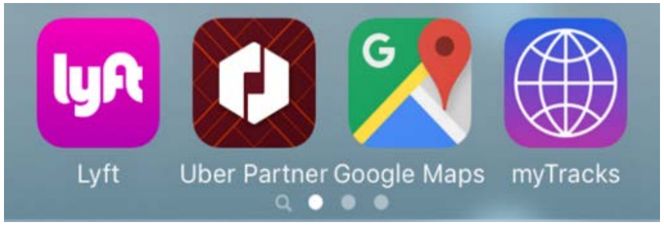
Impacts of Ridesourcing – Lyft and Uber – on Transportation including VMT, Mode Replacement, Parking, and Travel Behavior



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People and Organization

- Classmates and Friends
- Transportation Professionals
- Lyft and Uber
- Lyft/Uber Passengers
- **FAMILY**

ACKNOWLEDGMENTS

Agenda

I. Introduction
II. Background
III. Literature Review
IV. Research Methods
V. Data

Agenda

VI. Driver Perspective

VII. VMT Impacts

VIII. Parking Impacts

IX. Travel Behavior Changes

Agenda

X. Overall Results

XI. Summary Conclusions

- Policy Recommendations
- Future Applications
- Future Research

I. Introduction

- Motivation
- Research Needs

Cali, Colombia

Photo Source: A. Henao

INTRO

INTRO

Photo Source: A. Henao

INTRO

Photo Source: ElPais.com.co

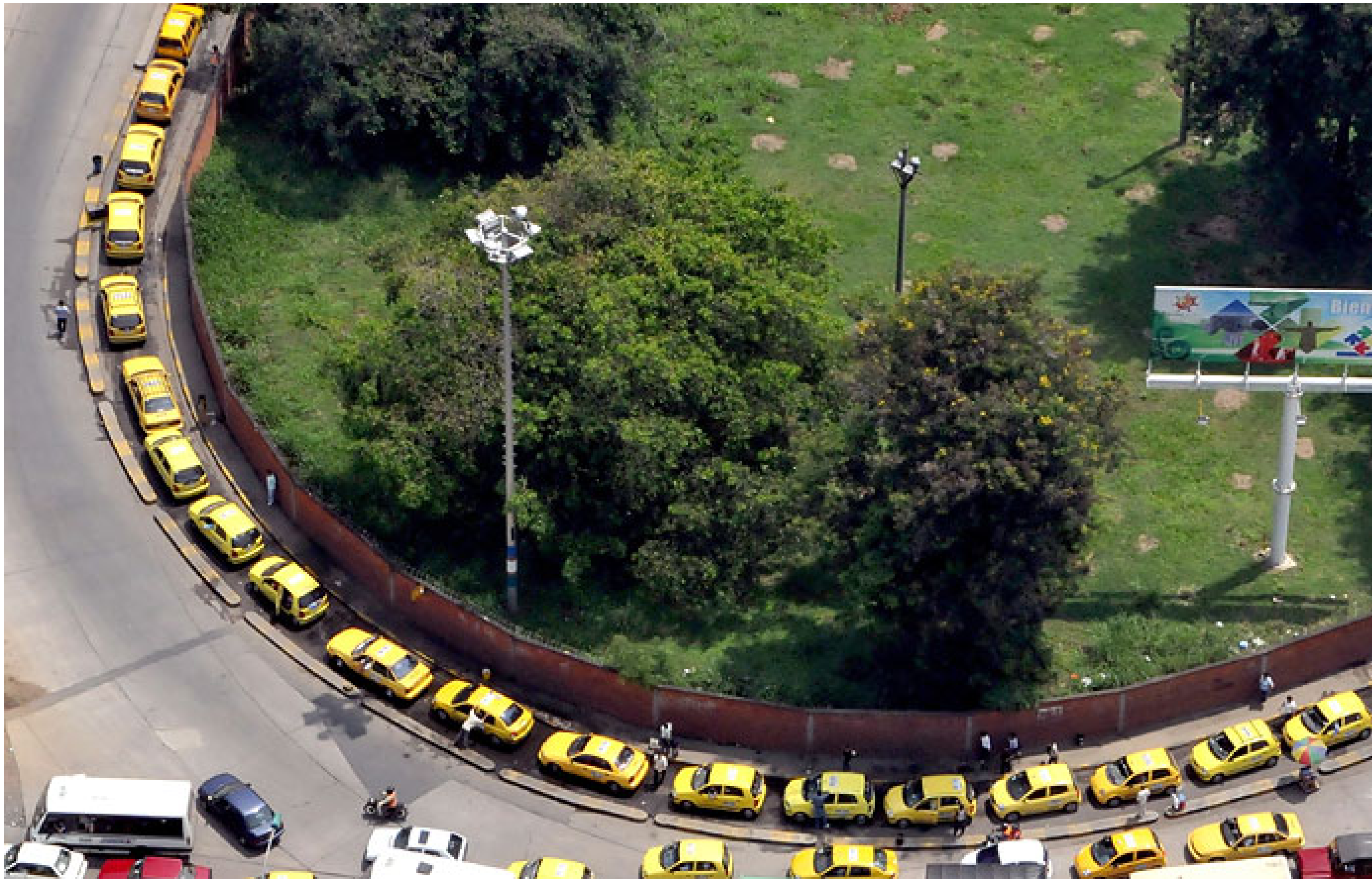

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Photo Source: ElPais.com.co

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Photo Source: ElPais.com.co

Colorado

<u>Photo Source</u>: Karl Gehring Denver Post

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Photo Source: A. Henao

Disrupting Transportation

Many factors, including:

- Social networks
- Real-time information
- Mobile technology

Allow the creation and popularization of on-demand transportation services all over the world.

lyft

TURO

enterprise CarShare

UBER

ego CarShare

via

Hertz 24/7

curb

zipcar

CAR 2GO

INTRO

Ridesourcing

Sourcing of rides from a 'for-fare' driver pool accessible through an app-based platform.

<u>Other names:</u>

"Transportation Network Companies (TNCs)", "ride-hauling", "ride-booking", "ride-matching", "on-demand-rides", "app-based rides"

Ridesourcing

Associated Press

RIDESOURCING

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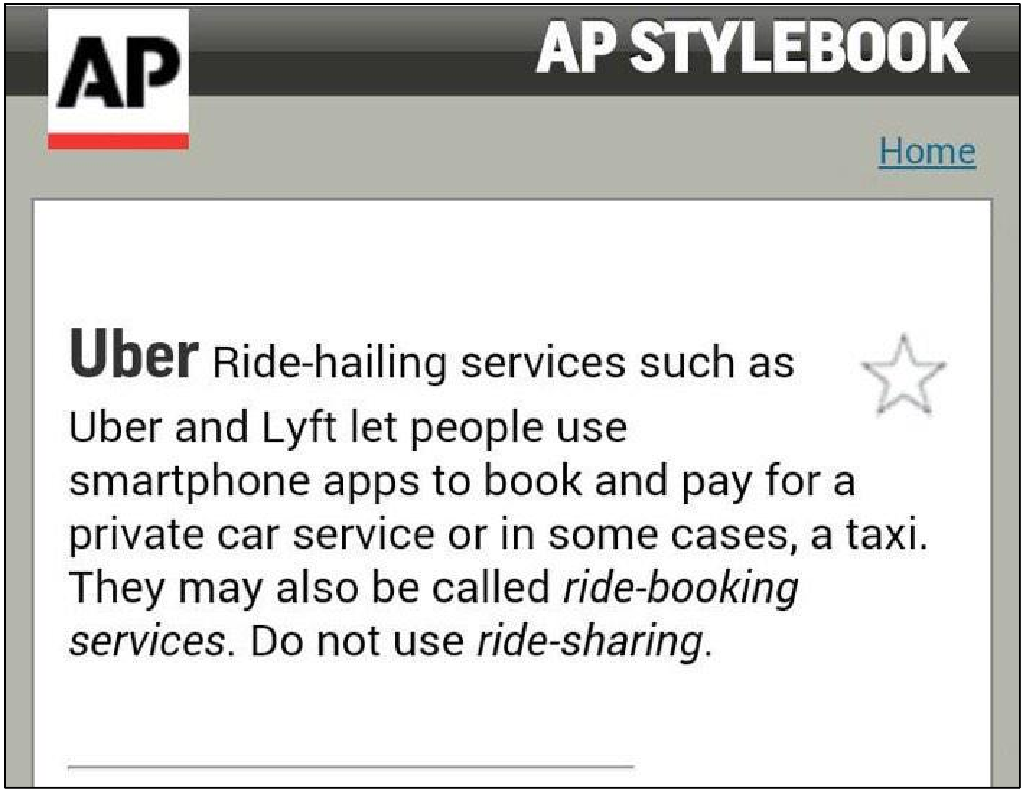
RIDESHARING



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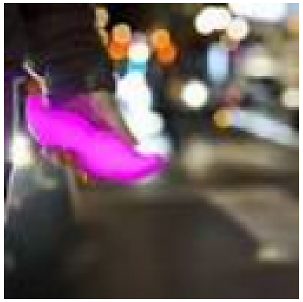


Lyft to go global and take on **Uber** outside the US
CNBC - Jan 13, 2017
Number two U.S. ride-hailing company, **Lyft**, is growing faster and cutting losses faster than its giant competitor, **Uber**. And this year, the startup ...

Lyft might be eyeing a global market to take on **Uber**
Business Insider - Jan 13, 2017

Uber, **Lyft**, transit agencies see potential for partnerships
In-Depth - San Francisco Chronicle - Jan 12, 2017

SECTIONS HOME SEARCH The New York Times 3 of 10

N.Y. / REGION

Ride-Hailing Drivers Are Slaves to the Surge

By MASHA GONCHAROVA JAN. 12, 2017

Lyft drivers say they are happier, better paid than Uber drivers

By Carolyn Said, San Francisco Chronicle Updated 3:30 pm, Tuesday, January 17, 2017

4

INTRO

Photos Source: The Telegraph

N.Y. / REGION

Yellow Cab, Long a Fixture of City Life, Is for Many a Thing of the Past

By WINNIE HU JAN. 15, 2017

NYC TRANSPORTATION

Uber and Lyft cars now outnumber yellow cabs in NYC 4 to 1

Who will sing for the yellow cab?

BY RACHEL SUGAR | JAN 17, 2017, 12:15PM EST

SF blasts Uber, Lyft for downtown traffic congestion

Ride-hail companies like Uber and Lyft are being blamed by the San Francisco Municipal Transportation Agency for a lack of regulation that has led to increased trafic in The City. (Ekevara Kitpowsong/Special to S.F. Examiner)

By Joe Fitzgerald Rodriguez on December 11, 2016 1:00 am

The potential 45,000 Uber and Lyft drivers circling San Francisco streets for commute fares are gumming up city traffic, according to transit officials.

In a recent state regulatory filing, the San Francisco Municipal Transportation Agency took the California Public Utilities Commission — which is tasked with regulating ride-hail companies — to task for failing to reasonably limit the industry's explosive growth.

The New York Times

N.Y. / REGION

City Hall and Uber Clash in Struggle Over New York Streets

By MATT FLEGENHEIMER and EMMA G. FITZSIMMONS JULY 16, 2015

David Plouffe, a top Uber operative, at Sylvia's restaurant in Harlem on Tuesday, was joined by more than a dozen community leaders, all of them critical of a proposed cap on the company's growth. Bryan R. Smith for The New York Times

For months, the clash has seemed inevitable: the professed disrupters of municipal transportation policy and the chief executive of the country's

INTRO

Lyft and Uber Won't Release Data to Shed Light on How They Affect Traffic

By Aaron Bialick Jun 30, 2015

As ride-hail services like Lyft and Uber have boomed in San Francisco and other cities, proponents claim they help reduce demand for parking and road space by making it easier for people to own fewer cars. But very little data has been released by the ride-hail companies that would allow experts to assess their impact on streets and traffic.

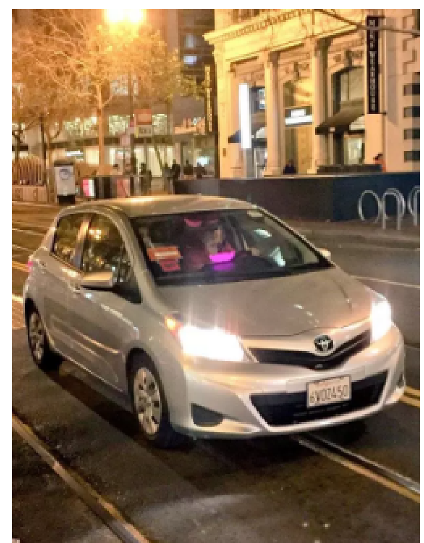


Photo: Jason A. Staats/Twitter

In a panel discussion yesterday, Lyft's Curtis Rogers emphasized that reducing car ownership is "our end goal that we think we share with the city."

But when Thea Selby of the SF Transit Riders Union pressed Rogers for data to show whether Lyft might be substituting for transit trips more than car trips, he said he couldn't provide it. Rogers insisted, however, that Lyft doesn't want to compete with Muni, walking, or bicycling. "We think we're just one more piece to the puzzle."

"We celebrate Muni getting better," said Rogers. "We're well

INTRO

we pulled everyone off of Muni and put them in

l be going two miles per hour on the road. That's

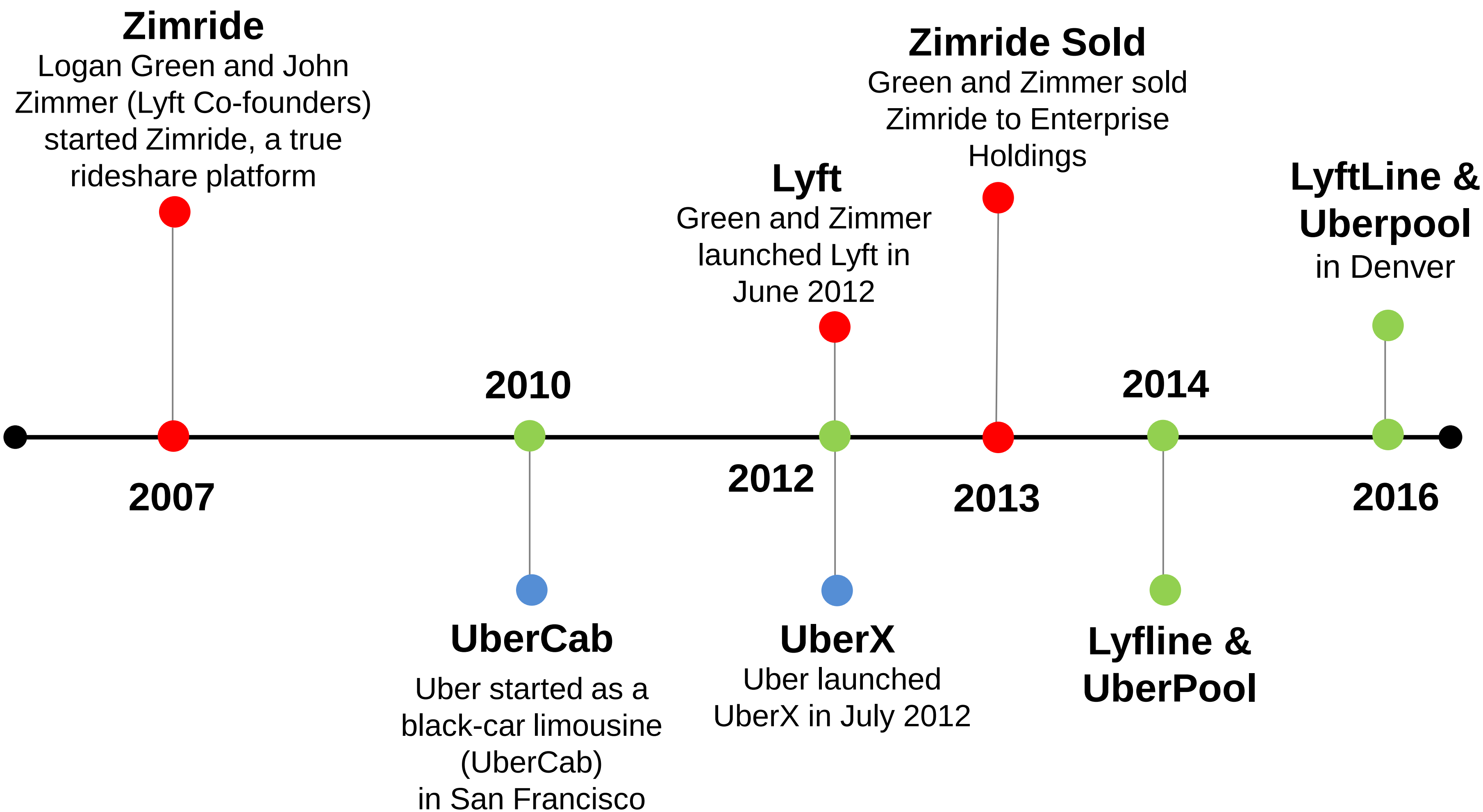
Research Needs

- DATA
- DRIVER SIDE
  - Efficiency
  - Earnings
- VMT IMPACTS
- PARKING IMPACTS
- TRAVEL BEHAVIOR
  - Mode Replaced
  - Why?

RIDESOURCING

STUDY

II. Background



Operations

- Uber operates globally (450+ cities)
- Uber completed 2 billion trips in the summer 2016
- First billion rides in 6 years
- Second billion in 6 months

- Lyft so far is only in the U.S.
- Lyft is giving rides at a rate of 17 million U.S. rides per month
- Lyft is estimated to have 20% market-share

BACKGROUND

Valuation

- Latest Uber valuation: $62.6 billion
- Lyft: $5.5. billion dollars
- Valuation without owning vehicles, physical infrastructure, or having to hire drivers as employees

III. Literature Review

Academic

- Anderson (2014): Interview 20 drivers (Anthropology) about driver strategies and possible VMT impacts
- Cramer & Krueger (2016): Comparison of UberX with Taxis. Hired by Uber to do the study
- Rayle et al. (2016): Intercept survey in San Francisco comparing ridesourcing with taxis. User characteristics, wait times, and trips served

III. Literature Review

Organizations

- SUMC (2016): Intercept Survey in seven U.S. cities. Higher use of shared modes, the more likely people use transit and own fewer cars.
- FiveThirtyEight (2015): Used data acquired via a Freedom of Information Act request to the city. In NY, Uber is taking rides away from taxis and covers a larger area

III. Literature Review

- Review of carsharing literature
- Help develop research methods for this dissertation
- Each Chapter includes a more detailed Literature Review

III. Literature Review

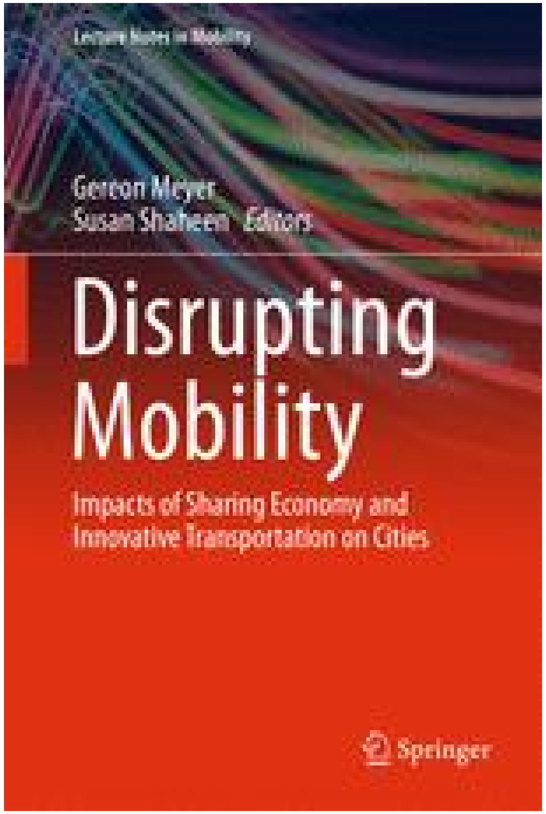
- Very limited research studies
- Lack of open data
  - Levitt, Freakonomics (2016). Why Uber Is an Economist's Dream.
- Independent data questionable
- Research design questionable
- Several gaps

LIT REVIEW

Book Chapter

"A Framework for Understanding the Impacts of Ridesourcing on Transportation"

(Henao & Marshall, 2017)



Disrupting Mobility

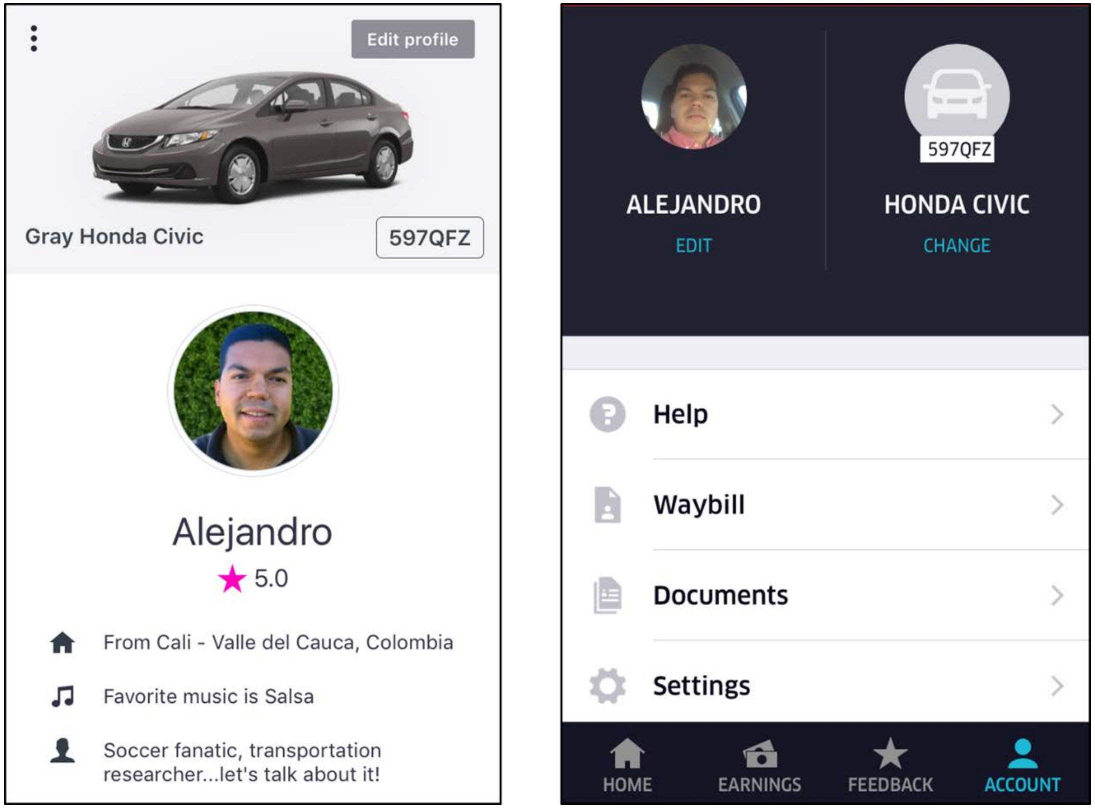
Impacts of Sharing Economy and Innovative Transportation on Cities

Editors: Gereon Meyer, Susan Shaheen

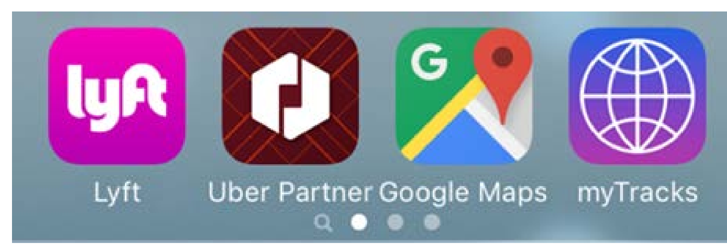
METHODS

IV. Research Methods

- Innovative approach to collect data
- Became an independent-contractor to drive for both Lyft and Uber and get access to exclusive data
- Exploratory Analysis
- IRB Approval
- Two Datasets:
  1. Driver Dataset (416 rides)
  2. Passenger Dataset: (311 Surveys)



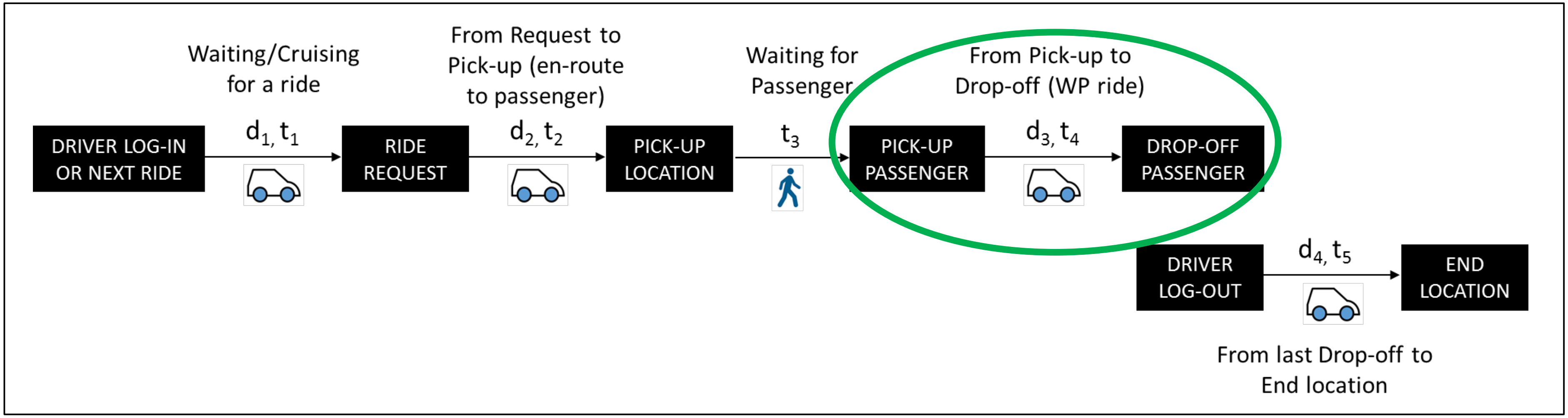
Lyft and Uber Driver Profiles



Smartphone Apps

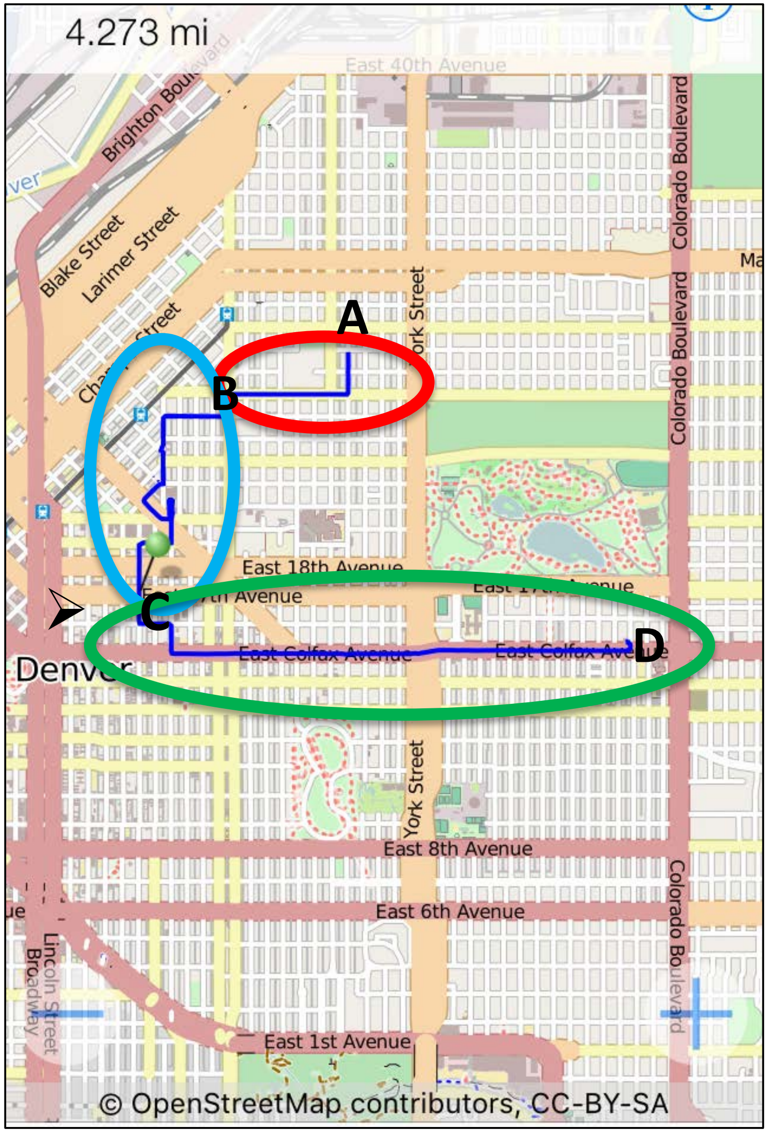
METHODS

Driver Dataset



Driver Data Collection (e.g. travel attributes)

METHODS



Mileage and Times

- Cruising/Waiting for a ride (A-B)
- En-Route to passenger (B-C)
- ➤ Waiting for Passenger (C)
- With-passenger (WP ride) (C-D)

GPS Tracking of a Lyft/Uber ride

METHODS

DRIVER DATA COLLECTION

Driver Initials: ____ Date: ________ Time: _______ Odometer: ________ **LOG-IN -** Location: ____________________________
BREAKS - Mins: _____________ Miles: ________________ Last ride to **LOG-OUT** time & dist: ____ mins (____ mi)
END - Time: _______ Odometer: ________ Location: ________________________ Log-out to End time & dist: ____ mins (____ mi)

Ride # (shift): ____ Ride Request from: □Lyft □LyftLine □UberX □UberPool # Passengers: ____
Weather: □Clear □Foggy □Rainy □Sunny □Snowy □Windy □Other: __________ Temperature: _____
Driver Location at Request: ____
Time at Request: ______ Waiting/Cruising for a ride time: ____ mins Cruising for a ride distance: _____ mi (from last)
Pick-up Location: ___________________________________ □SU-L □SU-M □SU-H | □U-L □U-ML □U-M □U-MH □U-H □Special
Lyft/Uber est. time: ____ mins GoogleMaps: ____ mins (____ mi) Arrival Time: _______ Req to Arr time: ____ mins
MyTracks distance: ____ mi Time Ride Starts: _______ Driver Waiting: ____ mins
Destin. Location: ___________________________________ □SU-L □SU-M □SU-H | □U-L □U-ML □U-M □U-MH □U-H □Special
Lyft/Uber est. time: ____ mins GoogleMaps: ____ mins (____ mi) Time when Ride Ends: _______ Ride Time: ____ mins
MyTracks distance: ____ mi Lyft/Uber report: ____ mins (____ mi)
PARKING - Location: _________________________________ P. Cost: $______ Cruising time & dist: ____ mins (____ mi)
Prime: _____ Fare shown on App: $_____ To Driver: $_____ + tip: $___ Walk to dest time & dist: ____ mins (____ mi)
Did person take survey? □Yes □T □No Where did passenger sit? □Front □Back □Chatty □Quiet □Male □Female

Driver Data Collection Form

METHODS

Passenger Survey

I interviewed passengers during the ride:

"Hi rider,
I'm a grad student doing research on transportation. Would you help me by doing a short survey (~6 minutes) about this ride?

You can use my tablet or go to this link: www.ride-survey.com.

Thank you!"

METHODS

Passenger Survey

- Passengers took survey on the tablet provided
- On their own devices: www.ride-survey.com
- In some cases, verbal interview

Passenger survey questions:

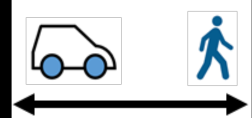
1. Specific Trip Questions (Q1-Q10)
2. General Use Questions (Q11-Q25)
3. Demographic Questions (Q26-28)

V. Data

RIDESOURCING DATA

DRIVER DATASET

Travel Attributes:
- Travel Times
- Travel Distances
- Earnings



PASSENGER DATASET

Survey Questions:
- Specific Trip (Q1-Q10)
- General Use (Q11-Q25)
- Demographics (Q26-Q37)

416 Rides

- 198 Lyft
- 164 UberX
- 39 LyftLine
- 15 UberPool

311 Passenger Surveys

SURVEY RESPONSE RATE: 87.5%

DATA

Origin-Destination (O-D) Matrix

DESTINATION / ORIGIN	Home	Work	School	Shopping/ Errands	Going Out/ Social	Airport	Hotel/ Airbnb	Family/ Friend	Other	Totals
Home	2	36	16	7	34	18	0	4	12	129
Work	21	8	1	1	1	2	6	0	1	41
School	5	0	0	3	0	0	0	2	0	10
Shopping/Errands	11	1	0	3	1	0	0	0	0	16
Going Out/Social	30	1	0	3	10	0	3	3	1	51
Airport	3	0	0	0	0	0	2	0	0	5
Hotel/Airbnb	0	2	0	0	7	4	0	0	4	17
Family/Friend	10	1	0	0	1	1	3	1	2	19
Other	8	3	0	2	2	1	3	1	3	23
Totals	90	52	17	19	56	26	17	11	23	311

DATA

	Ridesourcing Responses	(%)	Denver Population[a] (%)
Gender			
Female	145	46.9%	50.0%
Male	162	52.4%	50.0%
Prefer not to answer	2	0.6%	
n	309		
Residency			
Local Resident	254	82.2%	--
Visitor	55	17.8%	--
n	309		
Age			
18-24[b]	78	25.2%	10.0%
25-34	132	42.7%	21.8%
35-44	56	18.1%	15.4%
45-54	30	9.7%	11.7%
55-64	7	2.3%	10.5%
65+	6	1.9%	10.7%
n	309		
Race/Etchnicity			
Asian	24	7.8%	3.5%
Black/African American	16	5.2%	9.4%
Hispanic or Latino	39	12.7%	30.9%
White	206	66.9%	53.1%
Other	16	5.2%	3.1%
Prefer not to answer	7	2.3%	
n	308		
Household Income[c]			
$30K or less	34	11.5%	28.3%
$31K - $45K	56	18.9%	14.0%
$46K - $60K	58	19.6%	11.1%
$61K - $75K	30	10.1%	10.0%
$76 - $100K	40	13.5%	11.9%
Over $100K	50	16.9%	24.9%
Prefer not to answer	28	9.5%	--
n	296		

	Ridesourcing Responses	(%)	Denver Population[a] (%)
Marital Status			
Single or never married	185	62.7%	41.7%
Married or in a family relationship	80	27.1%	39.2%
Separated, divorced, or widow	28	9.5%	19.1%
Other	2	0.7%	
n	295		
Household size[b]			
1	65	22.3%	--
2	129	44.2%	--
3	56	19.2%	--
4	30	10.3%	--
5+	12	4.1%	--
n	292		
Children in household			
Yes	47	20.5%	25.1%
No	182	79.5%	74.9%
n	229		
Education			
Less than High School	9	3.0%	13.9%
Graduated high school or equiv.	49	16.5%	17.7%
Some college, no degree	58	19.5%	18.3%
Associate or Bachelor's degree	124	41.8%	32.5%
Advanced degree (Master's, PhD)	57	19.2%	17.6%
n	297		
Employment Status			
Working (Full-time or Part-Time)	246	81.7%	70.9%
Volunteer	1	0.3%	--
Unemployed	15	5.0%	6.3%
Retired	8	2.7%	--
N/A	31	10.3%	--
n	301		
Student Status			
Student (Full-time or Part-time)	70	23.3%	34.2%
Not currently a student	230	76.7%	65.8%
n	300		

[a] 2011-2015 ACS 5-Year Estimates, Denver County
[b] Age 1st Range is 15 - 24 for ACS
[c] Income Range for ACS slighly different

	Ridesourcing		Denver Population[a]
	Responses	(%)	(%)
Gender			
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Prefer not to answer	28	9.5%	--
n	296		

DATA

VI. Driver Perspective

- Travel times and distances
- Earnings

Data Analysis

TRAVEL DISTANCES

$$d_{shift} = \left[\sum (d_1 + d_2 + d_3)\right] + d_4$$

$$d_T = \sum d_{shift} = \sum d_1 + \sum d_2 + \sum d_3 + \sum d_4$$

$$VMT_T = \sum d_1 + \sum d_2 + WPMT_T + \sum d_4$$

$$VMT_T = WPMT_T + Additional\ VMT$$

$$Ridesourcing\ Efficiency\ Distance = \frac{\sum d_3}{d_T} = \frac{WPMT_T}{VMT_T}$$

ADDITIONAL PERCENT OF WPMT

$$\frac{Additional\ VMT}{WPMT_T} = \frac{VMT_T}{WPMT_T} - 1$$

$$Total\ Miles\ per\ 100\ \mathrm{WPMT} = \frac{100 * VMT_T}{WPMT_T}$$

TRAVEL TIMES

$$t_{shift} = \left[\sum (t_1 + t_2 + t_3 + t_4)\right] + t_5$$

$$t_T = \sum t_{shift} = \sum t_1 + \sum t_2 + \sum t_3 + \sum t_4 + \sum t_5$$

$$Ridesourcing\ Efficiency\ Time = \frac{\sum t_4}{t_T}$$

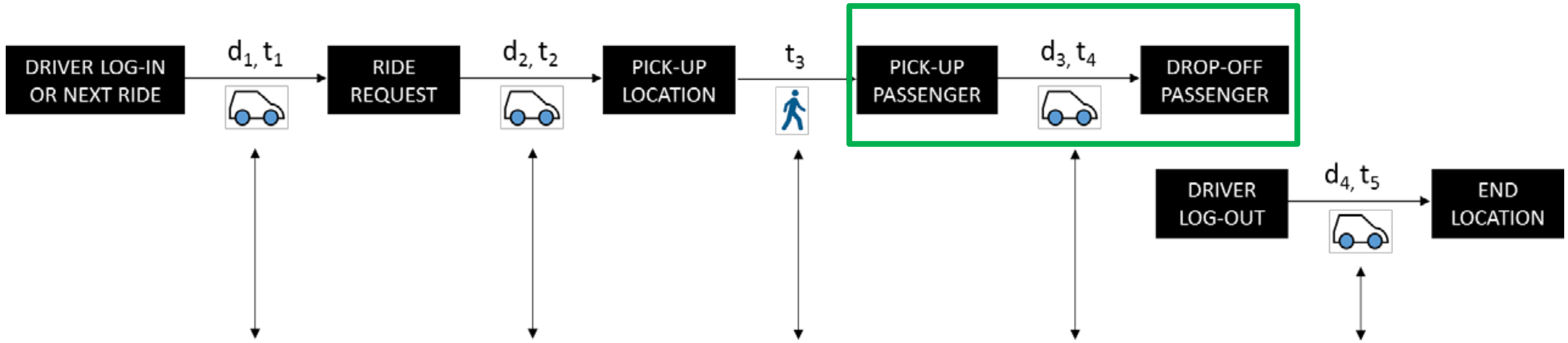
EARNINGS

$$Gross\ Earnings\ \left(\$/_{hr}\right) = \frac{\sum Driver\ Earnings\ (incl.tip)}{t_T}$$

$$Gross\ Earnings\ \left(\$/_{mile}\right) = \frac{\sum Driver\ Earnings\ (incl.tip)}{d_T}$$

$$Net\ Earnings = Gross\ Earnings - Expenses$$

Travel Times and Distance Summary Statistics



		Waiting/Cruising for a ride	From Request to Pick-up (en-route to passenger)	Waiting for Passenger	From Pick-up to Drop-off (WP ride)	From last Drop-off to End Location	Totals (t_T & d_T)
Time (minutes)	Total (Σt)	4,965.00	2,511.00	531.00	6,106.00	1,416.00	15,529.00
	Mean	11.94	6.04	1.28	14.68	21.78*	37.33
	St. Dev.	15.46	3.65	2.10	10.04	12.27*	20.30
	Median	7.50	5.00	1.00	11.50	20.00*	32.83
Distance (miles)	Total (Σd)	635.91	600.56		2,929.94	784.29	4,950.69
	Mean	1.53	1.44		7.04	12.07*	11.90
	St. Dev.	3.94	1.44		8.60	7.43*	10.37
	Median	0.20	1.00		3.55	12.00*	8.30
Average mph			14.35		28.79	33.23	19.13

n=416 (Lyft: 198, LyftLine: 39, UberX:164, UberPool: 15)

* Commute based on 65 shifts

DRIVER STUDY

Times and Distance Efficiency

	WP Ride (Σd_3 & Σt_4)	Total minus Commute at End	Efficiency: WP/(Total minus Commute at End)	Totals (t_T & d_T)	Overall Efficiency (WP/Total)	Additional Percent of WPMT	VMT per 100-WPMT
Time (minutes)	6,106.0	14,767.0	41.3%	15,529.0	39.3%		
Distance (miles)	2,929.9	4,482.9	65.4%	4,950.7	59.2%	69.0%	169.0

DRIVER STUDY

Earnings

DRIVER STUDY

Earnings

Lyft/Uber Fares & Commission

	Passenger Cost*						
	Lyft/Uber Service Fee	Base Fare	Cost per Minute Fare	Cost per Mile Fare	Minimum Paid by Passenger (Fee + Fare)	To Driver**	Lyft/Uber Commision**
Lyft	$2.10	$0.50	$0.12	$1.01	$7.10	80% Fare + 100% Tips	100% Service Fee + 20% Fare
UberX	$1.95	$0.75	$0.13	$1.00	$6.95		

* Rates as of Fall 2016 in U.S. dollars. Rates varied and have been lowered over time

** 20% Commision when first signed-up in 2014. Newer drivers pay a higher commision (25% or more)

Passenger Cost, Driver Earnings, Real Commission

	Passenger Cost		To Driver			To Lyft/Uber	
	Total Paid (before tip)	Total Cost per WP Mile (before tip)	Total Earned (before tips)	Tips	Total Earned (with tips)	Actual Commision (before tip)	Actual Comission (after tip)
Lyft (n=237)	$2,934.58	$1.87	$2,059.25	$276.00	$2,335.25	29.8%	27.3%
Uber (n=179)	$2,505.62	$1.84	$1,687.83	$39.00	$1,726.83	32.6%	32.1%
All Trips (n=416)	$5,440.20	$1.86	$3,747.08	$315.00	$4,062.08	31.1%	29.4%

* Earnings include prime and guarantee bonus per hour but does not include initial sign-up bonus.

** Earnings in Year 2016 U.S. dollars

Gross Earnings – Lyft vs Uber

	Gross Earnings (before tip) ($/hr)	Gross Earnings (with tip) ($/hr)	Gross Earnings (before tip) ($/mile)	Gross Earnings (with tip) ($/mile)
Lyft (n=237)	$14.38	$16.31	$0.77	$0.87
Uber (n=179)	$14.60	$14.93	$0.75	$0.76
All Trips (n=416)	$14.48	$\boxed{\$15.69}$	$0.76	$0.82

* Earnings based in Totals (t_T & d_T)

** Earnings in Year 2016 U.S. dollars

DRIVER STUDY

Expenses

Item	Basic Added Cost 1-15hr/week, ~11k miles/year	Most Drivers 16-49hr/week, ~33K miles/year	U.S. Federal Standard Mileage Rate (2016)	Average Mileage Rate
Ownership				
Depreciation	$1,320.00	$3,960.00		
Finance Charge	-	$500.00		
License, Registration & Tax	-	$350.00		
Insurance	-	$1,500.00		
Operating				
Gas	$1,015.38	$3,046.15		
Maintenance	$589.60	$1,768.80		
Miscellaneous	$150.00	$2,000.00		
Total	$3,074.98	$13,124.95		
$/mile	$0.28	$0.40	0.54*	**$0.41**
$/hr	$5.34	$7.60	$10.31	**$7.75**

Assumptions: Car value: $18,000; Lifetime mileage: 150,000; Work: 50 weeks/year; Gas price: $2.40/galon (Average in 2015); Gas efficiency: 26 MPG; Maintenance: 5.36 cents/mile; Miscellaneous include car wash & cleaning, mobile device & data fees, parking & traffic violations, risk of crash or injury

* 2016 U.S. Federal Standard Mileage Rate

Expenses

Item	Basic Added Cost 1-15hr/week, ~11k miles/year	Most Drivers 16-49hr/week, ~33K miles/year	U.S. Federal Standard Mileage Rate (2016)	Average Mileage Rate
Ownership				
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Finance Charge	-	$500.00		
License, Registration & Tax	-	$350.00		
Insurance	-	$1,500.00		
Operating				
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Maintenance	$589.60	$1,768.80		
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DRIVER STUDY

Expenses

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* 2016 U.S. Federal Standard Mileage Rate

DRIVER STUDY

Net Earnings (Gross minus expenses)

	Net Earnings	
	Range (Low to High)	Average
\$/hr	\$5.38 - \$10.36	\$7.94
\$/mile	\$0.28 - \$0.54	\$0.41

n=416. Earnings include tips (Year 2016 U.S. dollars)

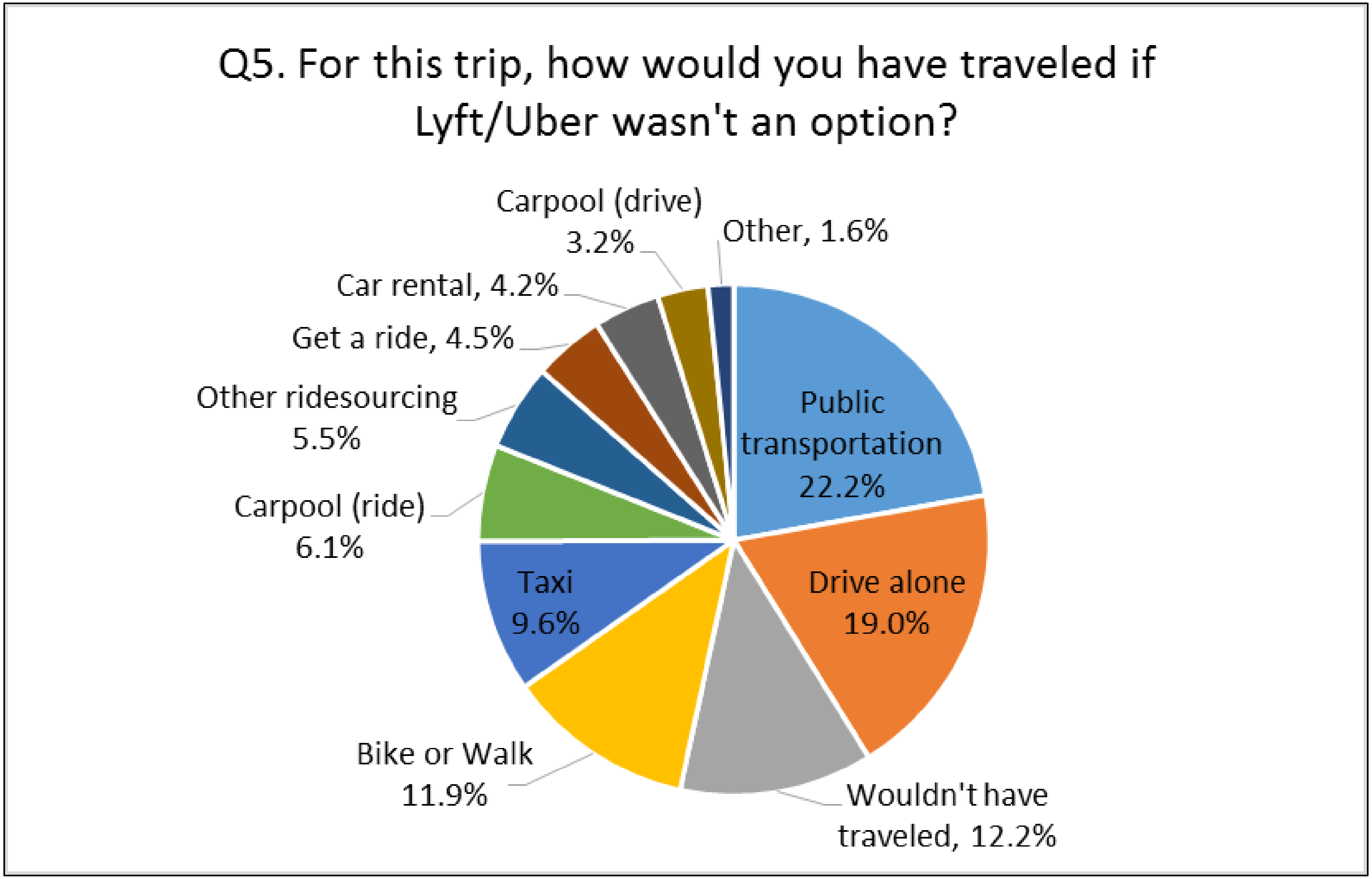
	Net Earnings (before tip) (\$/hr)	Net Earnings (with tip) (\$/hr)	Tip Percent
Lyft (n=237)	\$6.63	\$8.56	29.1%
Uber (n=179)	\$6.85	\$7.18	4.9%

DRIVER STUDY

VII. VMT Study

- Mode Replacement
- VMT Impacts

Mode Replacement (Specific Trip)



PMT and VMT

- Passenger Miles Traveled (PMT)
- Vehicles Miles Traveled (VMT)

Mode	PMT:VMT	PMT/VMT
Drive (SOV)	1 : 1	100%
Bike/Walk	1 : 0	∞
Get a ride	1 : 2	50%

Ridesourcing?

PMT/VMT, before and after

PMT	VMT Replaced or VMT_{BEFORE}	Ridesourcing VMT or VMT_{AFTER}	Efficiency Replaced $\frac{PMT}{VMT_{BEFORE}}$	Ridesourcing Efficiency $\frac{PMT}{VMT_{AFTER}}$
Total (Σd)				
2,200.03	1,959.58	3,617.68	112.3%	60.8%

VMT STUDY

PMT and VMT

- Passenger Miles Traveled (PMT)
- Vehicles Miles Traveled (VMT)

Mode	PMT:VMT	PMT/VMT
Drive (SOV)	1 : 1	100%
Bike/Walk	1 : 0	∞
Get a ride	1 : 2	50%
Ridesourcing	1 : 1.6	60.8%

PMT/VMT, before and after

PMT	VMT Replaced or VMT_{BEFORE}	Ridesourcing VMT or VMT_{AFTER}	Efficiency Replaced $\frac{PMT}{VMT_{BEFORE}}$	Ridesourcing Efficiency $\frac{PMT}{VMT_{AFTER}}$
Total (Σd)				
2,200.03	1,959.58	3,617.68	112.3%	60.8%

VMT STUDY

VMT Impact

Mode Replaced	n	PMT		VMT Replaced or VMT_{BEFORE}		Ridesourcing VMT or VMT_{AFTER}		$\frac{VMT_{BEFORE}}{PMT}$	$\frac{VMT_{AFTER}}{PMT}$	$\frac{VMT_{AFTER}}{VMT_{BEFORE}}$
		Total (Σd)	Median	Total (Σd)	Median	Total (Σd)	Median			
Public transportation	69	419.6	3.50	27.2	0.00	768.9	7.54	0.065	1.832	2826.7%
Drive alone	59	661.3	5.17	661.2	5.17	935.5	10.97	1.000	1.415	141.5%
Wouldn't have traveled	38	194.0	3.67	0.0	0.00	370.2	8.00	0.000	1.908	∞
Bike or Walk	37	74.3	1.65	0.0	0.00	195.9	4.95	0.000	2.638	∞
Taxi	30	364.2	5.77	639.5	14.41	568.3	10.74	1.756	1.560	88.9%
Carpool (ride)	19	132.1	3.87	82.2	1.82	227.7	7.64	0.622	1.724	277.1%
Other ridesourcing	17	52.8	3.00	143.3	7.58	143.3	7.58	2.713	2.713	100.0%
Get a ride	14	132.6	5.67	265.3	11.33	140.5	9.75	2.001	1.060	53.0%
Car rental	13	54.6	3.71	54.6	3.50	119.7	6.52	1.000	2.191	219.1%
Carpool (drive)	10	77.1	2.74	77.1	2.74	93.6	5.51	1.000	1.215	121.5%
Other	5	37.5	2.55	9.2	2.28	54.1	6.09	0.244	1.441	589.8%
Total	311	$\boxed{2200.0}$	3.50	1959.6	1.82	$\boxed{3617.7}$	7.56	0.891	$\boxed{1.644}$	**184.6%**

VMT STUDY

VMT Impact

Mode Replaced	n	PMT Total (Σd)	PMT Median	VMT Replaced or VMT_{BEFORE} Total (Σd)	VMT Replaced or VMT_{BEFORE} Median	Ridesourcing VMT or VMT_{AFTER} Total (Σd)	Ridesourcing VMT or VMT_{AFTER} Median	$\frac{VMT_{BEFORE}}{PMT}$	$\frac{VMT_{AFTER}}{PMT}$	$\frac{VMT_{AFTER}}{VMT_{BEFORE}}$
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VMT STUDY

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Bike or Walk	37	74.3	1.65	0.0	0.00	195.9	4.95	0.000	2.638	∞
Taxi	30	364.2	5.77	639.5	14.41	568.3	10.74	1.756	1.560	88.9%
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Total	311	2200.0	3.50	1959.6	1.82	3617.7	7.56	0.891	1.644	**184.6%**

Legend: Worst VMT

Better VMT

VMT STUDY

VIII. Parking

- Parking Demand
- Locations, Trip Purpose, Transit Stations
- Parking as a stated reason

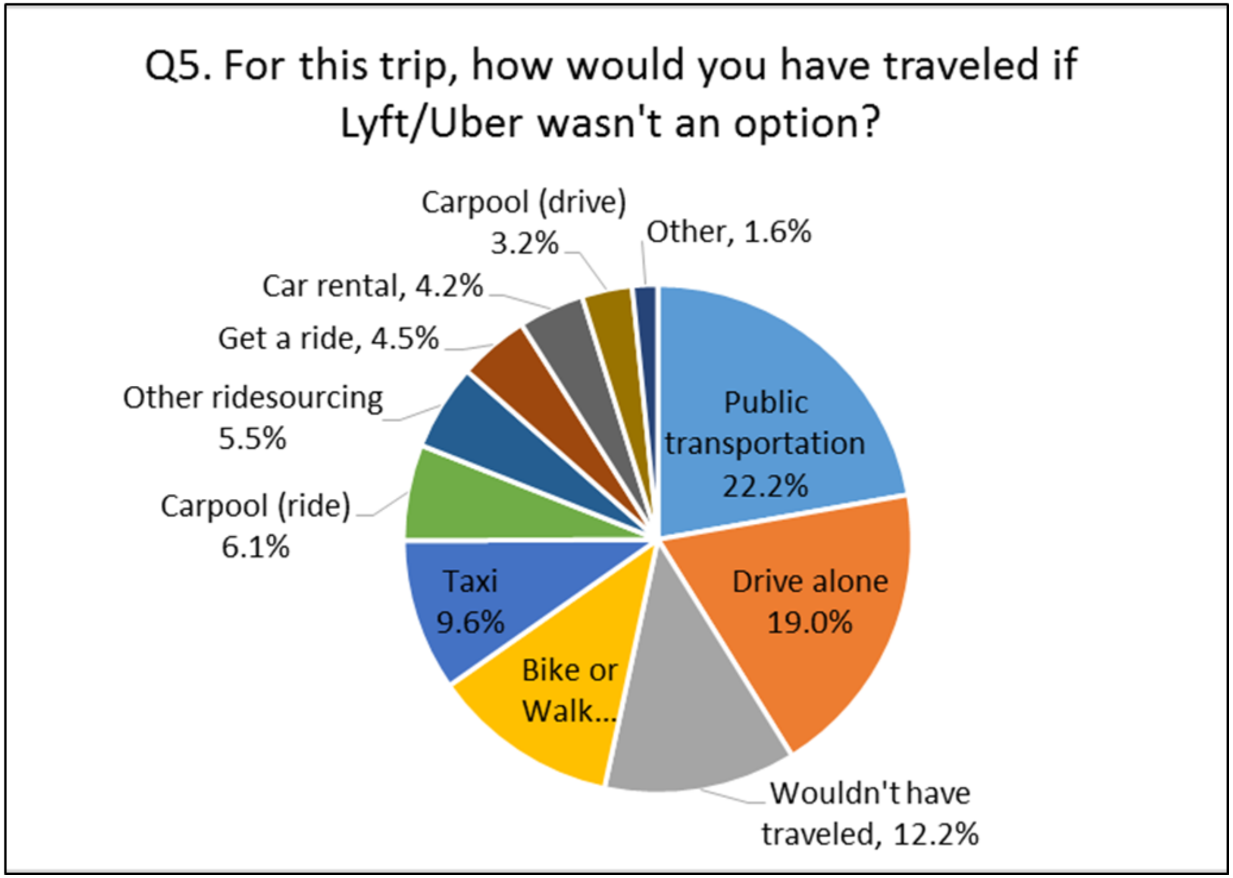
Each theme was explored for:

- Specific trip
- General use

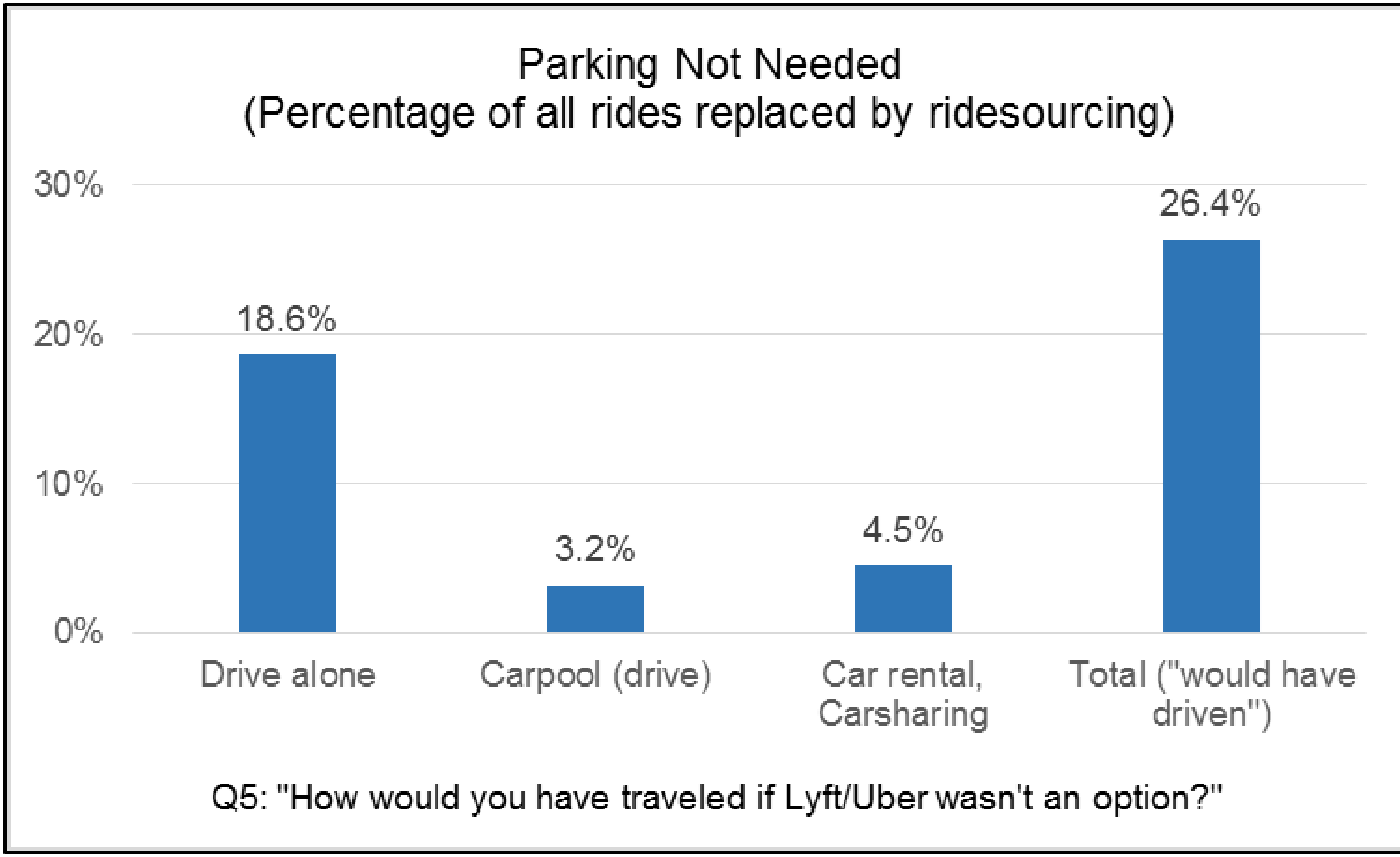
PARKING

Parking Demand (Specific Trip)

Mode Replacement (Specific Trip)

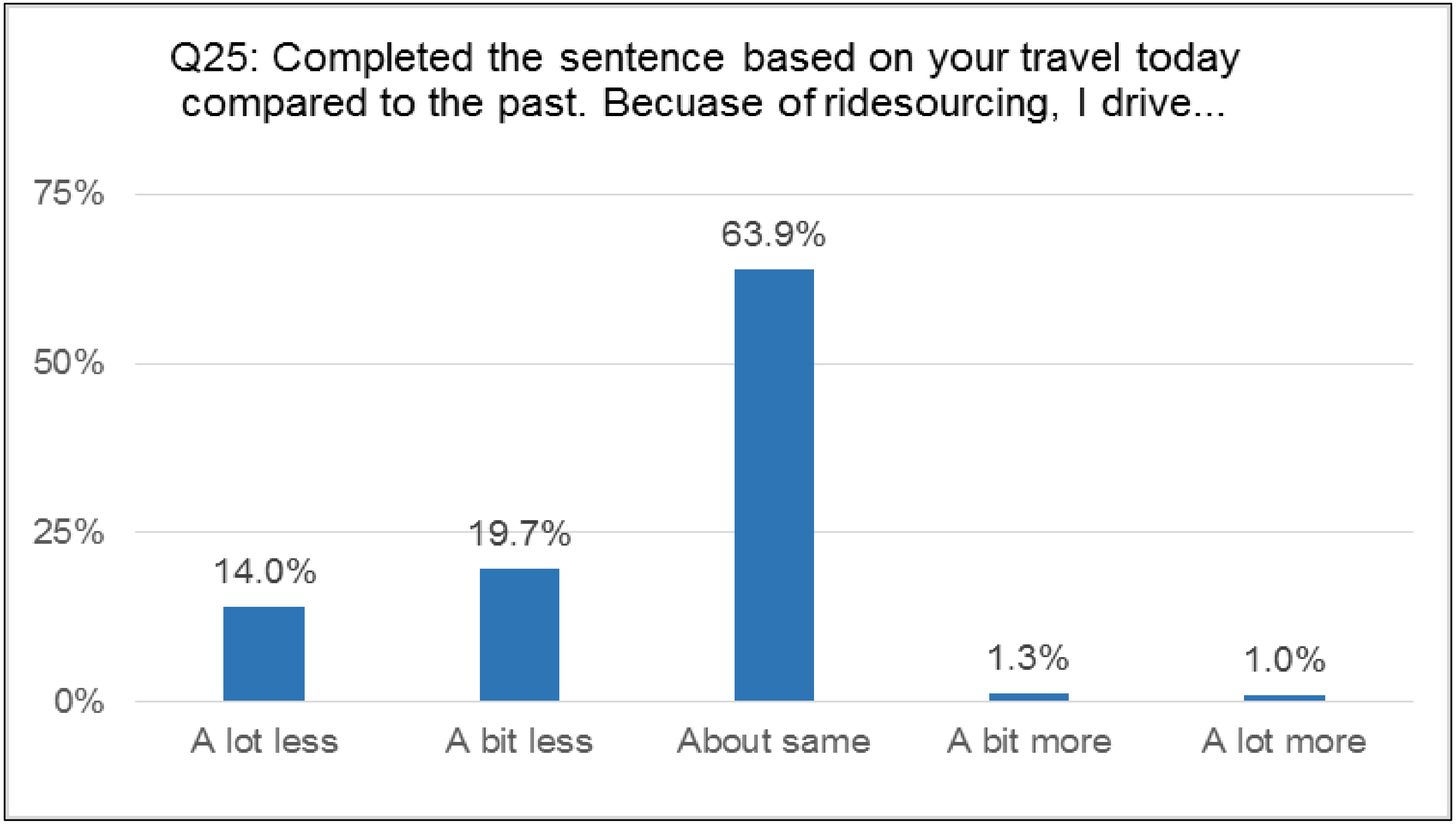


PARKING


Parking Not Needed
(Percentage of all rides replaced by ridesourcing)
30%
20%
10%
0%
18.6%
3.2%
4.5%
26.4%
Drive alone
Carpool (drive)
Car rental, Carsharing
Total ("would have driven")
Q5: "How would you have traveled if Lyft/Uber wasn't an option?"

PARKING

Parking Demand (General Use)



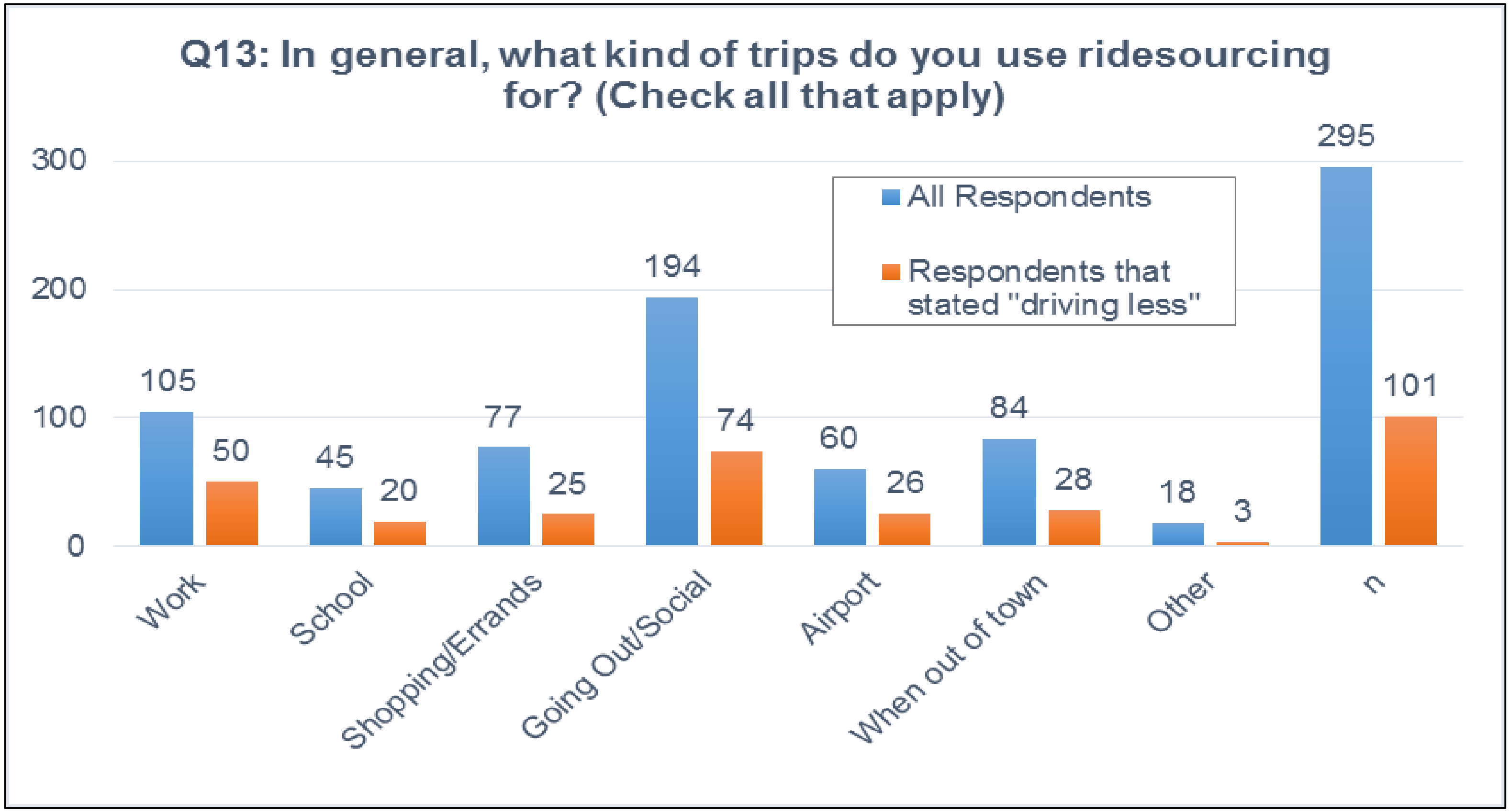
PARKING

Parking: Locations (Specific Trip)

O-D Matrix (Driving Trips Replaced)

DESTINATION / ORIGIN	Home	Work	School	Shopping/ Errands	Going Out/ Social	Airport	Hotel/ Airbnb	Family/ Friend	Other	Totals
Home	0	5	1	1	19	13	0	1	2	42
Work	2	2	1	0	0	0	4	0	1	10
School	1	0	0	0	0	0	0	1	0	2
Shopping/Errands	1	0	0	0	0	0	0	0	0	1
Going Out/Social	8	0	0	0	2	0	0	2	1	13
Airport	0	0	0	0	0	0	1	0	0	1
Hotel/Airbnb	0	2	0	0	0	0	0	0	2	4
Family/Friend	2	0	0	0	1	0	1	0	0	4
Other	1	1	0	0	0	1	2	0	0	5
Totals	15	10	2	1	22	14	8	4	6	82

Trip Purpose (General Use)

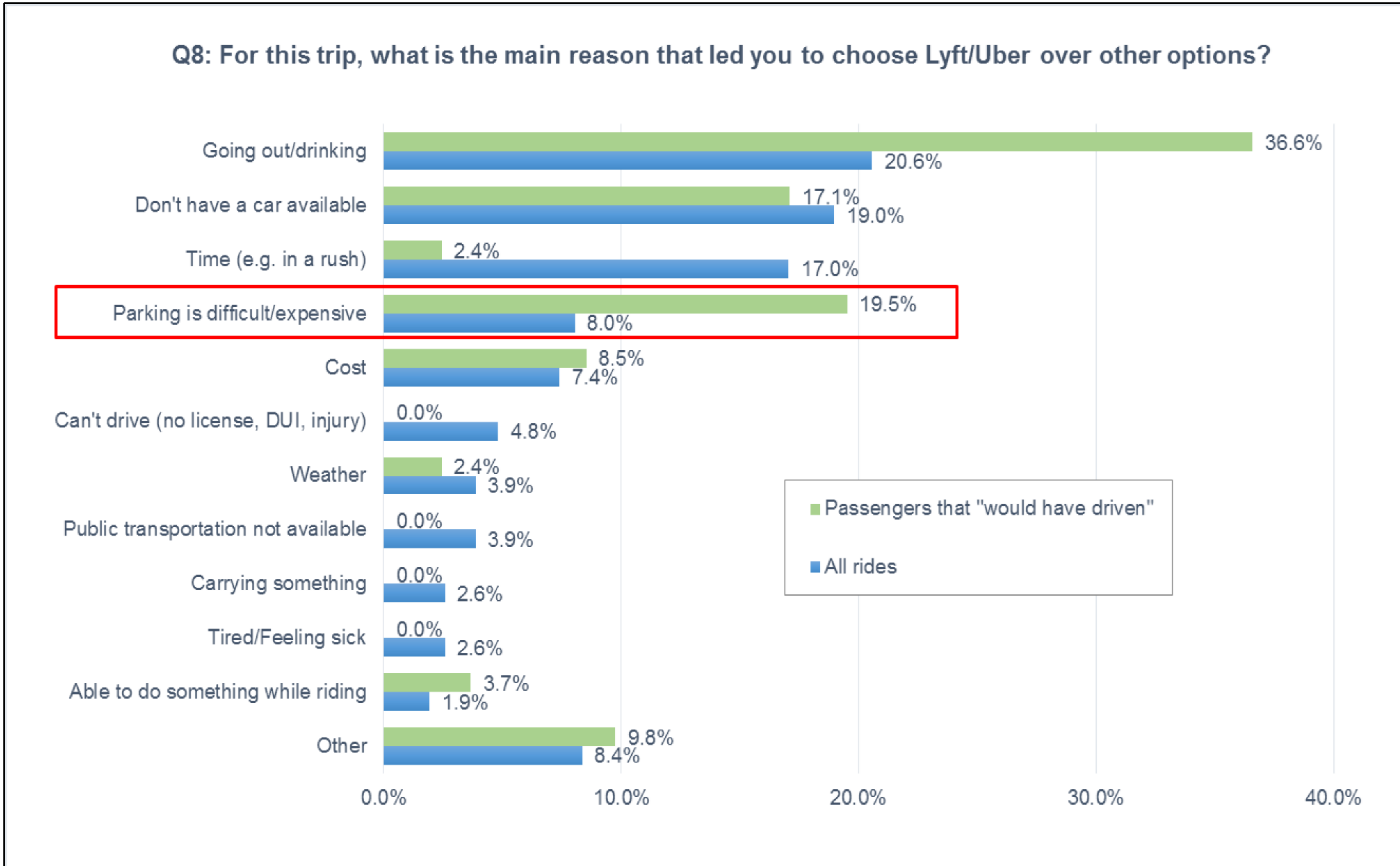


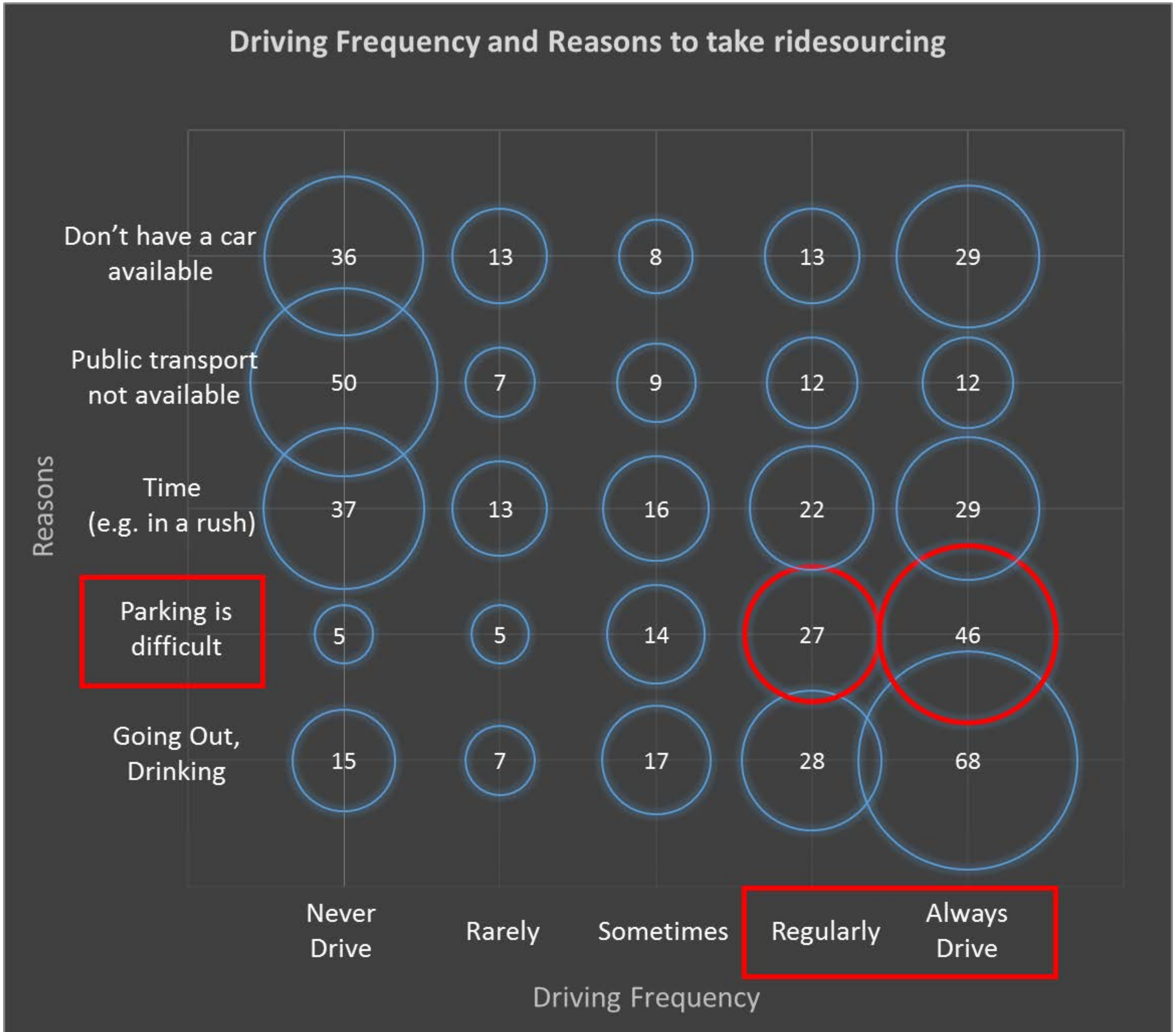
PARKING

Parking: Connectivity to Transit

Q9. Ride connecting with other mode (n=311)		
No	294	94.5%
Yes	17	5.5%
If yes, number of rides replacing driving and connecting to transit	3	1.0%
Q22. Have you ever connected with other mode? (n=293)		
No	233	79.5%
Yes	60	20.5%
If yes, number of passenger that stated driving less and public transportation (e.g. bus, rail) as the connection mode	21	7.2%

Stated reason (Specific Trip)

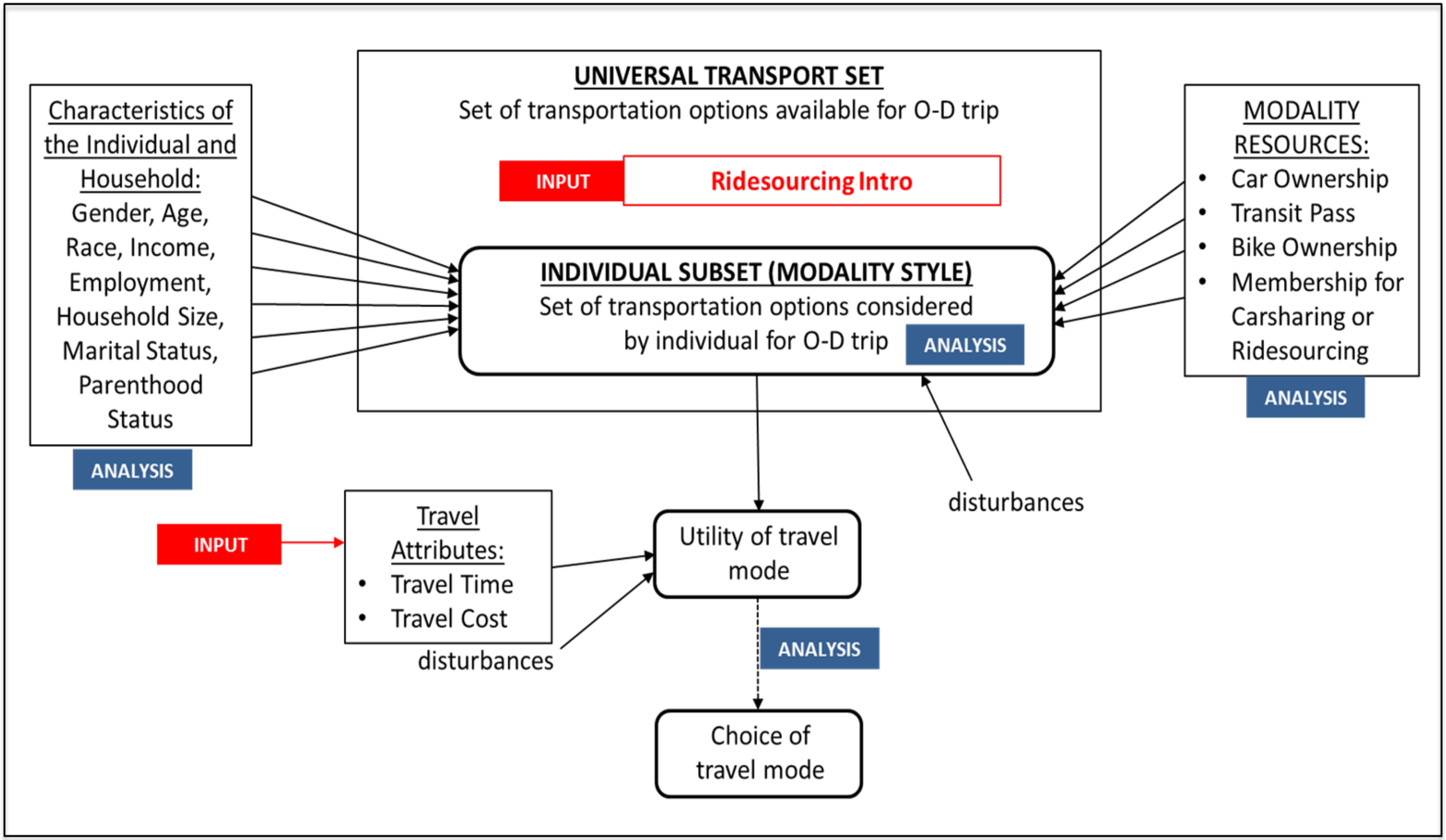



Driving Frequency and Reasons to take ridesourcing
Don't have a car available
Public transport not available
Time (e.g. in a rush)
Parking is difficult
Going Out, Drinking
Reasons
36
13
8
13
29
50
7
9
12
12
37
13
16
22
29
5
5
14
27
46
15
7
17
28
68
Never Drive
Rarely
Sometimes
Regularly
Always Drive
Driving Frequency

IX. Travel Behavior

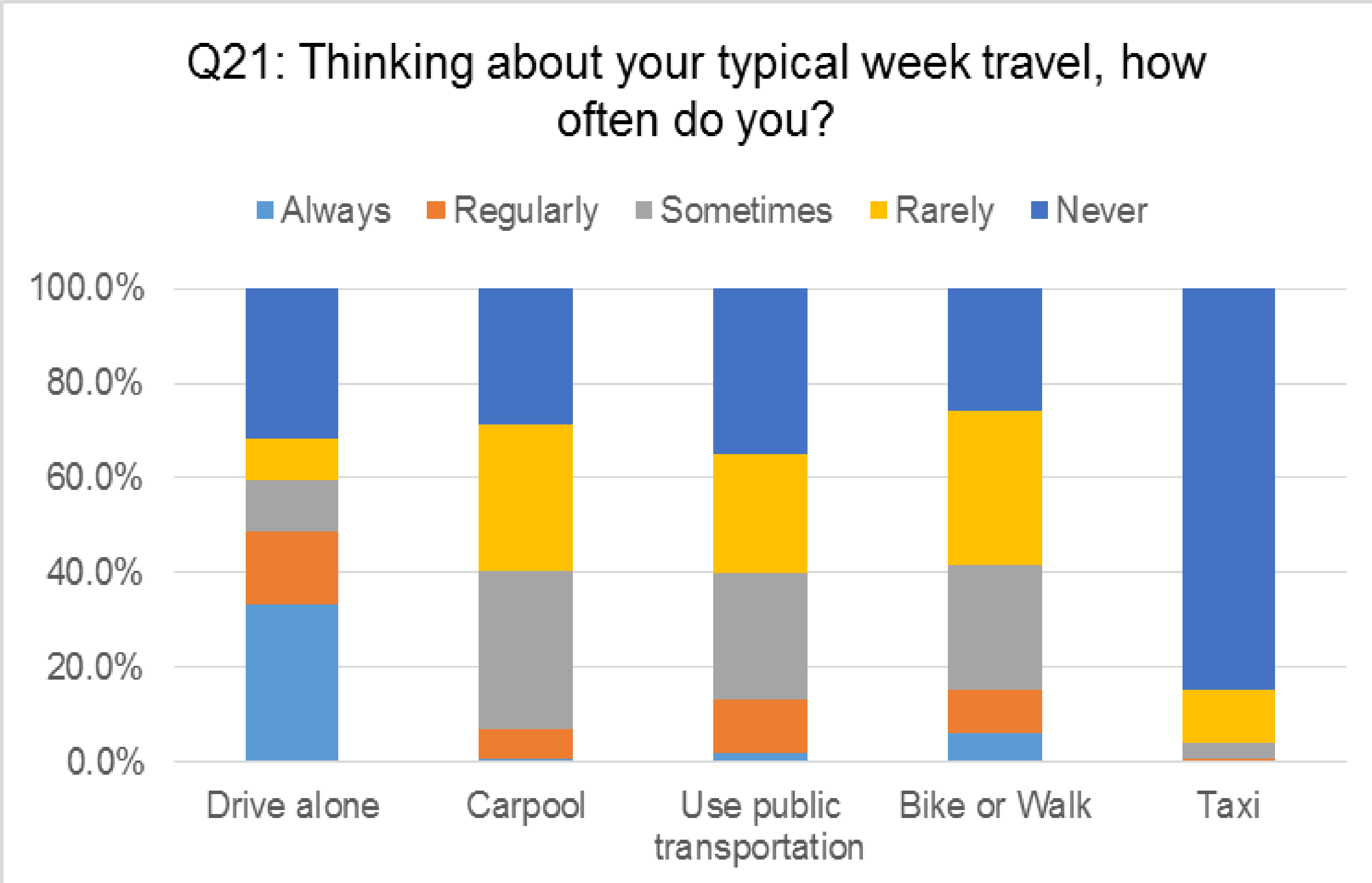
- Travel Demand Framework
- Mode Frequency
- Travel Behavior Changes
- Trip Purpose
- Reasons
- Modality Style

Travel Demand Framework



TRAVEL BEHAVIOR

Mode Frequency

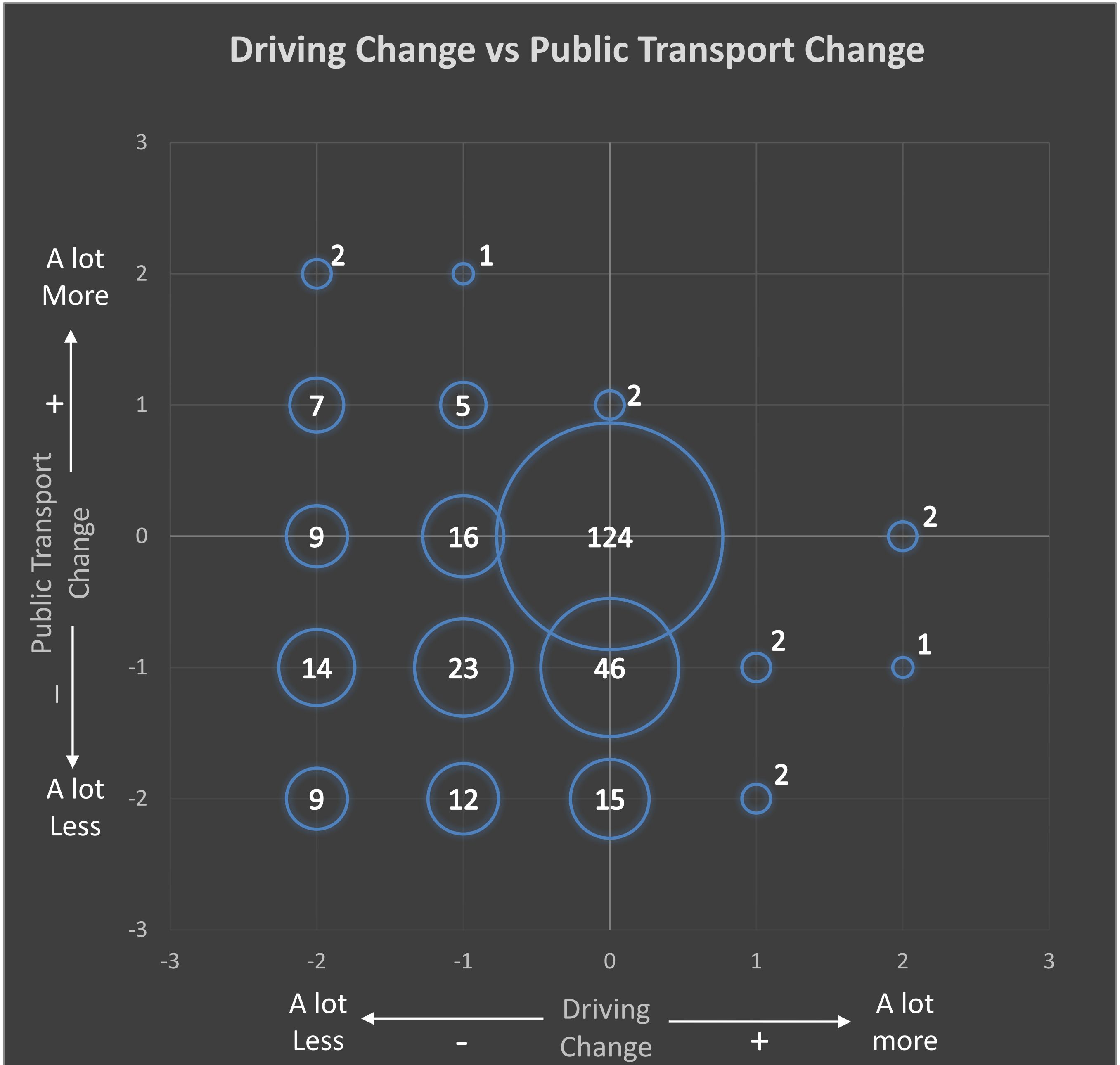


TRAVEL BEHAVIOR

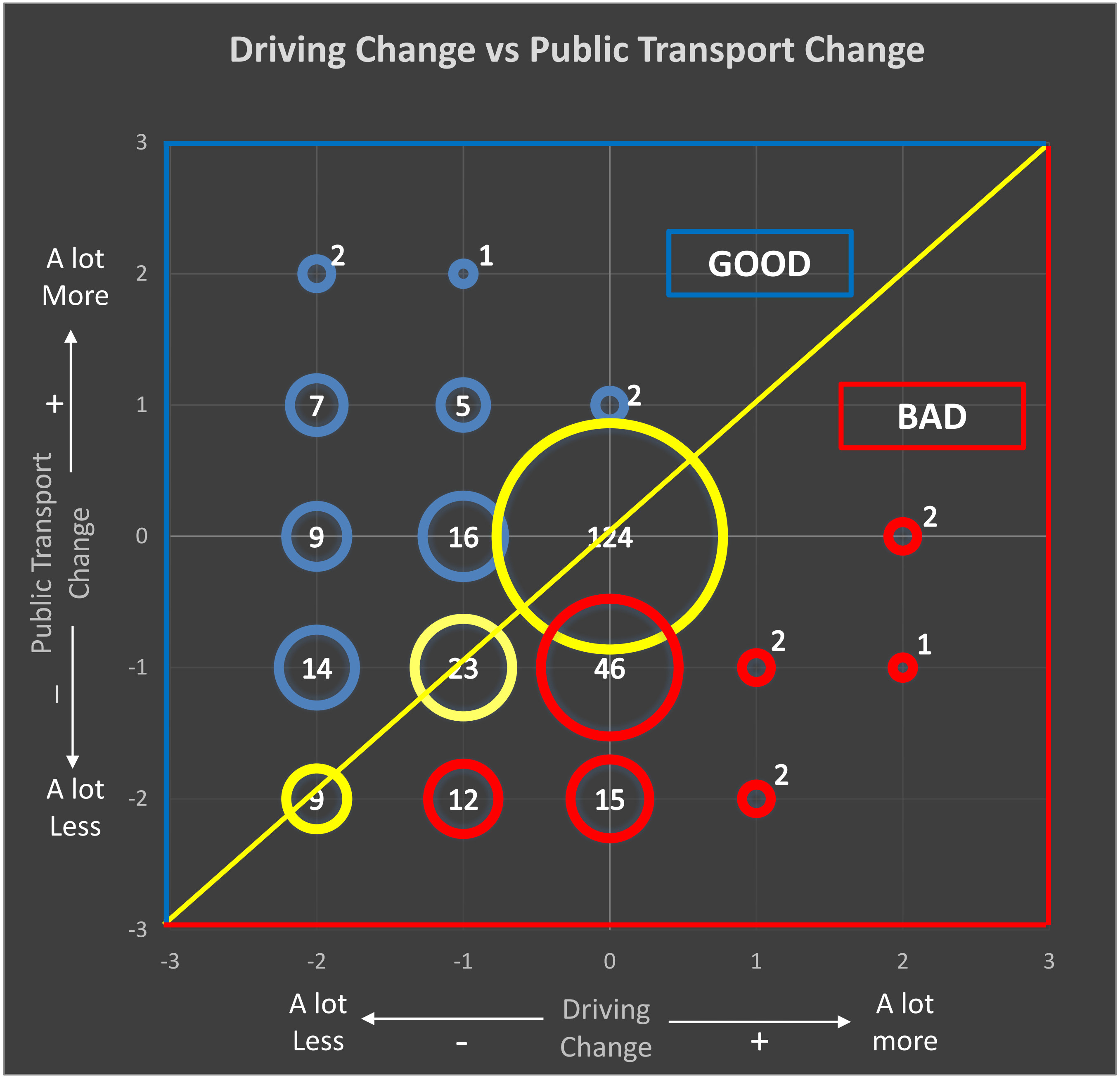
Changes

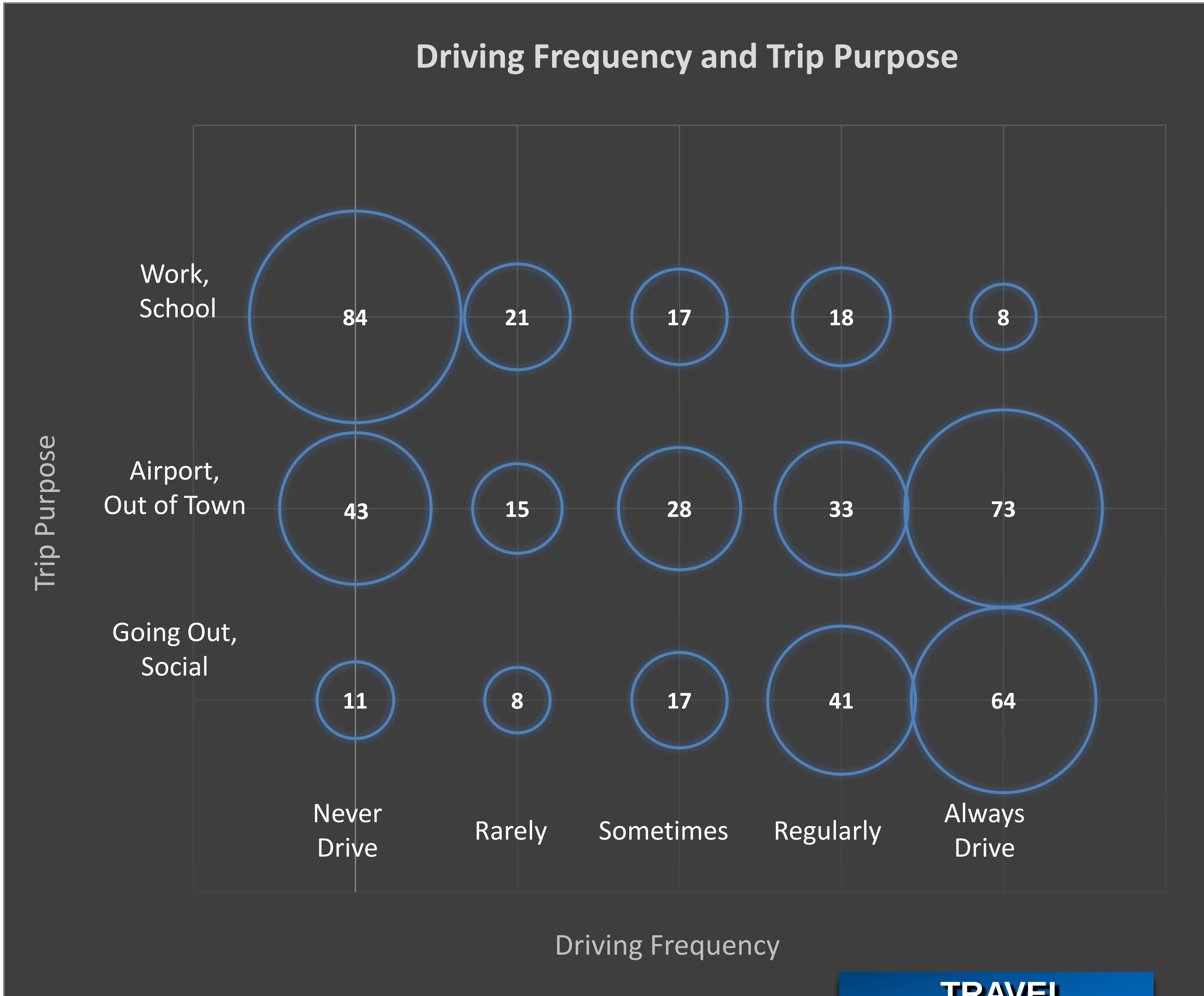
25. For the next few questions, complete the sentence based on your travel today compared to the past

	A lot less	A bit less	About same	A bit more	A lot more
Because of ridesourcing, I go to places...	3 1.0%	2 0.7%	144 50.0%	121 42.0%	18 6.3%
Because of ridesourcing, I drive...	41 14.3%	57 19.9%	182 63.4%	4 1.4%	3 1.0%
Because of ridesourcing, I use public transport...	38 13.2%	86 30.0%	146 50.9%	14 4.9%	3 1.0%
Because of ridesourcing, I bike or walk...	10 3.5%	77 26.7%	187 64.9%	7 2.4%	7 2.4%
Because of ridesourcing, I take taxis...	88 31.5%	25 9.0%	165 59.1%	1 0.4%	0 0.0%

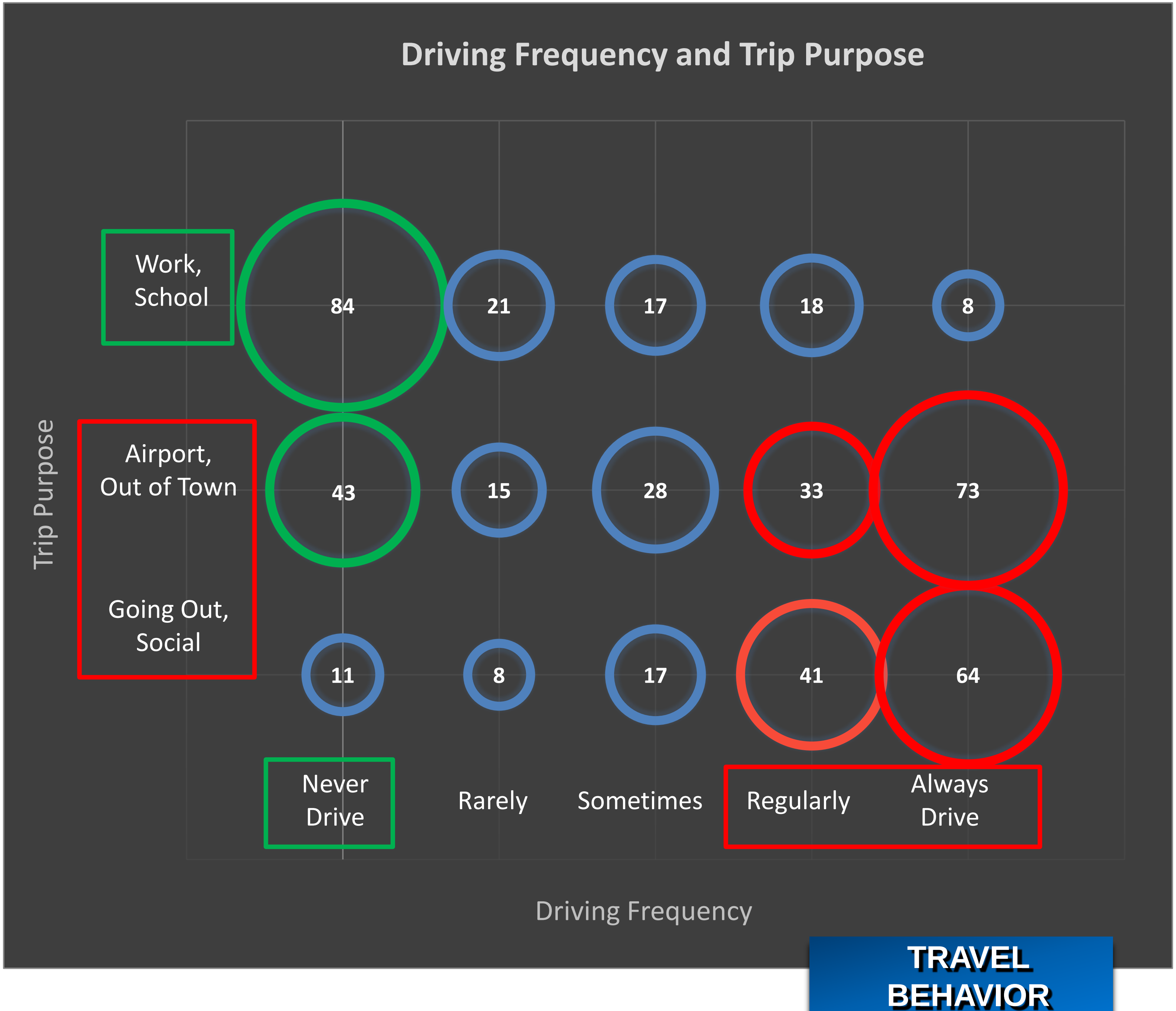


Driving Change vs Public Transport Change
A lot More
+
Public Transport Change
–
A lot Less
3
2
1
0
-1
-2
-3
2
1
7
5
2
9
16
124
2
14
23
46
2
1
9
12
15
2
-3
-2
-1
0
1
2
3
A lot Less
-
Driving Change
+
A lot more

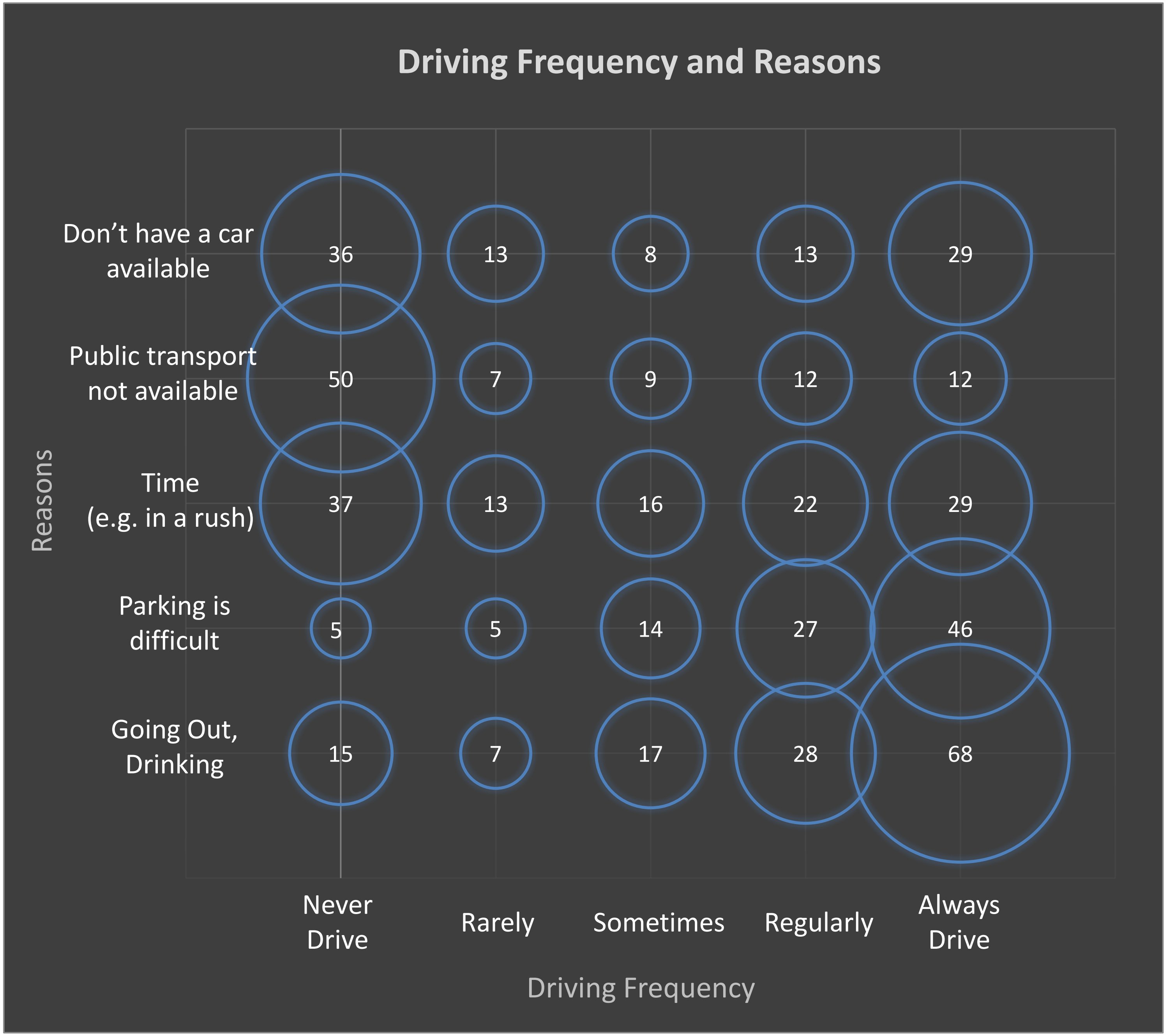

Driving Change vs Public Transport Change
GOOD
BAD
Public Transport Change
A lot More
+
–
A lot Less
3
2
1
0
-1
-2
-3
-3
-2
-1
0
1
2
3
A lot Less
-
Driving Change
+
A lot more
2
1
7
5
2
9
16
124
2
14
23
46
2
1
9
12
15
2



TRAVEL BEHAVIOR



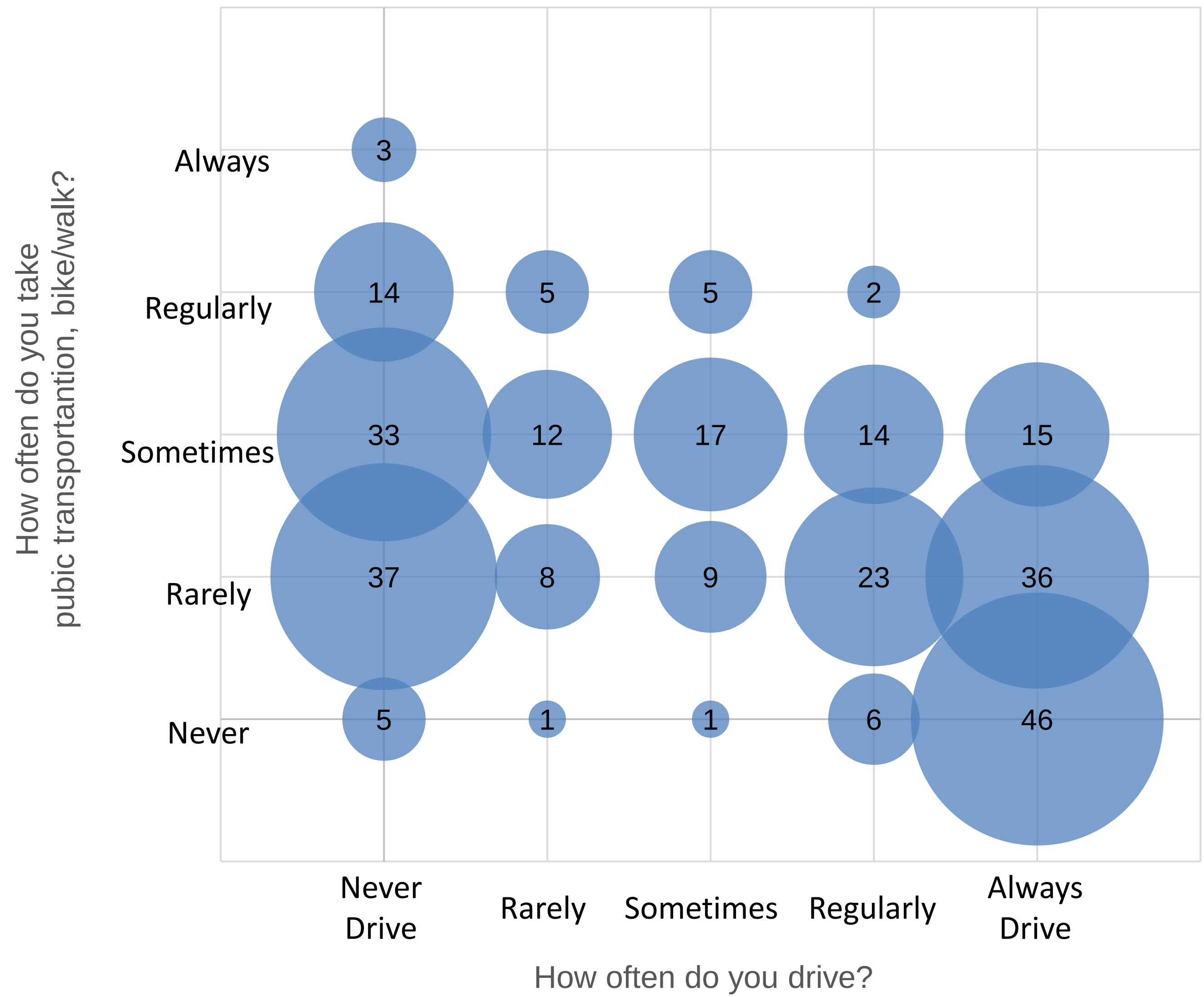
Driving Frequency and Trip Purpose
Trip Purpose
Work, School
Airport, Out of Town
Going Out, Social
84
21
17
18
8
43
15
28
33
73
11
8
17
41
64
Never Drive
Rarely
Sometimes
Regularly
Always Drive
Driving Frequency
TRAVEL BEHAVIOR



Driving Frequency and Reasons
Reasons
Don't have a car available
Public transport not available
Time (e.g. in a rush)
Parking is difficult
Going Out, Drinking
36
13
8
13
29
50
7
9
12
12
37
13
16
22
29
5
5
14
27
46
15
7
17
28
68
Never Drive
Rarely
Sometimes
Regularly
Always Drive
Driving Frequency

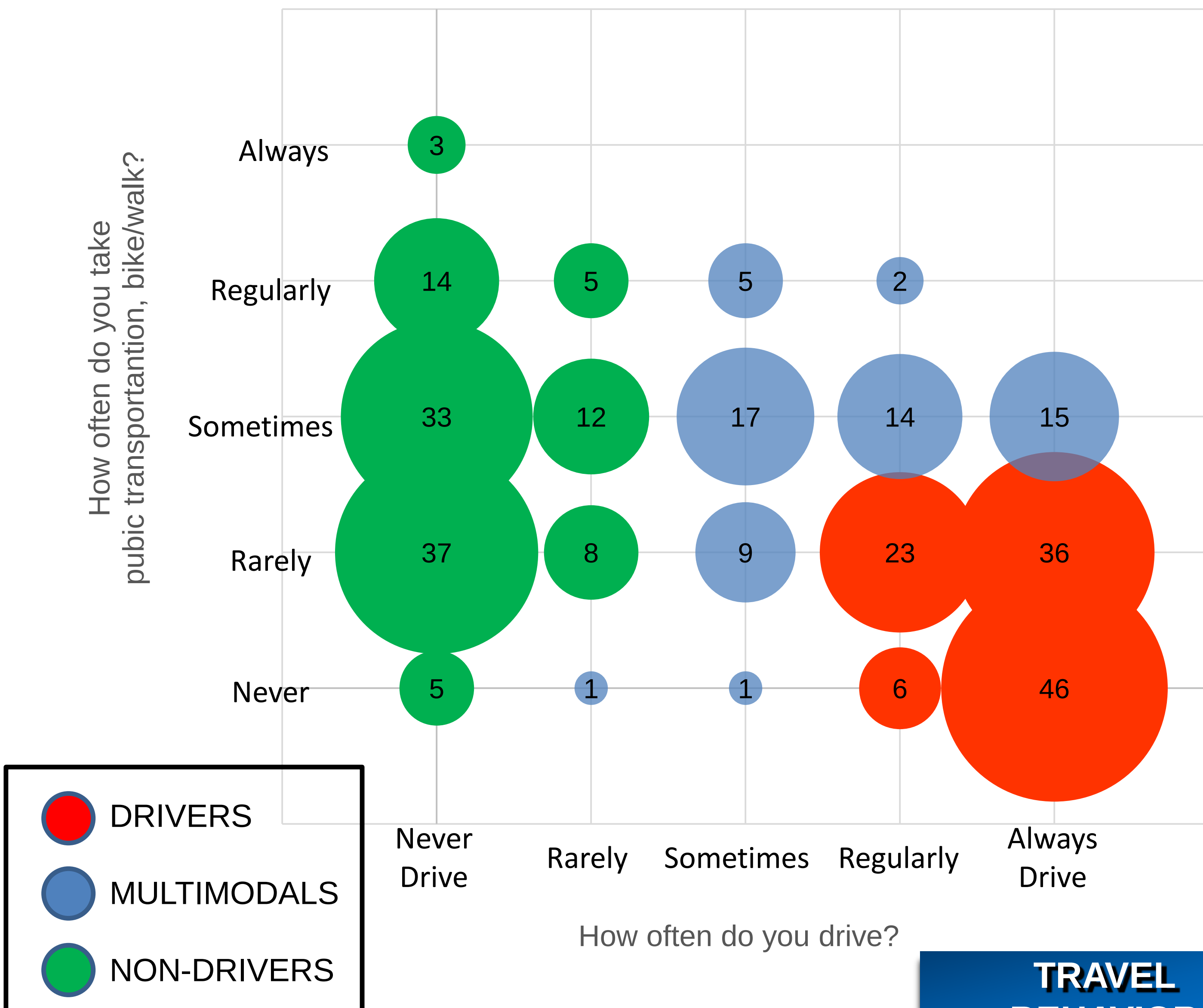

Driving Frequency and Reasons
Reasons
Don't have a car available
Public transport not available
Time (e.g. in a rush)
Parking is difficult
Going Out, Drinking
36
13
8
13
29
50
7
9
12
12
37
13
16
22
29
5
5
14
27
46
15
7
17
28
68
Never Drive
Rarely
Sometimes
Regularly
Always Drive
Driving Frequency

"Drive Frequency" versus "Public Transportation + Bike/Walk Frequency"



TRAVEL BEHAVIOR

Modality Style



TRAVEL BEHAVIOR

X. Overall Results

- Driver Perspective
- VMT
- Parking
- Travel Behavior

X. Overall Results

Ridesourcing Times and Distances

- Overall efficiency rate for the study is 39.3% based on time, and 59.2% based on distance
- In terms of distance, drivers have to travel 69 extra miles in dead-heading for every 100 miles with a passenger

X. Overall Results

<u>RIDESOURCING EARNINGS</u>

- The gross earnings is $15.69/hour but discounting expenses is less than minimum wage, with an average of **<u>$7.94/hr</u>** (tips included).

X. Overall Results

<u>VMT IMPACT</u>

- ➢ Ridesourcing provides more mobility:
  - 12.2% of passengers stated that they "wouldn't have traveled"
- ➢ But PMT/VMT efficiency goes from **<u>112.3% to 60.8%</u>**

- ➢ Current ridesourcing VMT is **<u>185%</u>** what would have been before, which has significant implications for our cities in terms of congestion and environmental concerns

X. Overall Results

VMT IMPACT

Based on Lyft/Uber current rate of 1 billion rides per year in the U.S. and assuming the results hold true for the country:

Lyft and Uber rides per year in the U.S.	1,000,000,000.00
$t_{T\ mean}$= (Σd)/ride (Table IV.1)	11.90
VMT_{AFTER} = Rides per year * 11.90	11,900,707,268.24
VMT_{AFTER}/VMT_{BEFORE} (Table V.3)	1.85
VMT_{BEFORE} = VMT_{AFTER} / 1.85	6,446,228,741.23
VMT_{EXTRA} = VMT_{AFTER} - VMT_{BEFORE}	$\boxed{5,454,478,527.02}$

Estimated VMT impact from Lyft/Uber is around

5.5 billion extra miles per year in the U.S.

RESULTS

X. Overall Results

PARKING

High potential to decrease car dependency

- Ridesourcing is replacing driving modes, reducing the need for parking
- Parking difficulty/expense is one of the main reasons for passengers to use ridesourcing instead of driving.

X. Overall Results

<u>TRAVEL BEHAVIOR</u>

- Three common groups of ridesoucing:
  1. Drivers
  2. Multimodals
  3. Non-drivers
  - Drivers become bi-modal based on trip purpose
- For typical drivers, ridesourcing is mostly replacing social trips (e.g. go out), to/from airport, and when out of town
- For typical non-drivers, it's replacing work/school trips

XI. Summary Conclusions

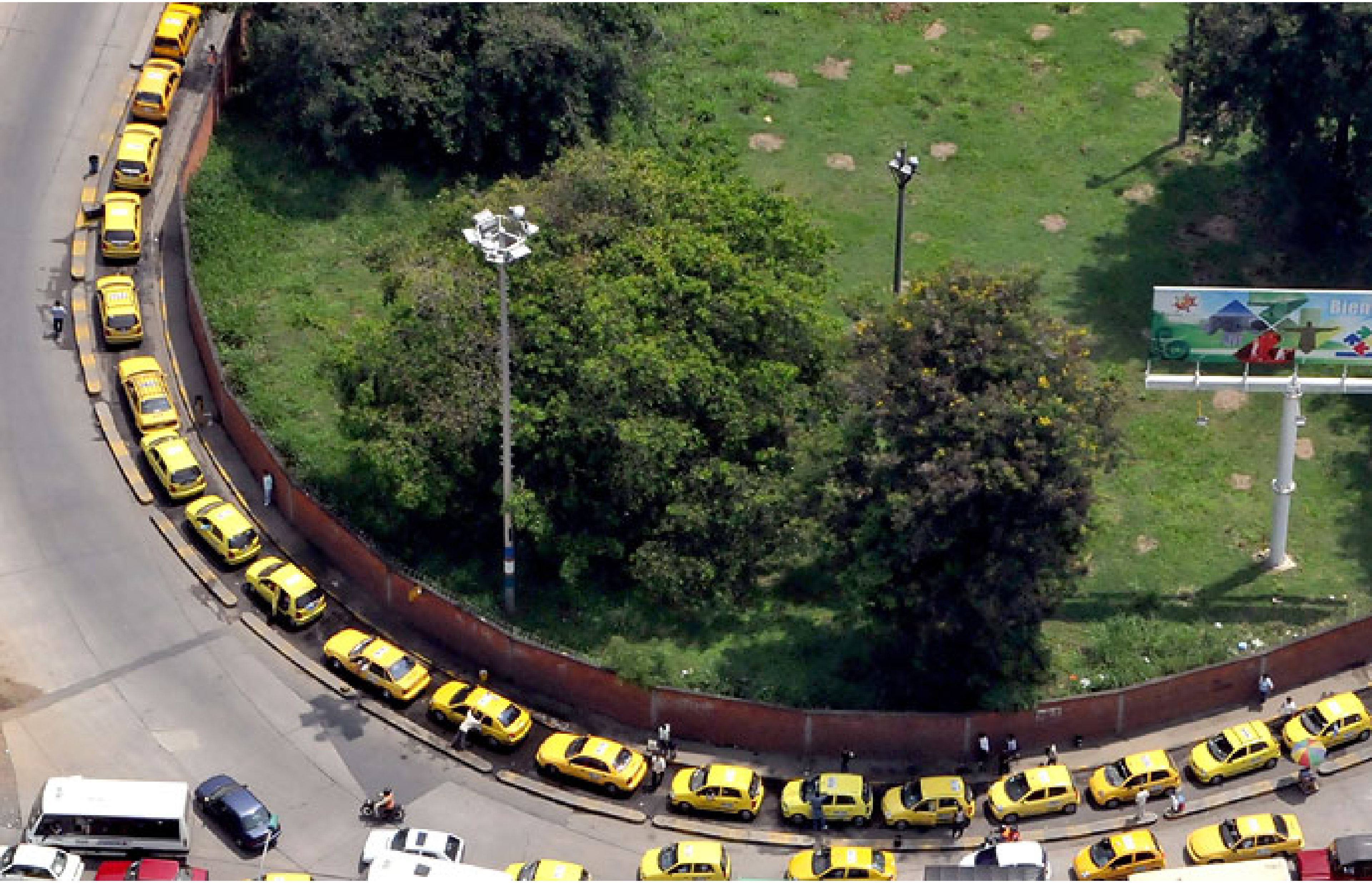
- Opportunities and Barriers
- Policy Recommendations
- Future Applications
- Future Research

Limitations

This study doesn't come without limitations:

- Trip sample size
- Denver metro area
- Driver strategy

Photo Source: ElPais.com.co



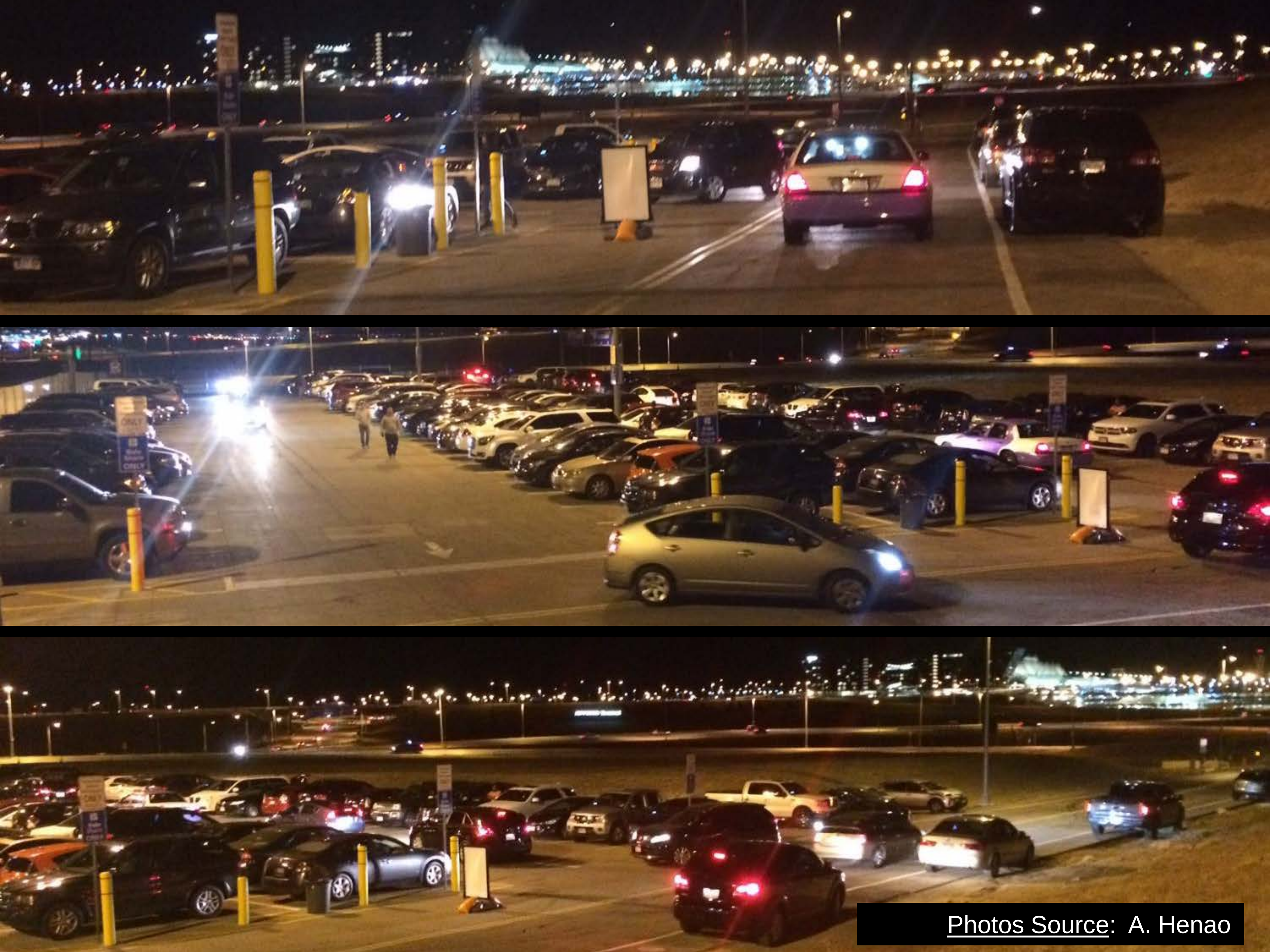
CONCLUSIONS

Photo Source: El Richie

CONCLUSIONS

Photo Source: W. Marshall

CONCLUSIONS



Photos Source: A. Henao

WE NEED DATA

- Cities and agencies need data
  - REAL, USEFUL DATA

Highly touted Boston-Uber partnership has not lived up to hype so far

–Robert Galbraith / Reuters

By Adam Vaccaro June 16, 2016

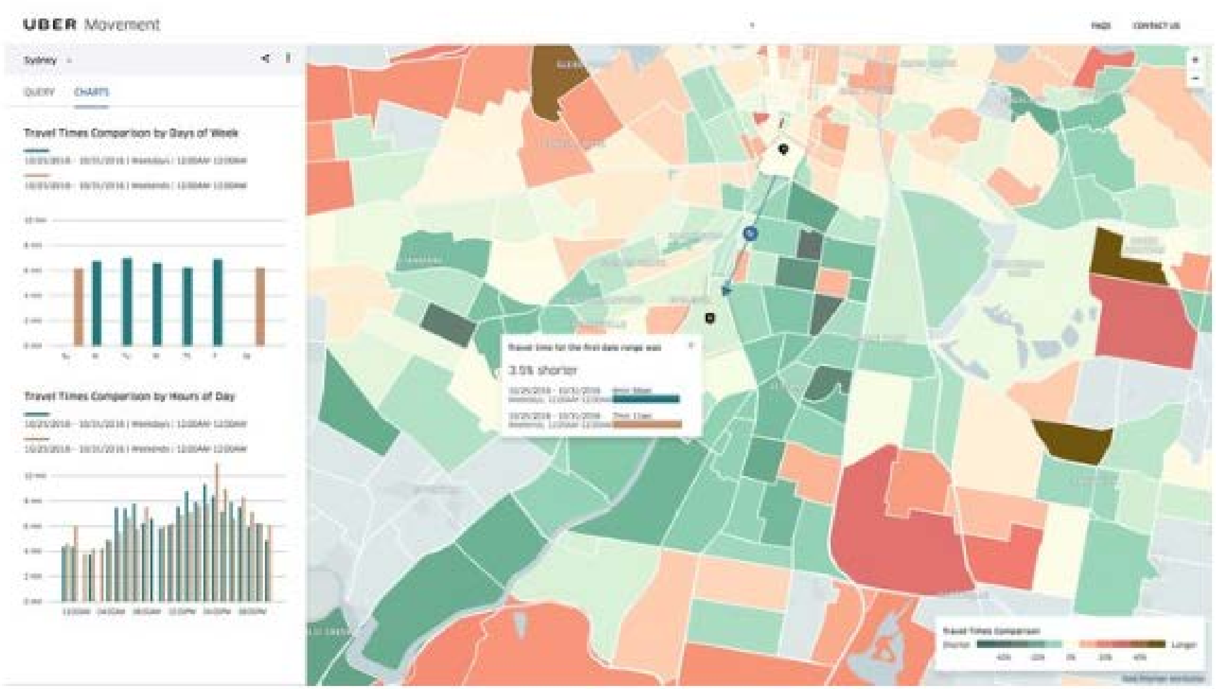
It was hailed as a milestone for both Boston and Uber in January 2015, when the increasingly ubiquitous ride-for-hire service agreed to share data with City Hall on trips conducted in the city.

CONCLUSIONS

WIRED SUBSCRIBE

ALEX DAVIES TRANSPORTATION 01.08.17 4:00 PM

UBER'S MILDLY HELPFUL DATA TOOL COULD HELP CITIES FIX STREETS



UBER

CONCLUSIONS

POLICY DECISIONS

- Cities and agencies need data
  - REAL, USEFUL DATA
  - BE CAREFUL WITH INFRASTRUCTURE DECISIONS (TRANSIT)

LYFT AND UBER

- Uber and Lyft are great and could be part of the solution for better transportation systems
  - LYFTLINE, UBERPOOL
  - DESTINATION FILTER
  - PARTNERSHIPS
  - CAR-OWNERSHIP
  - EQUITY (PASSENGERS & DRIVERS)

- Changing business models
  - CAR INDUSTRY
  - TAXI INDUSTRY
  - STAKEHOLDERS

THE FUTURE

- Autonomous Vehicles
- Infrastructure Changes
- Transportation as a service

CONCLUSIONS

ACADEMIA AND RESEARCH

- NEED MORE EMPIRICAL STUDIES
- BETTER RESEARCH METHODS
- BETTER IMPLEMENTATION IN MODELS
  - Alonso-Mora, J., Samaranayake, S., Wallar, A., Frazzoli, E., & Rus, D. (2017). On-demand high-capacity ride-sharing via dynamic trip-vehicle assignment. *Proceedings of the National Academy of Sciences*.

FUTURE STUDIES

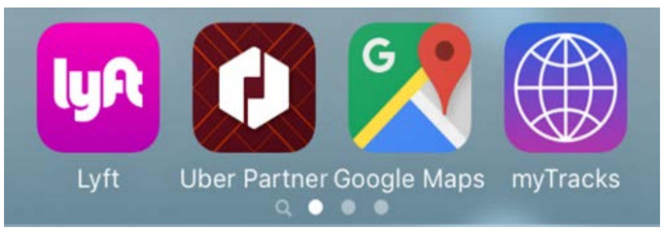
- Equity Study using the Uber/Lyft API
  - Hughes & McKenzie (2016): Equity study in Seattle
  - Yanbo Ge et al. (2016): Discrimination study in Seattle and Boston. African American sounding names.

- Deeper analysis of travel demand models
  - Demographics
  - Modality resources
  - Modality Style
  - Mode Choice

FUTURE STUDIES

- More interesting things on the data
  - Parking (extra time and cost)
  - Passenger side
  - Geographical Variations (e.g. density, urban-suburban)
  - Uber/Lyft Estimated Arrival Time (EAT)
  - LyftLine/UberPool user characteristics
  - Value of Transit increase
  - Value of Time
- Austin, Texas

Impacts of Ridesourcing – Lyft and Uber – on Transportation including VMT, Mode Replacement, Parking, Equity, and Travel Behavior



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Doctoral Dissertation Defense
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