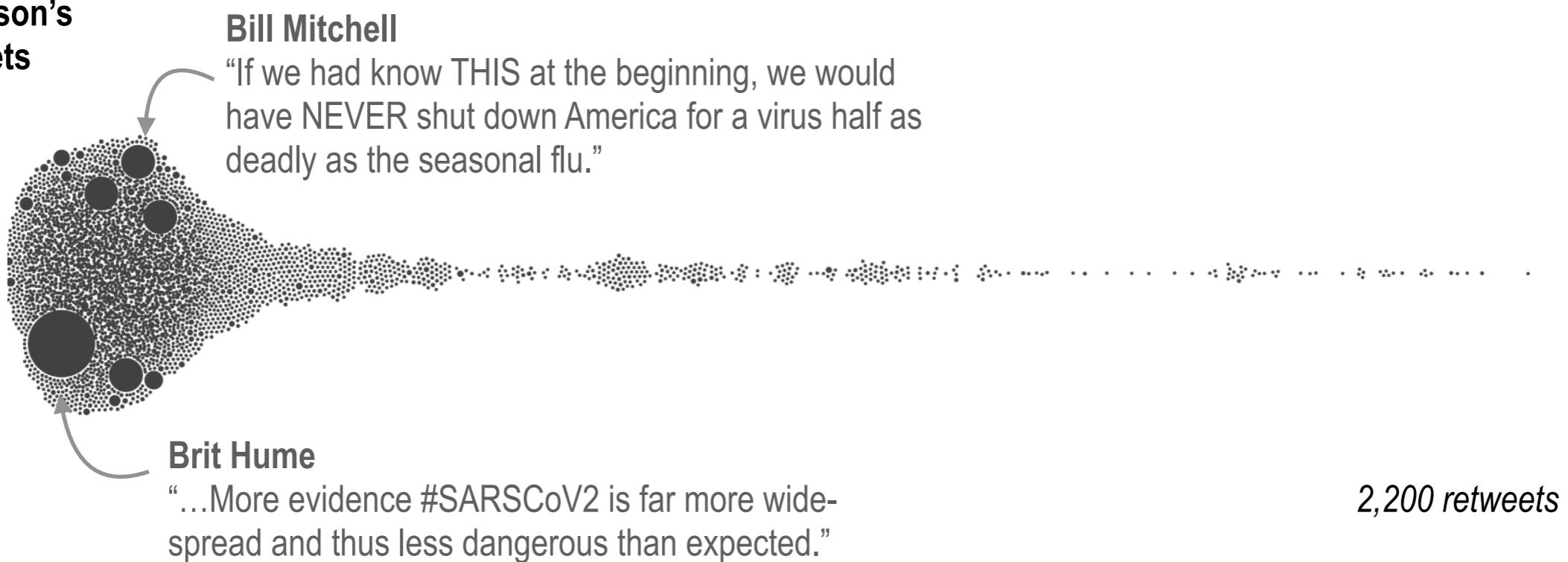
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City string		
Population number	Colors	Labels
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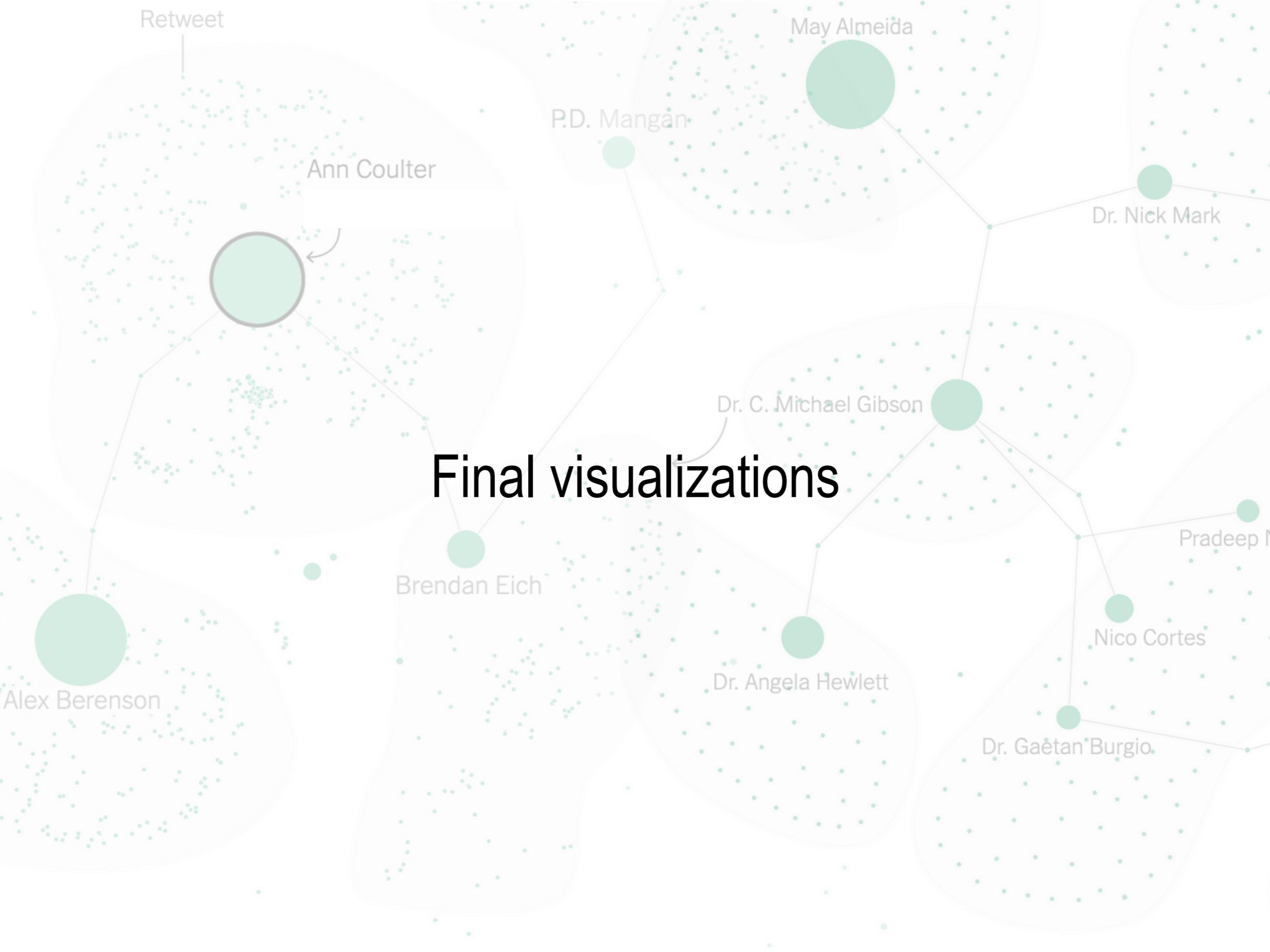


Lisa Marie Boothe's retweets



Alex Berenson's retweets

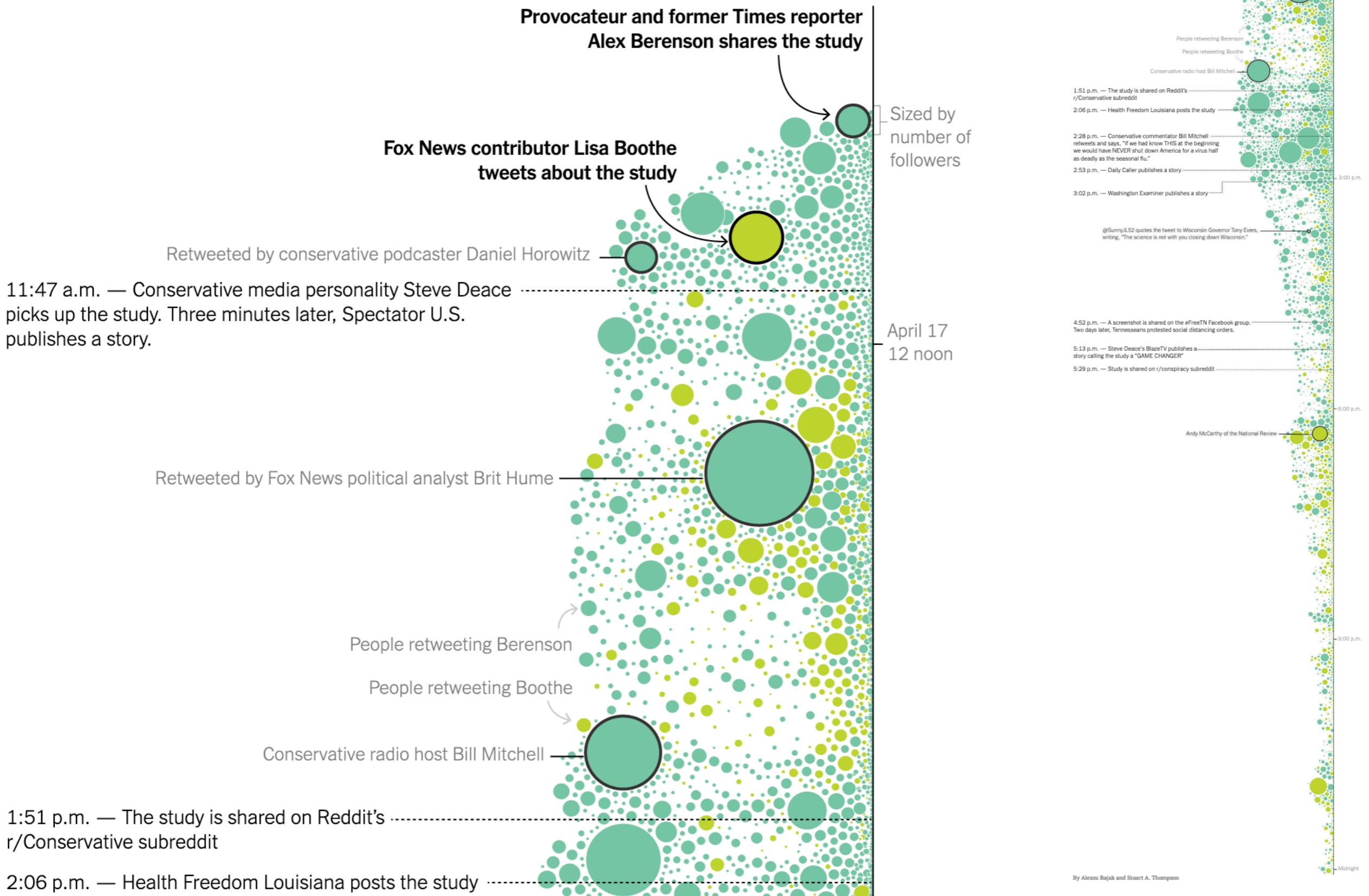




Final visualizations

How a Few Tweets Led to a Surge of Misinformation

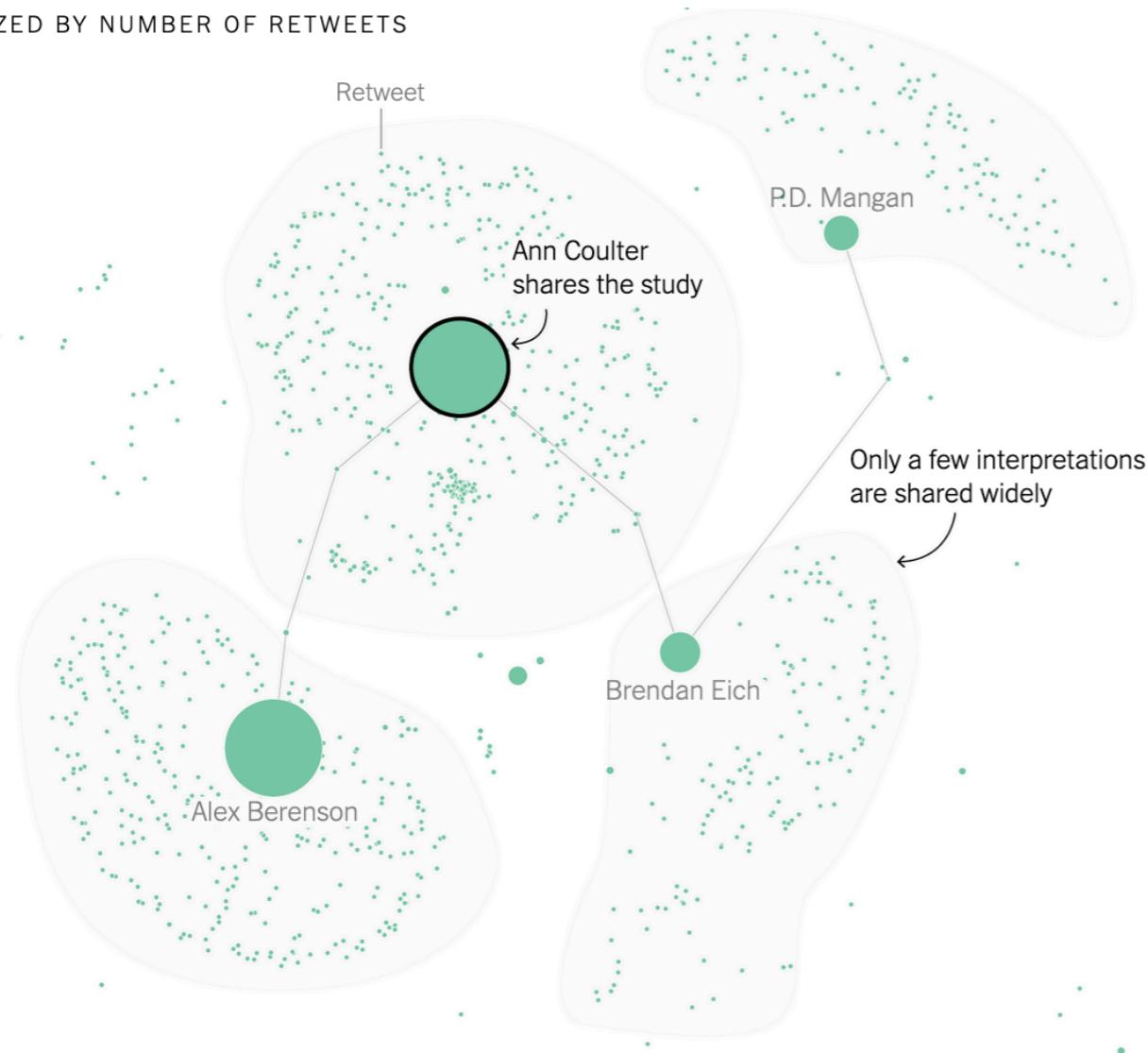
Two conservative commentators tweeted the Stanford study one Friday morning, resulting in thousands of retweets, shown below. Conservative media and Facebook groups picked up the study. Protestors later claimed the virus was less dangerous than believed.



Few Interpretations, Many Followers

Sharing among right-wing provocateurs mostly depends on a few voices sharing to many followers. Here, Ann Coulter and others share a preprint study suggesting the virus is not transmissible outdoors.

SIZED BY NUMBER OF RETWEETS

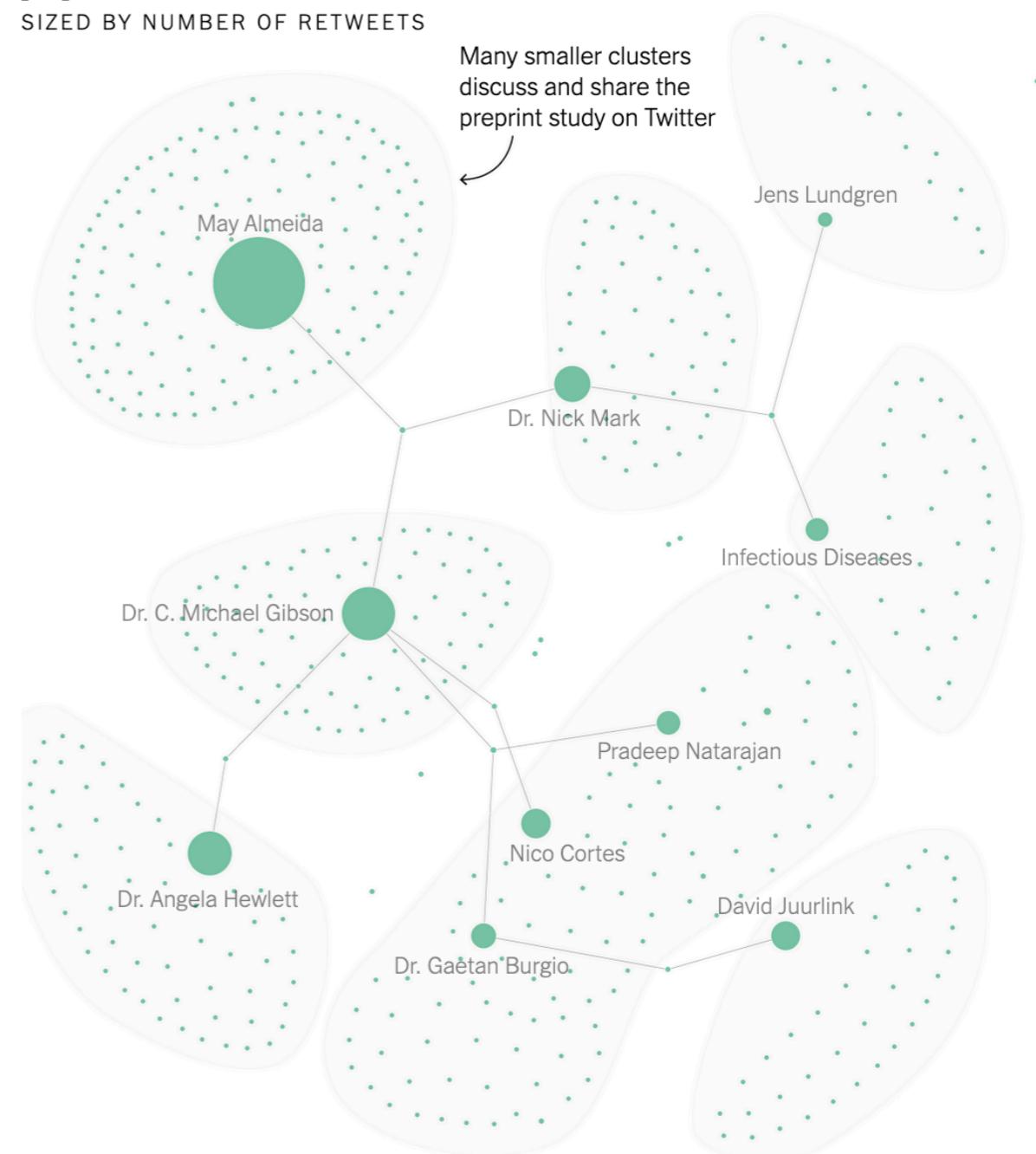


By Aleszu Bajak and Stuart A. Thompson

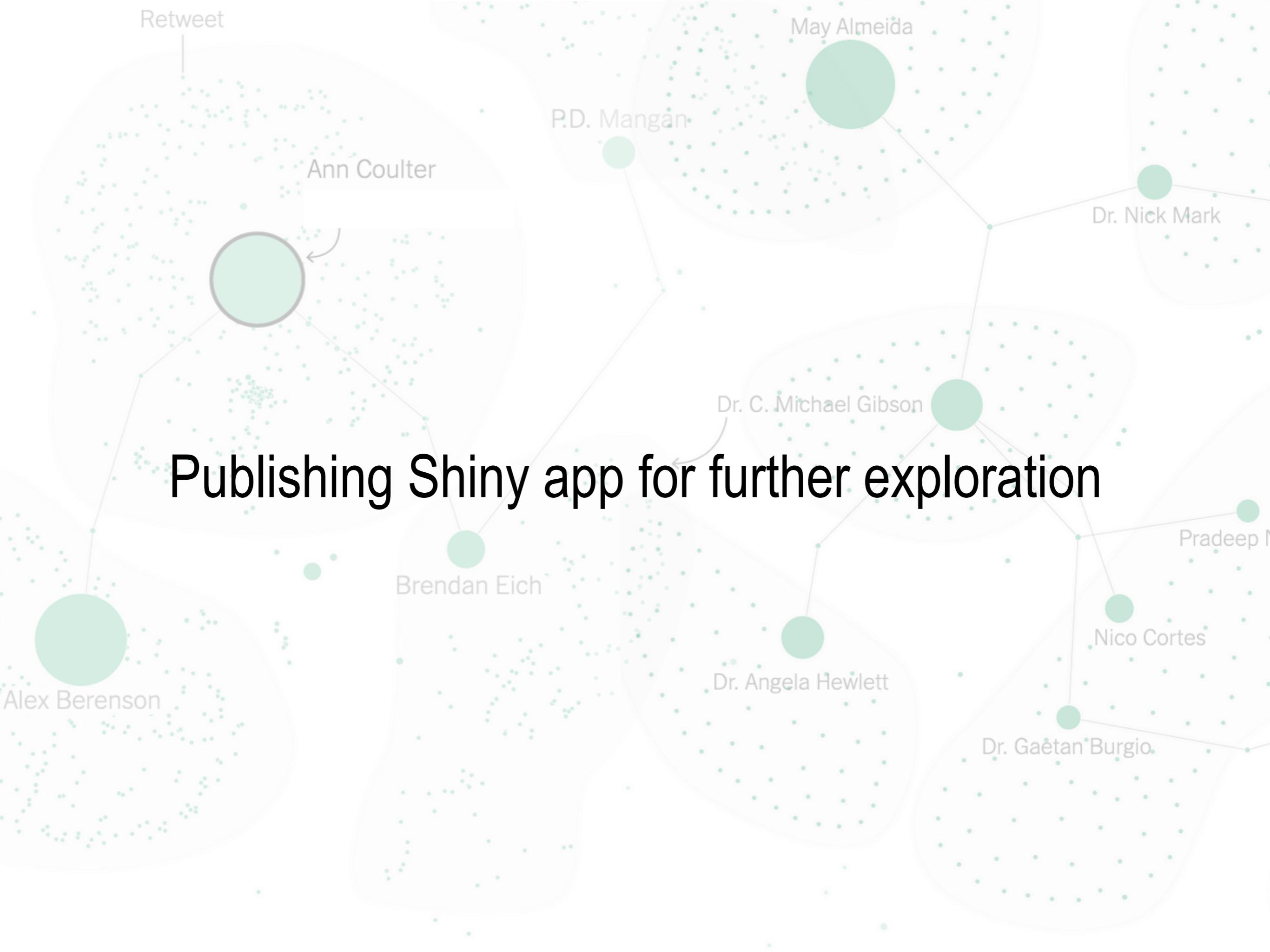
Many Interpretations, Fewer Followers

Among researchers and other academics, preprints were shared and discussed within many groups and between fewer followers. This is the ideal outcome from releasing preprint studies.

SIZED BY NUMBER OF RETWEETS



By Aleszu Bajak and Stuart A. Thompson

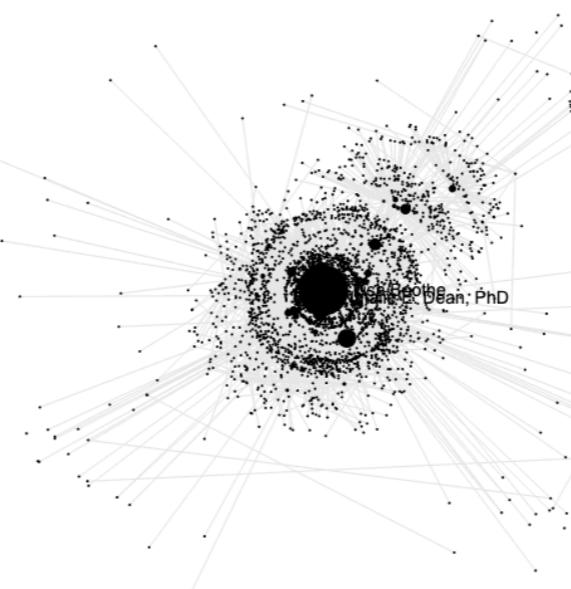


How Covid-19 preprints spread on Twitter

Select a preprint

- COVID-19 Antibody Seroprevalence in Santa Clara County, California
- Hydroxychloroquine application is associated with a decreased mortality in critically ill patients with COVID-19
- Saliva is more sensitive for SARS-CoV-2 detection in COVID-19 patients than nasopharyngeal swabs
- Chloroquine diphosphate in two different dosages as adjunctive therapy of hospitalized patients with severe respiratory syndrome in the context of coronavirus SARS-CoV-2 infection
- No evidence of clinical efficacy of hydroxychloroquine in patients hospitalized for COVID-19 infection with oxygen requirement results of a study using routinely collected data to emulate a target trial
- Indoor transmission of SARS-CoV-2

Retweet network



Selected preprint

Show 10 entries

Search:

	title	publish.date	author	total.retweets
1	COVID-19 Antibody Seroprevalence in Santa Clara County, California	2020-04-17	Bendavid	17023

Showing 1 to 1 of 1 entries

Previous [1](#) Next

Top tweets

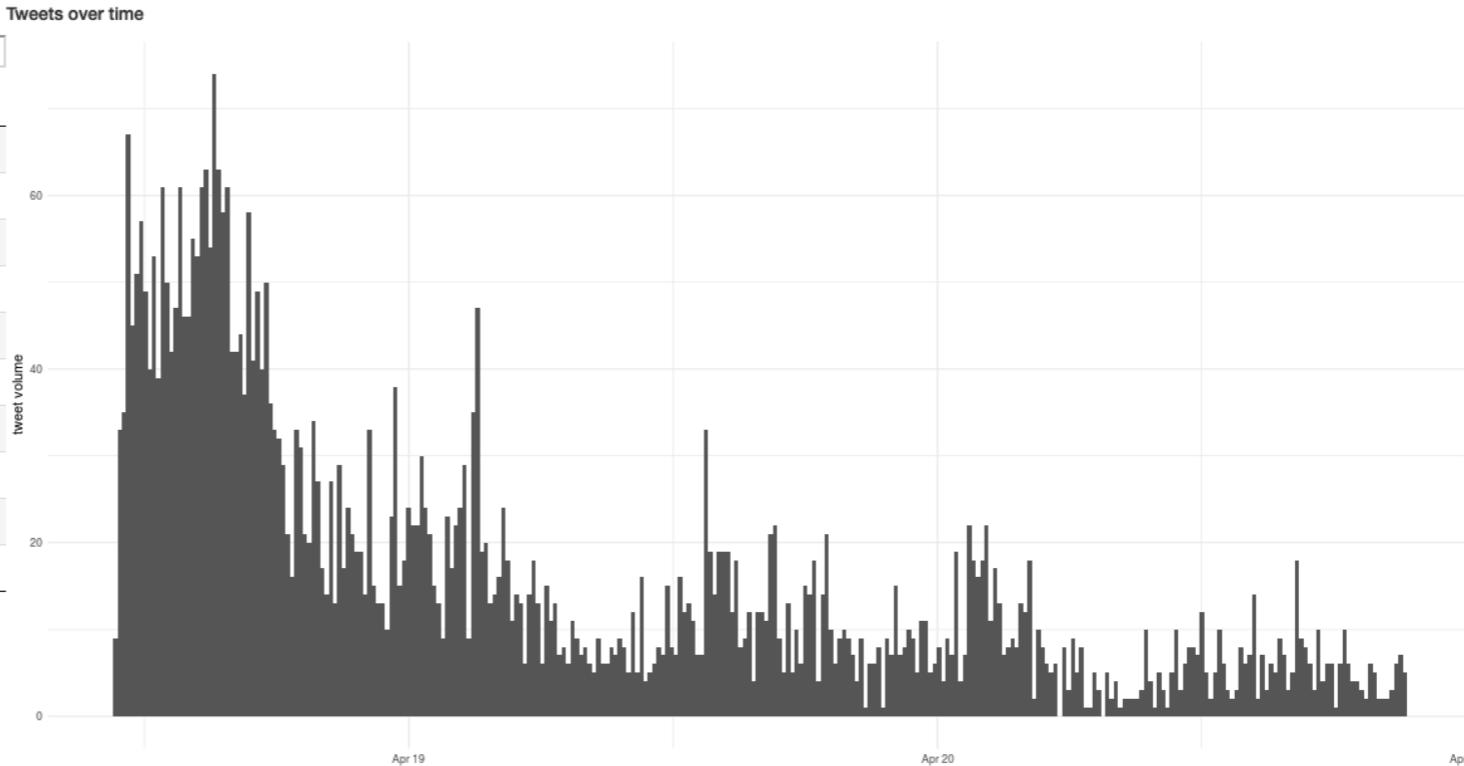
Show 10 entries

Search:

	retweet_name	retweet_retweet_count
1	Lisa Boothe	7291
2	Justin Hart	1603
3	Ben Shapiro	1037
4	Natalie E. Dean, PhD	804
5	Trevor Bedford	574
6	Dave Smith	438
7	VirusDoctor	353
8	Alejandro Macias	330
9	Balaji S. Srinivasan	328
10	Fareed Zakaria	322

Showing 1 to 10 of 258 entries

Previous [1](#) [2](#) [3](#) [4](#) [5](#) ... [26](#) Next



Lessons learned

Put a fence around your story

Save everything (datasets, code, screenshots of evidence)

Be up front about the **limits** of your data and skills

Sketch your data viz first!

Run methods by experts early; let them in on your goals

