Understanding mobility change in response to COVID-19: A Los Angeles Case Study

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Background

- COVID-19 pandemic
  - Global pandemic
  - As of Mar 24, 2021, more than 124 million cases and 2.74 million deaths globally
  - About 25% of cases and 20% of deaths in U.S.
- Non-pharmaceutical interventions
  - Social distancing
  - Wear mask/face covering
  - Non-essential business closure
  - Shelter-in-place order/lockdown
- Higher risk for disadvantaged population
  - More than 75% of COVID-19 cases were from the poorest neighborhoods in LA County
  - 58.1% of COVID-19 cases are Hispanics, only 12.2% are whites

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Research Questions

- How does COVID-19 affect people's travel behavior?
- Do different population groups respond differently to COVID-19?
- Do different population groups respond differently to policy restrictions on mobility?

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Study Period

California issued shelter-in-place order

LA County first phase of business re-opening

LA County closes bars, indoor restaurants, movie theaters, etc.

2020.01.01   2020.03.19   2020.05.08   2020.07.01   2020.08.09

**Stage 0:
Before pandemic**

**Stage 1:
Enforcement of shelter-in-place order**

**Stage 2:
Business re-opening**

**Stage 3:
Business restriction**

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Mobility Data

- Mobile phone data—SafeGraph[1]
  - Measure foot traffic patterns to various points of interest (POIs) based on GPS location from apps on mobile phone
  - More than 850,000 devices (~8.5% of population) in LA County
  - Anonymous and aggregated data at Census Block Group (CBG) level


SafeGraph Core Places 2020
GeoDS Lab @UW-Madison
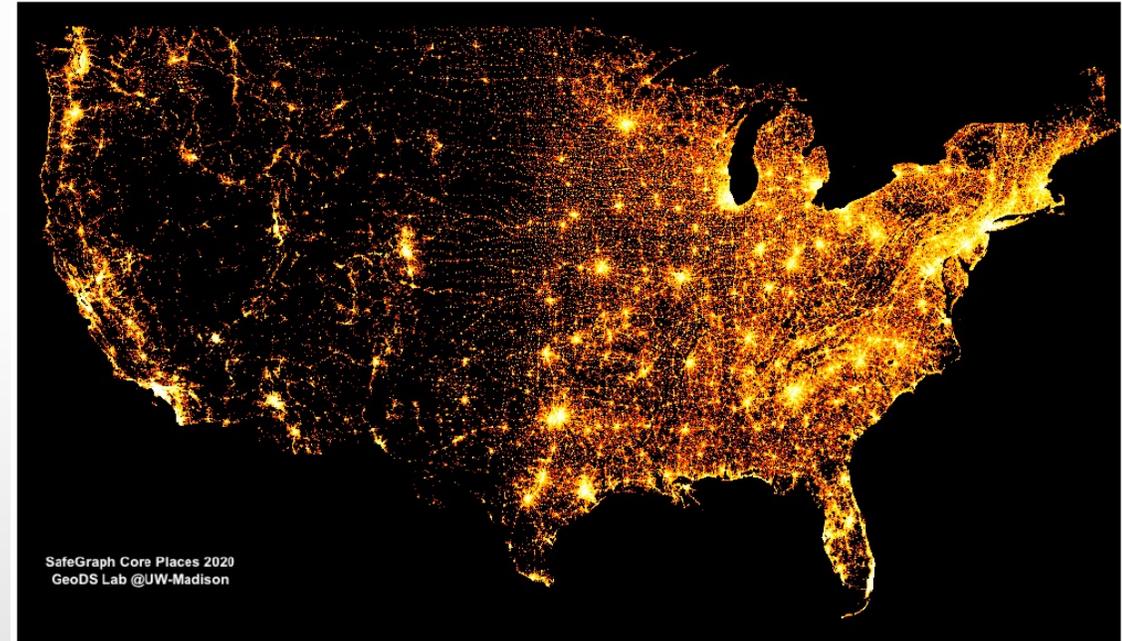
Spatial density distribution of over 3.6 million SafeGraph POIs

1. SafeGraph data, https://docs.safegraph.com/docs/social-distancing-metrics

Other Data

- Demographics from American Community Survey (ACS) (2014–2018)
  - Ethnicity
  - Income
  - Education status
- Other data
  - Access to Internet and computer—from the University of Southern California Neighborhood Data for Social Change (NDSC)
  - Weather condition (temperature, precipitation)—from the Global Historical Climatology Network (GHCN)
  - COVID cases—Los Angeles Times

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Method

- **Various population groups**
  - **High-, middle-, low-income**
    - Quartiles of median household income of each CBG
  - **White, Hispanic, African American, Other (e.g., Asian, Native American)**
    - Proportion in each CBG
  - **Twelve population groups**
    - Low-income Hispanic
    - ⋮
    - High-income White

Population group

- Low-income Hispanic
- Middle-income Hispanic
- High-income Hispanic
- Low-income African American
- Middle-income African American
- High-income African American
- Low-income White
- Middle-income White
- High-income White
- Low-income Other
- Middle-income Other
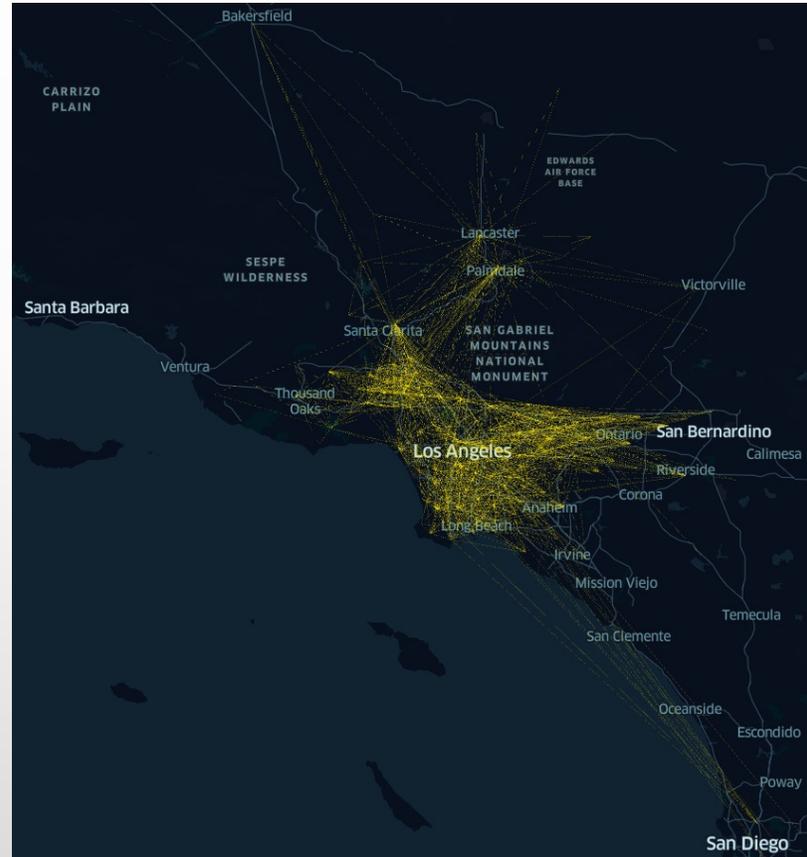- High-income Other

0 5 10 20 Miles
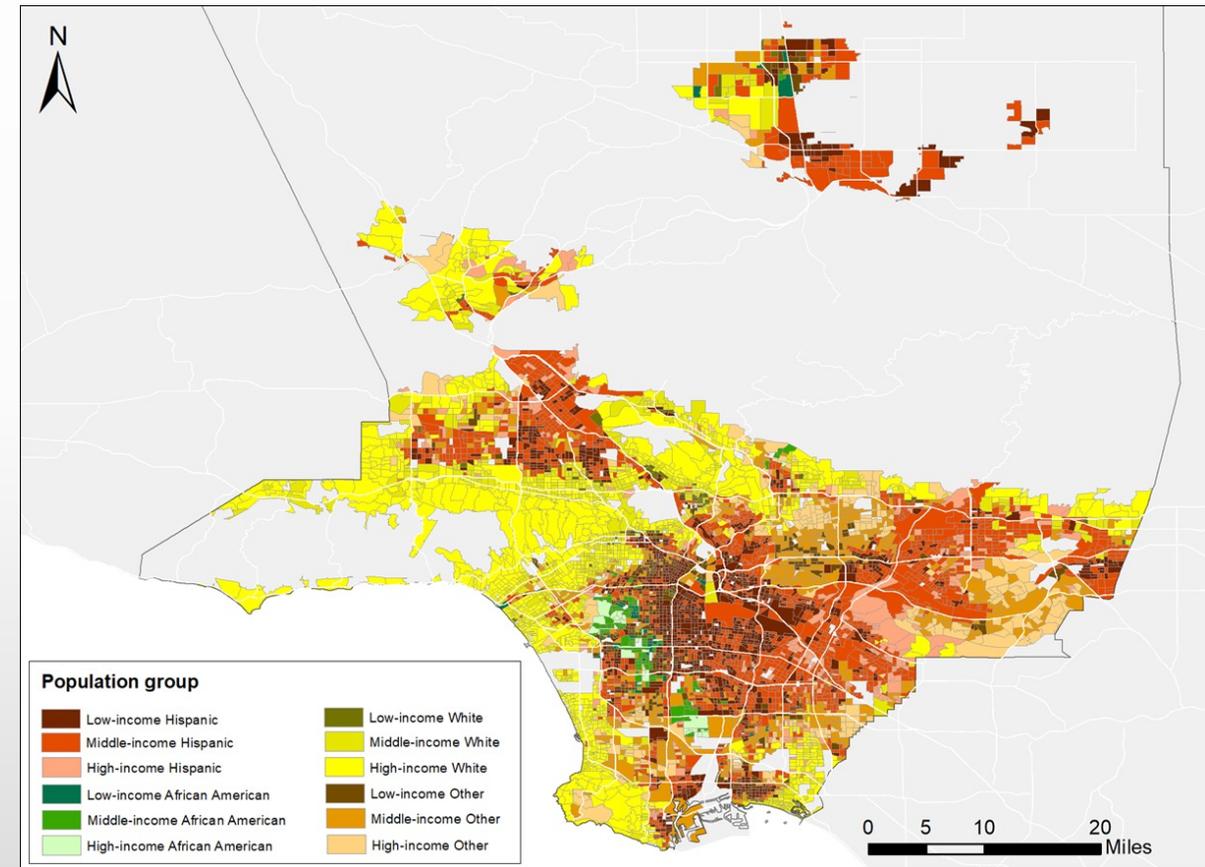
Method

- Difference-In-Difference (DID) regression model
  - Evaluate the impact of various policies on mobility change among different population groups
  - Compare changes in mobility across four different time periods and twelve groups
    - Base time period = before pandemic
    - Base population group = low-income White
  - Mobility measurements
    - CBG visited per device
    - Proportion of devices that remain at home

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Mobility change during pandemic
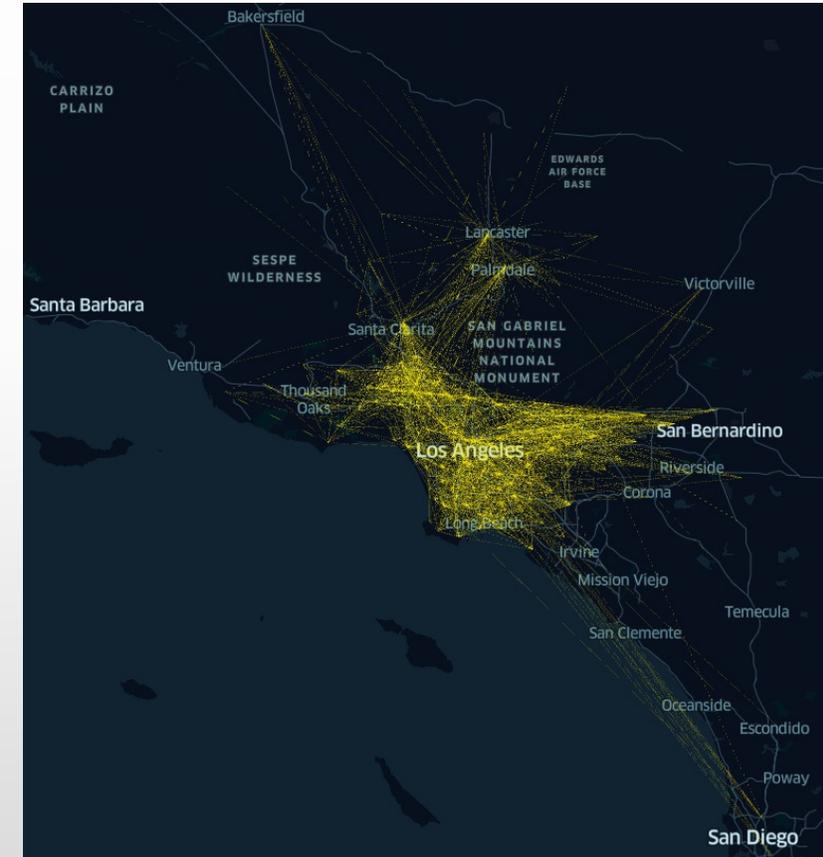
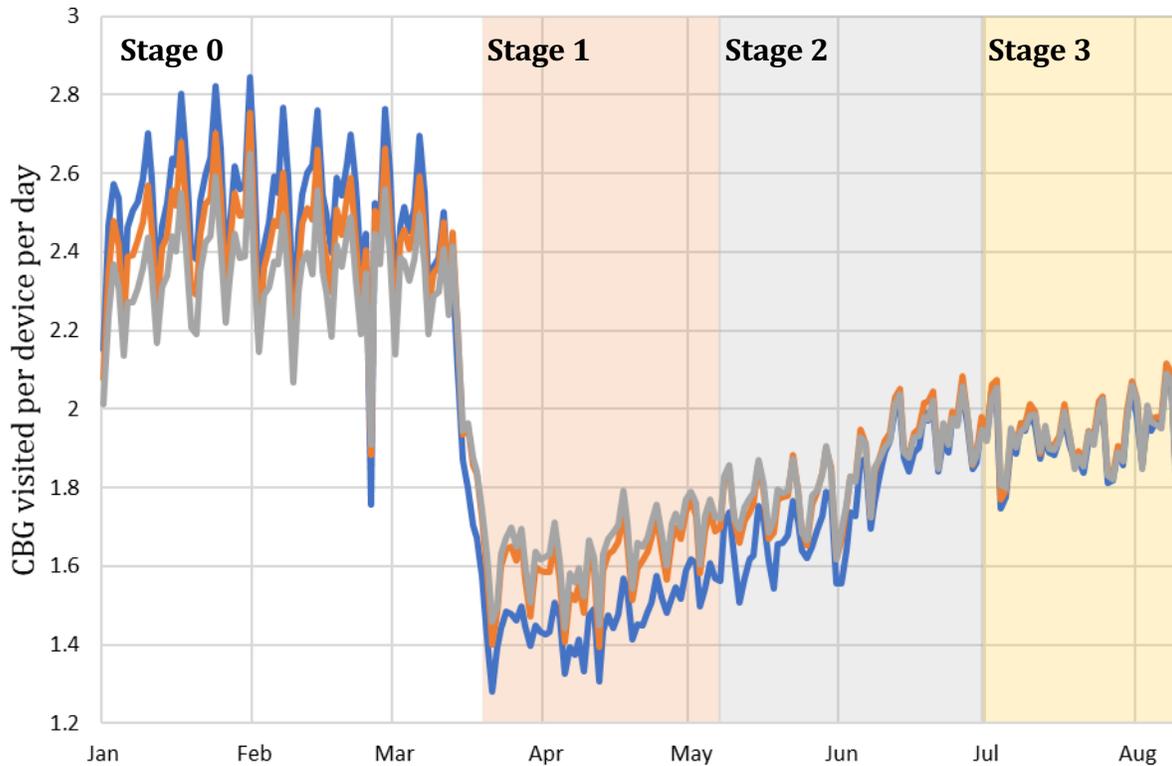Pre-pandemic (before Mar 19)   Shelter-in-place (Mar 19-May 7)   Business reopening (After May 7)
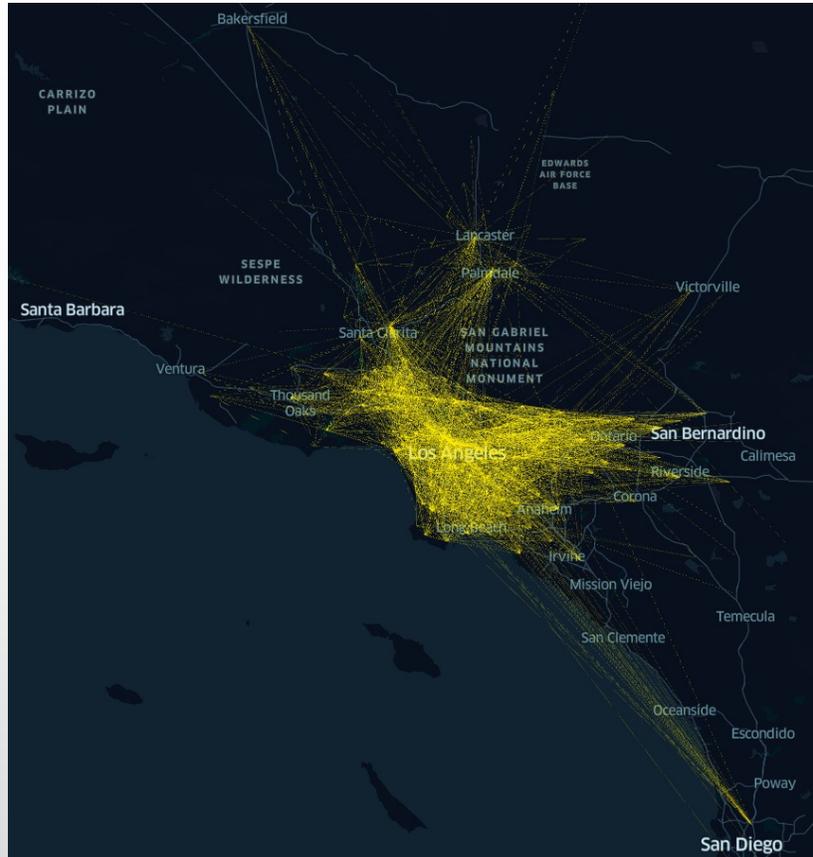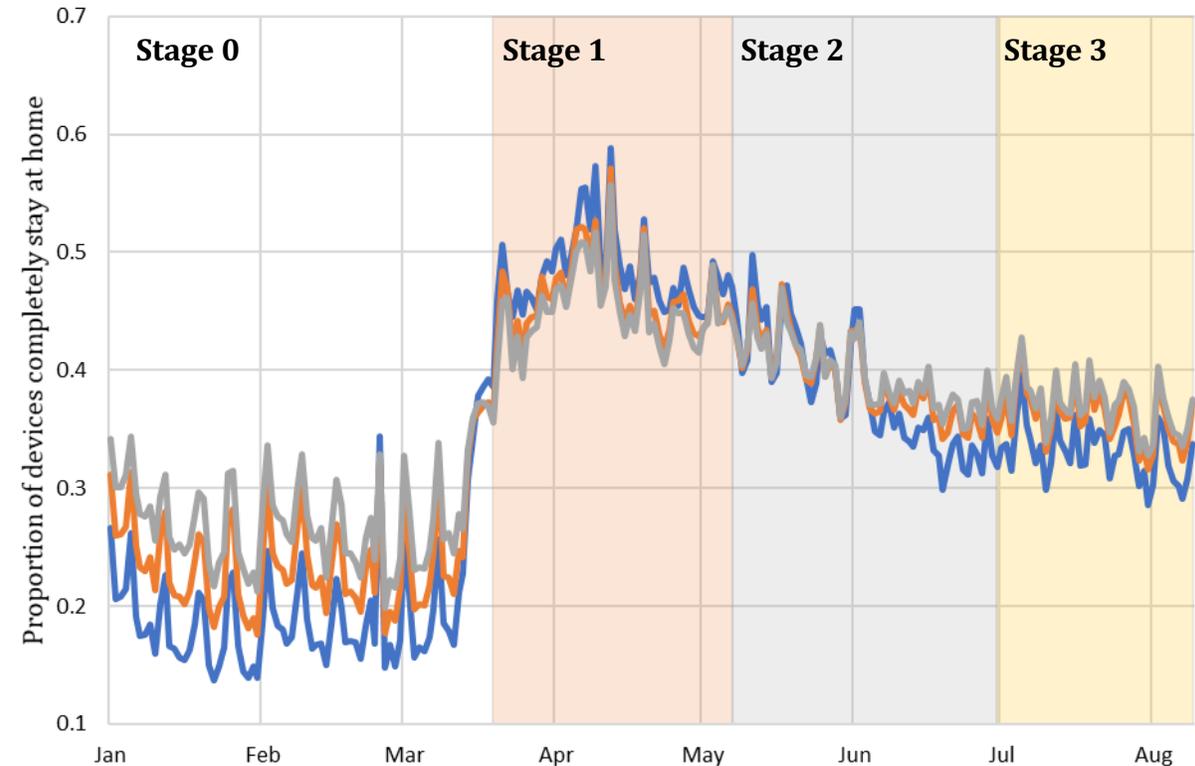
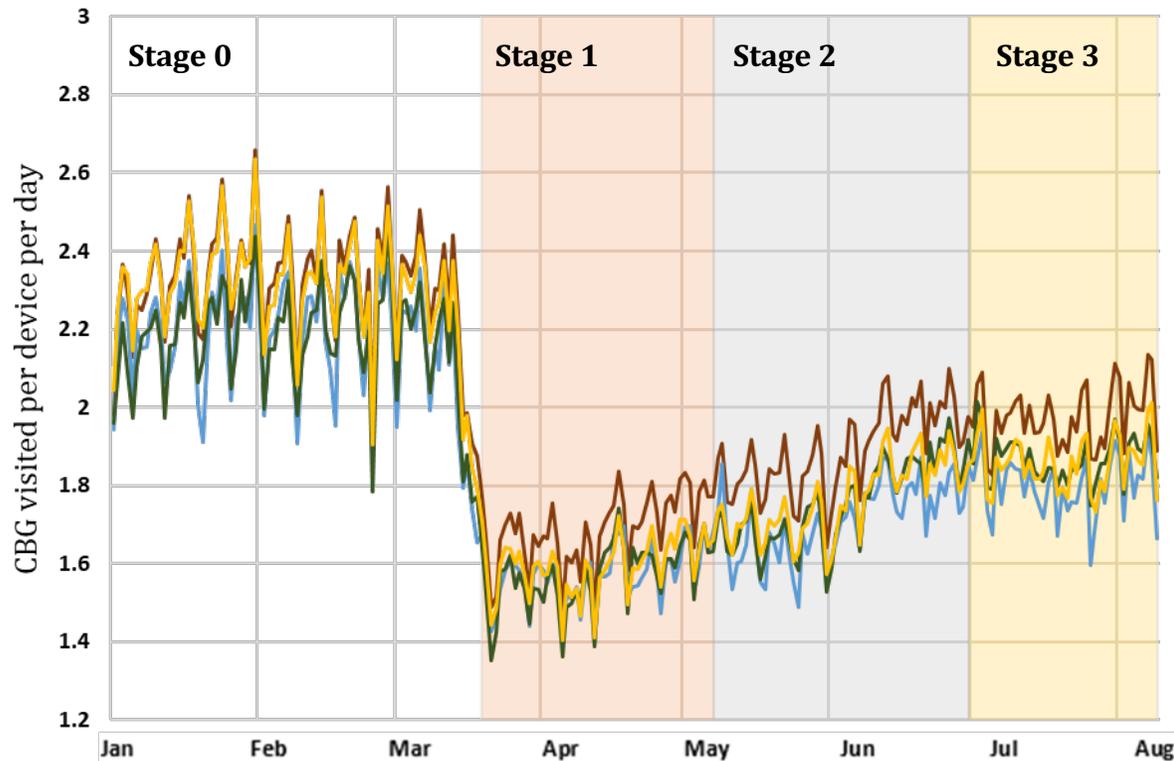# Mobility response varies by income level

Number of census blocks visited

Share of devices at home CBG
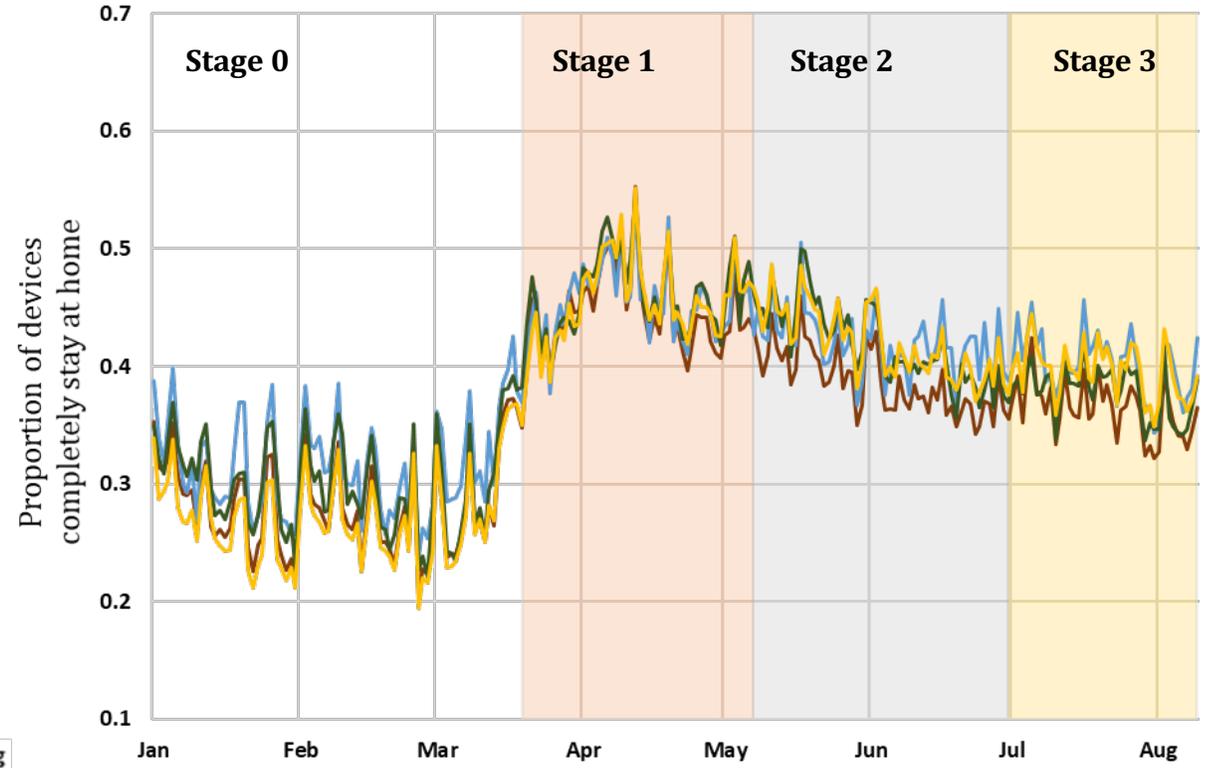
Mobility response varies by race/ethnicity, low income example

Number of census blocks visited

Share of devices at home CBG

Findings

Response to gov't orders

- **Shelter in place:**
  - Mobility down 41%.
  - Stay at home up 63%.
- **Business re-opening:**
  - Mobility up 8%.
  - Stay at home down 12%.
- Thereafter, steady increase in mobility.
- Second period of restriction has no effect.

Variation across income

- **Shelter in place:**
  - High income decreased travel more.
  - Low income decreased travel less, from a lower base.
- **Business re-opening:**
  - High income increased travel more, low income increased travel less.

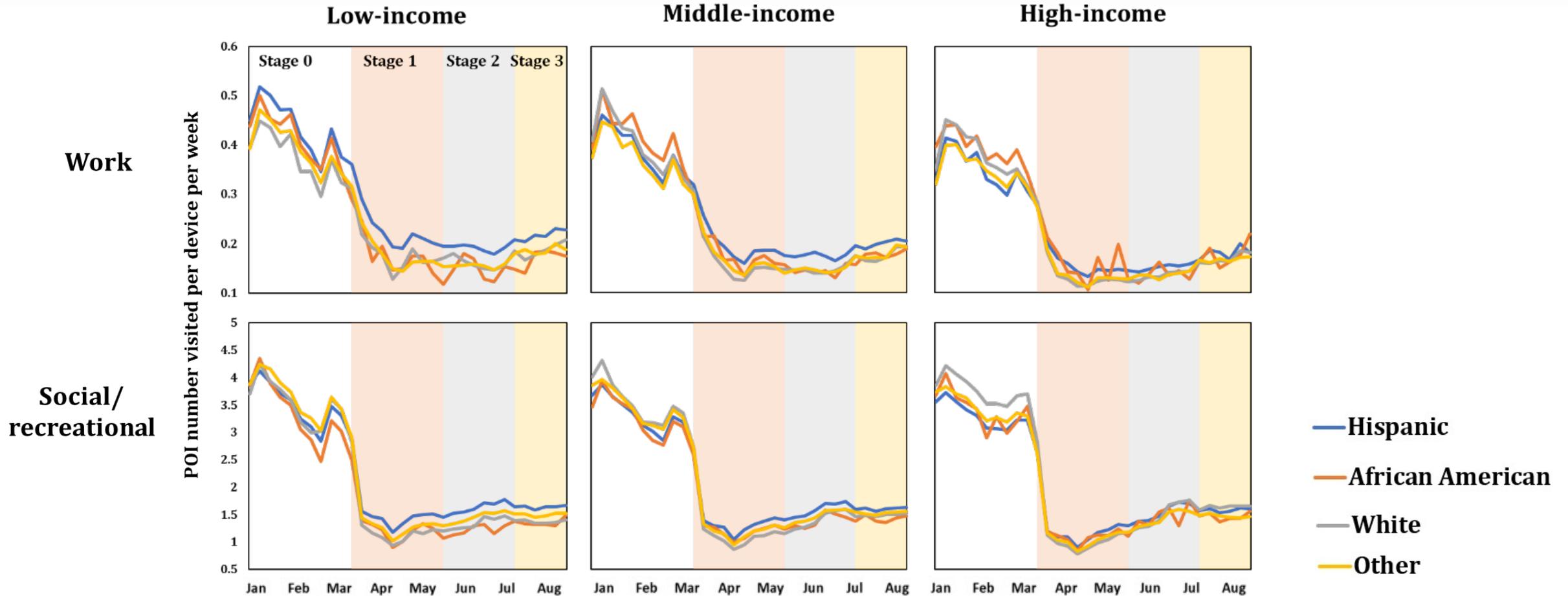## Variation across race/ethnicity

- **Shelter in place:**
  - Whites more responsive
  - Ethnic minorities less responsive.
- **Business re-opening:**
  - Whites more responsive.
  - Ethnic minorities less responsive.

COVID case rate seems to have no effect after the early period

Generating travel by purpose

Category	Sub-category[1]	Trip Purpose Categories
Discretionary Trip	Shopping	Buy goods (e.g., groceries, clothes, appliances, or gas)
	Family/personal business	• Volunteer activities (not paid) • Drop off/pick up someone • Attend adult care • Buy services (e.g., dry cleaners, service a car, or pet care) • Other general errands (e.g., post office or library)
	Social/recreational	• Perform recreational activities (e.g., visit parks, movies, bars, or museums) • Exercise (e.g., go for a jog, walk, walk the dog, or go to the gym) • Buy meals (e.g., go out for a meal, snack, or carry-out)
	Medical/dental	Make a health care visit (e.g., medical, dental, or therapy)
Non-discretionary Trip	Work	Trips undertaken for work or business purposes

1. Federal Highway Administration, TRENDS IN DISCRETIONARY TRAVEL—2017 National Household Travel Survey, https://nhts.ornl.gov/assets/FHWA_NHTS_Report_3D_Final_021119.pdf

Mobility change by trip purpose

Findings

Response to gov't orders

- **Shelter in place:**
  - Social/recreational and shopping trips down 110% and 94%.
  - Work trips down 100%.
- **Business re-opening:**
  - Social/recreational and shopping trips up 13% and 8%.
  - Work trips down 7%.
- **Business restriction:**
  - Social/recreational and shopping trips down 12% and 18%.
  - Work trips up 9%.

Variation across income

- **Shelter in place:**
  - High income decreased travel more for both work and discretional trips.
  - Low income decreased travel less.
- **Business re-opening:**
  - Low-income increased travel less for work trips than middle- and high-income.
  - High income increased travel more for discretional trips, low income increased travel less.
- **Same trend found in business restriction phase.**

Variation across race/ethnicity

- **Shelter in place:**
  - Whites and others more responsive.
  - Hispanics and African Americans less responsive.
- **Business re-opening:**
  - Hispanics and African Americans increased travel more for work trips.
  - Whites and other more responsive to discretional trips.
  - Hispanics and African Americans less responsive to discretional trips.
- **Same trend found in business restriction phase.**

Conclusions

- Shelter-in-place order was effective in reducing travel.
- Low-income and ethnic minority groups were more likely to leave home during pandemic both for work trips and discretionary trips.
  - Less ability to work from home.
    - Lack access to Internet and digital resources.
    - Most work at essential business (e.g. grocery stores) or business requires in-person service (e.g. restaurant).
  - Less capacity to purchase services (e.g. deliveries and in-home childcare).
- Policymakers should provide more support to low-income and ethnic minority populations.

Next steps

- Extend the time series to capture responses after August 2020
  - Impacts of holidays
  - The winter surge
- Consider implications of reduced mobility on social interactions
  - Does reduced mobility imply reduced daily interactions between different socio-economic groups?
  - Did COVID reinforce spatial segmentation?

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THANK YOU