Day 5 - The Web, Computational Infrastructure, and Innovative Datasets

UMN CSS Workshop 2025

Instructor: Alvin Zhou

Learning Goals

- Understand behavioral trace data
- Overview of prior-decade data collection methods (API)
- Post-API era: Scraping, data donation, collaboration, audit, etc.
- Discuss data ethics

A Paradigm Shift in Social Science

- From surveys and self-reports → behavioral traces and digital exhaust
- Surveys: What people say they do
- Traces: What people actually do

- **Both are biased**, but differently
- Key advantage: Less filtered, less recall bias
- Key risk: Less context, harder to interpret meaningfully

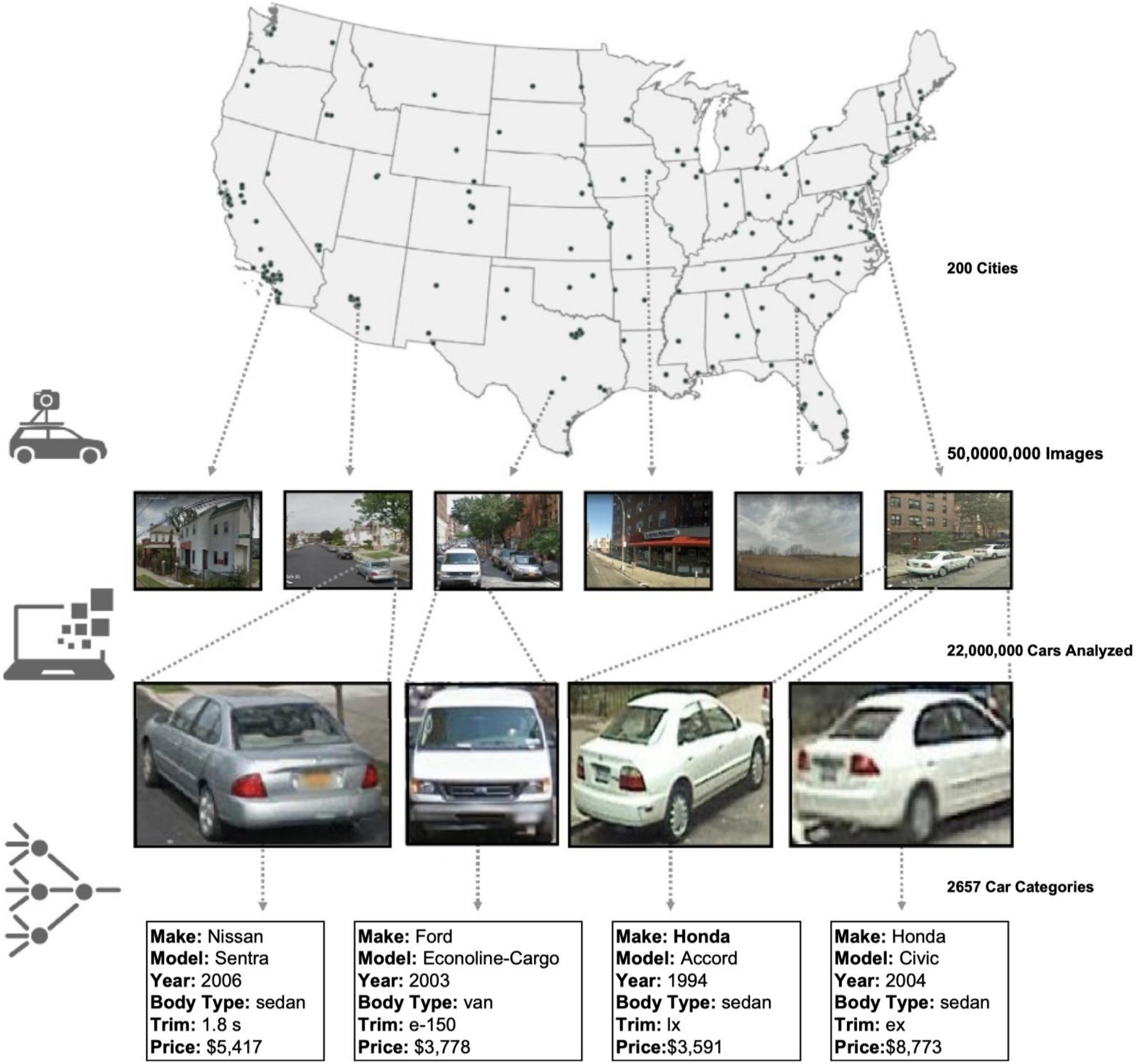
Behavioral Trace Data: Beyond Social Media

- First of all, we should not equate **behavioral trace** to **online behavioral trace** or **online social media behavioral trace**
- Online social media activity ≠ entire digital life ≠ entire life

- Browsing logs
- Search histories
- Location & mobility data (e.g., Google Maps)
- Environmental imagery (e.g., Street View, satellite)
- Wearables, app logs, e-commerce trails

Gebru et al. (2017): Google Street View

- RQ: Can we infer socioeconomic patterns from the environment people live in?
- Analyzed 50 million Google Street View images across 200 U.S. cities.
- Used deep learning to identify 22 million vehicles by make, model, and year.
- Found strong correlations between vehicle types and:
  - Income levels
  - Educational attainment
  - Racial composition
  - Voting patterns:
    - More sedans → likely Democratic; More pickups → likely Republican

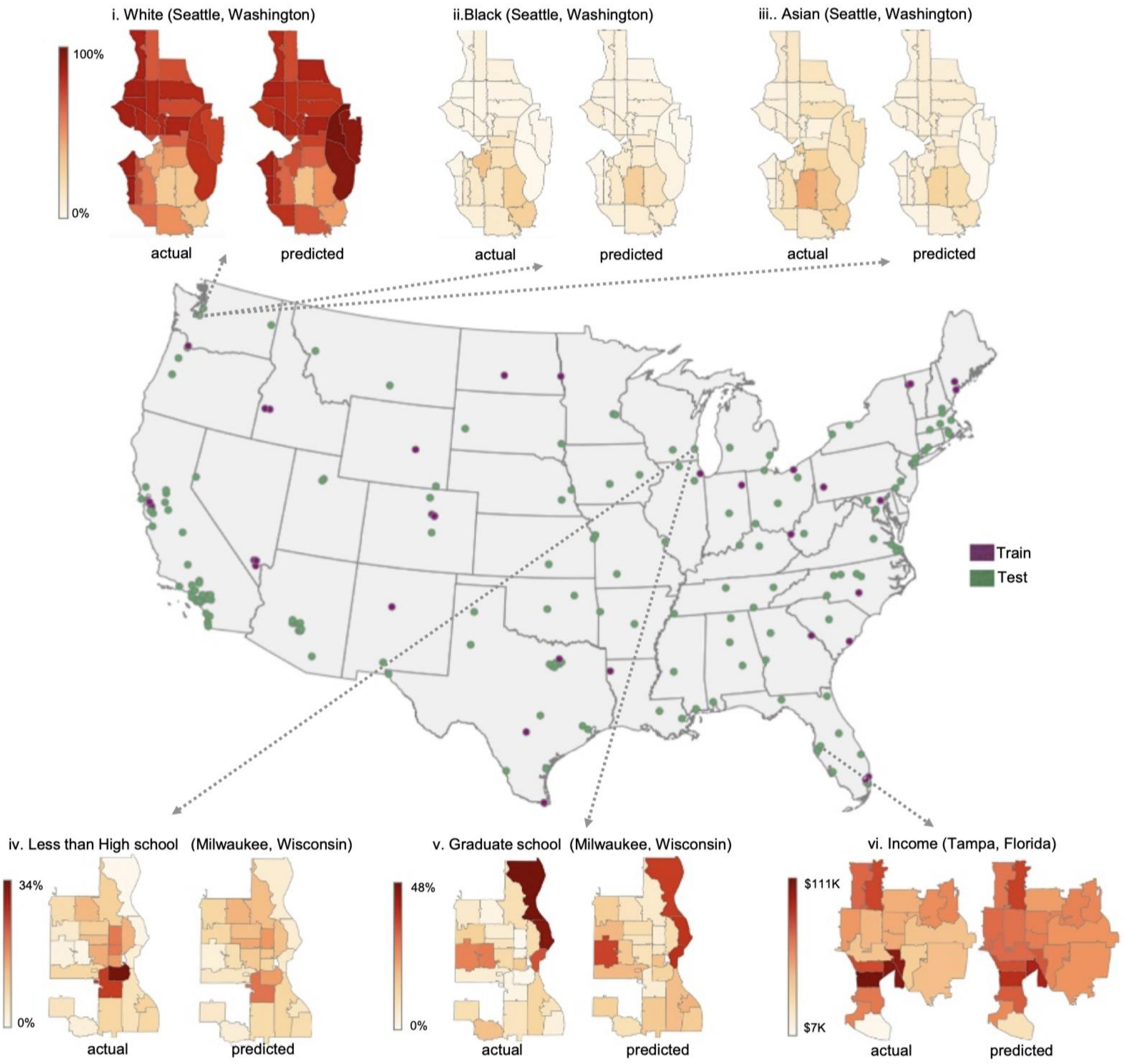


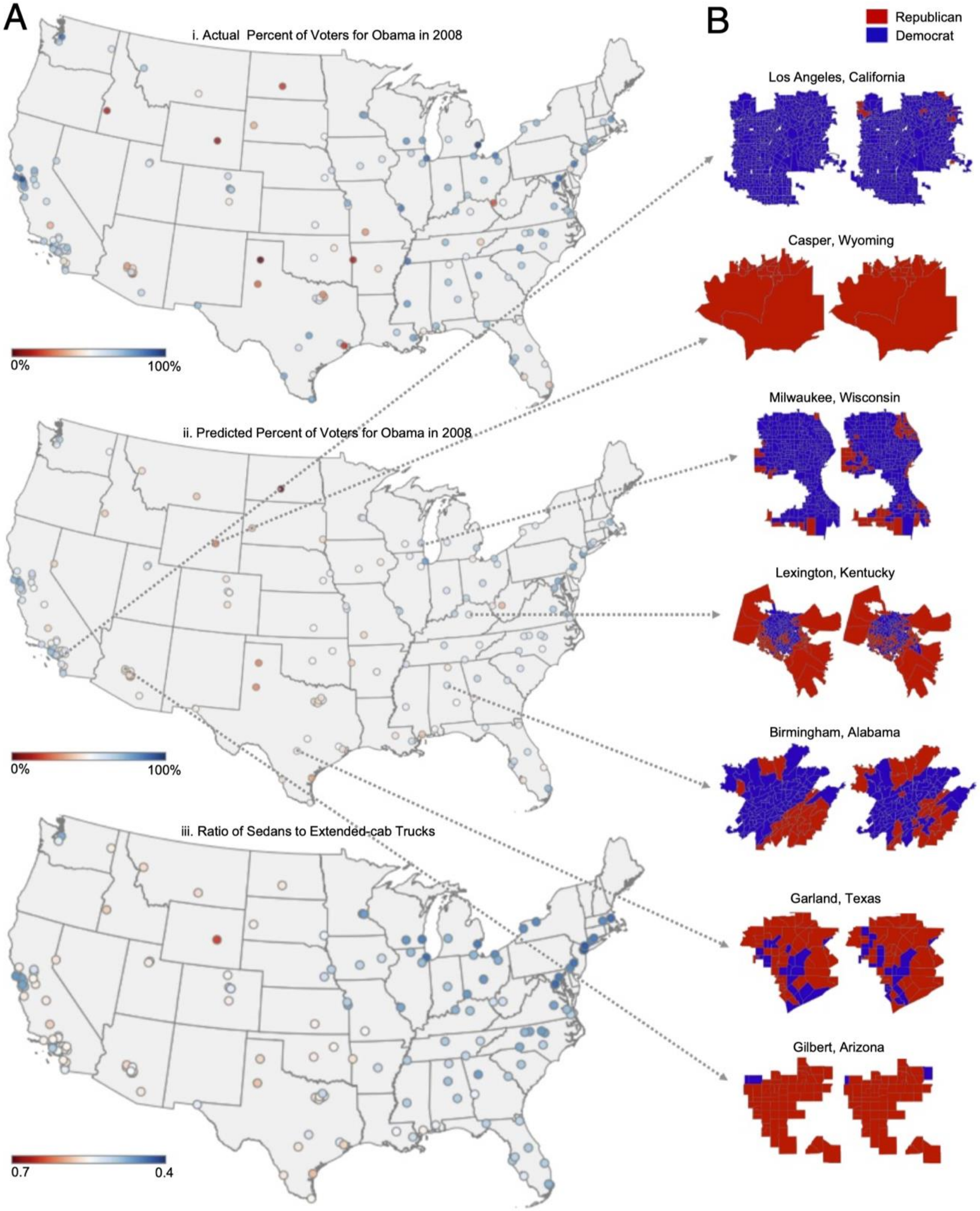
Make: Nissan
Model: Sentra
Year: 2006
Body Type: sedan
Trim: 1.8 s
Price: $5,417

Make: Ford
Model: Econoline-Cargo
Year: 2003
Body Type: van
Trim: e-150
Price: $3,778

Make: Honda
Model: Accord
Year: 1994
Body Type: sedan
Trim: lx
Price:$3,591

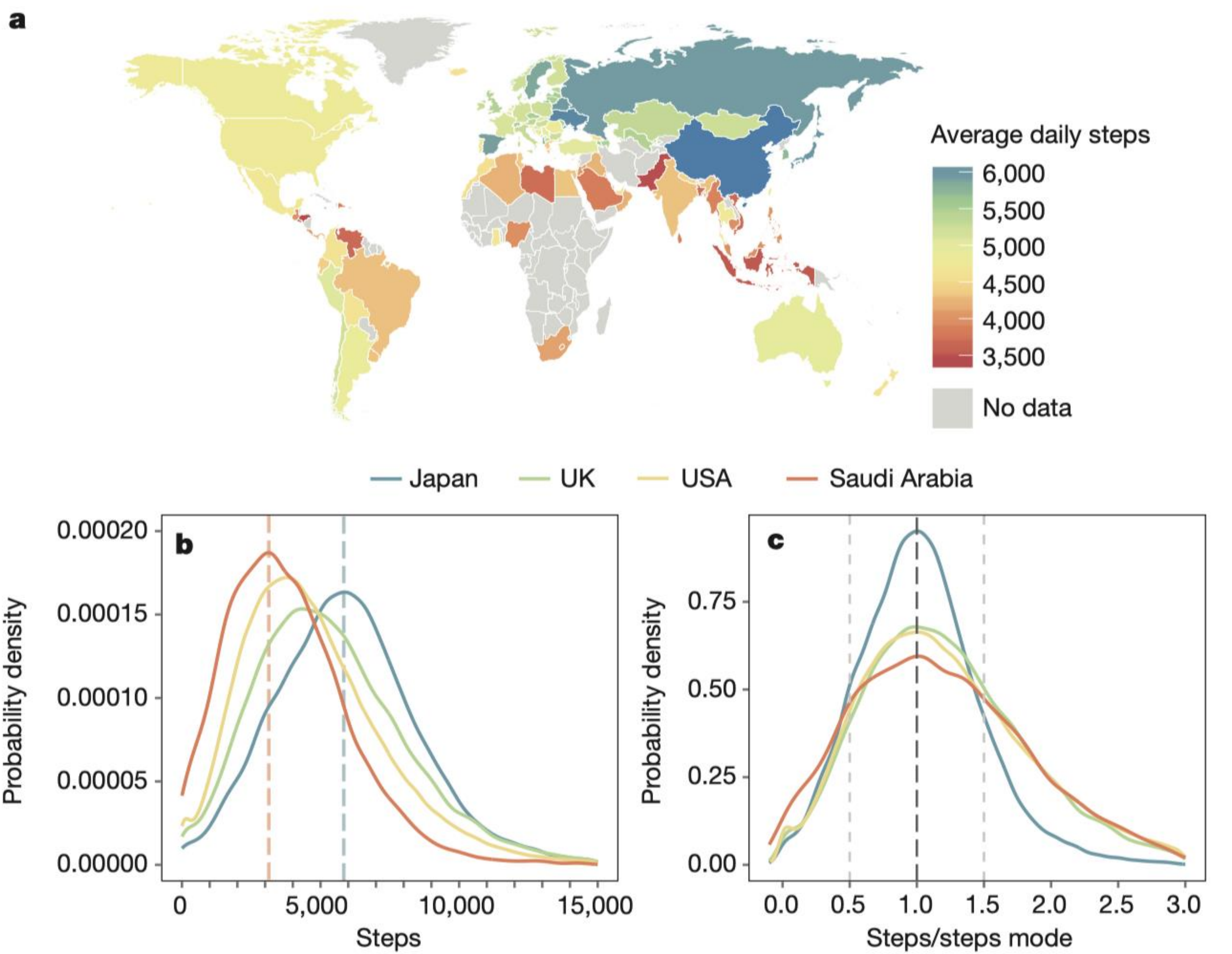
Make: Honda
Model: Civic
Year: 2004
Body Type: sedan
Trim: ex
Price:$8,773

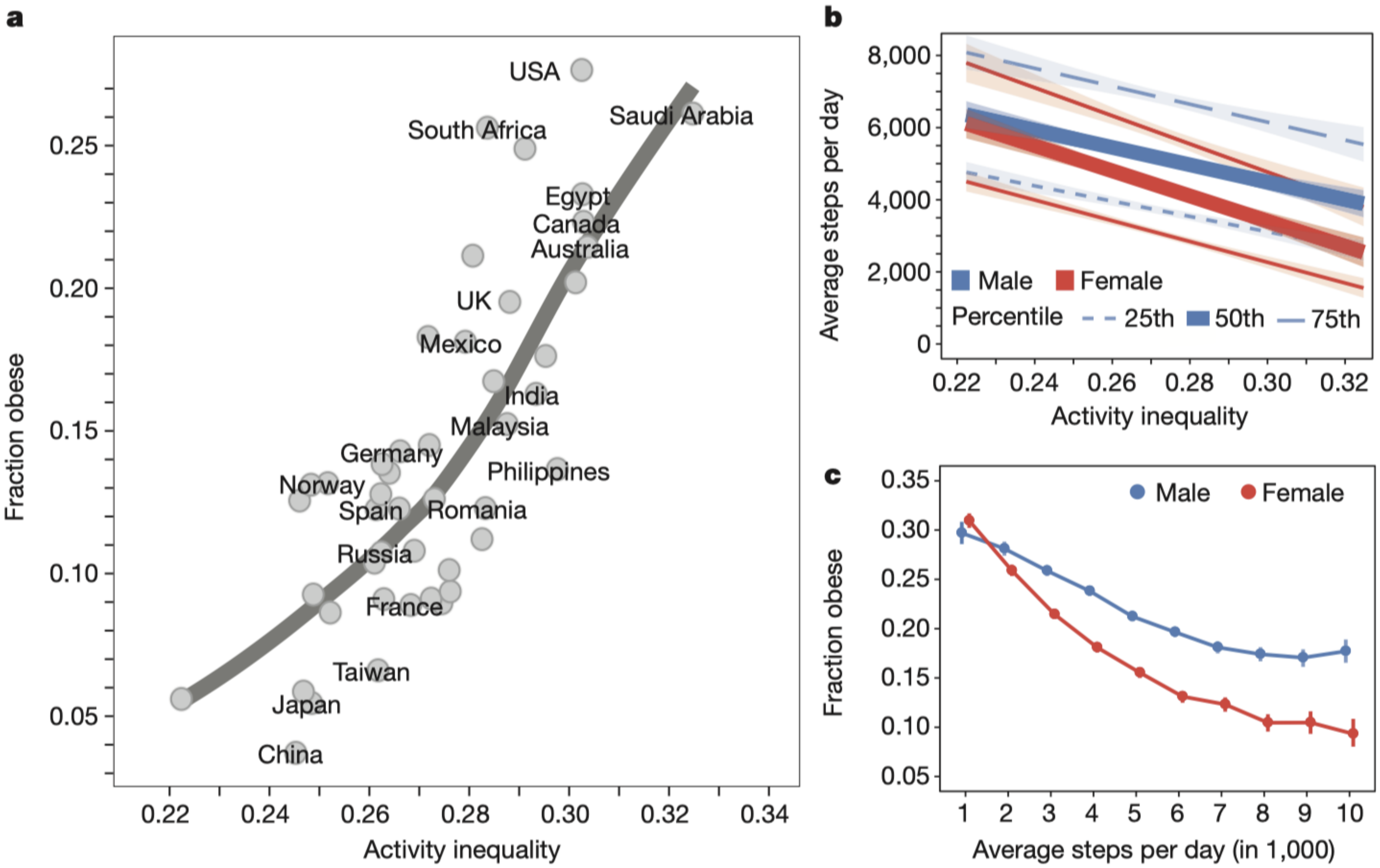

i. White (Seattle, Washington)
100%
0%
actual
predicted
ii.Black (Seattle, Washington)
actual
predicted
iii.. Asian (Seattle, Washington)
actual
predicted
Train
Test
iv. Less than High school (Milwaukee, Wisconsin)
34%
0%
actual
predicted
v. Graduate school (Milwaukee, Wisconsin)
48%
0%
actual
predicted
vi. Income (Tampa, Florida)
$111K
$7K
actual
predicted

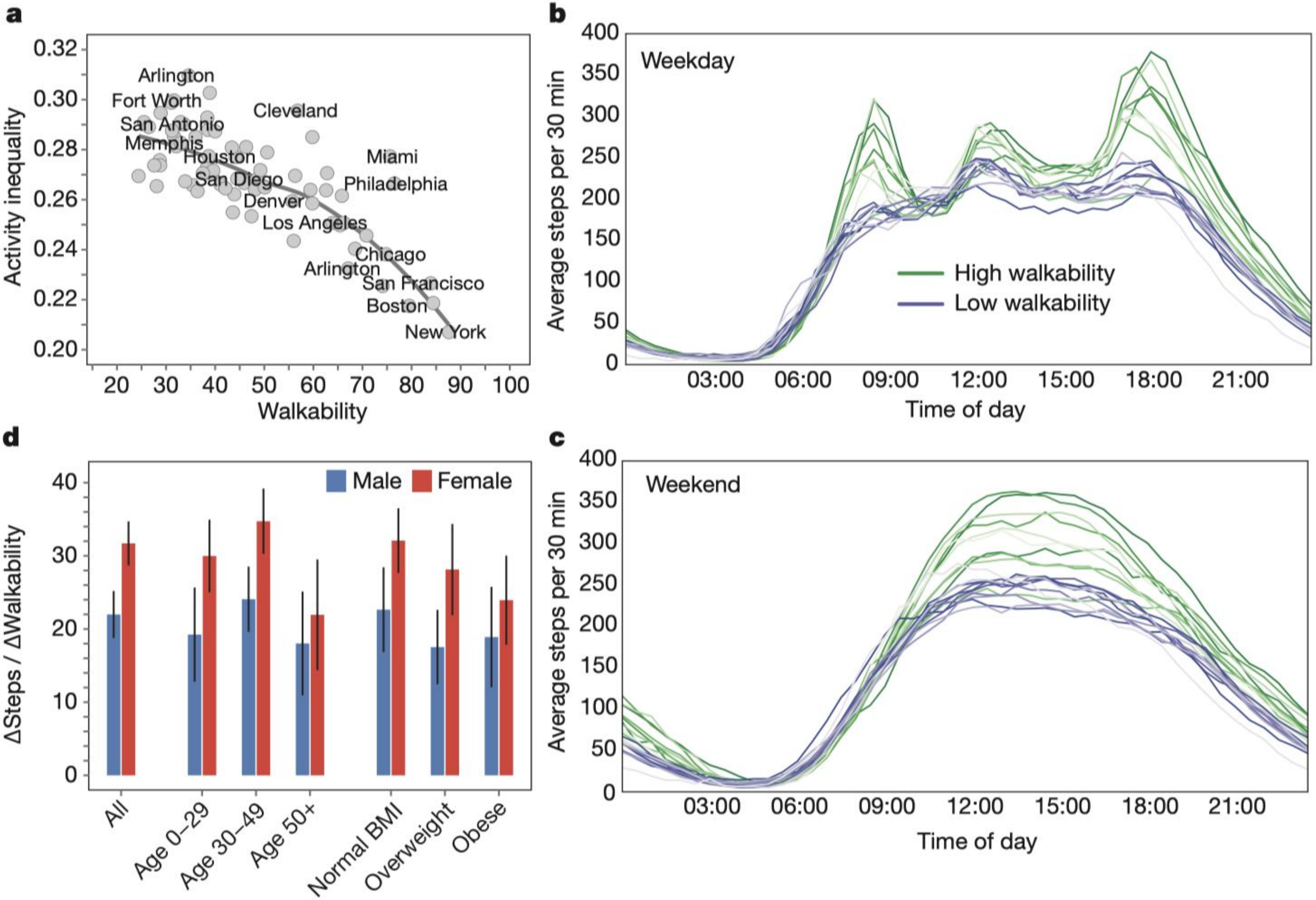

A
i. Actual Percent of Voters for Obama in 2008
0%
100%
ii. Predicted Percent of Voters for Obama in 2008
0%
100%
iii. Ratio of Sedans to Extended-cab Trucks
0.7
0.4
B
🟥 Republican
🟦 Democrat
Los Angeles, California
Casper, Wyoming
Milwaukee, Wisconsin
Lexington, Kentucky
Birmingham, Alabama
Garland, Texas
Gilbert, Arizona

Althoff et al. (2017): Fitness Tracking

- Traditional social science relied on surveys, diaries, or lab studies to track health behavior.
- Mobile apps and wearable tech (e.g., smartphones, Fitbit) enable real-time, passive, global data collection.
- Collaboration with corporate platforms (e.g., Argus app) allows access to massive behavioral datasets.
- 68 million days of physical activity from 717,000 users across 111 countries.
- Activity inequality as a stronger predictor of obesity.

a
Average daily steps
6,000
5,500
5,000
4,500
4,000
3,500
No data
Japan
UK
USA
Saudi Arabia
b
Probability density
0.00020
0.00015
0.00010
0.00005
0.00000
0
5,000
10,000
15,000
Steps
c
Probability density
0.75
0.50
0.25
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Steps/steps mode


a
USA
Saudi Arabia
South Africa
Egypt
Canada
Australia
UK
Mexico
India
Malaysia
Germany
Philippines
Norway
Spain
Romania
Russia
France
Taiwan
Japan
China
Fraction obese
0.05
0.10
0.15
0.20
0.25
Activity inequality
0.22
0.24
0.26
0.28
0.30
0.32
0.34
b
Average steps per day
0
2,000
4,000
6,000
8,000
Male
Female
Percentile
25th
50th
75th
Activity inequality
0.22
0.24
0.26
0.28
0.30
0.32
c
Fraction obese
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Male
Female
Average steps per day (in 1,000)
1
2
3
4
5
6
7
8
9
10


a
Activity inequality
0.32
0.30
0.28
0.26
0.24
0.22
0.20
Walkability
20
30
40
50
60
70
80
90
100
Arlington
Fort Worth
San Antonio
Memphis
Houston
Cleveland
San Diego
Denver
Los Angeles
Miami
Philadelphia
Chicago
Arlington
San Francisco
Boston
New York
b
Weekday
Average steps per 30 min
400
350
300
250
200
150
100
50
0
03:00
06:00
09:00
12:00
15:00
18:00
21:00
Time of day
High walkability
Low walkability
c
Weekend
Average steps per 30 min
400
350
300
250
200
150
100
50
0
03:00
06:00
09:00
12:00
15:00
18:00
21:00
Time of day
d
ΔSteps / ΔWalkability
40
30
20
10
0
Male
Female
All
Age 0–29
Age 30–49
Age 50+
Normal BMI
Overweight
Obese

The Golden Age of APIs: Then and Now

- APIs once made massive platform data accessible to researchers
- Then: Open endpoints, easy rate limits, little restriction
  - Twitter:
    - Era 1:
      - Firehose: Full access to all public tweets in real time; Only available to a handful of partners or through expensive commercial contracts (e.g., Gnip, now part of Twitter)
      - Garden Hose: A sampled feed, ~10% of public tweets. Researchers request access
      - Spritzer: An even smaller sampled stream, around 1%—what most researchers actually got via the free Streaming API
    - Era 2 (launched in 2021, until Elon takeover in 2023):
      - Academic Research API v2, free, full-archive access, 10M tweets/month cap
- Now:
  - High barriers (e.g., paid access, deprecated tools)
  - Legal gray zones (e.g., scraping = violation of TOS)
  - Platform shutdowns (e.g., Pushshift, Facebook Research)

Twitter API Now

Tier	**Monthly Cost**	**Access Details**
Free	$0	For write-only access You can post 500 posts per month
Basic	$200	Up to 10,000 tweets read per month. 7-day search history
Pro	$5,000	Up to 1 million tweets read per month. Search enabled
Enterprise	$42,000+ (rumor)	Full-archive search access

https://docs.x.com/x-api/getting-started/about-x-api

The Golden Age of APIs: Then and Now

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- Then: Open endpoints, easy rate limits, little restriction
  - Reddit:
    - Pushshift: historical and real-time Reddit data access far beyond what Reddit's own API
    - Full archives of comments and posts since Reddit's founding
    - Queryable JSON file and downloadable dumps (still exists it seems like)
    - Reddit cut off Pushshift access in 2023
    - The "PullPush" effort tries to recreate it - we will try it in the lab
- Now:
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  - Legal gray zones (e.g., scraping = violation of TOS)
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The Golden Age of APIs: Then and Now

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- Then: Open endpoints, easy rate limits, little restriction
    - YouTube:
        - YouTube Data API v3
        - Originally open and easy to use.
        - Now requires an API key with quota limits.
        - Strict use policy and compliance with YouTube’s Terms of Service.
        - Increased risk of API key revocation for TOS violations
- Now:
    - High barriers (e.g., paid access, deprecated tools)
    - Legal gray zones (e.g., scraping = violation of TOS)
    - Platform shutdowns (e.g., Pushshift, Facebook Research)

The Golden Age of APIs: Then and Now

- APIs once made massive platform data accessible to researchers
- Then: Open endpoints, easy rate limits, little restriction
  - Facebook:
    - Graph API (launched 2010)
    - Allowed programmatic access to posts, likes, friends, group memberships, etc
    - Huge for early CSS research (e.g., Facebook friendship networks)
    - Used (and abused) in scandals like Cambridge Analytica
    - After 2018, Facebook locked down its Graph API
    - CrowdTangle (with Instagram access) became the semi-official tool, focusing only on public pages and groups (recently deprecated and now blocked for new access)
- Now:
  - High barriers (e.g., paid access, deprecated tools)
  - Legal gray zones (e.g., scraping = violation of TOS)
  - Platform shutdowns (e.g., Pushshift, Facebook Research)

Freelon (2018): The post-API age

- We used to rely on APIs for social media data. Those days are (mostly) over. Now what?

- Heavy dependence on platform APIs is risky: companies can (and do) change access rules overnight.
- Teaching platform-specific tools is fragile and short-lived.
- We must train students to be adaptable, platform-agnostic, and ethically reflexive.

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- We used to rely on APIs for social media data. Those days are (mostly) over. Now what?

- Learn Web Scraping
  - More flexible than APIs, works on most sites
  - But: harder to learn, fragile, may violate TOS
- Understand TOS and Legal Risks
  - Do not confuse TOS compliance with basic data privacy and ethics
  - Violating TOS may result in revoked access, lawsuits, or worse

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	APIs	**Scraping**
Access	Provided by platform	Extracted from public web pages
Limits	Rate-limited, selective data	Depends on HTML structure & your own limit
Reliability	Stable but platform-controlled	Fragile; breaks with site redesign
Legal/Ethical	Often within TOS	Often violates TOS or copyright
Use Case	Ideal for structured, historical data	Better for current or hard-to-access content

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- New skillsets researchers need:
  - Technical: scraping, automation, browser instrumentation
  - Legal: understanding TOS, DMCA, GDPR, platform policy
  - Ethical: balancing public benefit, user rights, and reproducibility
- Methodological future:
  - Less plug-and-play, more hand-crafted, bespoke pipelines
  - More emphasis on replication packages and ethical transparency

Freelon (2018): The post-API age

- We used to rely on APIs for social media data. Those days are (mostly) over. Now what?

- Should researchers ever violate TOS to obtain important social data?
- How do we balance public interest, user privacy, and corporate control?
- What ethical guidelines should we follow when APIs disappear?

Several Methodological Pivots

Platform Auditing: Studying the Black Box

- What is auditing?
  - Systematic evaluation of platforms' inner workings—what content is recommended, censored, or boosted? Who sees what and why?
- Why audit?
  - Because platforms don't give us the full picture. APIs are limited. Internal data is off-limits. Platform behavior is opaque by design.

- Audit studies often involve data collection methods outside official APIs—scraping, browser instrumentation, or custom logging pipelines are common technical foundations.

Presentation: Haroon et al. (2023)

Platform Auditing: Audit Design as a Genre

- Auditing is a genre, not a single method. Sock puppets are one tool, but many others exist.
- Examples of audit techniques:
  - Bots / Sock Puppet
  - User-side instrumentation (browser extensions, screen recording)
  - Crowdsourced data donation (especially prevalent in Europe)
  - Differential exposure experimental tests: Instruct users to do something first (search terms, video watches), then observe algorithmic outputs
- Design Challenges:
  - Keeping everything constant (e.g., geolocation, cookies)
  - Scaling up without violating terms of service
  - Minimizing bias from volunteer samples

The Hunt for Innovative Data

- Natural experiments from platform changes
  - Jaidka, K., Zhou, A., & Lelkes, Y. (2019). Brevity is the soul of Twitter: The constraint affordance and political discussion. *Journal of Communication*, *69*(4), 345–372. https://doi.org/10.1093/joc/jqz023
  - Guo, Y., Li, Y., & Yang, T. (2023). Civilizing social media: The effect of geolocation on the incivility of news comments. *New Media & Society*, 14614448231218989. https://doi.org/10.1177/14614448231218989
- User-generated data (reviews, images, social features)
  - Yelp Reviews, LinkedIn Job Posting, Google Images, etc.
  - Yu, C., & Margolin, D. (2024). Sharing inequalities: Racial discrimination in review acquisition on Airbnb. *New Media & Society*, *26*(3), 1627–1647. https://doi.org/10.1177/14614448221075774
- Government or nonprofit data
- Open datasets from unexpected places (e.g., real estate, transportation, Google Street View)

Presentation: Park et al. (2023)

User-Centric Behavioral Tracking

- What if users are your best data collectors?
- Shift focus from platform-provided data to *user-contributed* data: “If platforms won’t give you the data, work with users who already have it”
  - Data Donation
    - Participants manually export and donate their platform activity data (e.g., Facebook “Download Your Data” or Google Takeout)
  - Screen Tracking
    - Software logs user interaction in real time (e.g., apps, screenomics)
  - User-Centric Behavioral Tracking
    - Usually involves recruiting users to install a new piece of software
- Issues/disadvantages?

Presentation: Robertson et al. (2023)

Lab Preview

- **Web Scraping**
  - Basic
  - Advanced

- Reddit API – try out

- YouTube API – try out

- TikTok API – Apply and hope for the best