CENTER FOR TRANSPORTATION RESEARCH

Integration of Stated Preference and Revealed Preference Methods in Regional Travel Survey Programs

WORKSHOP

Dr. Chandra Bhat, Katie Asmussen, Lisa Macias, and Aupal Mondal

Thursday July 21st, 2022

Workshop Outline

1. Overview of the Project
2. Review of the survey design and deployment process
3. Presentation of survey results
    a. Descriptive Statistical Analysis
    b. Choice Modeling Analysis
    c. WPL Prediction Process

OVERVIEW OF THE PROJECT

Overview of the Project

Objective 1:

(1) Identify state-of-the-art stated preference (SP) techniques

(2) Develop a guidebook that explains the factors to consider when designing an integrated revealed preference (RP)-SP survey

(3) Recommend the SP components that may be appended to existing surveys to enhance their use for long-term travel forecasts

Objective 2:

(1) Design

(2) Deploy

(3) Organize

(4) Analyze

An RP-SP survey about future Workplace Location (WPL) behavior and trends in a future scenario involving the COVID-19 pandemic

The benefits of Stated Preference (SP)

- SP surveys seem to get a bad rap in some quarters, but are firmly entrenched now
- Skeptic position – Revealed Preference (RP) questions measure "real" behavior

THIS IS NOT TRUE

- SP behavioral measures outperform RP measures in many instances (Arslan et al., 2020)
- When technology/policy are in a state of flux, RP approaches not very helpful

- In our study, did not combine current WPL RP choice and SP "idealized" WPL choices.

- But still used RP in several ways:
    - Pivoting off commute time for SP experiments
    - Compared what they do now with SP

Only Revealed Preference (RP)

RP questions seek information on observed activity-travel characteristics of respondents in the context of *currently available travel options.*

Main limitations of only RP data:

- Can only capture data from currently available services or policies
- Have to assume temporal stability
- Correlation among independent variables
- Measurement error
- Omitted variables

Q: Which mode of transportation do you commute to work with?

A. Car (drive alone)
B. Car (carpool)
C. Bus
D. Train

Only Stated Preference (SP)

SP questions record decisions in the context of hypothetical scenarios that have not yet materialized.

The main limitations of SP data:

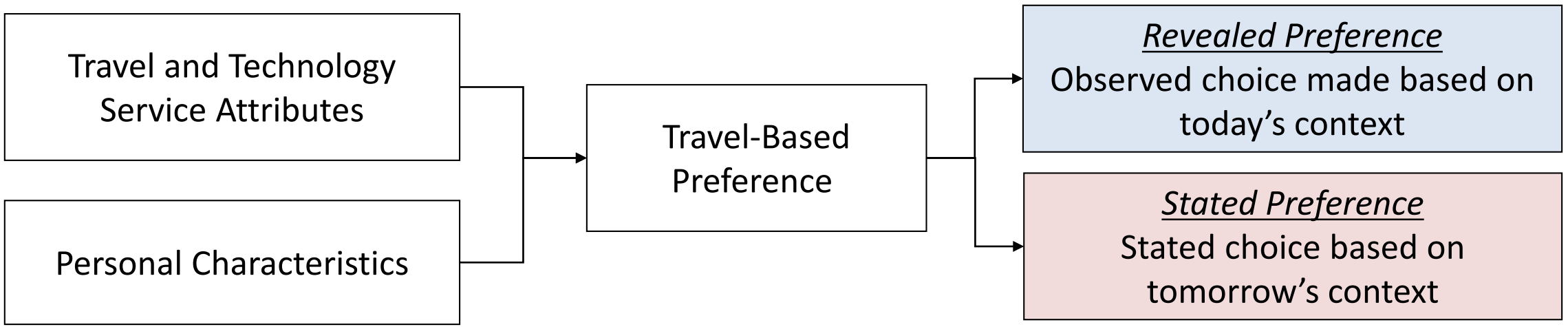
- "Setting bias" (i.e., the choice is made in a hypothetical setting)
- "Policy bias" (i.e., respondents attempt to influence the outcome)

Q: Pick your ideal work commute on the new Express Lanes (EL) based on the 3 different following travel options.

A. Drive Alone on EL:
27 min, $4.50
B. Express Bus on EL:
29 min, $2.00
C. Drive Alone on Regular Lanes:
55 min, Free

Combination of RP and SP

RP and SP questions complement each other to harness the advantages of each type of data where the other falls short.



SP Questions are Important

We are in an era where there are so many emerging technology/mobility options that do not even exist today.

Rapidly advancing technology

Complex transportation polices

Large-scale infrastructure projects

Life after COVID

SP Questions are Important

We are in an era where there are so many emerging technology/mobility options that do not even exist today.

Rapidly advancing technology

Complex transportation polices

Large-scale infrastructure projects

Survey Motivation

Life after COVID

REVIEW OF THE SURVEY DESIGN AND DEPLOYMENT PROCESS

Survey Motivation: Life after COVID

Teleworking

During COVID, the world shut down and most employees worked from home

Survey Motivation: Life after COVID

Teleworking

During COVID, the world shut down and most employees worked from home

Vaccination distribution opened the country up again

Survey Motivation: Life after COVID

Teleworking

During COVID, the world shut down and most employees worked from home

Vaccination distribution opened the country up again

Employers and employees must make an important decision:
WHERE TO WORK?

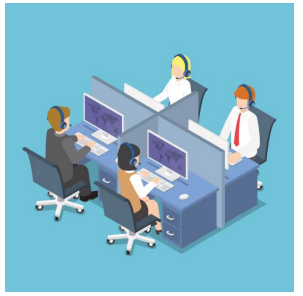
Survey Motivation: Life after COVID
Workplace Location (WPL)

During COVID, the world shut down and most employees worked from home

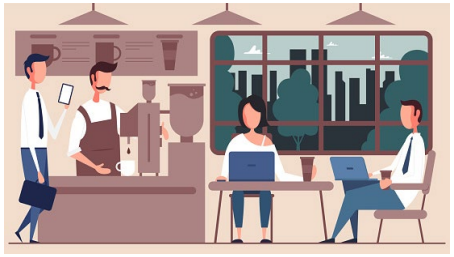
Vaccination distribution opened the country up again

Employers and employees must make an important decision:
WHERE TO WORK?

Home



Office



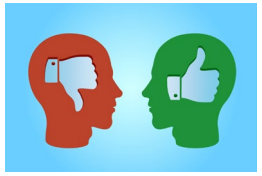
Third Workplace

Survey Design

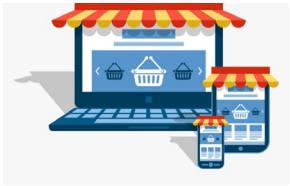
RP and SP Data

Demographics

Employment Characteristics



Attitudes on COVID and their workplace



Online and in-person shopping trends

from 4 time periods

1. Before the pandemic
2. First peak of the pandemic
   (March 2020 - May 2021)
3. Since vaccines became widely available to today
   (June 2021 until “today”)
4. In a not-too-distant future
   (when the impact of the pandemic wanes considerably)

and an SP experiment

Workplace location in a future scenario

Based on:

- Commute times
- Flexibility of work hours
- COVID risk intensities
- Measures of distraction

Survey Deployment

- February and March, 2022
- Across the entire state of Texas
- Recruitment focused on Employed individuals
  - Unemployed individuals could respond to the sociodemographic and online/in-person shopping sections

Final sample size: ~1,300 respondents

- Employed individuals (before and after COVID): 1,218 – the analyzed sample*
- Unemployed individuals: ~100

*The sample size for the choice modeling analysis was condensed to 1,136

PRESENTATION OF SURVEY RESULTS

FIRST: DESCRIPTIVE STATISTICS AND EXPLORATORY ANALYSIS

Sample vs. Population Employment Characteristics

Self-employed?	Sample	Texas
Yes	16.4%	6.7%
No	83.6%	93.3%

Part time-employed?	Sample	Texas
Yes	6.3%	11.4%
No	93.7%	88.6%

Average Number of Days Worked per Month

Sample: 21.5 days
Texas: 22 days

Average Commute

Sample: 25.2 minutes
Texas: 26.4 minutes

Remote Work?	Before COVID		Today	
	Sample	Texas	Sample	Texas
Yes, everyday	9.3%	5.0%	19.4%	22.0%

All Texas population stats are from the 2020 Texas Census.

These statistics suggest that our sample reasonably represents characteristics of the employed population in Texas

The desired WPL status in the future, as expressed in our sample, should be a good reflection of the future WPL desires of the Texas employed population as a whole

Describing the Sample: EMPLOYMENT CHARACTERISTICS

Employment Industry	Sample	Texas
Manufacturing/Construction/Warehousing	4.4%	17.0%
Healthcare	4.4%	5.0%
Sales/Food Services	0.2%	8.5%
Education/Social Services	40.4%	21.6%
Public Services/Administration	5.4%	5.5%
Information/Finance	9.9%	8.4%
Professional Services	16.3%	16.6%
Other	19%	17.4%

Sample contains:

- **Overrepresentation of those in education services**
- **Underrepresentation of those in manufacturing, construction or warehousing**

Otherwise, there is a pretty good spread across all occupation types.

In-Person WPL Stats

There is too much congestion during my commute to or from work.	
Strongly agree	20.2%
Somewhat agree	30.6%
Neither agree nor disagree	17.9%
Somewhat disagree	15.6%
Strongly disagree	27.2%

Discontent Commuter

Happy Commuter

Describing the Sample: Perspectives on COVID

	My personal wellbeing was or still is at risk during the pandemic.	COVID-19 was or still is an immediate threat to my loved ones
Strongly agree	21.3%	27.1%
Somewhat agree	35.5%	35.3%
Neither agree nor disagree	9.9%	8.9%
Somewhat disagree	14.1%	13.3%
Strongly disagree	19.2%	15.4%

	Are you immunocompromised?	Is someone you frequently see immunocompromised?
Yes	16.3%	37.8%
No	83.7%	62.2%

"COVID is a risk"

The majority of employees think COVID is a risk to their loved ones

About 40% of employees frequently interact with immunocompromised individuals

Remote WPL Stats

%(T) – percent from the total sample

%(P) – Percent based on only those who participate in teleworking

How often did/do/will you telework	Before COVID		During COVID		Now		In the Future	
	%(T)	%(P)	%(T)	%(P)	%(T)	%(P)	%(T)	%(P)
Never telecommuted	**59.4%**	--	**8.6%**	--	**34.1%**	--	**36.6%**	--
A few times per month	16.4%	40.5%	8.4%	9.2%	13.6%	20.6%	14.2%	22.3%
Once per week	5.9%	14.6%	3.7%	4.0%	7.2%	11.0%	7.1%	11.3%
2-4 days per week	6.9%	17.0%	12.6%	13.7%	19.9%	30.2%	23.9%	37.7%
5 days a week (everyday)	11.4%	27.9%	66.8%	73.1%	25.2%	38.2%	18.2%	28.7%

Where have you teleworked from/will telework from?	Before COVID	During COVID	Now	In the Future
From your home only	85.4%	95.8%	89.8%	86.3%
From a third workplace only	4.3%	1.2%	3.9%	4.2%
From both your home and a third workplace	10.3%	3.0%	6.3%	9.5%

The *never-teleworked* population has reduced from 59.4% before COVID to 34.1%

In terms of teleworking frequency, today *teleworking at least once a week* has increased 50% since before COVID

Comparatively, employees' remote work trends today will resemble those they intend to have in the future

Remote work from a third workplace decreased slightly since before COVID, but employee's intend to work from them more in the future

Example SP WPL Survey Question

In this scenario, you have three different options for where to work across the period of one month. Regardless of the options your employer currently offers, assume you have all options available when distributing your time. Please carefully review the scenario.

COVID Risk Level	60% of people are vaccinated and the vaccine is effective for all current strands. Risk is low.		
Attributes	***Work from Home***	***Work from the Workplace***	***Work from a 3rd Workplace***
Distraction level	Low distraction	Low distraction	High distraction
Commute time	-	7.5 minutes longer than before	Shorter than your out-of-home workplace commute
Level of crowding	-	The out-of-home workplace is crowded and you are in close proximity to quiet coworkers	The third workplace is crowded and you are in close proximity to loud strangers
Workplace safety implementation for COVID	-	Only one safety measure is implemented	-
Splitting Work Hour	Allowed	Not allowed	Allowed
Shifting Work Hours	Allowed	Not allowed	Allowed

You reported to work **22** days last month. For this scenario, please distribute the number of days you would work at each workplace choice based so that they all add up to **22**. You can put 0 days as one or two of the alternatives as long as it adds up to **22**.

Work from home	0	**12**
Work from the workplace	0	**0**
Work from a 3rd workplace (teleworking from a location that is not your home)	0	**10**
Total	0	**22**

WPL Stats

SP data: Idealized choice situation

WPL Location	Portion of choice occasions with positive participation [1]	Mean number of days conditional on positive participation	% of total number of participations in each WPL location with participation…. [2]			
Work from home	72.0%	14.5	Only in home	Only in home and work office	Only in home and third WPL	All WPLs
			36.6%	47.2%	5.1%	11.1%
Work from workplace	68.7%	14.5	Only in work office	Only in work office and home	Only in work office and third WPL	All WPLs
			36.6%	49.4%	2.3%	11.7%
Work from a third workplace	14.5%	6.9	Only in third WPL	Only in third WPL and home	Only in third WPL and work office	All WPLs
			8.8%	25.1%	10.9%	55.2%

Home and work office alternatives are about equally chosen with close to about 70% participation

The third WPL location is less likely to be chosen at only 14.5%

Conditional on participation, employees spend less average time working from a third workplace, than those working from the other two locations

Split of WPL combo are the same for the first two alternatives, where they work the most from the combination of the two, followed by only working at the single WPL for the entire month

The majority of those working from a third workplace work from a combination of all WPLs

[1] Percentages across rows in the column do not sum to 100% because of hybrid WPL configurations.
[2] Percentages sum to 100% for each row across the two columns, since the percentages are with respect to the total number of choice occasions with positive participation in each WPL (the second column in the table).

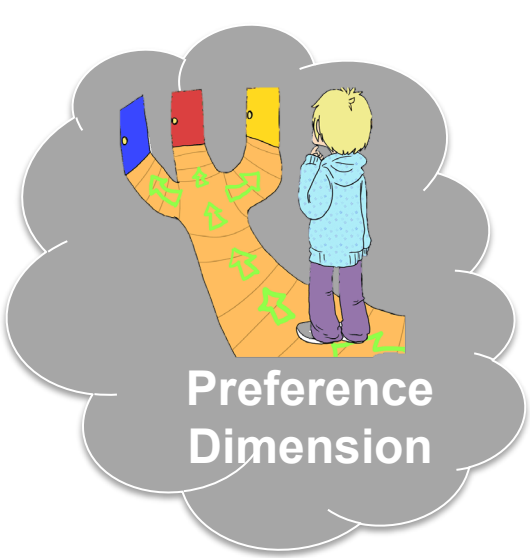
CHOICE MODELING ANALYSIS

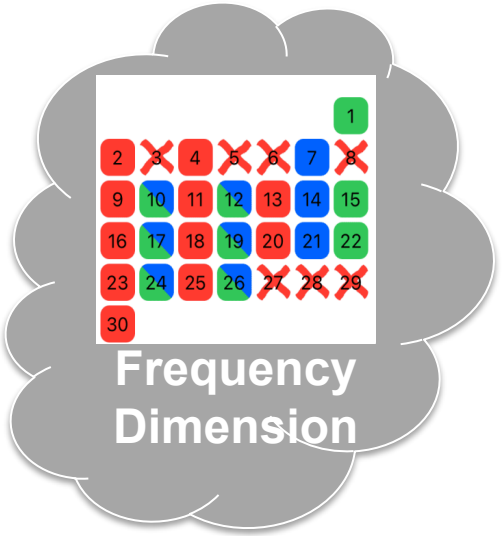
All of the following results and analysis can be found in the final report for this project and in the paper Asmussen et al., 2022 titled *On Modeling Workplace Location Decisions in a Post-COVID Future*

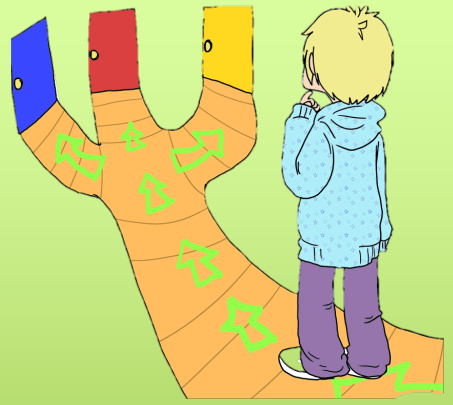
Main Outcome Variable

Arrangement of Work Place Locations (WPLs) for a month

Using SP data





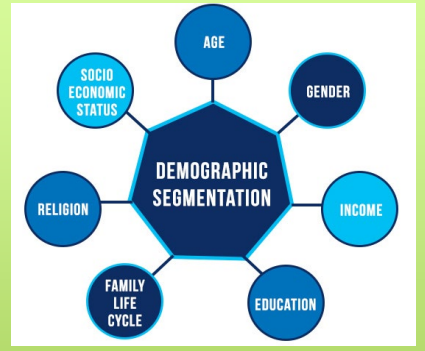


Preference Dimension

Frequency Dimension

Satiation Effects

Workplace Location



Who

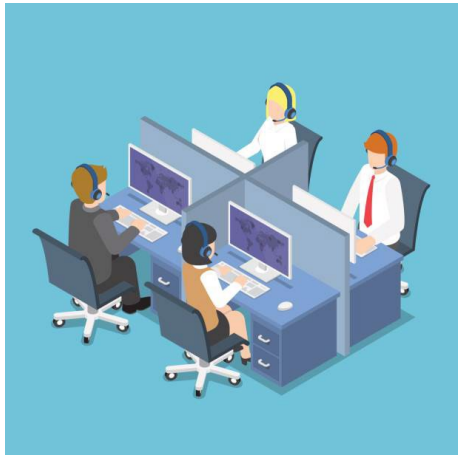
What

Multiple Discrete-Continuous Extreme Value Model (MDCEV) Bhat, 2008

where the WPL choice situation is a horizontal choice structure, where the individual decides on an optimal combination of the three work location arrangements over a certain time period (a month)

Work Place Location Alternatives

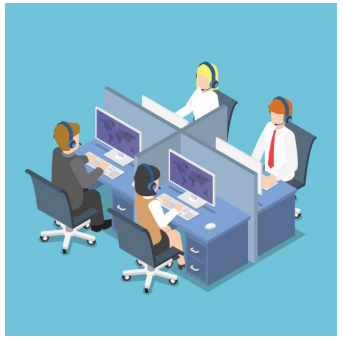
Work from home



Work from the in-person workplace

Work from a third workplace

Details on SP WPL Survey Question

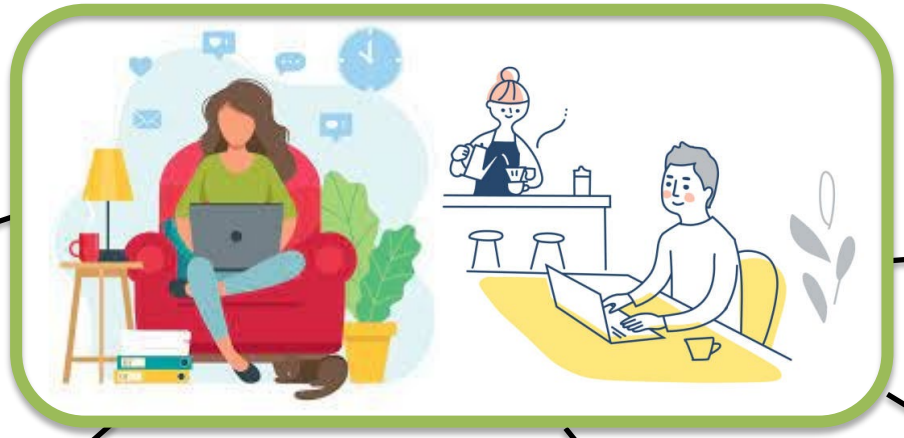


Attributes of SP Experiment

- COVID risk level
- Splitting work hours
- Shifting work hours
- Distraction level at home
- Level of crowding at the out-of-home workplace
- Change in commute time
- Workplace safety implementation for COVID
- Crowding and distraction level at the third workplace
- Commute length to third workplace

WHO WORKS WHERE?

Who is a remote worker?



Single

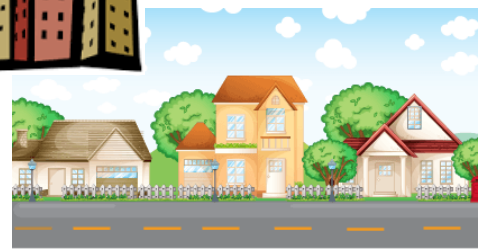
Women

With a baby

Young

Higher income

A white-collar worker

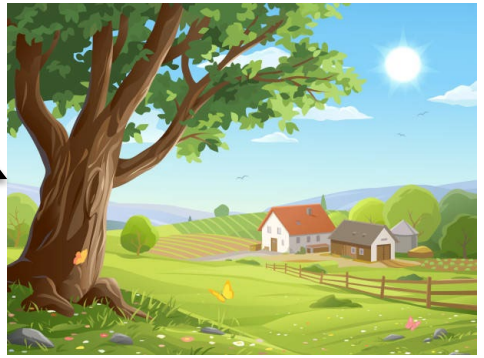


Urban or Suburban dwellers

Who is a commuter?

Men

Essential Worker

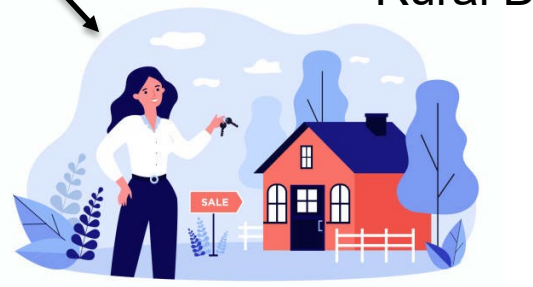


Rural Dweller

Live-in partner

Older

Lower income



Home owner

What about a Digital Nomad?

Women with a small child and partner

A white-collar worker

Single

Young

Part Time

Lower income

WHY WORK WHERE?

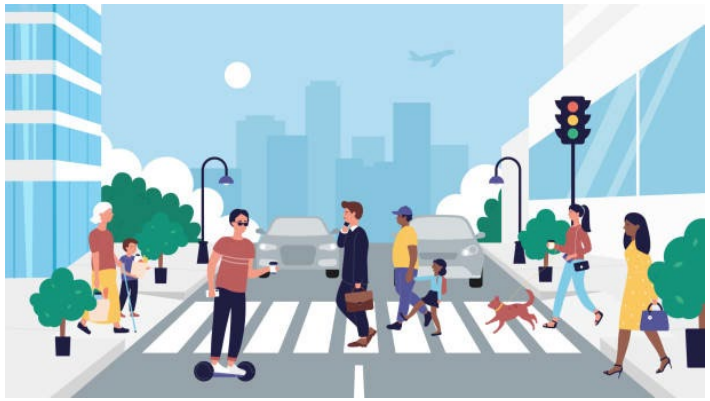
Geographic WPL Attribute

Longer **commute**, less likely to work from that WPL

Elevated for Women

Due to →

Typically more time-poor



Disclination towards working from the office if:

- **Work office is located** in a high density area
- **Home residence** located in an urban or suburban area

Due to →

High parking costs

→

Longer commutes

Environment WPL Attribute

Distraction Level

None > Medium > High

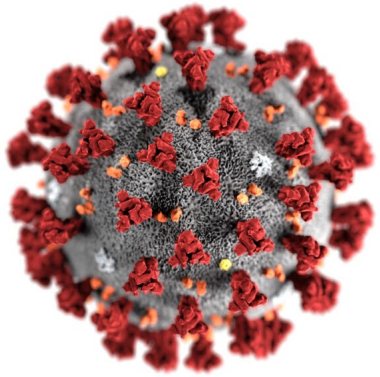
Decrease preference for any WPL

Higher effect on older workers than younger ones at the work office WPL

Women are more sensitive to distractions than men

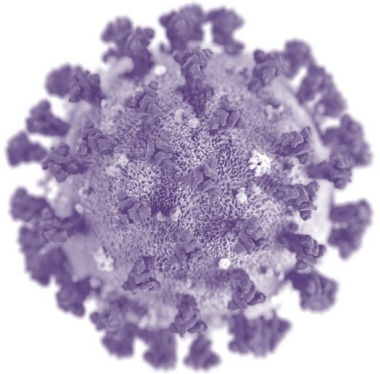
COVID-19 Threat Attributes

Immunocompromised will stay away from the work office



High COVID risk increases preference for working from home, and for more days during the month

<



Unknown COVID risk increases preference for working from home even more

Unknown COVID risk decreases preference for working from a third WPL

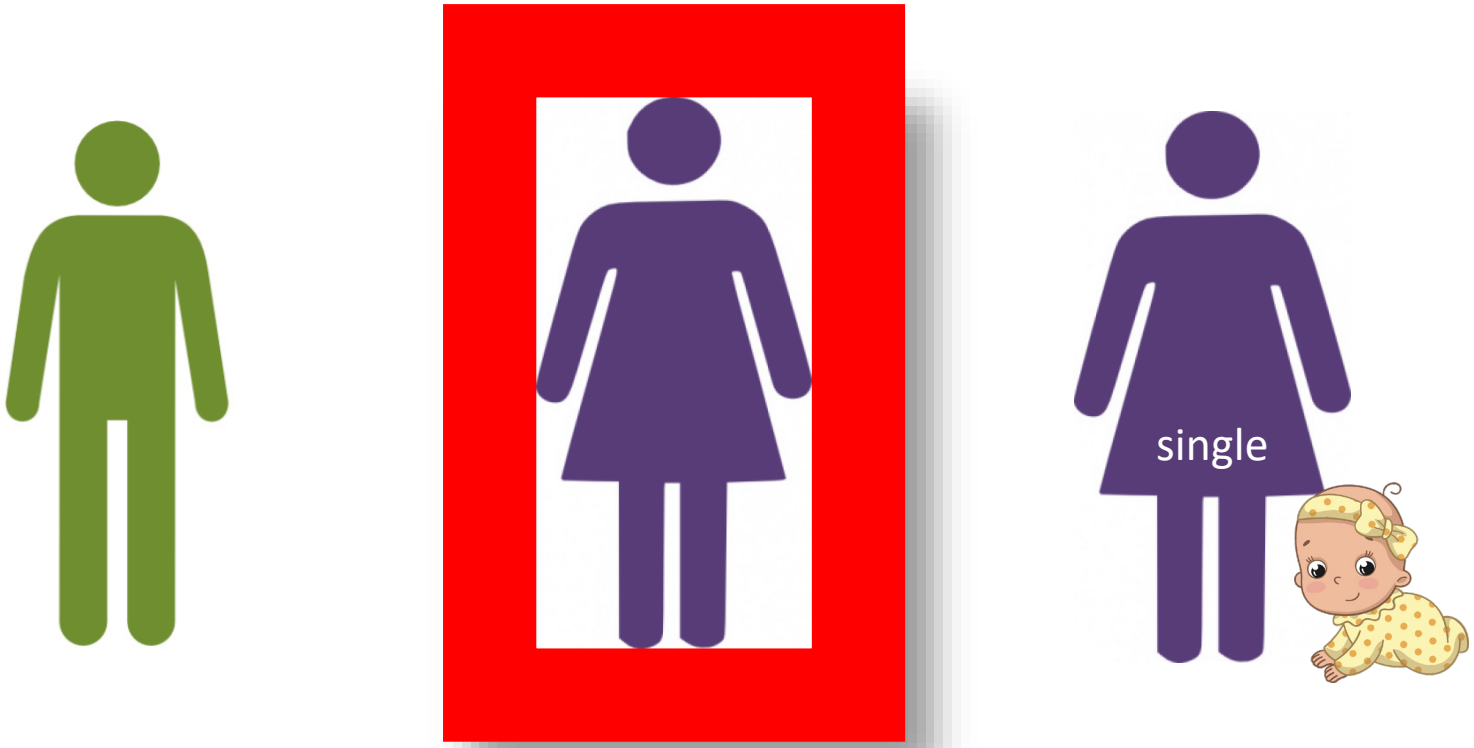
What is the monthly split across all three WPL, and how do sociodemographics and WPL attributes change them?

WPL PREDICTIONS AND IMPLICATIONS

Finalized Prediction Gendered Life Cycle Groups

- Predict exactly where an employee of a certain gendered life cycle group, age group, income level and occupation- type will split their month working
- Mediate splits by invoking changes in WPL geographic and environmental attributes and COVID threat characteristics

Finalized Prediction
Gendered Life Cycle Groups



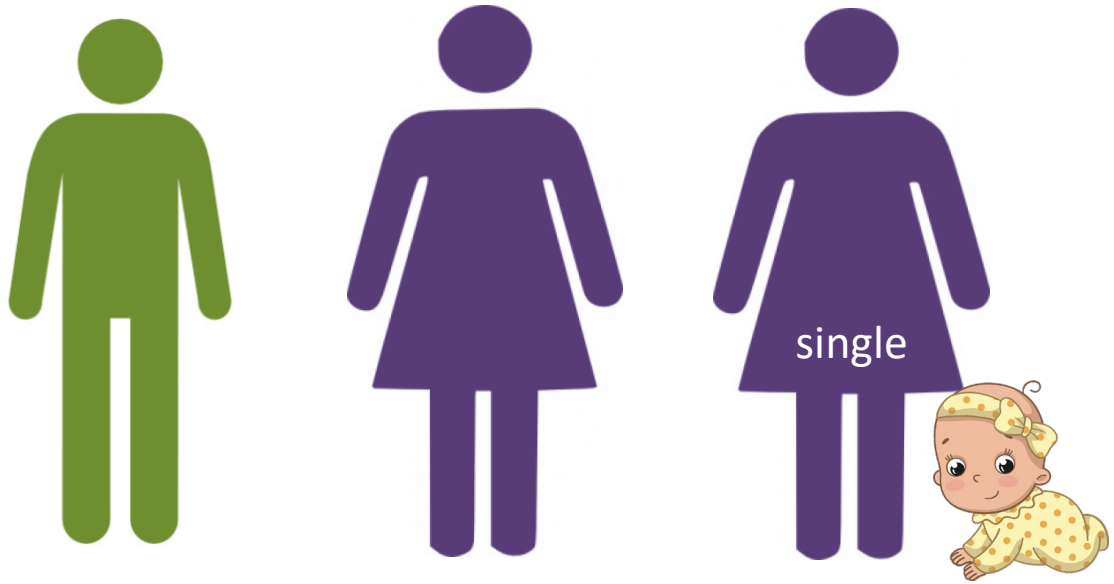
- Predict exactly where a employee of a certain gendered life cycle group, age group, income level and occupation- type will split their month working
- Mediate splits by invoking changes in WPL geographic and environmental attributes and COVID threat characteristics

WHO ARE THE ONES WHO PREFER MORE WPL HYBRIDIZATION?

Assuming all full-time employees, working 22 days a month

Predictions

(number of days across a month)



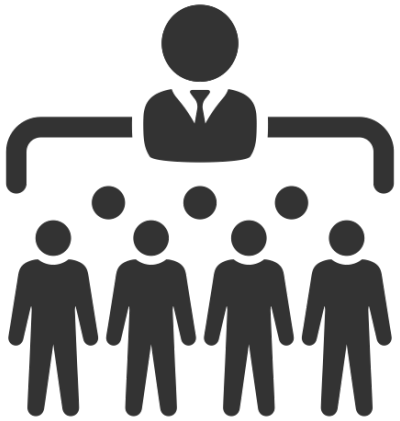
Home	9.8 days	11.6 days	19.9 days
In-person	11.5 days	8.8 days	1.9 days
Third WPL	0.7 days	1.6 days	0.2 days

* All % changes are from lowest category to highest category

Age and Gender Predictions

Age (years)	18 to 29	30 to 64	65 and older	*% change
Home	11.9	11.7	10.8	**-9.3%**
In-person	8.3	8.6	10.1	**21.8%**
Third WPL	1.8	1.7	1.1	**-38.2%**

Income	<$100K	$100 to $250K	≥ $250K	*% change
Home	10.8	12.0	12.3	**13.4%**
In-person	9.5	8.3	8.6	**-9.7%**
Third WPL	1.7	1.7	1.1	**-31.4%**



HOW SHOULD EMPLOYERS PREPARE FOR AND DESIGN HYBRID WORKPLACE STRUCTURES?

Occupation Predictions

Occupation (essential services)	Healthcare	Retail Sales/ Food Services	Education
Home	9.3	9.2	10.3
In-person	11.3	11.4	10.4
Third WPL	1.4	1.4	1.3

Occupation ("white collar" workers)	Public Admin	Information/ Finance	Professional/ Managerial/Technical job
Home	13.6	15.7	12.0
In-person	6.2	4.4	8.2
Third WPL	2.2	1.9	1.9

Essential services (health case/retail sales/education) recognize importance of their in-person presence reporting the highest split for work from the work office

Those in the information/finance, professional/managerial/technical, and public administration occupations express the highest preference for working remote

GEOGRAPHIC OR ENVIRONMENTAL ATTRIBUTES: WHICH IMPACTS HYBRIDIZATION PREFERENCES MORE?

Geographic v Environmental attributes

Commute Time

In-Person Commute Time (minutes)	50% shorter (13.2)	Average (26.4)	50% longer (39.6)	% change
Home	11.1	11.7	12.3	**11.3%**
In-person	9.4	8.6	7.9	**-15.6%**
Third WPL	1.6	1.7	1.8	**13.6%**

Third WPL Commute Time (minutes)	Same as comm. to IP WP	50% shorter than comm. to IP WP	% change
Home	11.6	11.5	**1.1%**
In-person	8.8	8.8	**0.9%**
Third WPL	1.5	1.7	**-12.2%**

The **environmental** attribute of distraction level is more important than the **geographic** attribute of commute time

<

Distraction Level

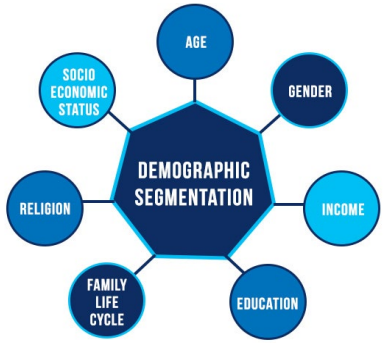
HOME	No	Low	High	% change
Home	12.4	11.8	10.7	**-13.5%**
In-person	8.2	8.7	9.5	**16.6%**
Third WPL	1.5	1.6	1.8	**21.4%**

In-person	No	Low	High	% change
Home	10.9	12.3	12.3	**12.9%**
In-person	9.6	8.0	8.0	**-17.1%**
Third WPL	1.5	1.7	1.7	**16.1%**

THIRD WPL	No	Low	High	% change
Home	11.3	11.8	11.9	**5.1%**
In-person	8.6	9.0	9.0	**5.0%**
Third WPL	2.1	1.2	1.1	**-48.5%**

TRAVEL DEMAND CONSIDERATIONS

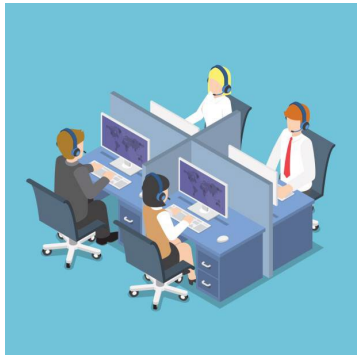
Travel Demand Considerations (1)

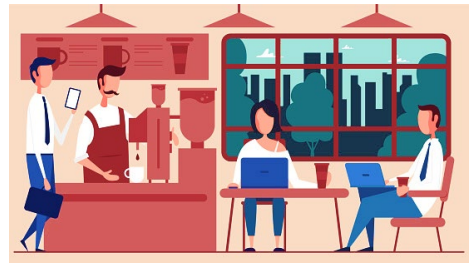


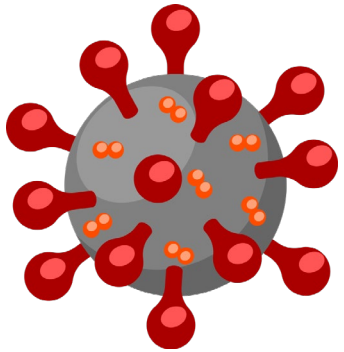
- Sociodemographics and job-related characteristics vary work hybridization preferences
- Work hybridization will be the norm as the job market adjusts to employee WPL preferences
- Effects of hybrid work arrangements include
  - **peak traffic congestion**
  - **land-use patterns**
  - **broader activity-travel patterns of individuals**

Travel Demand Considerations (2)

- Current travel demand models account for only single day analysis
- Clearly, there is a shift toward a hybridization of work, rather than a single-day, binary choice of WPL
- This prompts the possible need to change to a multi-day unit of analysis in travel demand modeling



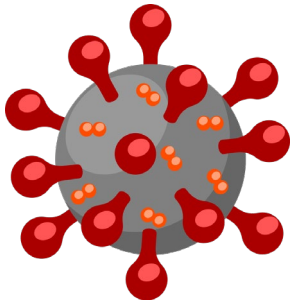




HOW TO PREPARE FOR WHEN A COVID-LIKE PANDEMIC STRIKES AGAIN?

How to prepare for when a COVID-like pandemic strikes again?

- There is an obvious shift away from the in-person office and towards remote working when an employee or someone they frequently see is immunocompromised
- Shifts toward a third workplace are higher than the shift towards the home office when employee is immunocompromised
- When the COVID risk is high or unknown, relative to no threat, there is a shift away from both the in-person workplace and the third workplace



ANY QUESTIONS?

References

Arslan, R. C., Brümmer, M., Dohmen, T., Drewelies, J., Hertwig, R., and Wagner, G. G. (2020). How people know their risk preference. *Scientific reports*, *10*(1), 1-14.

Asmussen, K. A., Mondal, A., and Bhat, C. R (2022). On Modeling Workplace Location Decisions in a Post-COVID Future. *Working paper* at University of Texas at Austin.

Bhat, C. R. (2008). The multiple discrete-continuous extreme value (MDCEV) model: role of utility function parameters, identification considerations, and model extensions. *Transportation Research Part B: Methodological*, *42*(3), 274-303.