The Adoption of Shared Mobility in California and Its Impacts on the Use of Other Travel Modes

October 23, 2019

Dr. Giovanni Circella

Director, 3 Revolutions Future Mobility Program
Institute of Transportation Studies, University of California, Davis
gcircella@ucdavis.edu

Twitter: @CircellaG
LinkedIn: @giovannicircella
Shared mobility, electrification and autonomous vehicles are bringing big changes in:

- Transportation supply
- Transportation demand

Need for rigorous research and impartial policy analysis to understand the impacts of these revolutions, and guide industry investments and government decision-making.

https://islandpress.org/books/three-revolutions
Future Mobility: “Heaven” or “Hell”? 

✓ Cars are all electric
✓ Energy mix is clean
✓ Increased capacity of transportation
✓ Better livability in cities
✓ Integration with public transit
✓ Everybody shares intelligent vehicles

vs.
✓ Increased congestion
✓ Electricity produced with coal
✓ Increased travel demand
✓ More car-dependence of society
✓ Reduced role of transit
✓ “Ghost” vehicles traveling on streets
"People won’t have as many vehicles because they’ll share one and own one."

Jim Hackett, Ford CEO
How are these transportation “revolutions” affecting vehicle ownership and travel behaviors?
Adoption of Shared Mobility Services Over Time

Carsharing in North America

Uber/Lyft ridership is growing quickly...

2018 Ridership (estimates):
- Local bus: 4.7 billion
- Urban rail: 4.2 billion
- Taxi/TNC: 3.8 billion

(Annual rate)

From *Bike Share* to *Shared Micromobility*
Shared Micromobility across the U.S. in 2018

Source: NACTO

Legend:
- Green dots: Station-based bike share only (>150 bikes)
- Yellow dots: Both station-based bike share & scooter share
- Orange dots: Scooter share only (>150 scooters)
- Black dots: Dockless bike share only

UCD	DAVIS
INSTITUTE OF TRANSPORTATION STUDIES

3 REVOLUTIONS
SHARED • AUTOMATED • ELECTRIC
Only **10% of U.S. residents** (aged 16+) reported to have used ridehailing in the past 30 days.

**Frequency of ride-hailing use in 30 days in the U.S.**

- Never, 90.2%
- Once, 2.4%
- Twice, 2.4%
- 3-4 times, 2.0%
- 5+ times, 3.0%

**At least once, 9.8%**

**Almost 50% of American ridehailing users live in five states:**
- California (20%)
- New York (9.2%)
- Florida (7.2%)
- Texas (6.4%)
- Illinois (5.9%)

Source: Hongwei Dong, using 2017 NHTS data
Spatial Distribution of Taxi/Ridehailing Trips

**Source:** Hongwei Dong, using 2017 NHTS data

**Percentage of taxi/ride-hailing trips between four metro rings**

<table>
<thead>
<tr>
<th>Origin</th>
<th>downtown</th>
<th>inner-ring suburb</th>
<th>mid-ring suburb</th>
<th>out-ring suburb</th>
</tr>
</thead>
<tbody>
<tr>
<td>downtown</td>
<td>17.6%</td>
<td>12.7%</td>
<td>1.2%</td>
<td>0.2%</td>
</tr>
<tr>
<td>inner-ring suburb</td>
<td>10.6%</td>
<td>18.3%</td>
<td>3.9%</td>
<td>0.4%</td>
</tr>
<tr>
<td>mid-ring suburb</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>out-ring suburb</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

**Percentage of auto trips between four metro rings**

<table>
<thead>
<tr>
<th>Origin</th>
<th>downtown</th>
<th>inner-ring suburb</th>
<th>mid-ring suburb</th>
<th>out-ring suburb</th>
</tr>
</thead>
<tbody>
<tr>
<td>downtown</td>
<td>1.3%</td>
<td>1.8%</td>
<td>1.8%</td>
<td>1.3%</td>
</tr>
<tr>
<td>inner-ring suburb</td>
<td>11.2%</td>
<td>5.9%</td>
<td>43.0%</td>
<td>3.3%</td>
</tr>
<tr>
<td>mid-ring suburb</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>out-ring suburb</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>
California Panel Study of Emerging Transportation Trends

- Statewide longitudinal study with **rotating panel**
- 2015 survey: **Millennials** (18-34) and **Generation X** (35-50)
- 2018 survey: **All age groups**
- Quota sampling by **geographic region** and **neighborhood type**
- Focus on changing lifestyles, adoption of shared mobility and attitudes towards AVs
Timeline of the Project

2015
Opinion panel
- Generation X
- Millennials
N = 2,400

2018
Opinion panel, paper survey
- Baby Boomers (and older)
- Generation X
- Millennials
- Post-Millennials
N = ~ 4,500
(Version in Spanish is also offered)

2021
(same method...)

Annual updates...
Changes in the Use of Shared Mobility

Changes from 2015 to 2018:

- **Carsharing** use little changed over the past few years

- Sharp increase in **ridehailing** use

- **Shared ridehailing** (e.g. UberPOOL) now a common presence in big cities

- Appearance of micromobility (**dockless bikesharing** and **e-scooter sharing**)
Adoption of Shared Mobility: 2015-2018

For more details:
Changes by Vehicle Ownership and Income Groups

Use of ridehailing by vehicle ownership

<table>
<thead>
<tr>
<th>Year</th>
<th>Zero vehicle hh</th>
<th>Low vehicle hh</th>
<th>High vehicle hh</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never used or no longer uses</td>
<td>Less than once a month</td>
<td>Monthly basis</td>
</tr>
<tr>
<td>2015</td>
<td>75%</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>2018</td>
<td>10%</td>
<td>5%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Adoption of ridehailing by household income

<table>
<thead>
<tr>
<th>Income Level</th>
<th>Less than $25,000</th>
<th>$25,000 to $49,999</th>
<th>$50,000 to $74,999</th>
<th>$75,000 to $99,999</th>
<th>$100,000+</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>15%</td>
<td>17%</td>
<td>24%</td>
<td>23%</td>
<td>27%</td>
</tr>
<tr>
<td>2018</td>
<td>17%</td>
<td>15%</td>
<td>14%</td>
<td>25%</td>
<td>27%</td>
</tr>
</tbody>
</table>
Ridehailing vs. Shared Ridehailing

Distribution of last Uber/Lyft trip by age group and service type

- Gen Z (18-20 yrs old)
- Gen Y (21-37 yrs old)
- Gen X (38-53 yrs old)
- Baby Boomers (54-72 yrs old)
- Silent Generation and older (73-90 yrs old)

- Ridehailing
- Shared-ridehailing
Distribution of last Uber/Lyft trip by gender and service type

- **Male**
  - Ridehailing: 40%
  - Shared-ridehailing: 30%

- **Female**
  - Ridehailing: 50%
  - Shared-ridehailing: 60%
Time of Day and Occupancy

Ridehailing ($N=1607$)

- Weekday: 47.9%
- Weeknight: 22.6%
- Weekend daytime: 16.0%
- Weekend night time: 13.4%

Shared ridehailing ($N=253$)

- Weekday: 44.4%
- Weeknight (excluding Friday night): 23.0%
- Weekend daytime: 15.1%
- Weekend night time (including Friday night): 17.5%

With one or more passengers
With another passenger
Alone

With two or more passengers
“Not all users behave the same way”

Latent-class adoption model to investigate differences in the use of ridehailing:

**Adoption Rate: 47%**
- Higher-educated independent millennials who live in more central areas and in households without kids
- The adoption rate significantly increases as the rates of technology adoption and frequency of long-distance leisure travel by plane increase.

**Adoption Rate: 27%**
- Most affluent individuals, predominantly dependent millennials or older Gen Xers, who live with their families.
- Technology adoption rate, household income, and frequency of non-car business long-distance trips affect the adoption.

**Adoption Rate: 5%**
- Least affluent and less educated individuals, who live in rural neighborhoods and do not work nor study.
- Adoption rate is affected by the characteristics of the built environment, including transit accessibility and land-use mix.

For more details:
How does the use of ridehailing affect the use of other modes?

...what replaces what?
Impacts on Other Travel Modes for Various Groups of Users

Latent-class analysis to investigate the impacts of ridehailing on other travel modes:

**Urban Travelers**
- Urban dwellers
- Walkable neighborhoods with good transit access
- Cost and time sensitive
- Least affluent
- Younger/Independent Millennials
- Frequent commuters
- Multimodal travelers
- Most frequent users of Uber/Lyft

Class 1 (size=53%)

**Car Users**
- Suburban Dwellers
- Car-oriented neighborhoods with poor transit access
- High number of vehicles per household drivers
- Frequent commuters
- Monomodal with high VMT
- Pro-suburban
- Materialistic/must own car
- Frequent air travelers
- Medium Uber/Lyft frequency

Class 2 (size=37%)

**Transit and TNC**
- Suburban Dwellers
- Low transit and walk accessibility
- Not cost and time sensitive
- Older Gen Xers
- Want to come back to urban area
- Non-frequent commuters
- Multimodal when possible
- Like biking
- Pro-environment
- Low frequency users

Class 3 (size=10%)

For more details:
“Not all on-demand mobility services are created equal”…

Impact of ridehailing on use of other modes - “What Would You Have Done if Ridehailing Was Not Available?”

(N=1,915)

For more details:
“Not all on-demand mobility services are created equal”...

Who does that? And for what type of trips?

- Higher and medium income
- Higher-vehicle-owning HHs
- Households with kid(s)
- Longer trips
- Trips without company
- Shopping and social trips

- Lower-income individuals
- Students and workers
- Multimodal (users of public transit and active modes)
- Trips during the daytime

- Lower-income individuals
- Zero-vehicle households
- Workers
- Trips during the daytime
- Very short trips

- Higher-income individuals
- Older generations
- Trips to/from Airports
- Trips with others

- Lower-income individuals
- Unemployed
- Zero-vehicle households
- Trips without company
- Shopping and social trips
- Medium distance

Impact of ridehailing on use of other modes - “What Would You Have Done if Ridehailing Was Not Available?”

- Drive alone
  - Ridehailing: 28.6%
  - Shared ridehailing: 28.5%

- Carpool
  - Ridehailing: 14.8%
  - Shared ridehailing: 16.2%

- Public bus
  - Ridehailing: 7.3%
  - Shared ridehailing: 13.5%

- Light rail/tram/subway
  - Ridehailing: 4.5%
  - Shared ridehailing: 7.5%

- Commuter rail
  - Ridehailing: 0.7%
  - Shared ridehailing: 0.8%

- Bike or walk
  - Ridehailing: 4.1%
  - Shared ridehailing: 7.5%

- Taxi
  - Ridehailing: 27.9%

- Other
  - Ridehailing: 5.0%
  - Shared ridehailing: 4.9%

- I would not have made this trip
  - Ridehailing: 7.0%
  - Shared ridehailing: 6.0%
How are micromobility options changing travel behaviors?

E-scooters largely similar in speed to bicycles...

Source: Pernia, Lu, and Birriel (2000); FHWA (2004); Fang and Handy (2017); Fang (2018)

Can share bike lane infrastructure!
“Not all trips are created equal”...

Where do trips happen?
Which trips could be made by...

Active Modes (Walking/Bicycling)  High-Occupancy Modes (Public Transit/Pooling)

Interest in the adoption of new mobility options, micromobility, MaaS, future with automation...
New Nationwide Study: “The Pulse of the Nation on 3R”

- New nationwide study
- Annual data collection
- N = 3,500-4,000 participants
- 2019 cities:
  - San Francisco
  - Los Angeles
  - Sacramento
  - Washington DC
  - Boston
  - Seattle
  - Salt Lake City
  - Kansas City
Study on New Mobility Trends in Southern US Cities

Interest in studying new mobility trends in rapidly growing cities in predominantly car-dependent southern US States

TOMNET Project with cooperation of ASU, Georgia Tech, UT Austin and USF
Micromobility Users

2019 Atlanta sample, N=969

Work/study status

- Neither a worker nor a student
- A student (part-time or full-time)
- Both a worker and a student
- A worker (part-time or full-time)
E-scooter Trips – Primary Trip Purpose

2019 Atlanta sample, active users, N=77
E-scooter Trips – Impacts on Other Modes

- Drive private vehicle, alone: 14.5%
- Drive private vehicle, with others: 7.2%
- Ride in private vehicle, with others: 4.3%
- Take subway: 1.4%
- Use Uber/Lyft: 1.4%
- Use my own bike or scooter: 15.9%
- Walk: 2.9%
- I would not have made this trip: 52.2%

2019 Atlanta sample, active users, N=77
Some Conclusions...

• Shared mobility options are getting rapidly adopted in California (and other places), even if they still account for a relatively small *mode share*

• Users predominantly include young, well-educated *urban residents*

• Use of Uber/Lyft often replaces use of *private vehicles* and *taxis*, but to a certain extent also use of *public transit* and *active modes*

• *Pooling* is (in theory) a good option – but (in practice) it often strongly competes with non-car modes in denser urban cores

• Medium-term impacts on car ownership are largely unclear: how many users might give up private *vehicle ownership*?
Next Steps…

• Longitudinal analysis of *changes in vehicle ownership* associated with adoption of shared mobility

• **Mobility as a Service (MaaS)** likely to affect future car ownership
  – *Under what conditions individuals prefer to access a vehicle when needed rather than owning one?*
  – *To date, only a minority (mainly in urban areas) seems interested in not owning a vehicle and accessing a suite of mobility services when needed*

• New study examining willingness to join *MaaS*

• New study focusing on *airport* access
Policy Implications

• Need to focus on human beings and not cars

• Future of mobility will depend on how the market is regulated (and priced)

• TNC drivers’ activity already compatible with EV range and performance (but need to remove barriers!)

• Need for behavioral nudge to support shift towards increased sustainability

• Land use and *pricing* will be key factors to promote more sustainable choices

• Micromobility provides critical mass for *bicycling* infrastructure

• Potential of MaaS to modify relationships with private vehicle ownership
March 2018 Report:
https://escholarship.org/uc/item/1kq5d07p

Additional references to papers from this project:


For more info, visit 3rev.ucdavis.edu
Behavioral Studies, Surveys and Experiments

California Panel Study of Emerging Transportation Trends

This research will expand the current statewide panel study to investigate emerging trends in travel behavior, vehicle ownership, adoption of shared mobility and propensities towards the use of AVs.

Travel Demand Modeling and Simulation Projects

Modeling Emissions Impacts of Automated Vehicle (AV) Deployment in California under Various Ownership Models

This project evaluates potential future scenarios of AV deployment impacts on emissions.

Environmental, Economic, Equity Impacts and Policy Analysis

3 Revolutions and Smart Cities: Exploring Future Potentials and Impacts on the Energy System

This research explores the impacts of the changes in the mobility ecosystem and travel demand provided by future potentials of a smarter city and energy system.
Acknowledgements

• Farzad Alemi
• Yongsung Lee
• Grant Matson
• Ali Etezady
• Rosaria Berliner

• Pat Mokhtarian
• Susan Handy
• Lew Fulton
• Dan Sperling
• Kate Tiedeman

• Tho Le
• Kailai Wang
• Jai Malik
• Melinda Matyas
Any questions? Please contact:

Dr. Giovanni Circella
Director, 3 Revolutions Future Mobility Program
Institute of Transportation Studies, University of California, Davis
Email: gcircella@ucdavis.edu | Twitter: @CircellaG