Evolution of remote/hybrid work adoption and travel choices: Insights from the analysis of the California Mobility Panel (CMP) data

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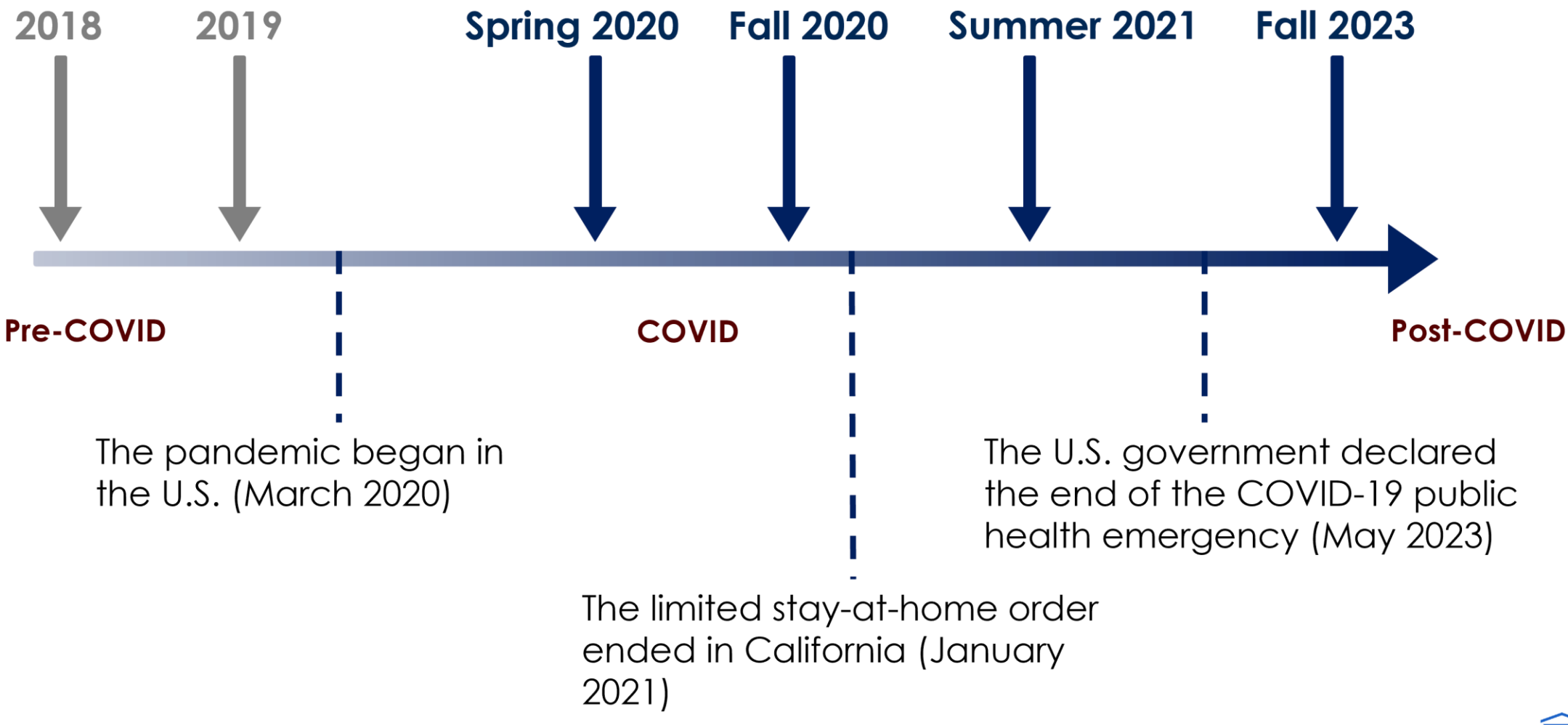
Mobility Study (2018-2023)

Longitudinal panel with six survey waves (so far)



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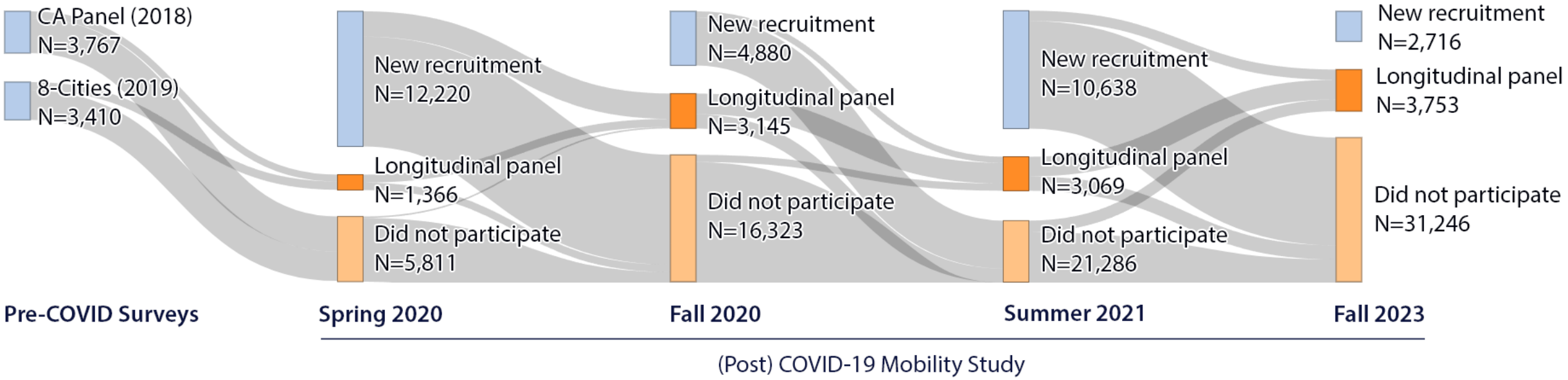


New data collection: Spring 2025

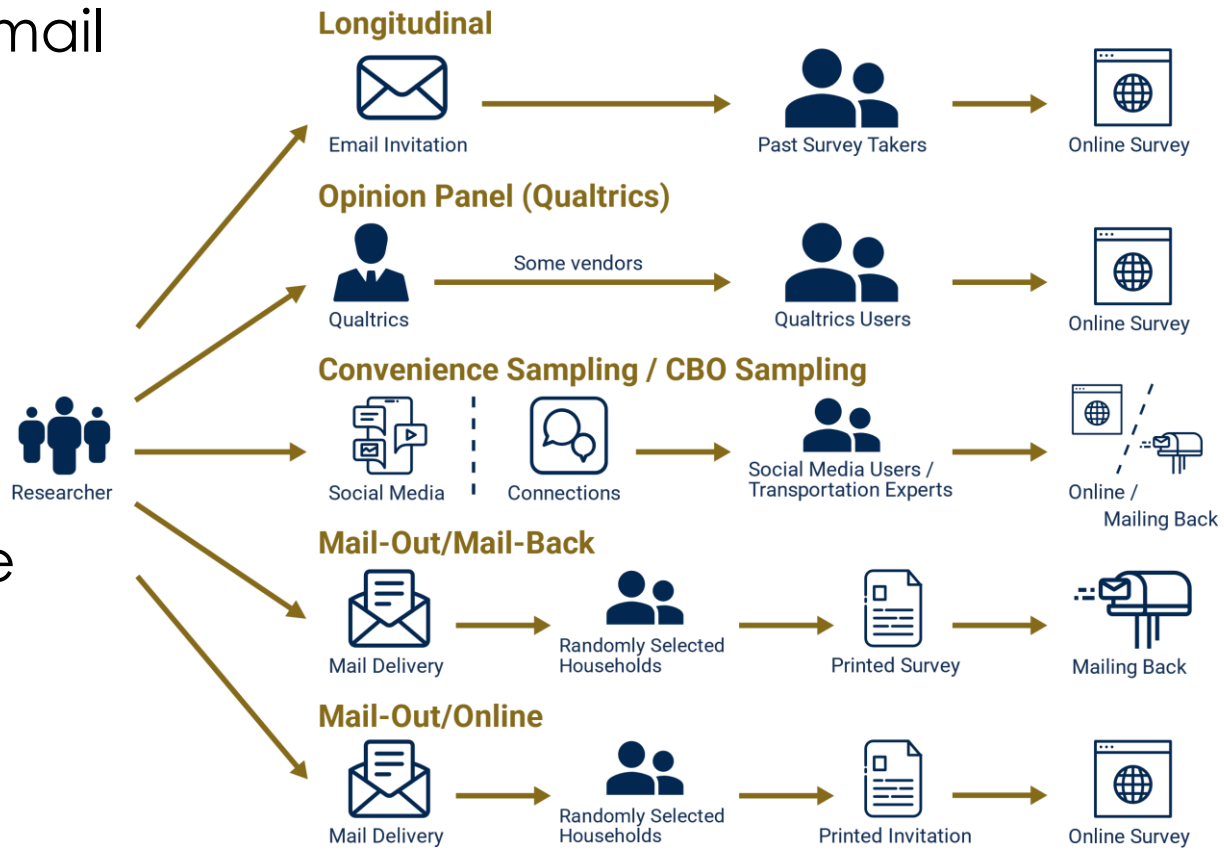
Key topics: Remote work, online shopping, emerging mobility (e.g., AVs, cargo e-bikes)

Analyses have been carried out on various topics including changes in vehicle ownership, use of travel modes, e-shopping adoption, and impacts of remote/hybrid work on travel.

Survey distribution channels

The survey waves were distributed over five different channels:

- **Longitudinal panel**
  - Recontacting prior survey takers by email
- **Opinion panel**
  - Via the Qualtrics online opinion panel
- **Convenience sampling / CBOs**
  - Social and community connections
- **Mail-out-mail-back**
  - Invitations to randomly selected CA residents with mail-back questionnaire
- **Mail-out-online**
  - Invitations to randomly selected CA residents with link to online survey



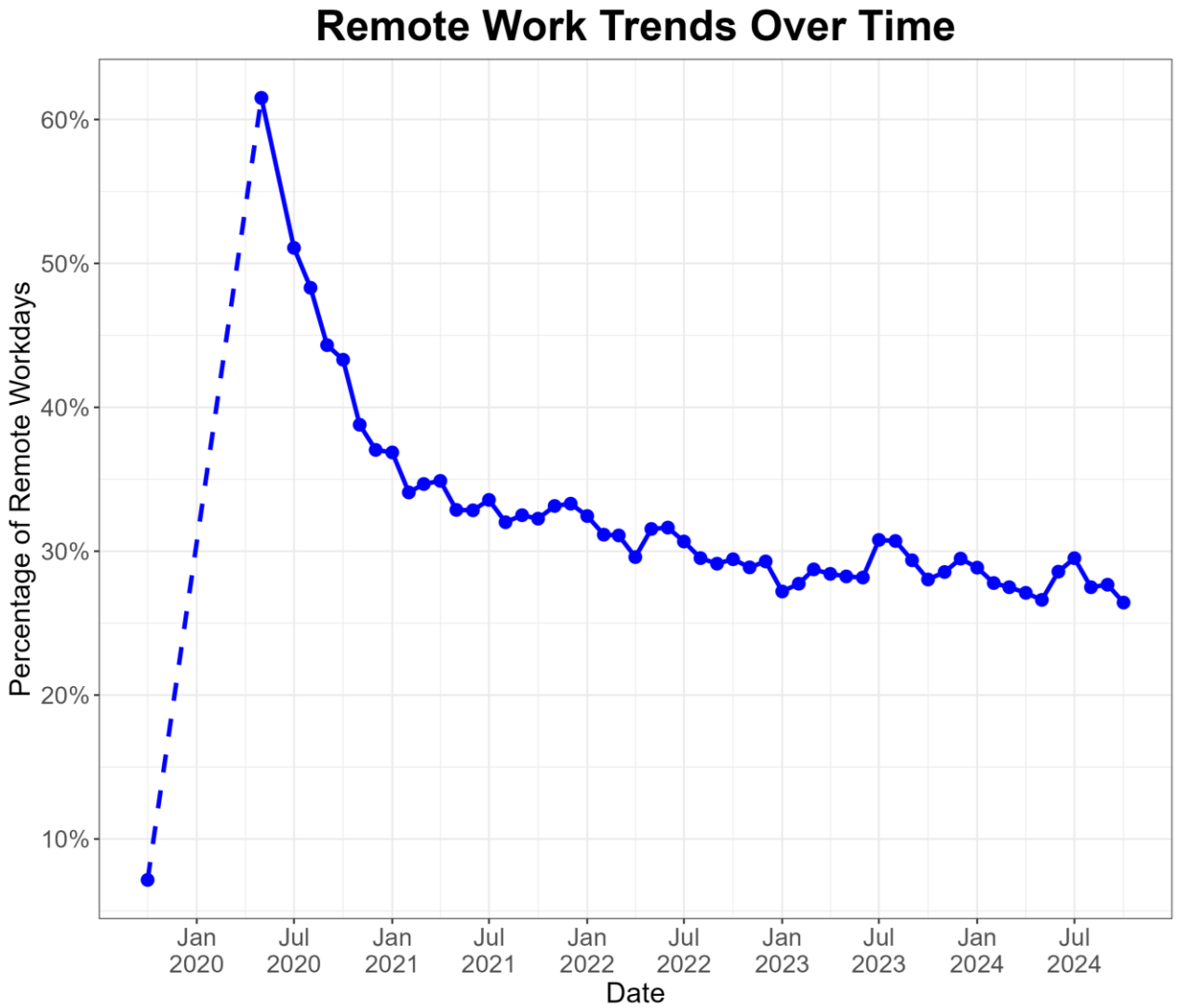
2023 sample sizes for different recruitment channels

The 2023 dataset includes 6,462 cases

Dataset	Sample size
Longitudinal panel	3,752
Opinion panel	2,074
Mail-out-online	636
Convenience/CBO sampling	117
Mail-in-mail-back	256

Adoption of Remote Work

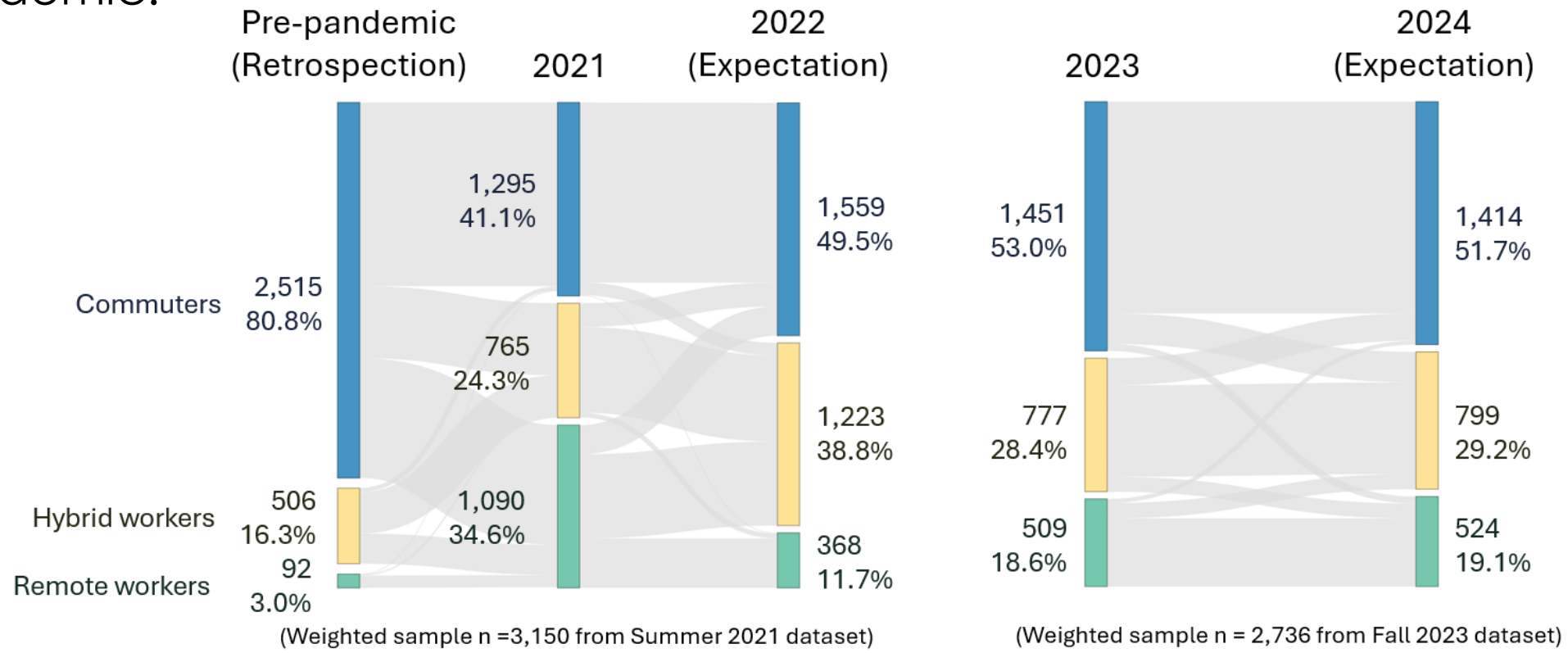
- Remote work surged in early 2020, reaching over 60% of paid workdays during the initial COVID-19 lockdowns.
- Following the peak, remote workdays steadily declined but stabilized around 30% by mid-2021.
- The trend remained relatively stable between 25% and 30% from 2022 onwards.
- A slight decrease in remote workdays is observed through 2024, potentially reflecting return-to-office policies.



Source: Barrero, Bloom, and Davis (2024)

Post-pandemic hybrid vs. remote work arrangements (1)

- Post-pandemic, hybrid work is much more common than before.
- Women, younger individuals, non-Hispanic, high-income, highly educated, and full-time workers are more likely to adopt remote/hybrid work during and after the pandemic.



Transition of commuting status in the CA (weighted repeated cross-sectional data)

Exploration of post-pandemic work arrangements

- The 2023 survey included a novel matrix question to capture spatial and temporal aspects of work arrangements for a week.
- Respondents had to select cells to indicate time and place of work.
- There were options for workplace:
  - Primary (e.g., regular/client office)
  - Temporary (e.g., cafe)
  - Home

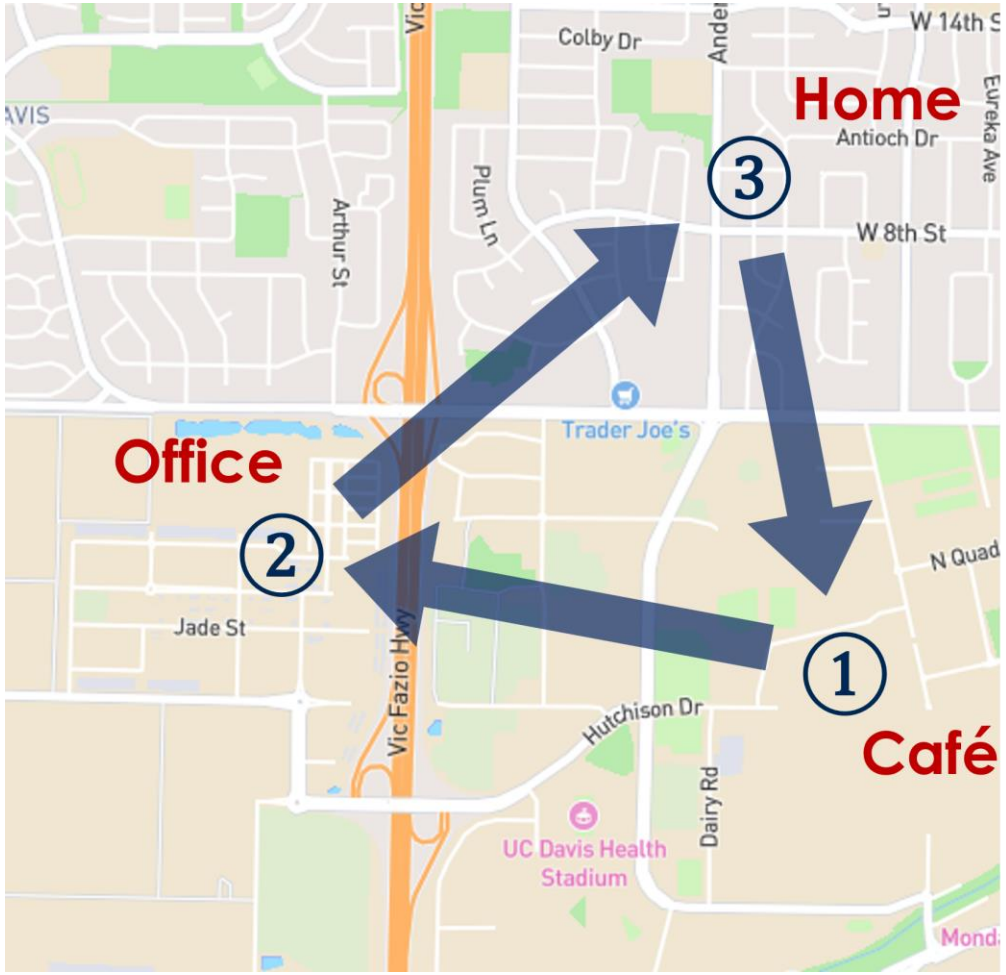
In the previous question, you indicated that you worked **8** hour(s) last **Monday**. Where did you work?

	At the primary or alternative workplace	At a temporary location	At home
12am-6am			
6am-8am			
8am-10am			
10am-12pm			
12pm-2pm			
2pm-4pm			
4pm-6pm			
6pm-8pm			
8pm-10pm			
10pm-12am			

Exploration of post-pandemic work arrangements (2)

In the previous question, you indicated that you worked **8** hour(s) last **Tuesday**. Where did you work?

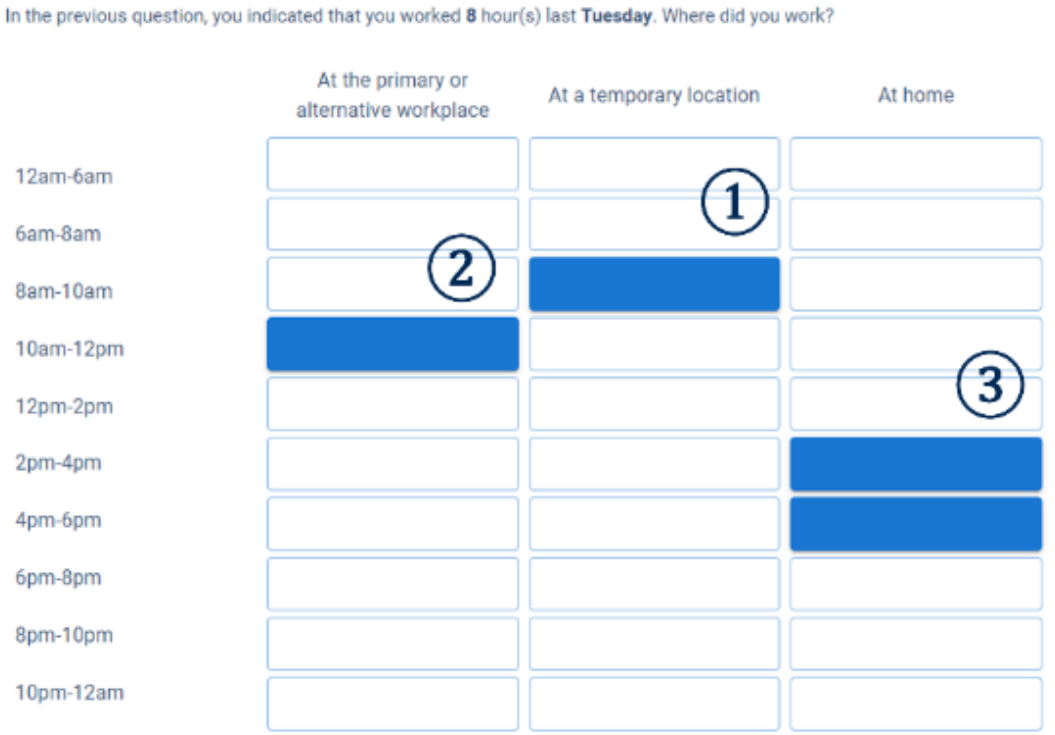
	At the primary or alternative workplace	At a temporary location	At home
12am-6am			
6am-8am		①	
8am-10am	②		
10am-12pm			
12pm-2pm			③
2pm-4pm			
4pm-6pm			
6pm-8pm			
8pm-10pm			
10pm-12am			



Post-pandemic hybrid vs. remote work arrangements (2)

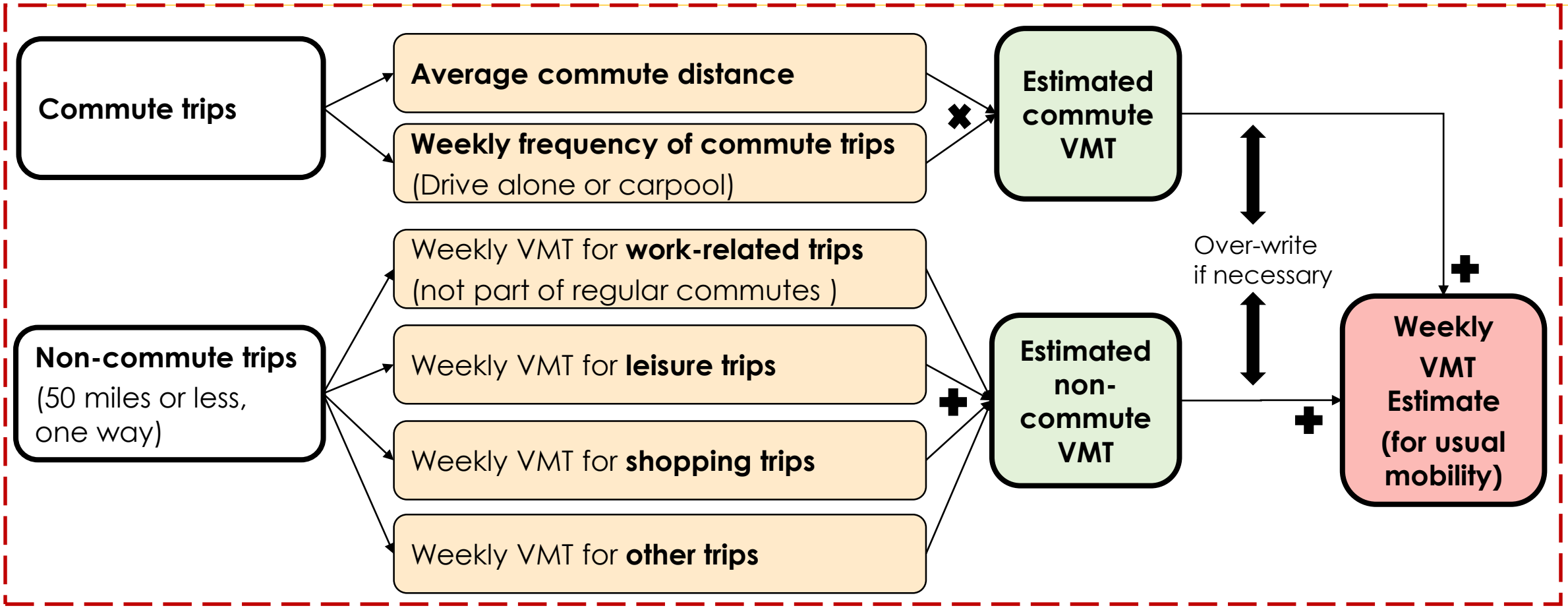
- **Multiple discrete-continuous nested extreme value (MDCNEV) Model**
  - To analyze how hybrid workers allocated their time across different workplaces each day of the week
- **Work hours distribution**
  - Primary work locations > home> temporary locations
  - Most workers work from a single location on a given day.
- **Temporal trends**
  - More work hours were spent on **mid-week days** compared to Mondays, Fridays and weekends.
  - Working at **home** or at **primary work location** associated with more **structured and fixed** schedules, whereas working at **temporary locations** often follows a more **flexible, on-demand** pattern.
- **Spatial patterns**
  - Working at **temporary locations** (e.g., café, library) is adopted by some, but not a long-term satisfying option.
  - Workers with **longer commute distance** are more likely to work at home or temporary work locations.

A paper led by Keita Makino based on these analysis will be presented at TRB 2025.



Example work arrangement on a given day

VMT-related variables



(n=903 California workers)

Treatment effects of remote/hybrid work

- A series of **ordered probit switching regression models**
  - To assess the impacts of potential changes in work status (i.e., treatments) on different types of VMT, while accounting for self-selection biases

Factual and Counterfactual Status	Current Work Arrangement		
	Commuter	**Hybrid Worker**	**Remote Worker**
If untreated (Commute)	Expected VMT of an **Onsite Worker**	Expected VMT if a **Hybrid Worker** transition to an **Onsite Worker**	Expected VMT if a **Remote Worker** transition to an **Onsite Worker**
If partially treated (Hybrid work)	Expected VMT if an **Onsite Worker** transition to a **Hybrid Worker**	Expected VMT of a **Hybrid Worker**	Expected VMT if a **Remote Worker** transition to a **Hybrid Worker**
If fully treated (Remote work)	Expected VMT if an **Onsite Worker** transition to a **Remote Worker**	Expected VMT if a **Hybrid Worker** transition to a **Remote Worker**	Expected VMT of a **Remote Worker**

Note: The highlighted cells along the diagonal represent factual VMTs, while the remaining cells indicate counterfactual VMTs.

Credit: Current paper led by Xiatian (Wu) Iogansen in cooperation with Pat Mokhtarian and Xinyi Wang

Treatment effects of remote/hybrid work

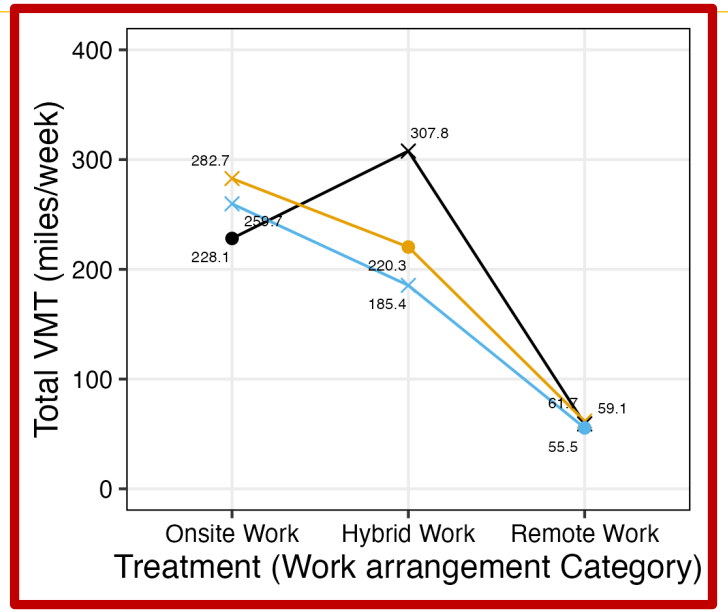
Work Arrangement

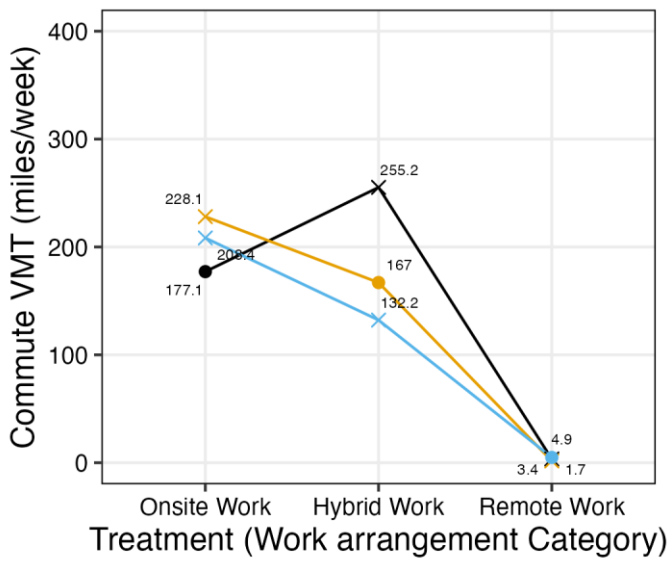
- Onsite Worker
- Hybrid Worker
- Remote Worker

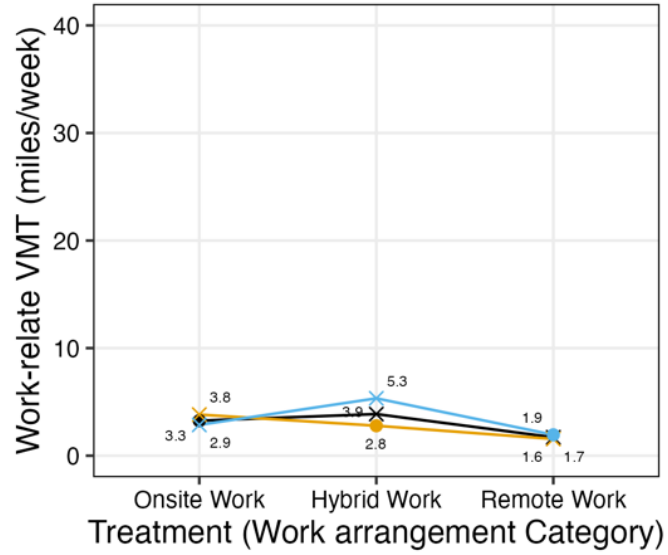
Estimation Type

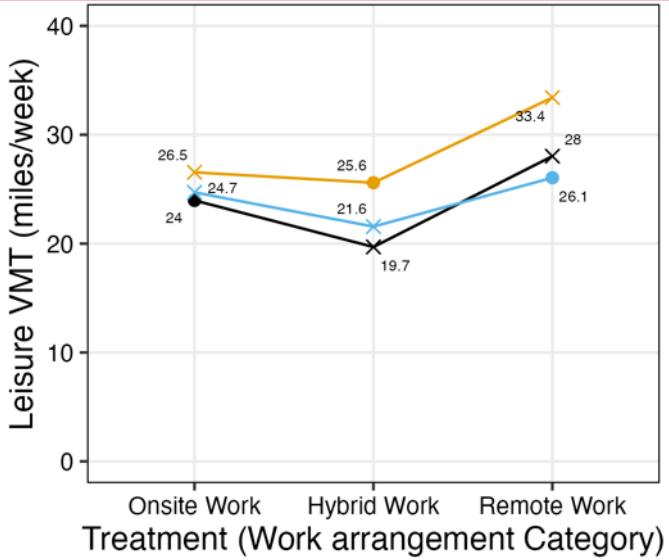
- ● Factual
- × Counterfactual

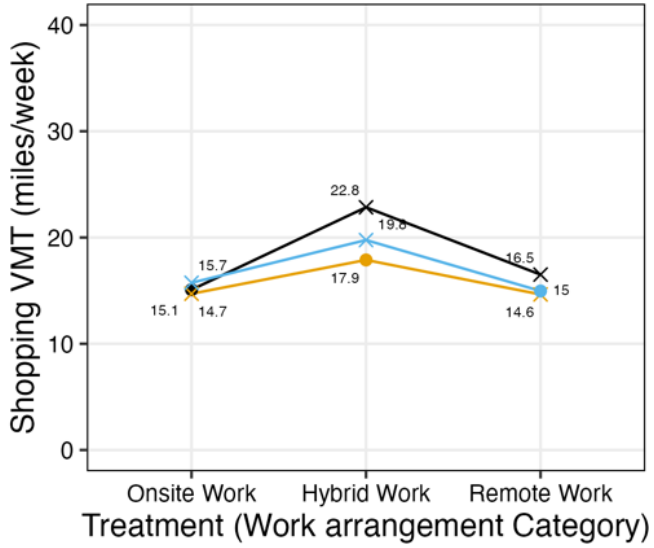
Note: the y-axis is in different scale for better visualization

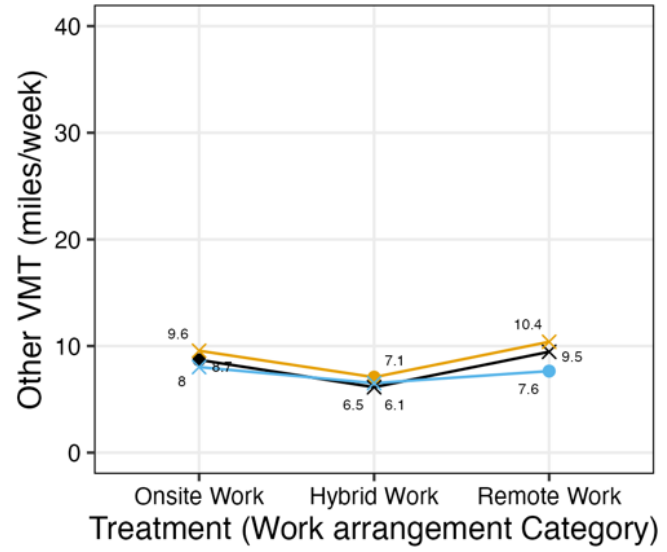






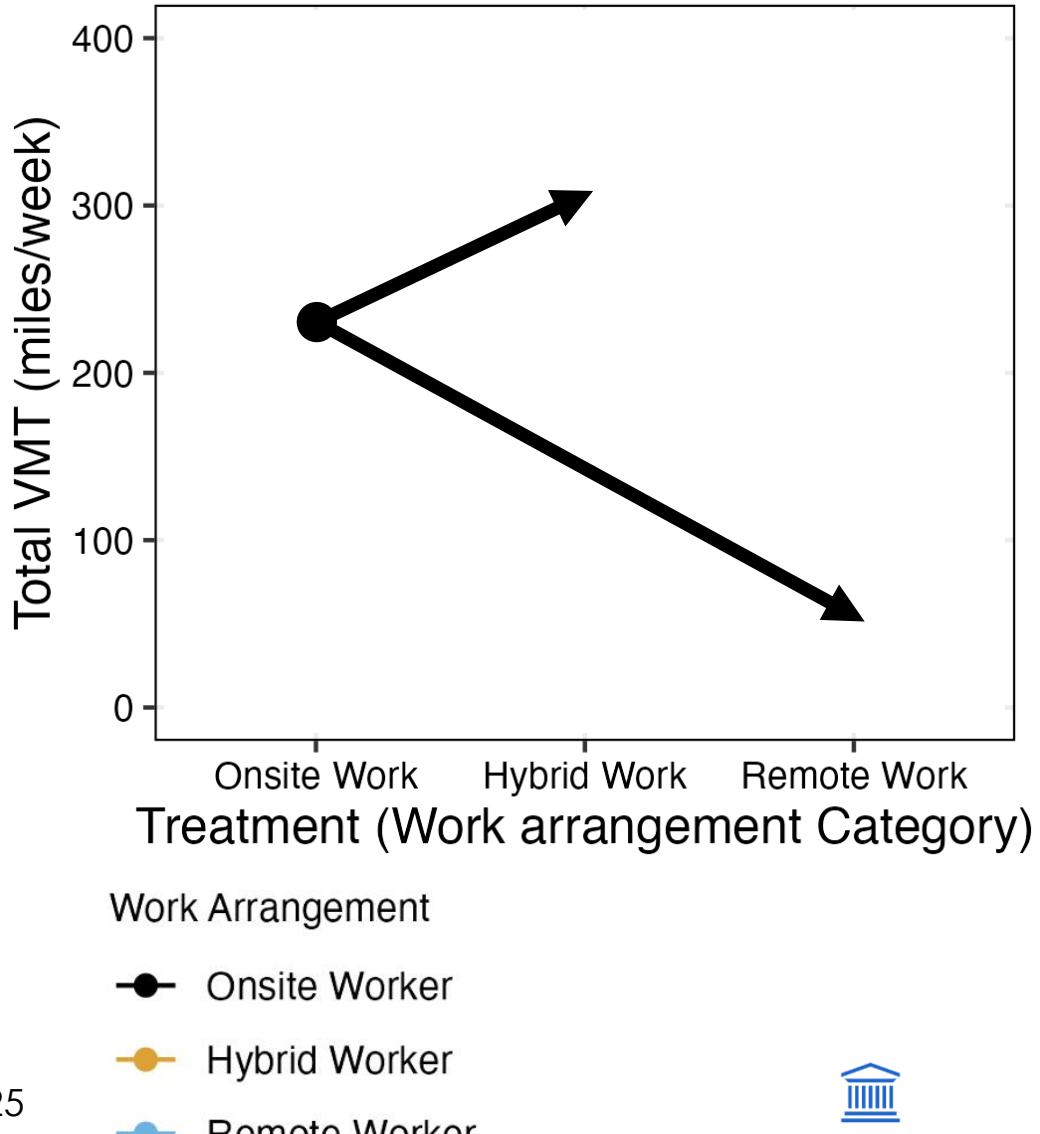






VMT implications of remote/hybrid work

- Individuals with longer commute distances are more likely to adopt hybrid/remote work.
- The total VMT increases when **Onsite Workers** transition to **Hybrid Workers.**
  - While hybrid work cuts commute days to primary workplaces, the savings could be offset by **longer commute distances** and increased **work-related VMT** (e.g., travel to temporary work locations) and **shopping VMT**.
- Only **fully remote work** delivers real total VMT savings, significantly reducing commute VMT, despite increases in leisure and other VMT.



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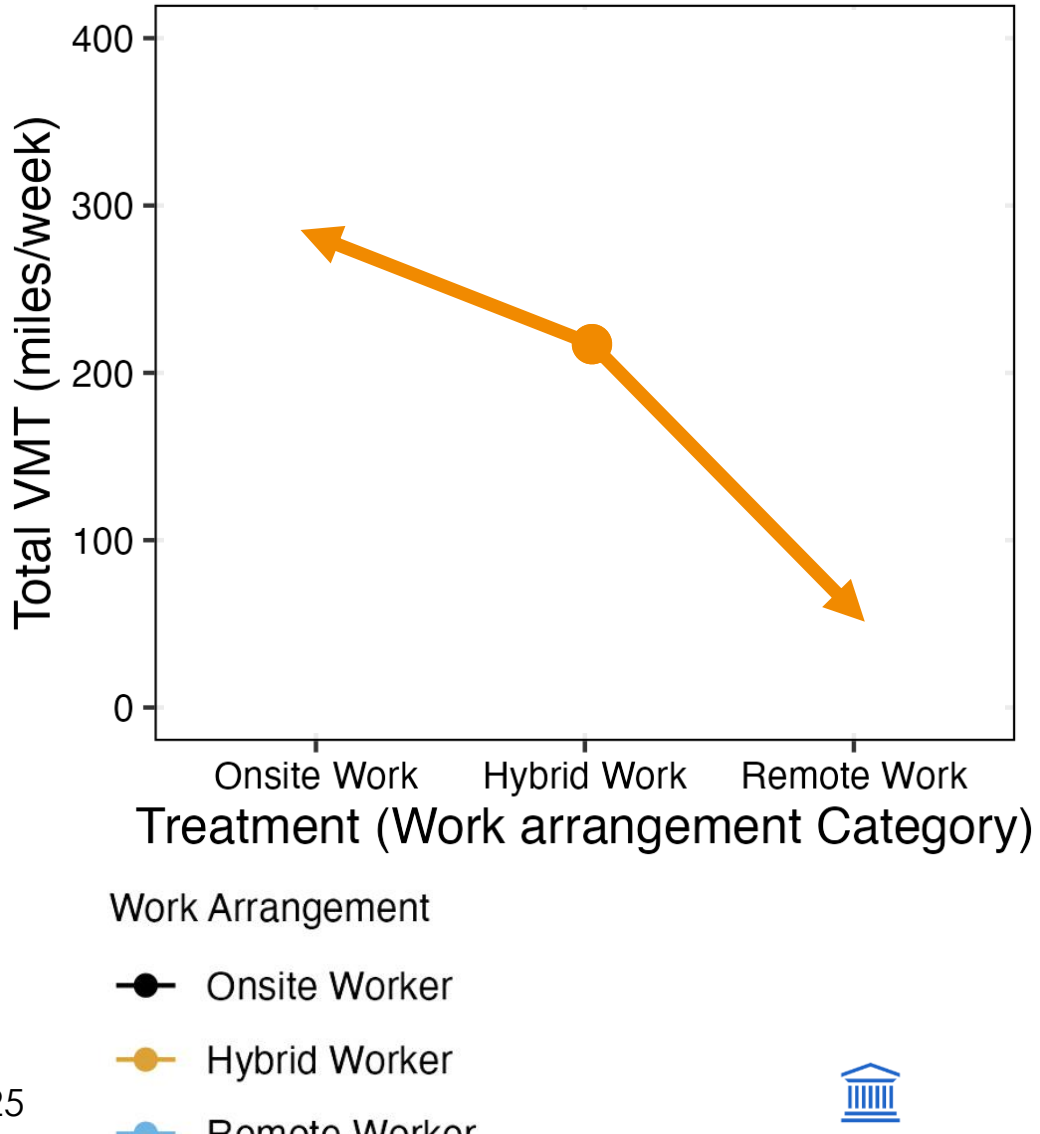

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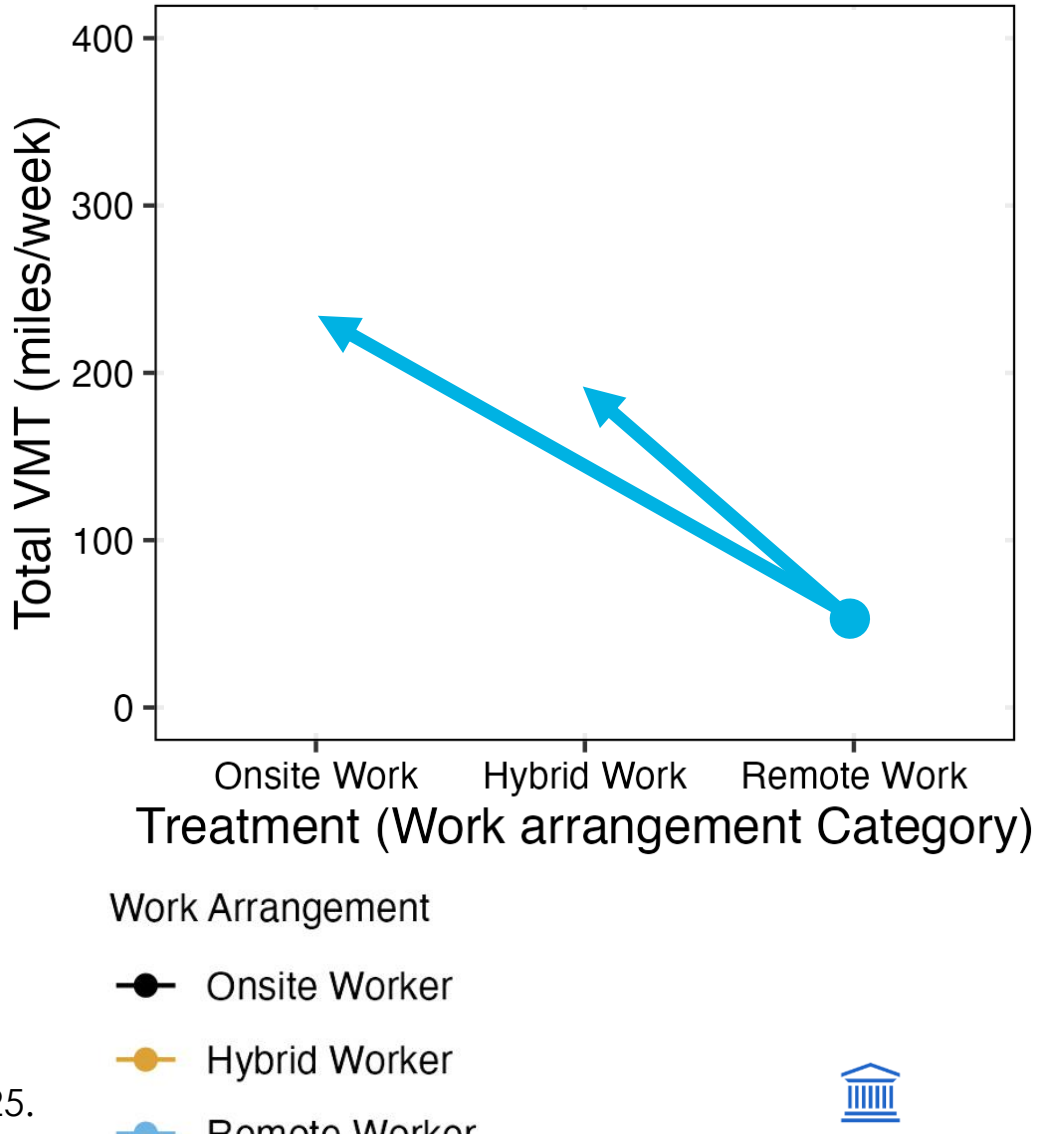

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Acknowledgments

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SCAG
SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

Selected publications from this project

- Iogansen, X., Malik, J. K., Lee, Y., & Circella, G. (2024). Change in work arrangement during the COVID-19 pandemic: A large shift to remote and hybrid work. Transportation Research Interdisciplinary Perspectives, 25, 100969. https://doi.org/10.1016/j.trip.2023.100969
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- Yousefi, N., Wang, K., & Circella, G. (2023). Factors influencing the types of merchandise purchased online: Evidence from the 2018 California survey of emerging transportation trends. Transportation Research Interdisciplinary Perspectives, 17, 100734, https://doi.org/10.1016/j.trip.2022.100734
- Soza-Parra, J., Circella, G., & Sperling, D. (2023). Changes in activity organization and travel behavior choices in the United States. In Transportation Amid Pandemics (pp. 191-199). Elsevier, https://doi.org/10.1016/B978-0-323-99770-6.00012-0

Selected publications from this project (2)

- Young, M., Soza-Parra, J., & Circella, G. (2022). The increase in online shopping during COVID-19: Who is responsible, will it last, and what does it mean for cities?. Regional Science Policy & Practice, 14, 162-178, https://doi.org/10.1111/rsp3.12514
- Loukaitou-Sideris, A., Bayen, A. M., Circella, G., & Jayakrishnan, R. (Eds.). (2022). Pandemic in the metropolis: transportation impacts and recovery (Vol. 20). Springer Nature.
- Malik, J., Affolter, B., & Circella, G. (2022). Adoption of telecommuting and changes in travel behavior in southern California during the COVID-19 pandemic. In Pandemic in the Metropolis: Transportation Impacts and Recovery (pp. 199-216). Cham: Springer International Publishing.
- McElroy, S., Fitch, D. T., & Circella, G. (2022). Changes in Active Travel During the COVID-19 Pandemic. In Pandemic in the Metropolis: Transportation Impacts and Recovery (pp. 179-197). Cham: Springer International Publishing.
- Bayen, A. M., Jayakrishnan, R., Circella, G., & Loukaitou-Sideris, A. (2022). Conclusion: Reflections and Lessons from the Pandemic. In Pandemic in the Metropolis: Transportation Impacts and Recovery (pp. 333-345). Cham: Springer International Publishing.
- Compostella, J., Wang, K., Iogansen, X., & Circella, G. (2022). Trips to the Grocery Store and Online Grocery Shopping: A Comparison of Individual Behaviors before and during the First Wave of the COVID-19 Pandemic. Transportation Research Record, 03611981231172505, https://doi.org/10.1177/03611981231172505
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Any Questions?

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