Analysis of Heterogeneity in Travel Behavior Changes during the COVID-19 Pandemic in the Greater Los Angeles Region
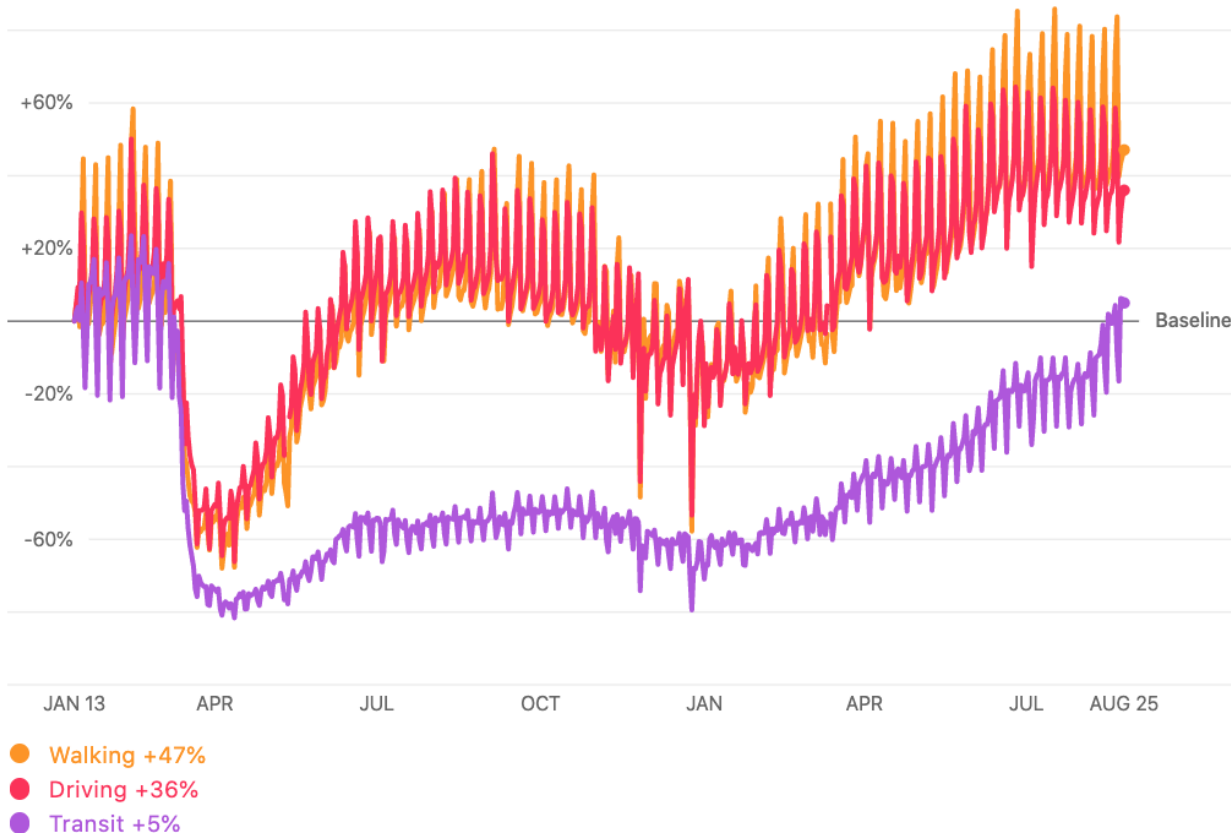## September 2, 2021

Dr. Giovanni Circella, Xiatian Iogansen, Jai Malik, Dr. Yongsung Lee, Dr. Jaime Soza-Parra

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

Car travel declined in the US (less than transit) and it is rebounding

California, US

Walking +47%
Driving +36%
Transit +5%

Changes in routing requests since January 2020 in California.
Source: *Apple mobility trends*

During the pandemic, the United States experienced:

- Steep decline in use of public transportation

- Sharp reduction in use of shared mobility

- Suspension of pooled rides (e.g. UberPOOL, Lyft Share)

- Temporary reductions in vehicle miles traveled (VMT) and greenhouse gas (GHG) emissions

- Increase in adoption of teleworking

- Devastating impacts on employment

- Recovery in car travel after reopening of activities

- Peak travel remains below pre-pandemic levels, but VMT levels are high again!

UC Davis blog on impacts of pandemic on transportation:

https://its.ucdavis.edu/blog-post/what-the-present-pandemic-means-for-the-future-of-transportation/

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UC Davis COVID-19 Mobility Study

- Research on temporary vs. longer-term impacts of the pandemic

- Targeted data collections in 15 regions of the United States and two regions in Canada (+ convenience sample internationally)

Previous 2018-2019 data

Information on many topics, e.g.

- Household organization
- Telecommuting patterns
- E-shopping behaviors
- Travel patterns
- Vehicle ownership
- Emerging delivery services
- Personal attitudes and preferences
- Shared mobility adoption
- Propensity towards AVs

➕

COVID-19 Spring 2020 data

Data collection on:

- Impacts of the COVID-19 on lifestyles
- Employment and activities
- Household organization and child care
- E-shopping behaviors
- Emerging delivery services
- Current travel patterns
- Vehicle ownership
- Shared mobility adoption
- Personal attitudes and preferences

➕
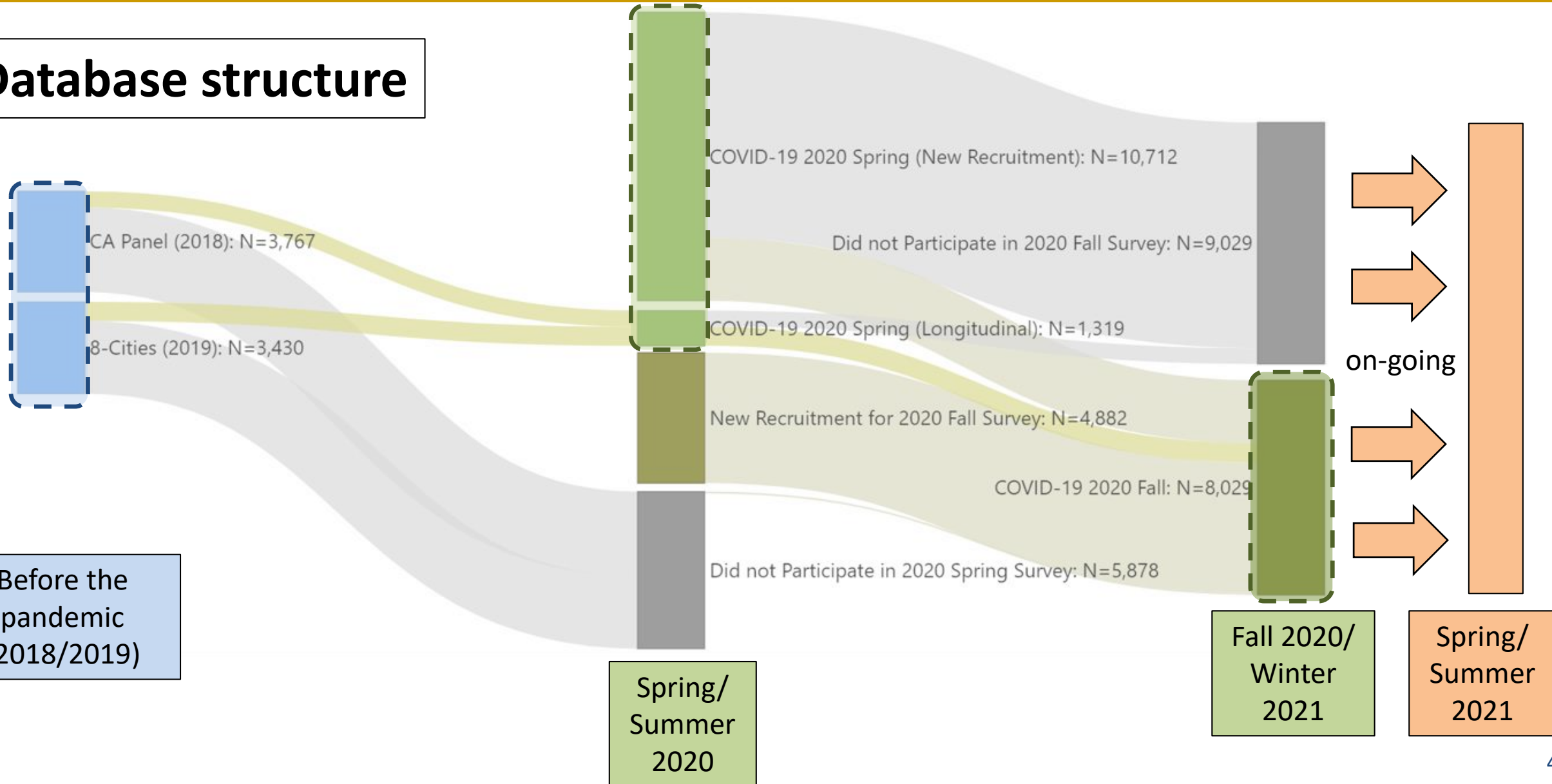
COVID-19 Fall 2020 longitudinal data

- Sampling Method: Recall of participants from previous surveys:
- Recruitment Method: Direct e-mail
- Valid Emails for Recontact: 9980
- Response Rate: 33.5%
- Incentives: $10 gift card from Amazon, Starbucks, Target or Walmart to each respondent
- Survey administration: Dec. 2020 – Jan. 2021

- On-going data collection in Spring/Summer 2021 and next wave of data collection in Spring/Summer 2022

- More information at postcovid19mobility.ucdavis.edu

UC Davis COVID-19 Mobility Study

Database structure

CA Panel (2018): N=3,767

8-Cities (2019): N=3,430

COVID-19 2020 Spring (New Recruitment): N=10,712

Did not Participate in 2020 Fall Survey: N=9,029

COVID-19 2020 Spring (Longitudinal): N=1,319

New Recruitment for 2020 Fall Survey: N=4,882

COVID-19 2020 Fall: N=8,029

Did not Participate in 2020 Spring Survey: N=5,878

on-going

Before the pandemic (2018/2019)

Spring/ Summer 2020

Fall 2020/ Winter 2021

Spring/ Summer 2021

UC Davis Mobility Study: COVID-19 Spring 2020 Datasets

Dataset L (Longitudinal, N=1,339)

- **Sampling Method**: Recall of participants from:
  - 2018 California Mobility Study
  - 2019 "8 Cities" (Boston, Kansas City, Los Angeles, Sacramento, Salt Lake City, San Francisco, Seattle and Washington DC) Study
- **Recruitment Method**: Direct e-mail
- **Valid Emails for Recontact**: 3,466
- **Response Rate**: 38.6%
- **Incentives**: $10 Amazon gift card to each survey respondent
- **Survey administration**: May to July 2020

Dataset O (Op. Panel, N=8,834)

- **Sampling Method**: Convenience sample through online opinion panel
- **Study Regions: 17 in the US and 2 in Canada:**
  - *United States:* Los Angeles, Sacramento, San Diego, San Francisco, Seattle, Chicago, Denver, Detroit, Kansas City, Salt Lake City, Atlanta, Boston, New York, Tampa and Washington D.C.
  - *Canada:* Toronto and Vancouver
- **Recruitment Method**: E-mail from online opinion panel
- **Sociodemographic Targets**: Age, gender, race and ethnicity, employment and HH income
- **Incentives:** Airline miles/points from opinion panel
- **Survey administration:** May to July 2020
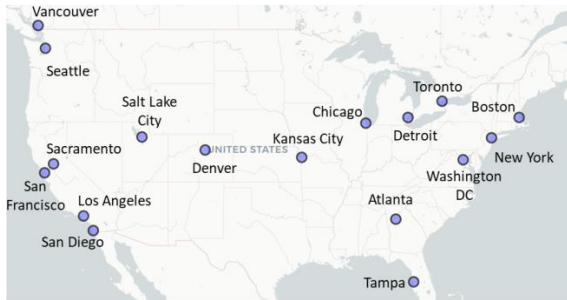
Dataset C (Convenience, N=1,266)

- **Sampling Method**: Convenience sample
- **Study Regions**: Open to all respondents with survey link
- **Recruitment Method:** Various channels, including
  - Professional listservs, online social media
  - Facebook and Instagram ads in the US and Canada
- **Incentives**: Participation in random drawing to win one of 200 $10 gift cards or one of 10 $100 gift cards from Amazon
- **Survey Administration**: May to July 2020

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COVID-19 **MOBILITY STUDY**

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UC Davis Mobility Study: COVID-19 Fall 2020 Datasets

Dataset L (Longitudinal, N=3,385)

- **Sampling Method**: Recall of participants from:
  - 2018 California Mobility Study
  - 2019 "8 Cities" (Boston, Kansas City, Los Angeles, Sacramento, Salt Lake City, San Francisco, Seattle and Washington DC) Study
  - 2020 COVID-19 Spring Survey
- **Recruitment Method**: Direct e-mail
- **Valid Emails for Recontact**: 9980
- **Response Rate**: 33.5%
- **Incentives**: $10 gift card from Amazon, Starbucks, Target or Walmart to each respondent
- **Survey administration**: Dec. 2020 – Jan. 2021

Dataset O (Op. Panel, N=3,766)

- **Sampling Method**: Convenience sample through online opinion panel
- **Study Regions**: Greater Los Angeles region (SCAG)
- **Recruitment Method:** E-mail from online opinion panel
- **Sociodemographic Targets:** Age, gender, employment, and household income
- **Incentives:** Airline miles/points from opinion panel
- **Survey administration:** Dec. 2020 – Jan. 2021

Dataset C (Convenience, N=878)

- **Sampling Method**: Convenience sample
- **Study Regions**: Open to all respondents with survey link who live in greater Los Angeles region
- **Recruitment Method:** Various channels, including
  - Professional listservs, online social media
  - Facebook ads in the Los Angeles region
- **Incentives**: Participation in random drawing to win one of 10 $100 or one of 200 $10 gift cards from Amazon, Starbucks, Target or Walmart
- **Survey Administration**: Dec. 2020 – Jan. 2021

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COVID-19 Survey Content

All survey versions include nine main sections:

1. Attitudes and preferences on transportation, residential location, environmental topics, etc.

2. Impacts of COVID-19 pandemic on lifestyle, including use of technology

3. Employment status, work and study activities

4. Household organization and child care

5. Online and in-person shopping patterns (for groceries, food delivery services, visits to restaurants, etc.)

6. Current travel choices (by trip purposes and modes)

7. Use of emerging transportation services

8. Household vehicle ownership and eventual plans for vehicle purchase

9. Household and individual sociodemographics
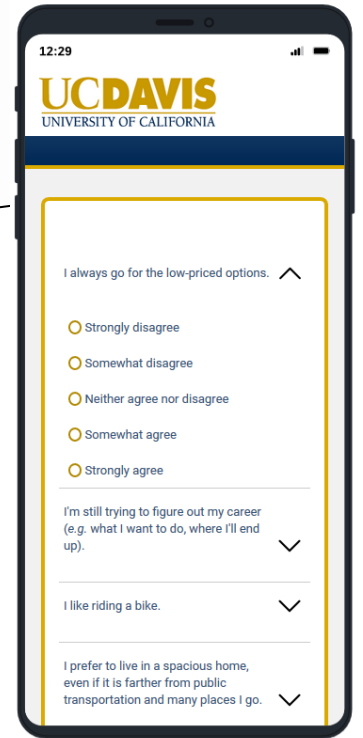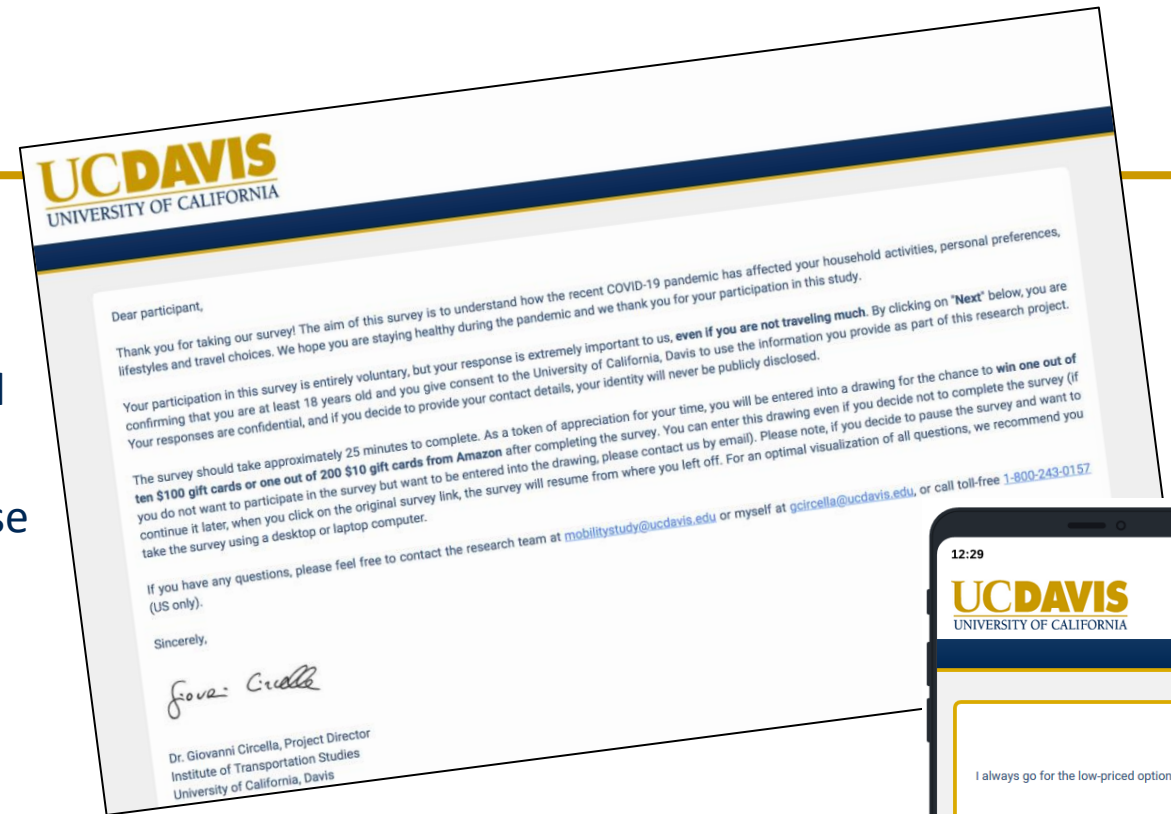
The online survey was available in both desktop and mobile version, even if the use of a computer or tablet was encouraged

Some Key Findings…

- Major shift to remote work, in particular among higher-income and higher-education workers

- About 25% of respondents expect to continue to work remotely after the pandemic is over more often than they did before COVID

- The pandemic caused a reduction in trips by all modes, but an increase in walking for non-commute travel

- Approximately 1/3 of those who reduced the use of transit have increased their driving
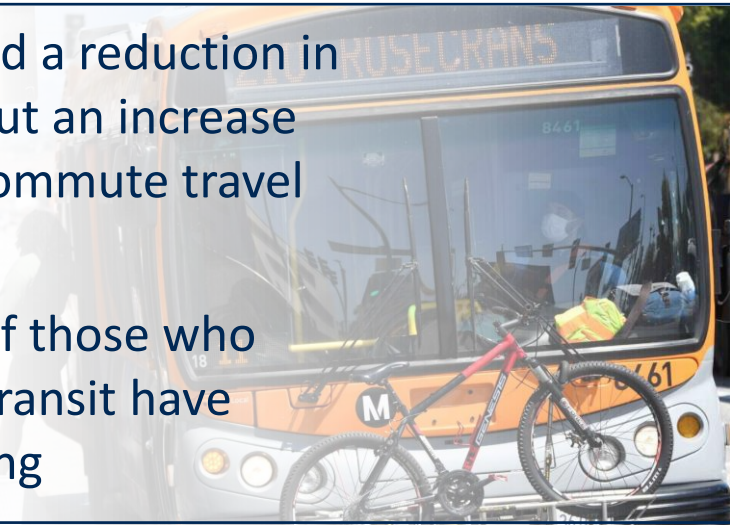
- Increase in e-shopping adoption, with expansion of user base among non-traditional users
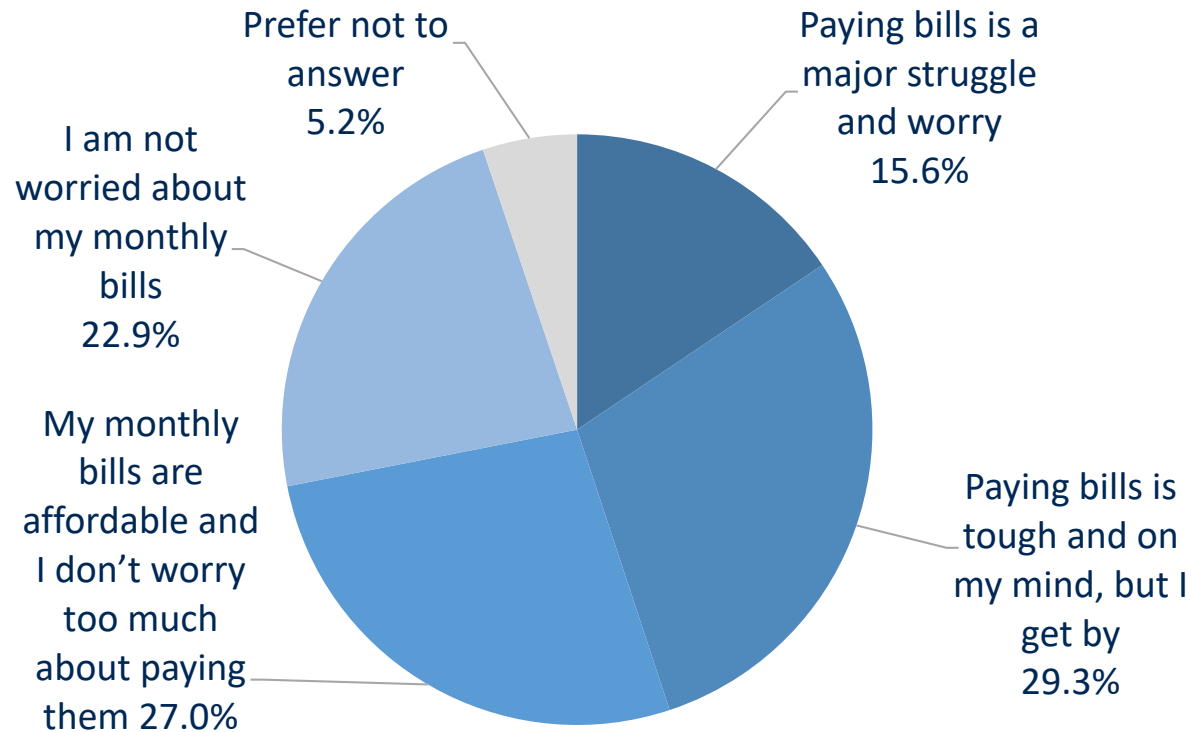
- Delivery apps are still an urban phenomenon, more popular among younger, dynamic groups

- Households that increased their number of vehicles outnumber those that decreased it

- Increased interest in vehicle ownership among those living in zero-vehicle households

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Impacts of COVID-19 Pandemic on Jobs and Financial Situation

Prefer not to answer 5.2%

Paying bills is a major struggle and worry 15.6%

I am not worried about my monthly bills 22.9%

My monthly bills are affordable and I don't worry too much about paying them 27.0%

Paying bills is tough and on my mind, but I get by 29.3%

Spring 2020, Dataset O *(N = 8,834)*

- Individuals in lower-income households are more likely to report they are financially struggling.

- Lower-income workers are more likely to have been furloughed without pay, to have lost their job or to have place of employment go out business.

	Household Income		
	Less than $50,000	$50,000 to $99,999	$100,000 or more
Total sample (n=8,834)	31.82%	31.12%	37.06%
I'm furloughed with pay from my previous job (n=136)	33.10%	41.90%	25.00%
I'm furloughed without pay from my previous job (n=425)	37.20%	30.60%	32.20%
I was let go from my job during the COVID-19 pandemic (n=340)	49.70%	28.20%	22.10%
My place of employment went out of business during the COVID-19 pandemic (n=115)	55.70%	28.70%	15.70%

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Commuting and Telecommuting

- Many set up home offices, upgraded hardware or software, Wi-Fi, etc. to improve ability to work remotely, in particular those living in urban areas and in the early stages of the pandemic.

- Remote work has been more accepted by employers and employee during the pandemic.

- The average self-reported number of telecommuting days in a week increased substantially during the pandemic:

0 days a week

1-2 days a week

3-4 days a week

5 or more days a week

0 days a week

1-2 days a week

3-4 days a week

5 or more days a week

Longitudinal Dataset *(N = 863)*

Fall 2019   Spring 2020   Fall 2020

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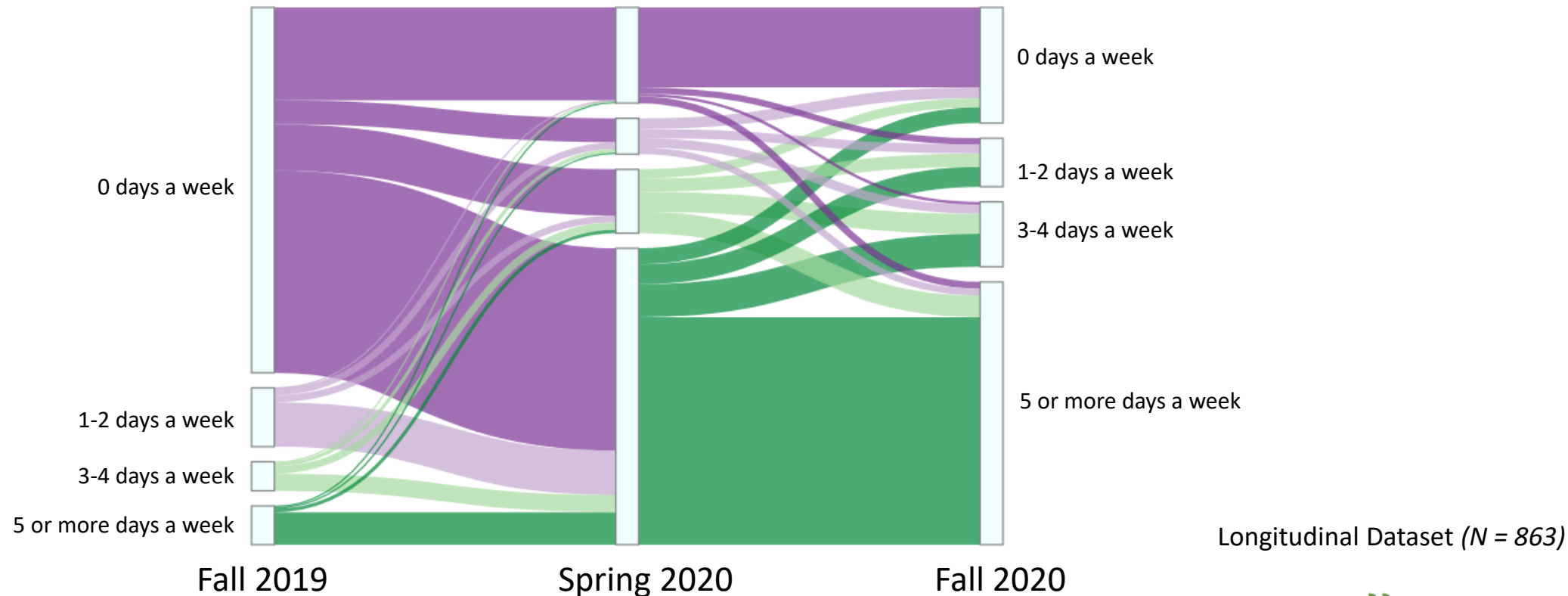
Commuting and Telecommuting (2)

- Lower-income workers are more likely to be essential workers and to have continued to physically commute during COVID-19.

- Higher-income, higher-educated and white-collar office workers are more likely to work remotely.
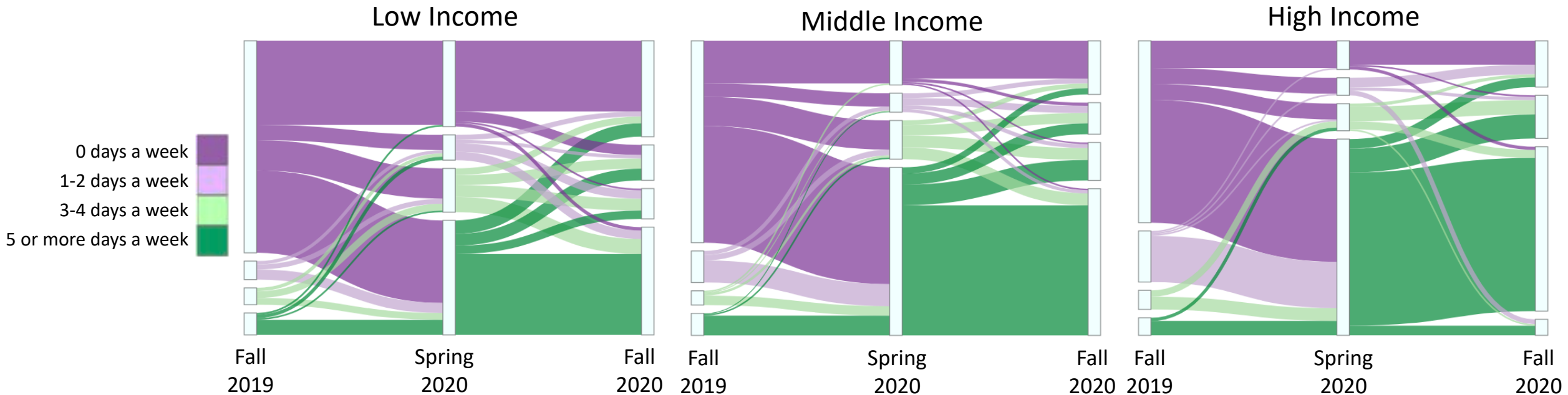
- No sizable differences in the increase in telecommuting frequency were observed by age and gender.

- A sizable portion (~25%) of Fall 2020 respondents reports an expectation to continue to work remotely more often than they used to do before the pandemic.

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Research Purpose and Method

- Goal: to identify distinctive groups in the sample based on their change in **commuting/non-commuting status** and mode use patterns between **two timepoints** (and understand their characteristics)
  - before the pandemic (**Fall 2019**)
  - during the second phase of the pandemic (**Fall 2020**)

- A nested framework:
  - Top nest: deterministic segmentation based on **commuting/non-commuting status** (6 groups)
  - Bottom nest: probabilistic segmentation with latent-class cluster analysis based on **perceived mode availability** and **change in trip frequency**
  - Investigate unique profiles of each group
    - Socioeconomics and demographics
    - Mobility constraints
    - Attitudes and lifestyles
    - Status of COVID vaccination

Data

- Dataset: Fall 2020 dataset
- Sample: 3,717 residents from Southern California Association of Governments (SCAG) (greater Los Angeles) region

County	Imperial	Los Angeles	Orange	Riverside	San Bernardino	Ventura	Total
Sample size	34	1,786	794	503	399	201	**3717**
% of total	0.9%	48.0%	21.4%	13.5%	10.7%	5.4%	**100.0%**

Self-reported monthly trip frequency (fall 2019 and fall 2020)

Commuting trips

Considering only your **commute trips to work/school during these past months (Fall 2020)**, please indicate how often you have been using each of the following means of transportation for such trips. *If you have been traveling to both work and school, please report the total trips to **both** destinations.*

		This Fall, I have used it…					
		Not available	*Available but I did*	*Less than once a*	*1-3 times a*	*1-2 times a*	*3-4 times a*	*5 or more times a*
a.	Private vehicle, alone							
b.	Private vehicle, with others							
c.	Work-/school-provided bus or shuttle							
d.	Public bus							
e.	Light rail/tram/subway/commuter train							
f.	Ridehailing (*e.g.* UberX, Lyft)							
g.	Personal bike, e-bike or e-scooter							
h.	Shared bike, e-bike (*e.g.* JUMP) or e-scooter (*e.g.* Bird, Lime)							
i.	Walk							
j.	Other (please specify): _____							

Non-commuting trips

Considering only your **leisure/social/shopping trips** (*e.g.* grocery shopping, visiting a family member, other errands or social activities) **during these past months (Fall 2020),** please indicate how often you have been using each of the following means of transportation for such trips.

		This Fall, I have used it…						
		Not available	*Available but I did not use it*	*Less than once a month*	*1-3 times a month*	*1-2 times a week*	*3-4 times a week*	*5 or more times a week*
a.	Private vehicle, alone	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$
b.	Private vehicle, with others	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$
c.	Carsharing (*e.g.* Zipcar, GIG Car Share)	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$
d.	Public bus	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$
e.	Light rail/tram/subway/commuter rail	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$
f.	Ridehailing (*e.g.* UberX, Lyft)	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$
g.	Personal bike, e-bike or e-scooter	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$
h.	Shared bike, e-bike (*e.g.* JUMP) or e-scooter (*e.g.* Bird, Lime)	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$
i.	Walk	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$
j.	Other (please specify): _____	$\square_0$	$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$	$\square_6$

Six deterministic groups based on commuting status

Fall 2019   Fall 2020

Commuter
2552 | 69%

Commuter
1385 | 37%

Noncommuter
2332 | 63%

Noncommuter
1165 | 31%

(N=3,717)

1. Commuted for school/work in both timepoints (1348|36%)

2. Started remote study/work entirely during the pandemic (1026|28%)

3. Stopped schooling /lost job /were furloughed during the pandemic (178|5%)

4. Started schooling /work during the pandemic (37|1%)

5. Remotely studied/worked in both timepoints (71|2%)

6. Neither student nor employees in both timepoints (1057|28%)

Distinctive characteristics by groups

Commuted for school/work in both timepoints (1348 | 36%)	Started remote study/work entirely during the pandemic (1026 | 28%)	Stopped schooling /lost job /were furloughed during the pandemic (178|5%)	Started schooling /work during the pandemic (37 | 1%)	Remotely studied/worked in both timepoints (71 | 2%)	Neither student nor employees in both timepoints (1057|28%)
• Working age (35-54) • Highest % of possessing a driver's license, highest % of household vehicle ownership • 11% reduced work hours • Largest household size, highest % who has kids who study remote • Pro-driving • Tech-savvy • Car-dependent • Pro in-person interaction	• Well-educated • 40%: all of job tasks can be performed at home • Highest household income • High % who has kids who study remotely • Pro-environment • Pro-active • Pro-urban • Pro-telecommute	• Female • Most pro-driving • Highest number of vehicles per driver • Highest constraints on taking transit • Lowest household income • Most concerned about the impacts of COVID • Least pro-environment	• Younger age group (18-34) • Non-female • Less-educated • 8% increased work hours • Less pro-telecommute • Least concerned about the impacts of COVID	• Full-time workers • Lowest % of possessing a driver's license • Highest constraints on driving • 45%: all of job tasks can be performed at home, the highest among all classes • Suburban/Rural residents • Pro-telecommute • Least pro in-person • Least car-dependent • Least pro-active • Least pro-driving	• Older age group (55+) • Non-Hispanic, Latino or Spanish origin whites • Highest constraints on biking and walking • Lowest % of household vehicle ownership • Least pro-urban • Least tech-savvy

Note: Exact distributions please refer to the complementary excel table.

Household education level by groups

Individuals with lower education level were more likely to start schooling /work during the pandemic (Group 4);
Individuals with higher education level were more likely to shift to telework (Group 2).
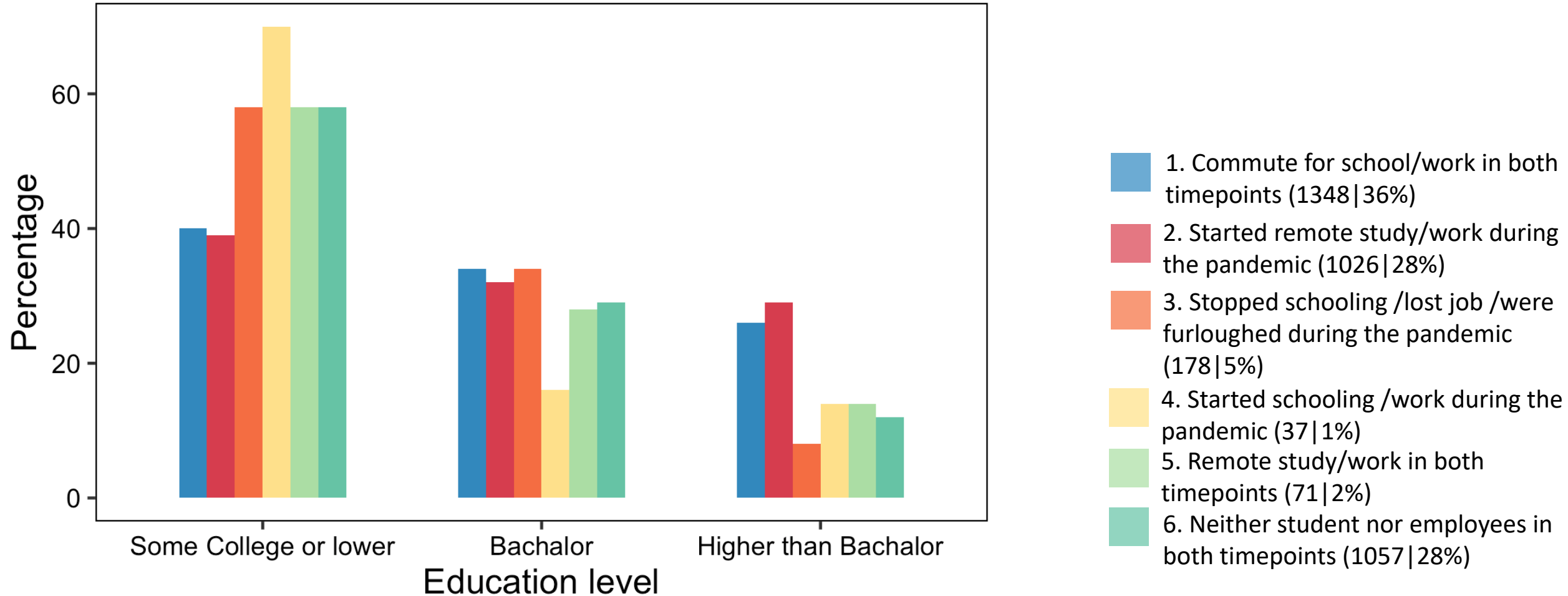
Household income level by groups

Individuals from low-income households were more likely to stop schooling /lose job /be furloughed (Group 3);
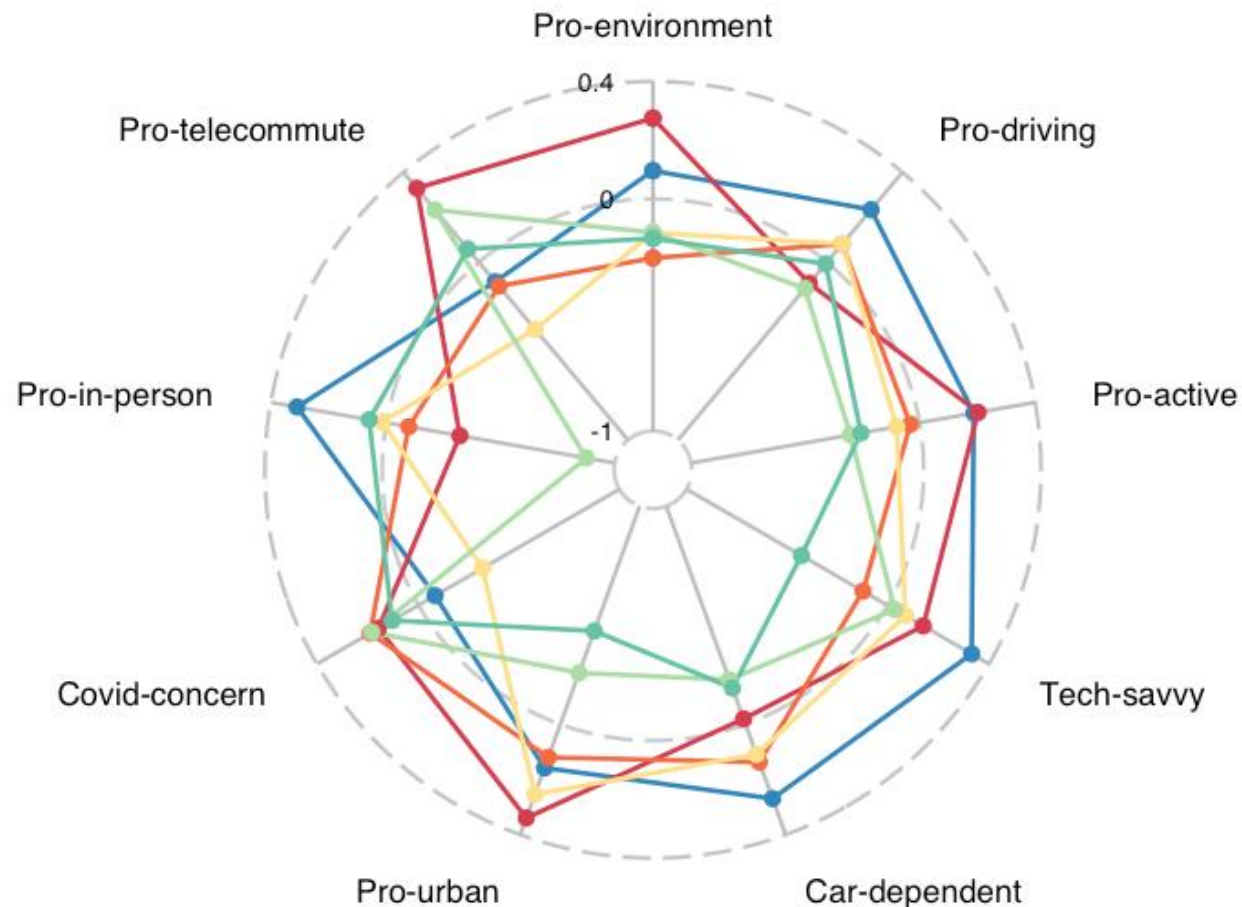Individuals from high-income households were more likely to keep commuting or switch to remote study/work (Groups 1 & 2).
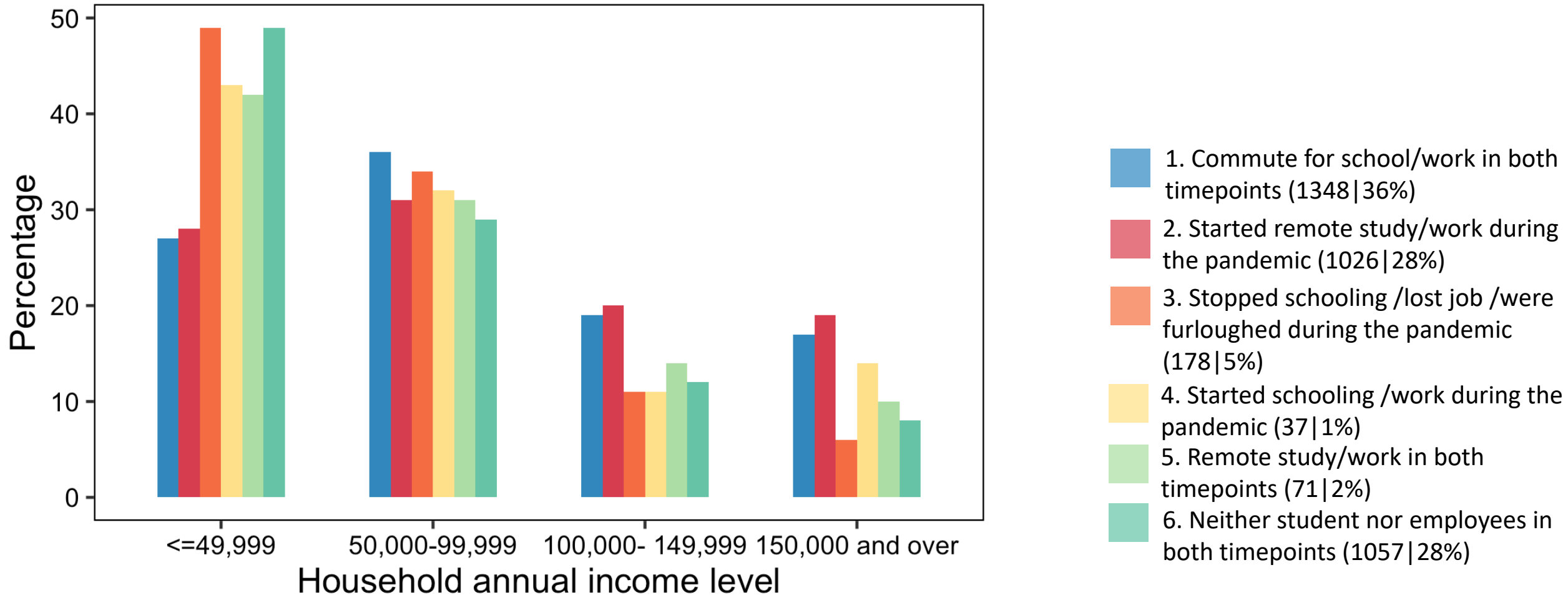
Attitudes by groups (factor analysis)

General attitudes:

Different groups show distinctive attitudes toward environmentalism, mobility, technology, residential location and lifestyle. For instance, those who continued commuting during the pandemic (Group 1) tend to be more pro-driving, pro-active, tech-savvy and car-dependent.
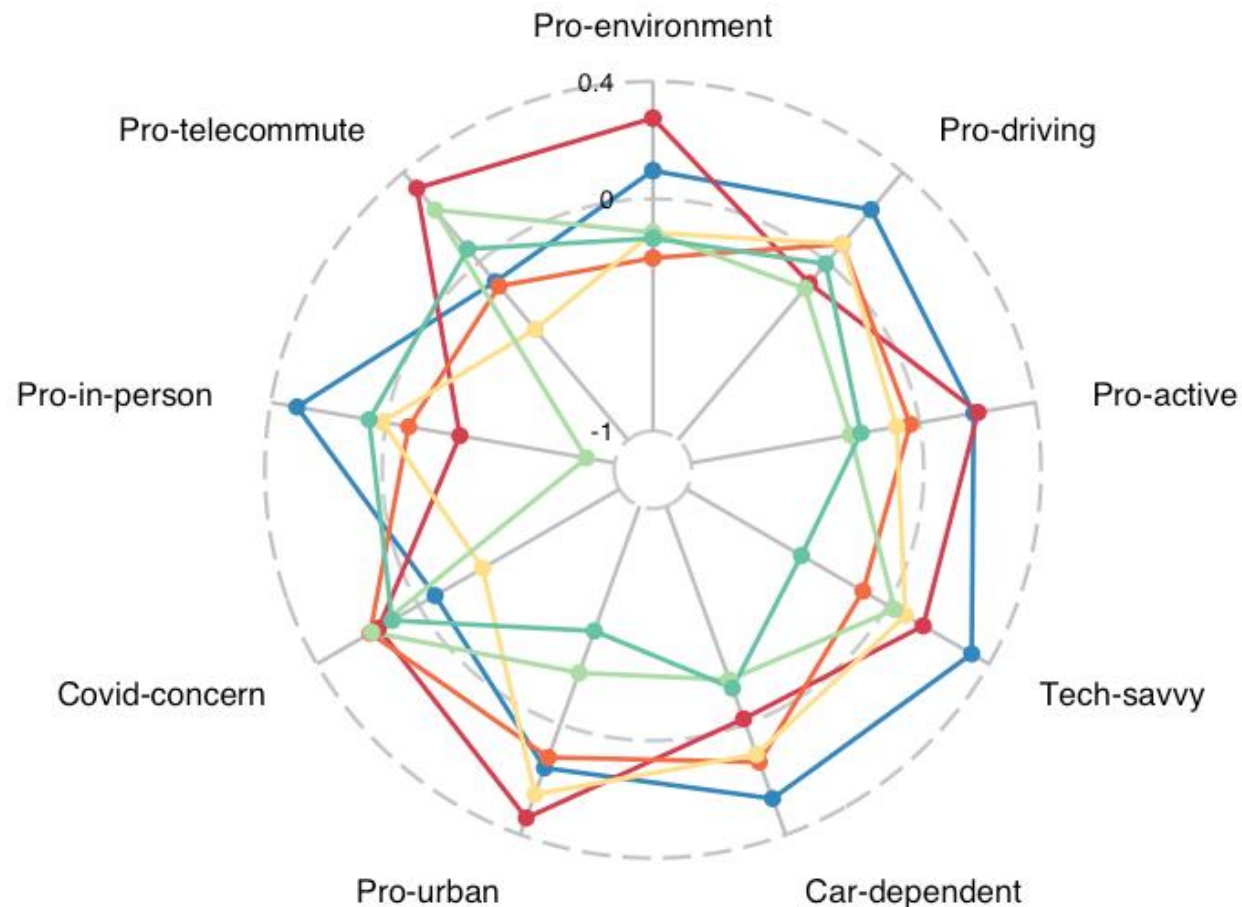

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Note: Values in the plot are factor scores from factor analysis.

Attitudes by groups (factor analysis)

Working condition:

Individuals who commuted in both timepoints (Group 1) value more the in-person interactions than those who always telecommuted or shifted to telecommute (Group 5 & Group 2);

At the same times, Group 5 and Group 2 show quite positive attitudes regarding their teleworking experience.

Legend:
- 1. Commute for school/work in both timepoints (1348|36%)
- 2. Started remote study/work during the pandemic (1026|28%)
- 3. Stopped schooling /lost job /were furloughed during the pandemic (178|5%)
- 4. Started schooling /work during the pandemic (37|1%)
- 5. Remote study/work in both timepoints (71|2%)
- 6. Neither student nor employees in both timepoints (1057|28%)

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Note: Values in the plot are factor scores from factor analysis.

Attitudes by groups (factor analysis)

COVID concerns:

Individuals who stopped schooling /lost job /were furloughed (Group 3) have the highest concerns about COVID, both in terms of health and financial impacts. This is the opposite of those who started to study/work during the pandemic (Group 4).
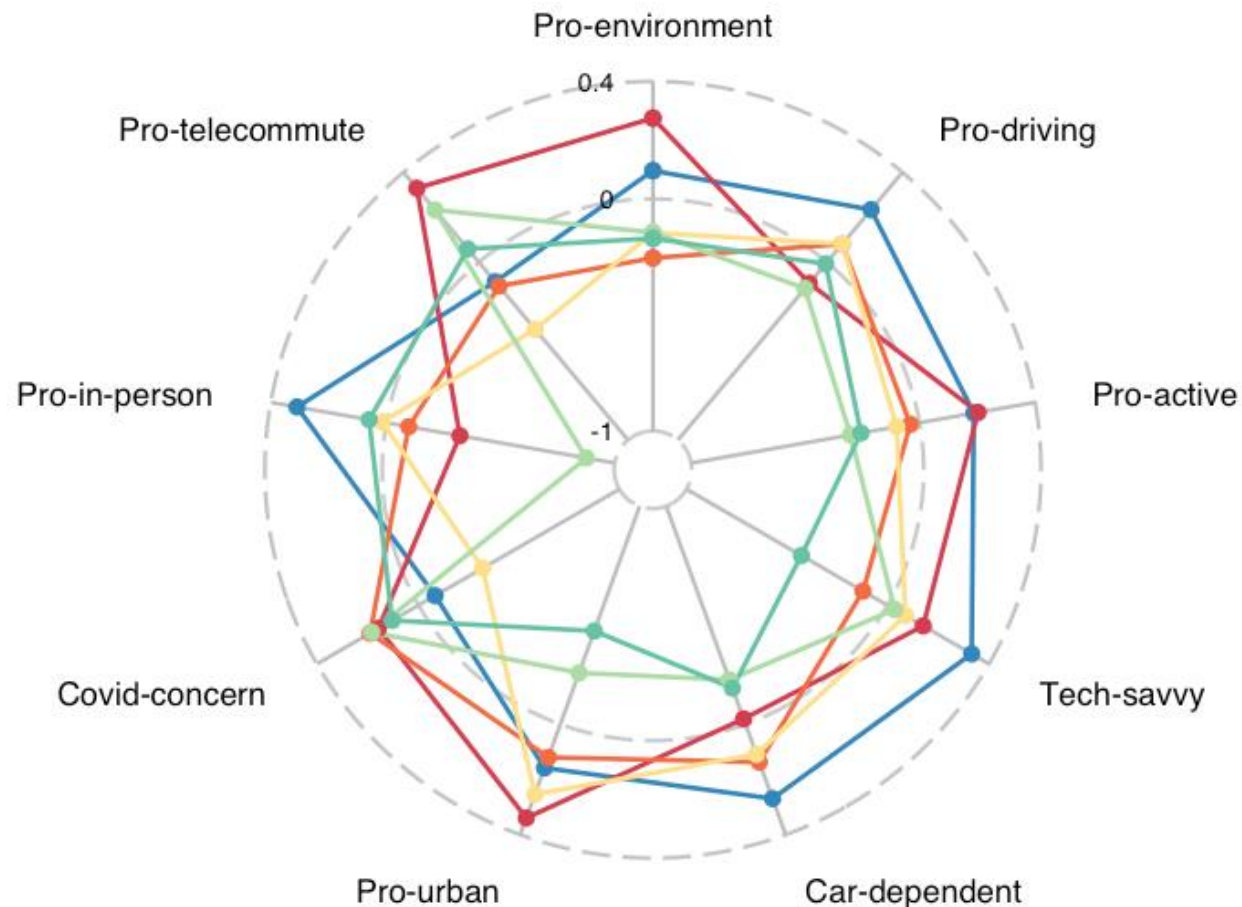
1. Commute for school/work in both timepoints (1348|36%)

2. Started remote study/work during the pandemic (1026|28%)

3. Stopped schooling /lost job /were furloughed during the pandemic (178|5%)

4. Started schooling /work during the pandemic (37|1%)

5. Remote study/work in both timepoints (71|2%)

6. Neither student nor employees in both timepoints (1057|28%)

Note: Values in the plot are factor scores from factor analysis.

# Reclassify travel modes and recode trip frequency

Modes in the survey (in the order in the survey)	Classified modes	
	Commuting	**Non-commuting**
Private vehicle, alone	Drive alone	Drive alone
Private vehicle, with others	Carpool	Carpool
Work-/school-provided bus or shuttle	Public transit	(Not asked)
Carsharing (e.g. Zipcar, GIG Car Share)	(Not asked)	Emerging modes
Public bus	Public transit	Public transit
Light rail/tram/subway/commuter rail	Public transit	Public transit
Ridehailing (e.g. UberX, Lyft)	Emerging modes	Emerging modes
Personal bike, e-bike or e-scooter	Active modes	Active modes
Shared bike, e-bike (e.g. JUMP) or e-scooter (e.g. Bird, Lime)	Emerging modes	Emerging modes
Walking/Jogging	Active modes	Active modes

Trip frequency in the survey	Proxy for the monthly frequency
Not available	0 (if only unavailable in one timepoint) Null (if unavailable in both timepoints)
Available but I never use it	0
Less than once a month	0.5
1–3 times a month	2
1–2 times a week	6
3–4 times a week	14
5 or more times a week	20

Transition of **perceived** mode availability

For commuting trips, **driving alone** was the most available mode among commuters before the pandemic, and it became even more so during the pandemic, while the availability of all other modes had declined.

For non-commuting trips, **driving alone** and **active modes** became more available for most groups, while **carpooling, transit** and **emerging modes** became less available for most groups.
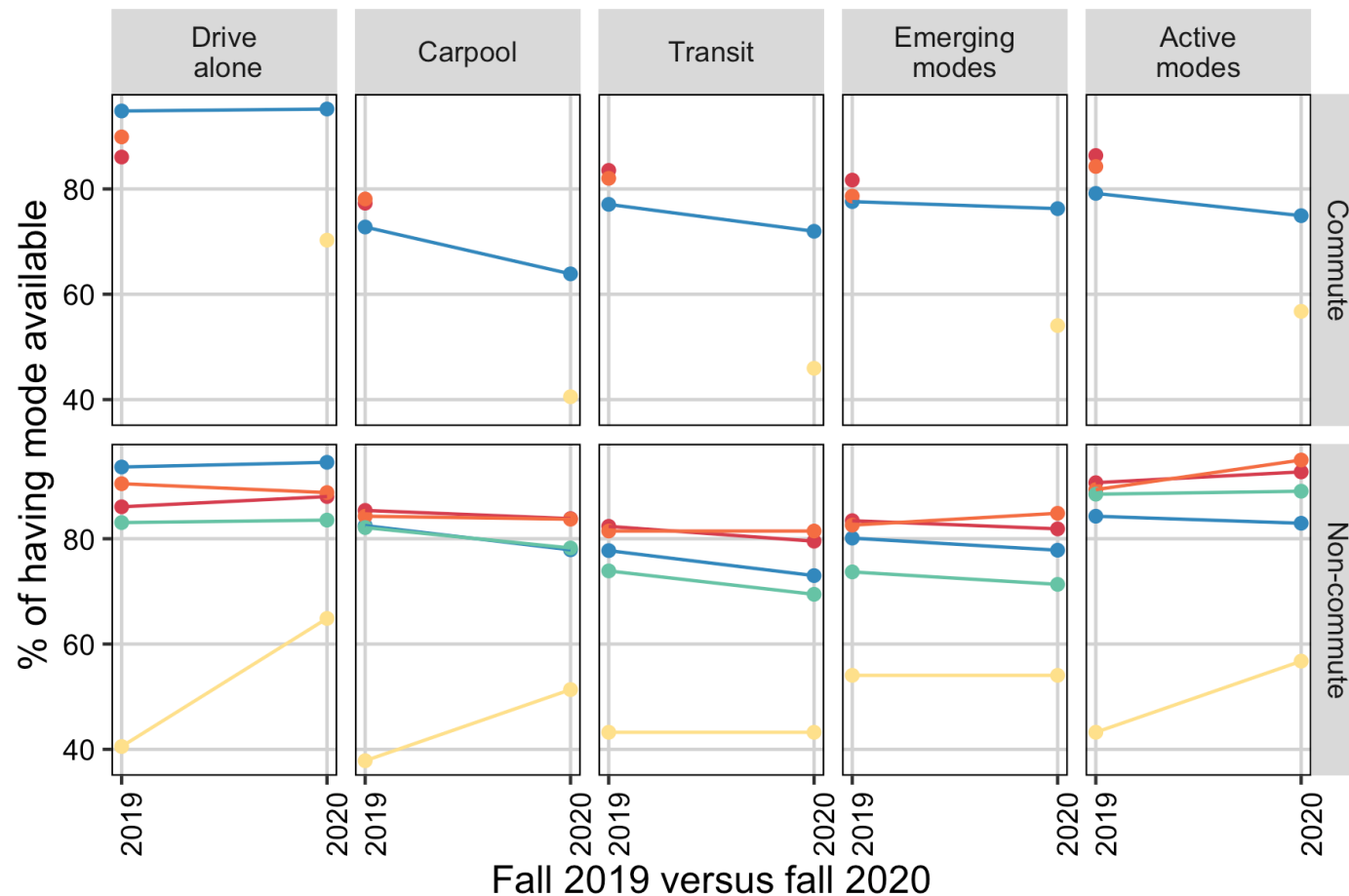

Note: The availability of commuting modes has been omitted in the figure for non-commuters.

Change of trip frequency by modes, purposes and groups

Commuters in both timepoints (Group 1) had the least changes in travel demand;
Those who started commuting during the pandemic (Group 4) increased both commuting and non-commuting trips significantly;
Group 2,3,4 and 5 all increased the use of active modes for non-commuting trips.
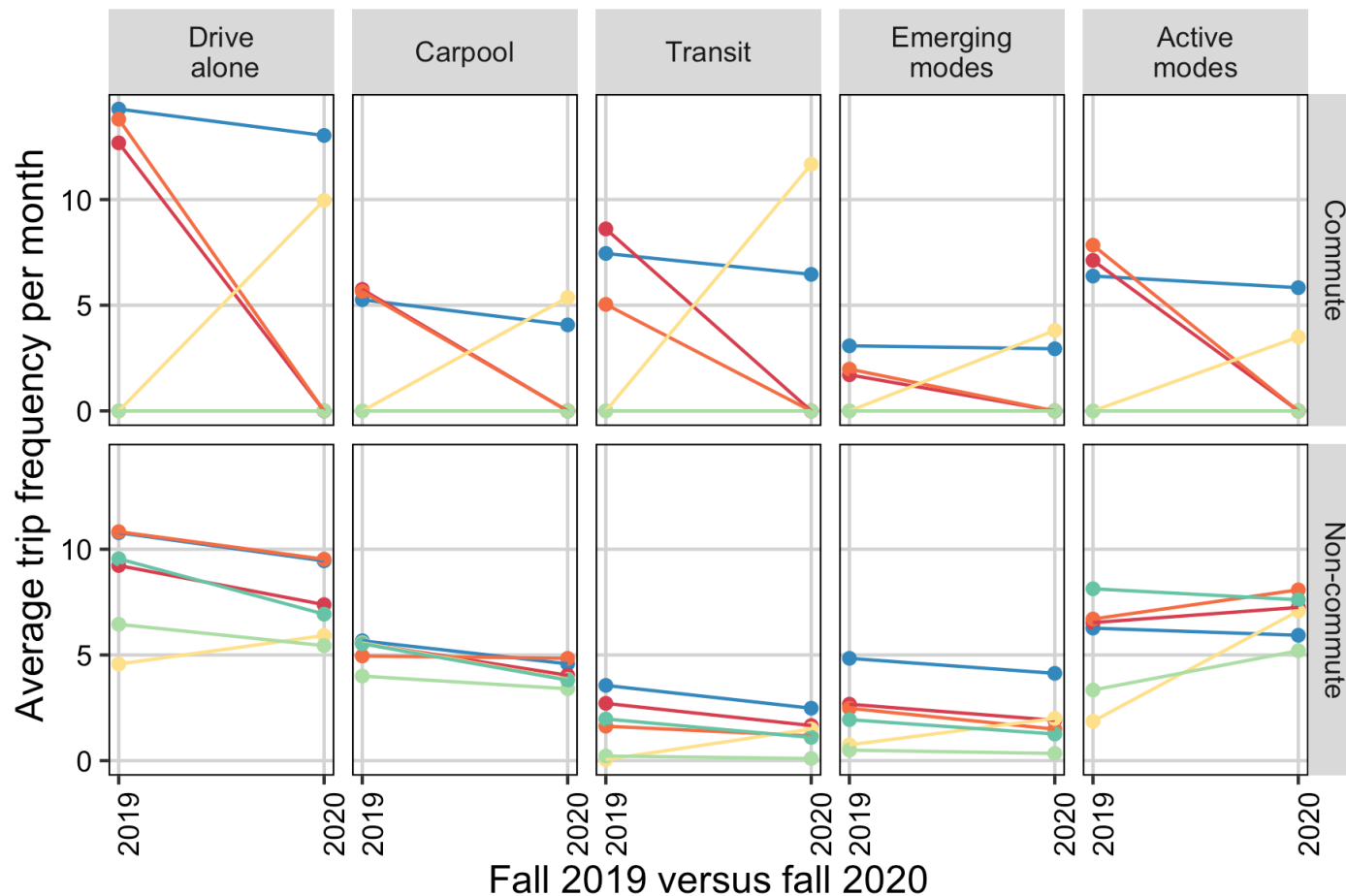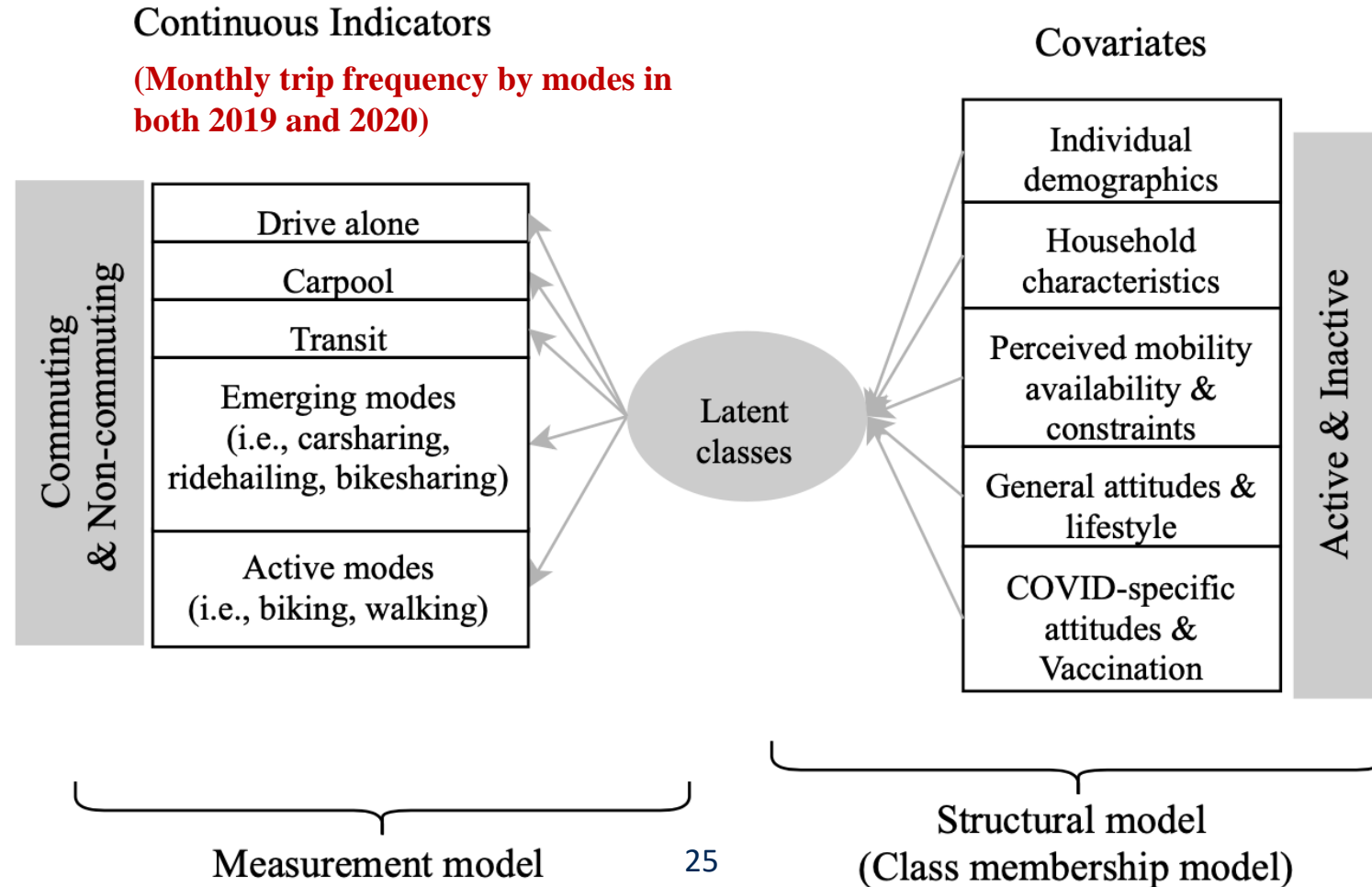

Note: Only those with certain mode available at least one timepoint have been included into the calculation above.
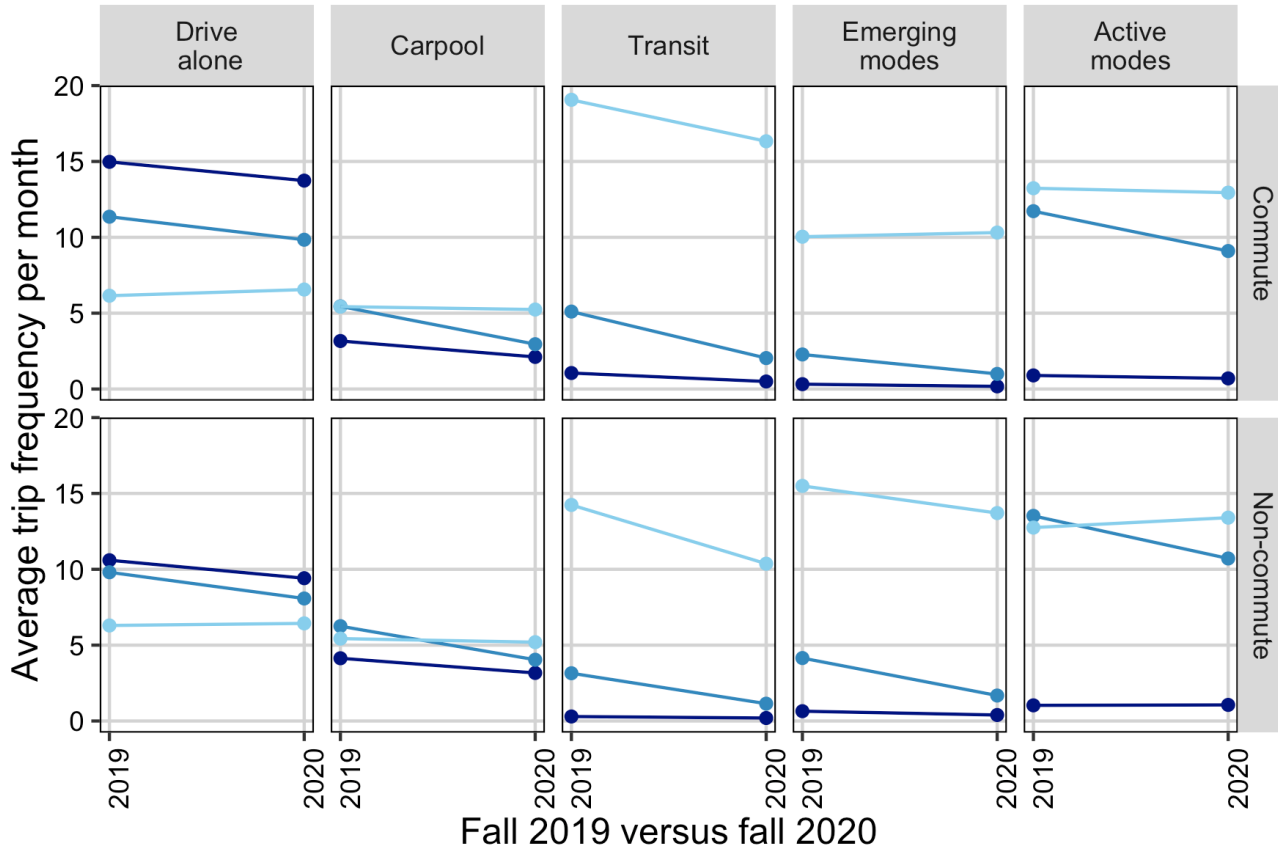
Latent-class cluster analysis (LCCA)

LCCA focuses on two groups:
1. Those who commuted for school/work in both timepoints (1348|36%),
2. Those who started remote study/work entirely during the pandemic (1026|28%).

LCCA results (Group 1: commuters in both timepoints)

Average trip frequency per month — Drive alone, Carpool, Transit, Emerging modes, Active modes (Commute and Non-commute rows). Fall 2019 versus fall 2020.

Trip type	Class 1			Class 2			Class 3		
	2020	2019	Change	2020	2019	Change	2020	2019	Change
Commuting	17.2	20.4	-3.2	24.9	35.9	-11.0	51.4	53.9	-2.5
Non-commuting	12.9	16.0	-3.1	25.6	36.9	-11.2	49.1	54.2	-5.1
Sum	30.1	36.4	-6.3	50.6	72.8	-22.2	100.5	108.1	-7.6

Class 1 — Heavy SOV Users (981 | 73%)

- Make the smallest reduction in the number of trips
- Older
- Female
- Highest % of possessing a driver's license, highest % of household vehicle ownership, but low availability of alternative modes
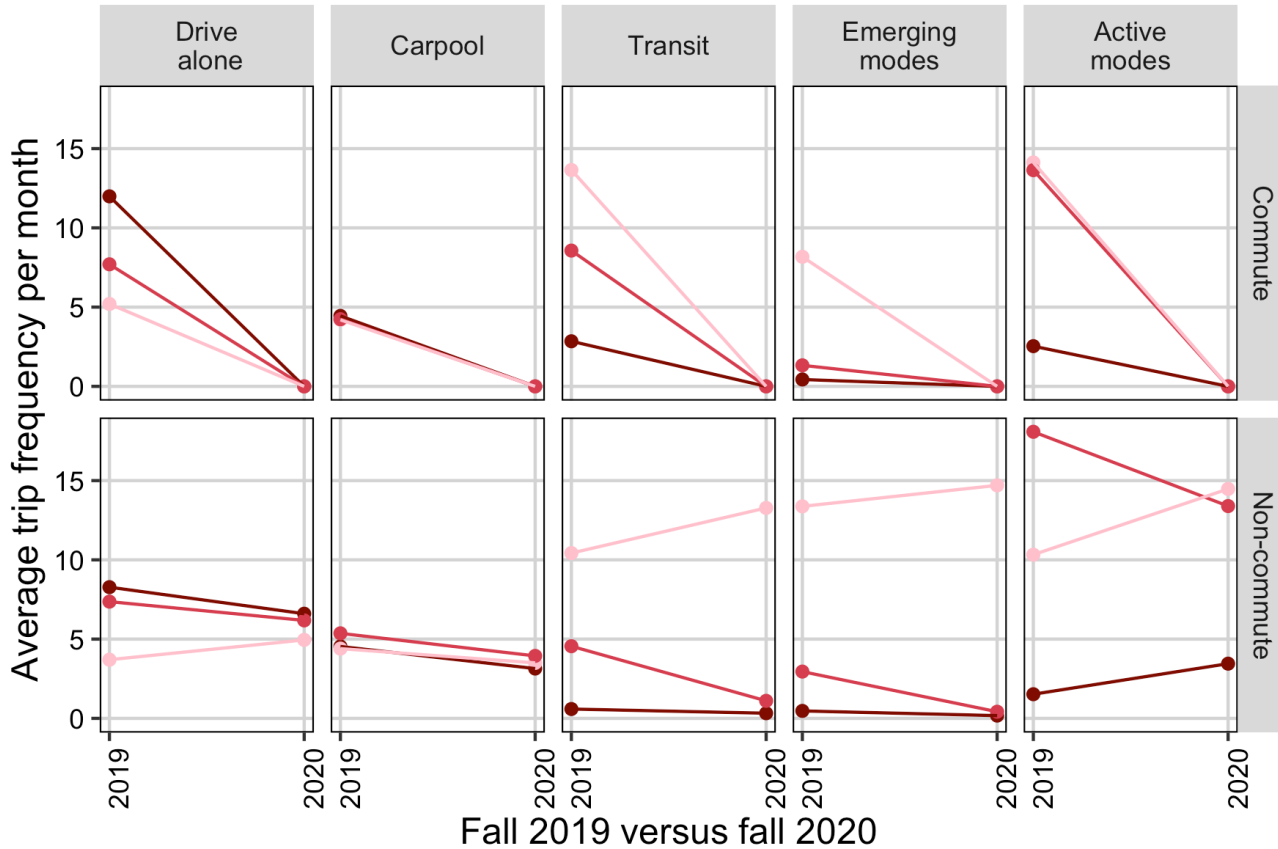- Rural/Suburban residents
- Car-dependent

Class 2 — Light SOV Users (245 | 18%)

- Reduce commuting, non-commuting and total trips the most
- Younger
- Non-Hispanic Whites
- Part-time employees
- Low constraint on active travel
- Pro-active

Class 3 — Multimodal Users (122 | 9%)

- Have the most diverse commuting and non-commuting patterns before and during the pandemic
- Some have increased SOV use
- Younger
- Non-Hispanic Whites
- Well-educated
- Full-time employees
- Median/High-income
- Urban residents
- Low availability of SOV, but high availability of alternative modes

LCCA results (Group 2: commuters➔teleworkers)

		Drive alone	Carpool	Transit	Emerging modes	Active modes

Average trip frequency per month

Fall 2019 versus fall 2020

Trip type	**Class 1**			**Class 2**			**Class 3**		
	2020	**2019**	**Change**	**2020**	**2019**	**Change**	**2020**	**2019**	**Change**
Commuting	0.0	22.3	-22.3	0.0	35.5	-35.5	0.0	45.4	-45.4
Non-commuting	13.7	15.4	-1.7	25.0	38.3	-13.3	50.9	42.2	8.7
Sum	13.7	37.6	-24.0	25.0	73.8	-48.8	50.9	87.6	-36.7

Class 1
Heavy SOV Users
(785 |76%)

- Mainly reduce commuting trips by car, and slightly reduce non-commuting trips

- Older
- Female
- Highest % of possessing a driver's license, highest % of household vehicle ownership, but low availability of alternative modes
- Rural/Suburban residents
- Pro-driving
- Car-dependent

Class 2
Light SOV Users
(201 | 20%)

- Reduce the total number of trips the most

- Non-Hispanic whites
- Well-educated
- Full-time employees
- 41%: all of job tasks can be performed at home (the highest among all classes)
- Highest household income

Class 3
Multimodal Users
(40 | 4%)

- Reduce commuting trips the most, but increase non-commuting trips by all modes except carpooling

- Younger
- Students
- Low-income
- Low-education
- Urban residents
- Low availability of SOV, but high availability of alternative modes
- Pro-environment
- Tech-savvy

Future travel expectation (factor analysis)

1. Those who started to work/study remotely (Group 2) during the pandemic reporting feeling the most **uncomfortable** using shared modes (including public transit, ridehailing, bikesharing) due to the concerns about pathogen, while those who started to work/study feel the least concerned.

2. Commuters in both timepoints think that social-distancing measures in public transit and other shared modes make them feel more **comfortable** using those modes of travel.
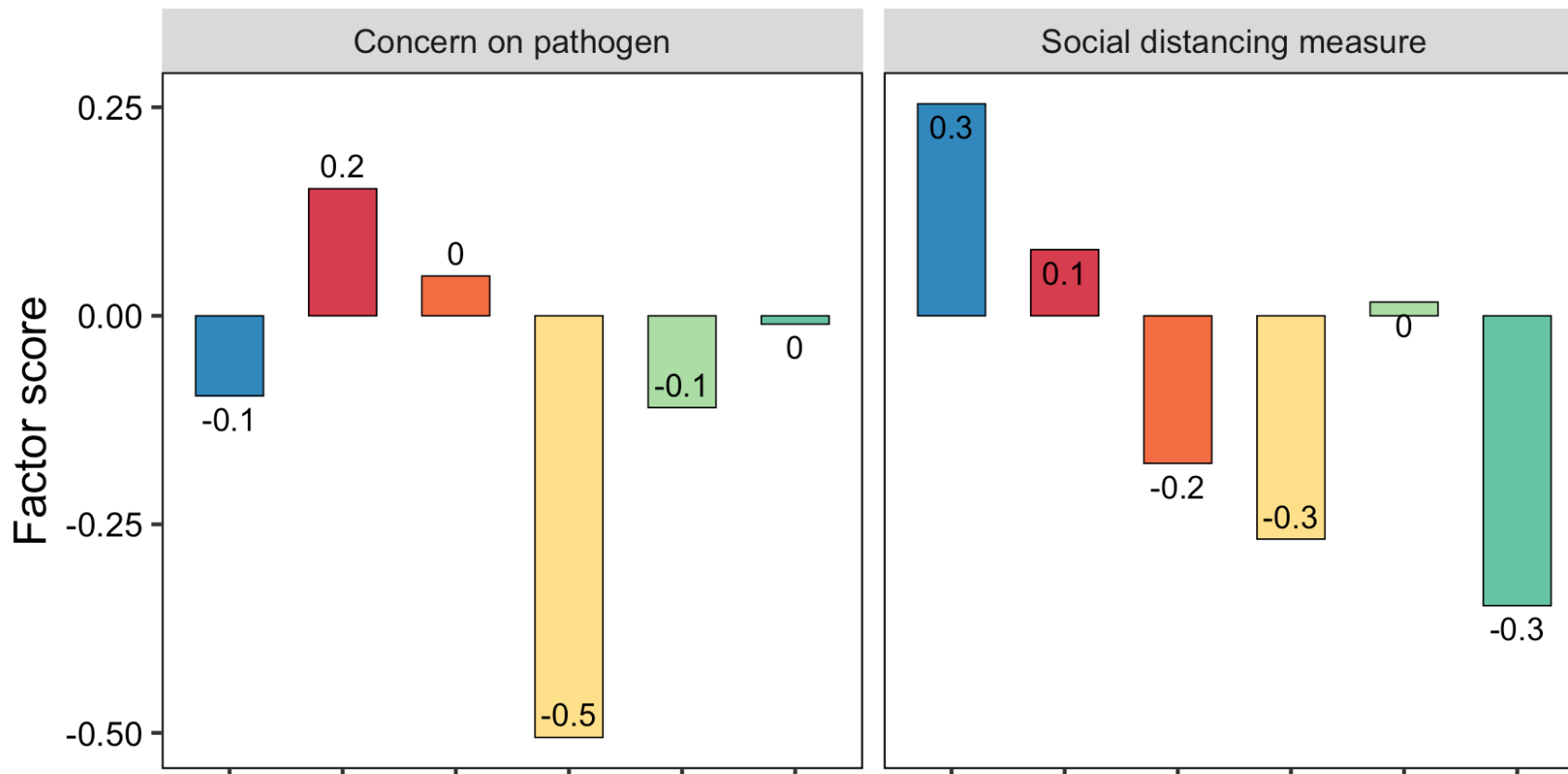
Legend:
1. Commuted for school/work in both timepoints (1348|36%)
2. Started remote study/work entirely during the pandemic (1026|28%)
3. Stopped schooling /lost job /were furloughed during the pandemic (178|5%)
4. Started schooling /work during the pandemic (37|1%)
5. Remotely studied/worked in both timepoints (71|2%)
6. Neither student nor employees in both timepoints (1057|28%)

Conclusions

- This study investigates how travel demand transitioned from the pre-pandemic conditions to the second phase of the pandemic among a sample of 3,717 individuals in California.
  - We identify six groups in the sample based on individuals' commuting status in both timepoints.
  - With LCCA, we further reveal unobserved groups among students/employees who commuted in both timepoints or shifted to study/work remotely.
- Our findings suggest that
  - The characteristics and behavioral changes are different among those subgroups and warrant tailored policy approaches;
  - There are uneven effects of the pandemic (with more severe impacts on female and low-income individuals);
  - Many workers who shifted to telecommute have undergone loss in productivity or performance during the pandemic;
  - Some multimodal users have increased their SOV use with the significant reduction of transit use.

Data limitation

- In the fall 2020 survey, the questions related to commuting trips were only asked among those that had traveled during their most recent school/work week:
  - Those who commuted only occasionally (e.g., less than once a week), but happened not to commute in the most recent school/work might have been classified as non-commuters.
  - As a result, **we may have undercounted typical frequencies of commute trips for fall 2020 and overestimated the impact of the pandemic** in terms of switching student/employees to study/work remotely. However, we believe this bias should not be very large.

- The conversion of self-reported travel frequency by travel mode might lead to double-counting of trips for multimodal travelers. This might lead to an overestimation of the reduction in travel for these users.

- The online survey tool and recruitment method have led to an overrepresentation of individuals that are able to telework. While this issue is biasing the descriptive statistics on the adoption of teleworking, the comparison across groups should remain valid.

Next Steps in the Project

- New on-going round of data collection in Spring/Summer 2021
  - Resampling of previous survey respondents, plus recruitment of new respondents with **stratified random sampling of California households** also with paper questionnaires, to reduce sampling biases towards tech-savvy and higher-education respondents
  - *Priority areas* with high proportion of Hispanics and lower-income communities are sampled with higher sampling rate
  - Survey available in two languages: English and Spanish

- Weighting to correct for non-representativeness of the population in the various regions, including adjustments to correct for over-sampling of those who can work remotely.

- Priority themes for next data analyses:
  - **Travel behavior choices**
  - **Sustainability**
  - **Equity issues**
  - **Telecommuting and impacts on travel patterns**
  - **E-shopping and app-based services**
  - **Adoption of new mobility and EVs**
  - **Residential location and household changes**

When you're still wearing your Zoom meeting outfit after then quarantine is lifted.

Will we go back to our previous life...?

- After a large disruption, individuals usually tend, to a certain extent, to go back to their behaviors and habits from before the disruption.

- But the longer the disruption, the more likely longer-term impacts might derive, and modifications in lifestyles might persist.

- Among other effects...
  - Increase in e-shopping will likely persist
  - Retail space will likely be modified forever (some stores are shutting down and will not reopen)
  - Economic activities will need time to recover
  - Travelers still seems hesitant to use shared travel modes
  - Even a *limited* persistence of *part-time* work from home could have sizable impacts on peak travel volumes (and traffic congestion)
  - A big role will be associated with policy making, in particular efforts to promote active modes of travel and avoid resurgence of car travel
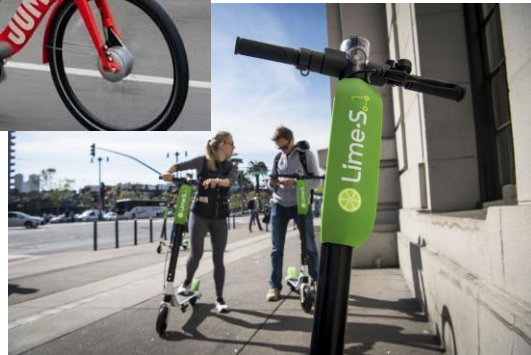
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Need to Consider Changes in Transportation Supply

Changes in transportation supply and business models

- Changes in supply side (e.g., JUMP-Lime merger) will affect demand.

- Potentially affected sectors include shared mobility, airline sectors, etc.

Source: *Uber*

Source: *Lime*

Cities Have Reclaimed (Some) Space from Cars

- *"Small window of opportunity to transform short-term responses into long-term change—and to create livable, breathable cities for all"*

  [World Bank Blog, August 2020]

New York City (Sources: *6sqft.com*)

More Space for Bicyclists?

- City level policies have promoted walking and bicycling.

- Some temporary changes are being converted into permanent.

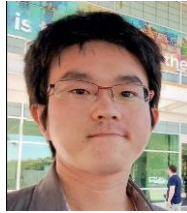
Source: *Elizabeth Conley, Houston Chronicle*

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More info on the UC Davis COVID-19 Mobility Study available at:

postcovid19mobility.ucdavis.edu

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