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
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?
Study Period

- **2020.03.19**: California issued shelter-in-place order
- **2020.05.08**: LA County first phase of business re-opening
- **2020.07.01**: LA County closes bars, indoor restaurants, movie theaters, etc.

**Stage 0**: Before pandemic
**Stage 1**: Enforcement of shelter-in-place order
**Stage 2**: Business re-opening
**Stage 3**: Business restriction
Mobility Data

- Mobile phone data—SafeGraph\textsuperscript{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

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
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
    - 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
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
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

- High-income
- Middle-income
- Low-income
Mobility response varies by race/ethnicity, low income example

Number of census blocks visited

Share of devices at home CBG

- Hispanic
- African American
- White
- Other
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

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-category</th>
<th>Trip Purpose Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discretionary Trip</td>
<td>Shopping</td>
<td>Buy goods (e.g., groceries, clothes, appliances, or gas)</td>
</tr>
</tbody>
</table>
|                               | 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                                         |

Mobility change by trip purpose

Work

Low-income

Middle-income

High-income

Social/recreational

POI number visited per device per week

Stage 0  Stage 1  Stage 2  Stage 3

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Jan  Feb  Mar  Apr  May  Jun  Jul  Aug

Hispanic

African American

White

Other
## 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 up 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 discrentional 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 discrentional 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 discrentional trips.
  - Hispanics and African Americans less responsive to discrentional 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?
THANK YOU

WHAT THE "NEW NORMAL" IN THE U.S. MAY LOOK LIKE

WHITE HOUSE CORONAVIRUS BRIEFING

TONIGHT ON CNN

CORONAVIRUS FACTS AND FEARS

8 PM ET

LIVE

CNN

2:34 PM PT

SOURCE: JOHNS HOPKINS UNIVERSITY