

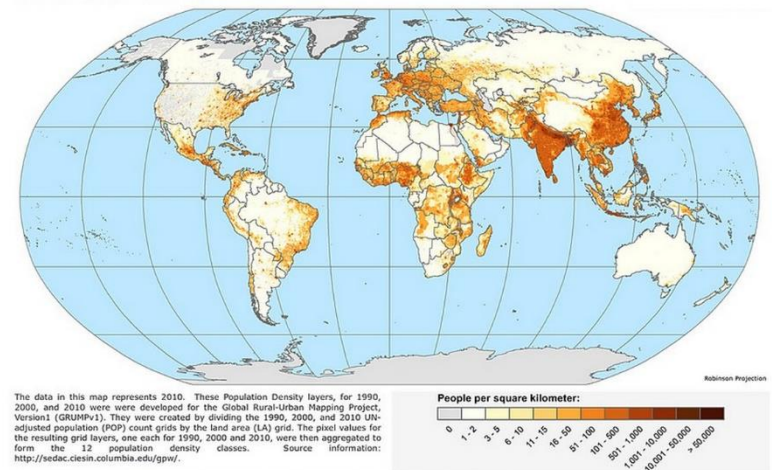
# Understanding Demographic Bias and Representation in Social Media Health Data

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Elaine Nsoesie *Department of Global Health, Boston University*

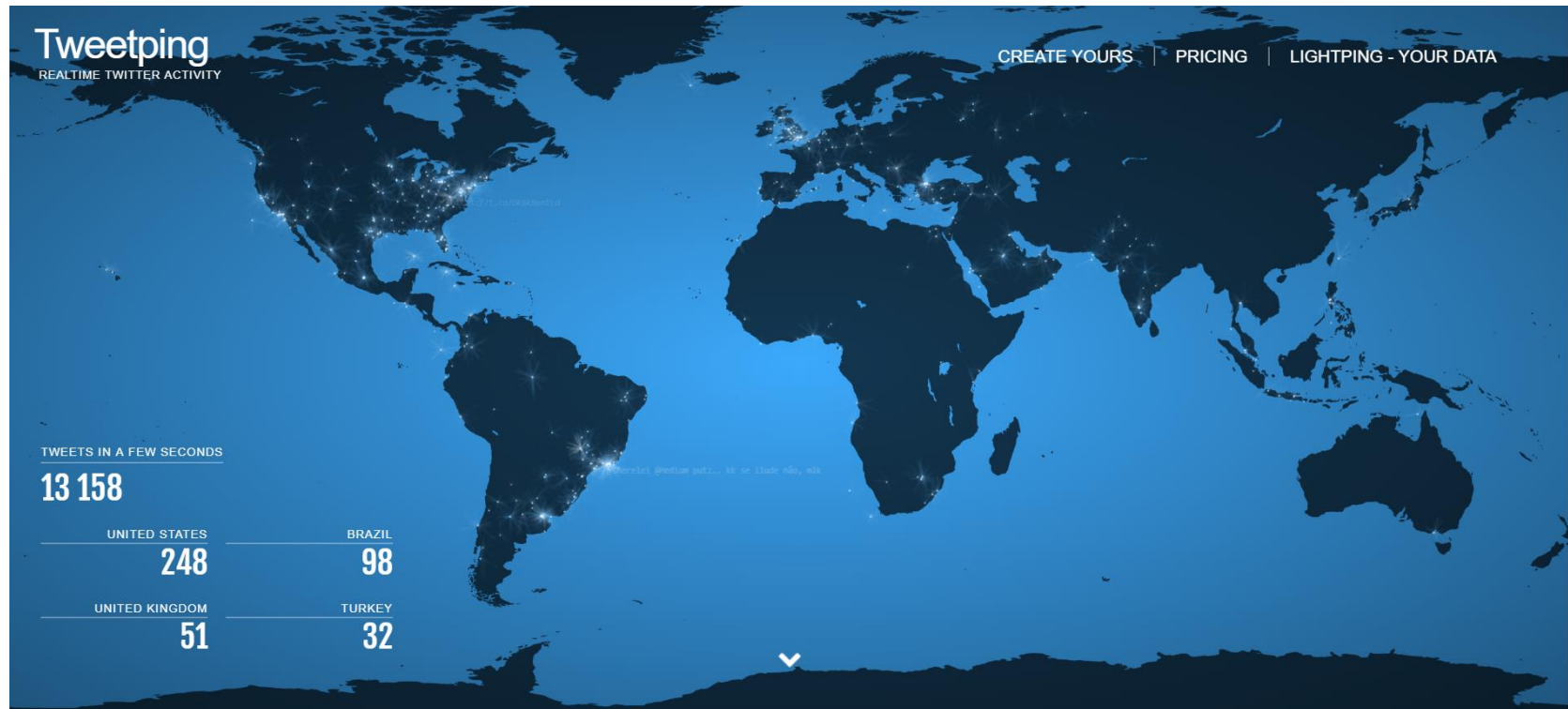
Christan Grant *Department of Computer Science, University of Oklahoma*

# Social Media for Population Studies



Every geotagged tweet from mid 2011- 2014, compared with 2010 global population density. Map by Eric Fischer. Source: <https://blog.mapbox.com/making-the-most-detailed-tweet-map-ever-b54da237c5ac>

# Social Media for Population Studies



Geotagged tweets visualized in real time via tweetping.net (developer: Franck Ernewein)

# Using social media for health research

The collage features several key elements:

- AJPH RESEARCH**: A box containing the title "Geotagged US Tweets as Predictors of County-Level Health Outcomes, 2015–2016" and a snippet of the abstract discussing the use of geotagged Twitter data to create national indicators of small-area indicators of prevalent sentiment and social mobility, and to test associations with county-level health outcome geographic characteristics.
- Shots**: A section titled "HEALTH NEWS FROM NPR" featuring an article "Yelp Reviews Can Take Food Poisoning Alerts Viral" by Barbara Feder Ostrov, dated October 23, 2015.
- PLOS ONE**: A research article titled "Assessing the Online Social Environment for Surveillance of Obesity Prevalence" by Rumi Chunara, Lindsey Boutin, John W. Ayers, John S. Brownstein, published April 24, 2015.
- PLOS ONE**: A research article titled "Assessing Vaccination Sentiments with Online Social Media: Implications for Infectious Disease Dynamics and Control" by Marcel Salathé and Shashank Khundwani, published October 13, 2011.
- Shots**: A section titled "HEALTH NEWS FROM NPR" featuring an article "What The Public Is Saying About Miscarriage In 140 Characters" by Elaine Nsoesie and Nina Cesare, dated August 27, 2017.
- The Atlantic**: A technology article titled "How Misinfodemics Spread Disease" by Nat Gyenes and An Xiao Mina, dated August 30, 2018, discussing how online misinformation fuels the spread of diseases.
- Image**: A photograph of a box of "MEASLES, MUMPS, AND RUBELLA VIRUS VACCINE M-M-R® II" with 10 single-dose 0.5-mL vials.

# Using social media for health research

## Temporally granular

- Foodborne illness
- Influenza
- Other communicable/infectious disease

## Geographically granular

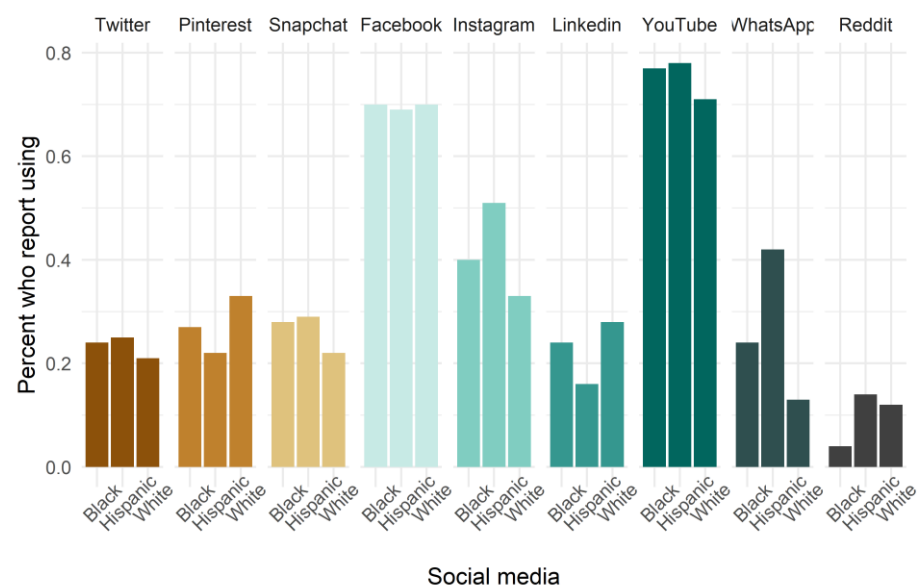
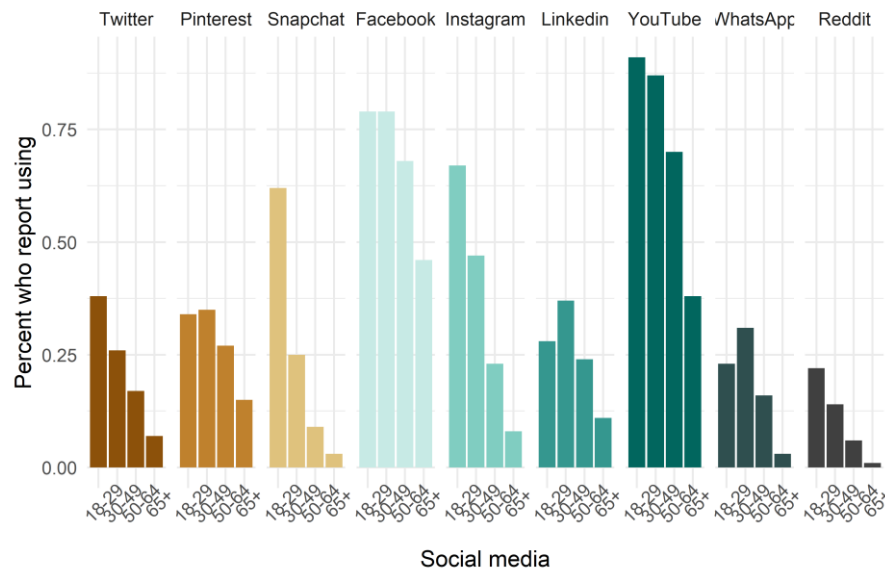
- Obesity
- Physical inactivity
- Other acute/chronic health outcomes

## Qualitative detail

- Attitudes toward health services (e.g. vaccines)
- Attitudes toward health behaviors (e.g. physical activity)

# Challenges of this work

## ■ Under/over representation of groups across platforms



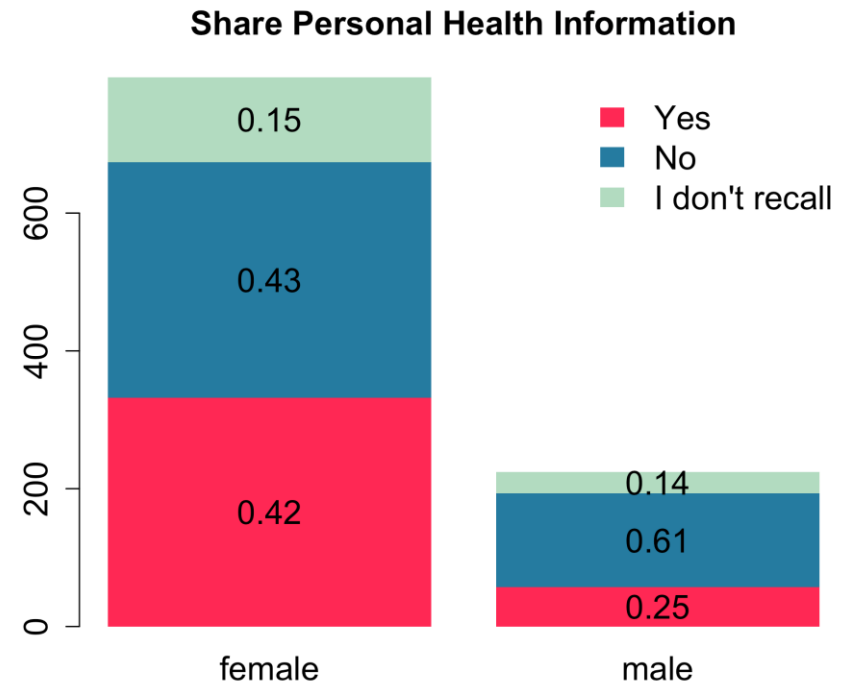
Data from the Pew Research Center Social Media Fact Sheet. Updated June 12<sup>th</sup>, 2019.

<https://www.pewinternet.org/fact-sheet/social-media/>

# Challenges of this work

## Patterns of social media use:

- May vary between demographically divided peer groups
- May be driven by unobserved social/cultural expectations



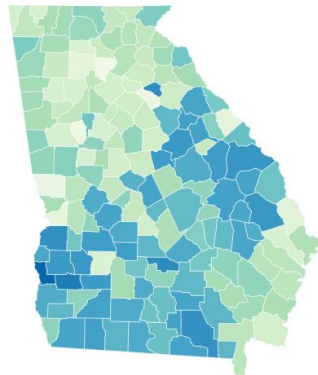
Results from a survey distributed by Nsoesie et al. via Pollfish. Results not nationally representative.

# Demographic bias within data

- Sampling from specific geographies != capturing communities of interest

Poverty in Georgia

Percent below poverty line

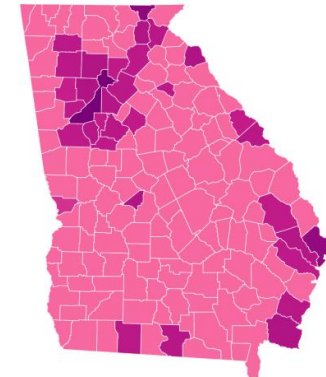
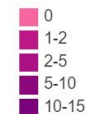


*The Conversation*, CC-BY-ND

Source: Elaine Nsoesie [Get the data](#)

Yelp reviews in Georgia

Yelp reviews per 1000 residents



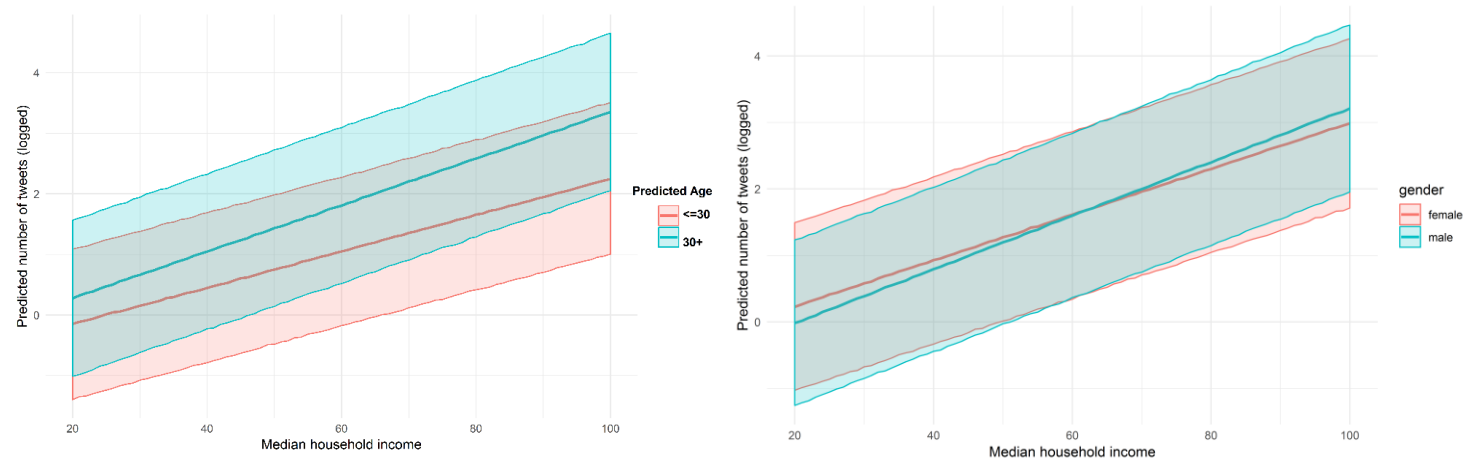
*The Conversation*, CC-BY-ND

Source: Elaine Nsoesie [Get the data](#)

Source: Elaine Nsoesie. "Social media helps officials spot public health threats - but only for the rich?" *The Conversation*. <http://theconversation.com/social-media-helps-officials-spot-public-health-threats-but-only-for-the-rich-76364>

# Demographic bias within data

- Sampling from specific geographies != capturing communities of interest



Predicted number of observed foodborne illness tweets per county, varying median income, estimated demographics of Twitter users

# Demographic bias within data

- Bias in **actual** sample composition
- Bias in **estimated** sample composition

	All	Female	Male	Darker	Lighter	DF	DM	LF	LM
<b>MSFT</b>									
Error Proportion	-	76.9%	23.1%	93.6%	6.4%	70.5%	23.1%	6.4%	0.0%
Error Count	78	60	18	73	5	55	18	5	0
<b>FACE++</b>									
Error Proportion	-	95.9%	4.1%	74.0%	26.0%	72.4%	1.6%	23.6%	2.4%
Error Count	123	118	5	91	32	89	2	29	3
<b>IBM</b>									
Error Proportion	-	74.7%	25.3%	85.7%	14.3%	61.0%	24.7%	13.6%	0.6%
Error Count	154	115	39	132	22	94	38	21	1

Table 1: The error proportion and count contribution of each subgroup to the overall error rates for the 3 evaluated commercial classifiers.

**Source:** Joy Buolamwini and Timnit Gebru. “Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification. Published in FAT 2018.

# Demographic bias within data

“In computer science literature, bias is defined in terms of the dataset—bias in labeling, bias in sample selection, bias in the task, or bias in model structure, favoring certain types of error over others....In medical and social science research, bias has been defined as any tendency that prevents unprejudiced consideration of a question or advances prejudice in favor of or against one group compared with another.”

- Kadija Ferryman and Mikaela Pitcan. *Fairness in Precision Medicine*. Data & Society

# Demographics, Ethics and Privacy

Data-driven approaches toward estimating, controlling for demographic bias within samples

What **can** we estimate, and what **should** we estimate?

What is acceptable/ethical data use?

# Moving forward

- **Interdisciplinary collaboration**
  - Researchers developing prediction models + domain experts + ethics experts = more reliable, ethical work?
- **Involve stakeholders**
  - Take administrative steps to ensure people are in control of their own metadata
  - Small-scale surveys of social media preference, comfort with domain specific research

# Moving forward

- Keep the conversation rolling!
- Interpret bias broadly!
- Hand the microphone to marginalized groups!
- Your ideas?...

# Thank you!

Contact: [ncesare@bu.edu](mailto:ncesare@bu.edu)



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