Measuring Impacts on Demands for *Transportation*

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UTTRI

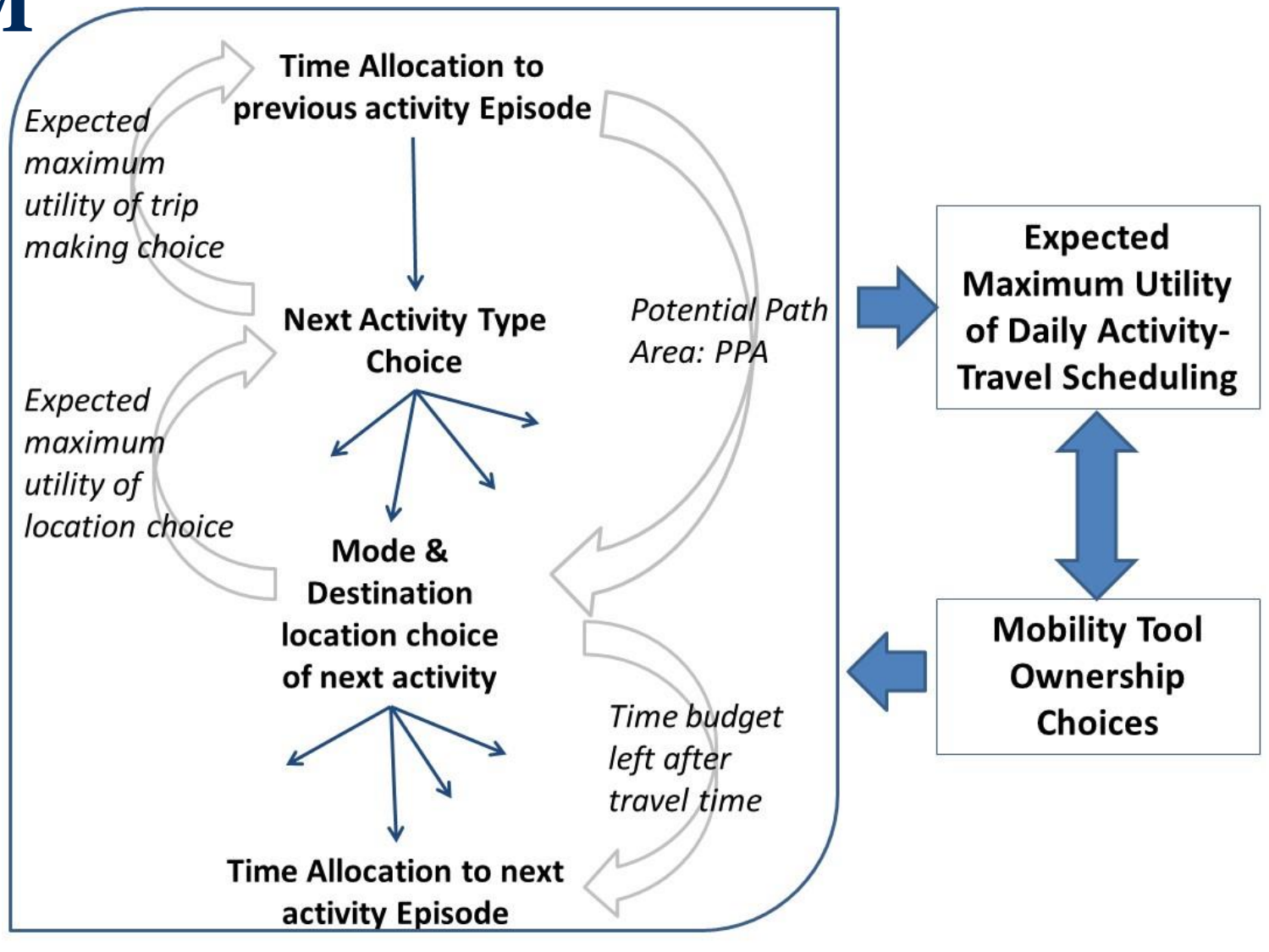
Presentation Overview

- Modelling Travel Demand and Land use Transportation Interaction
- Issues with modelling systems in using for predicting uncertain future
- Uncertain future and measurement
- Recent ongoing projects

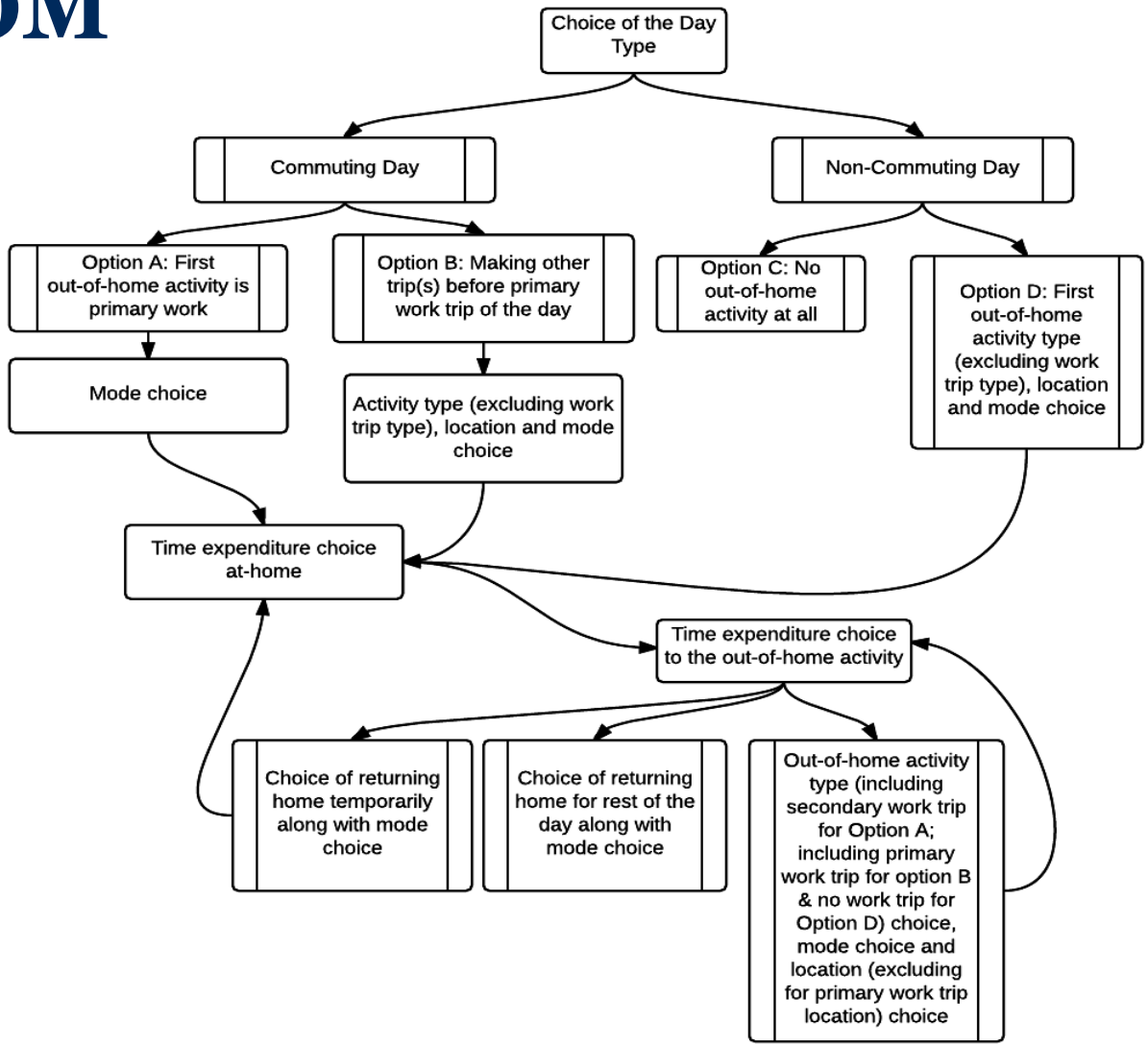
Modelling Systems

- My group has been developing modelling system for travel demand and land use-transportation interaction modelling
  - Activity-based model for travel demand
  - Computational equilibrium model for land use-transportation interactions
- It is important to have such modelling systems that are based on sound theoretical foundations
- However, empirical version of the models need data:
  - Data are observations of reality
  - Data are measurements of demand and demand generating factors/variables

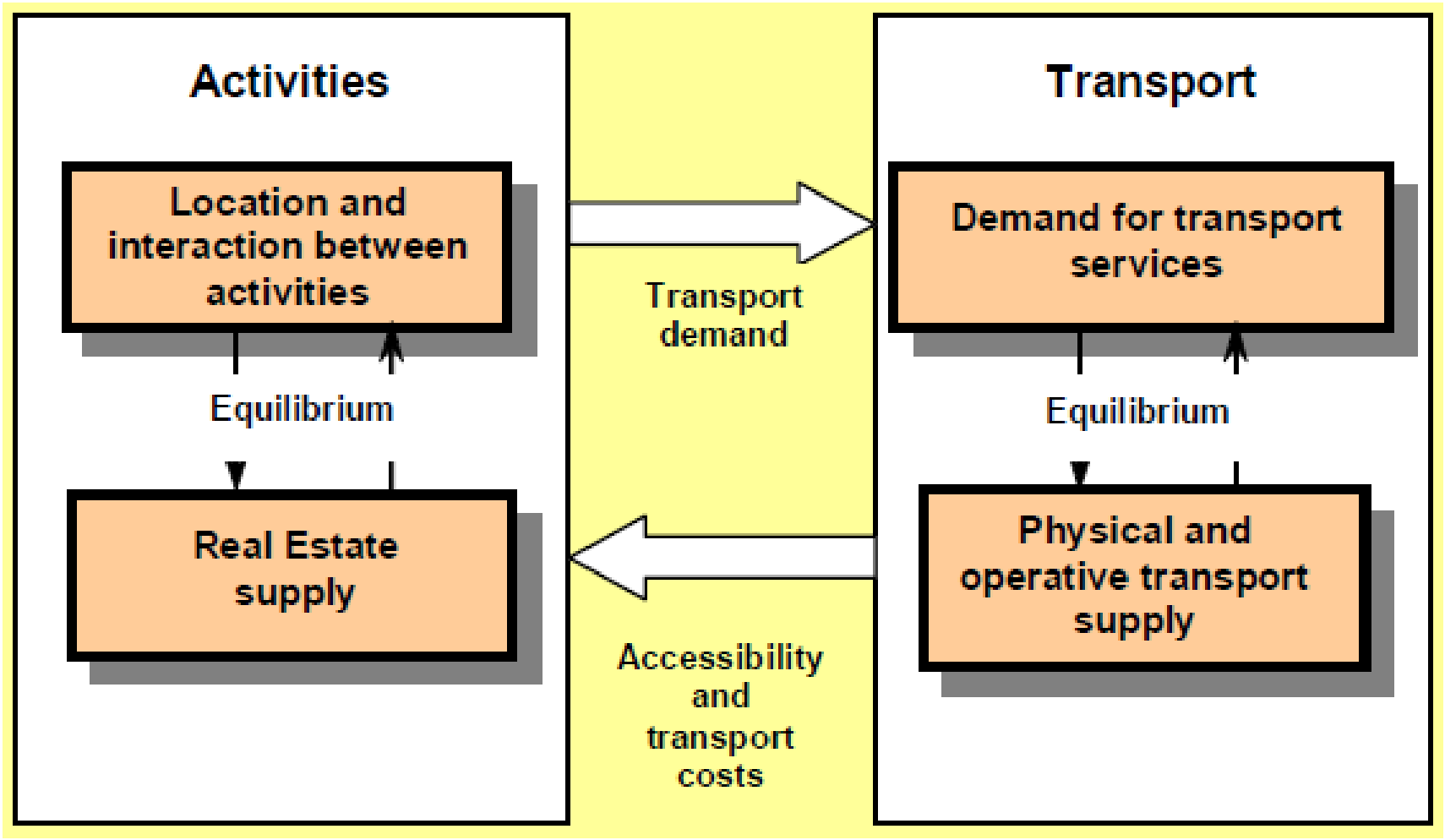
Activity-Based Travel Demand Model: CUSTOM



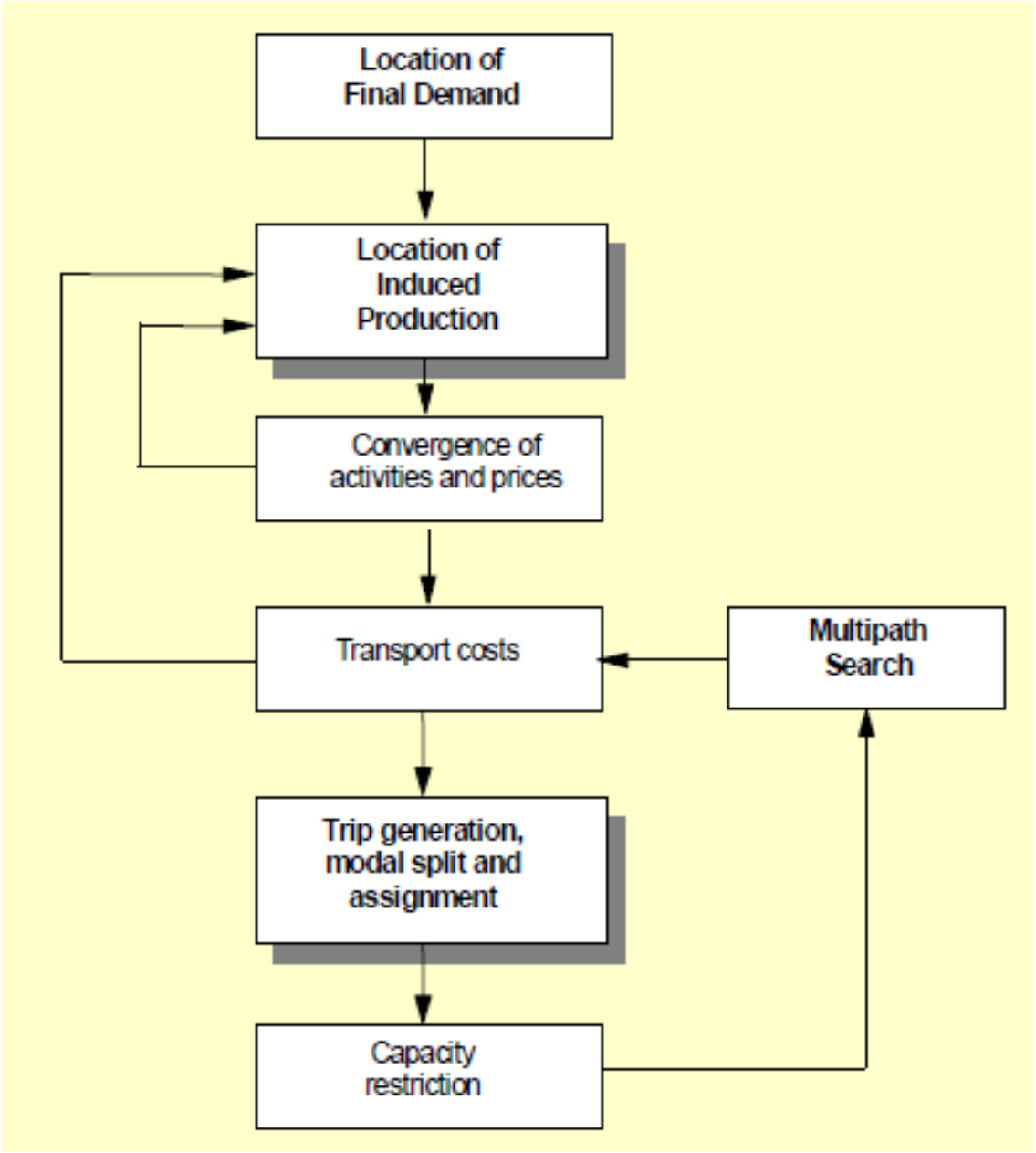
Activity-Based Travel Demand Model: CUSTOM



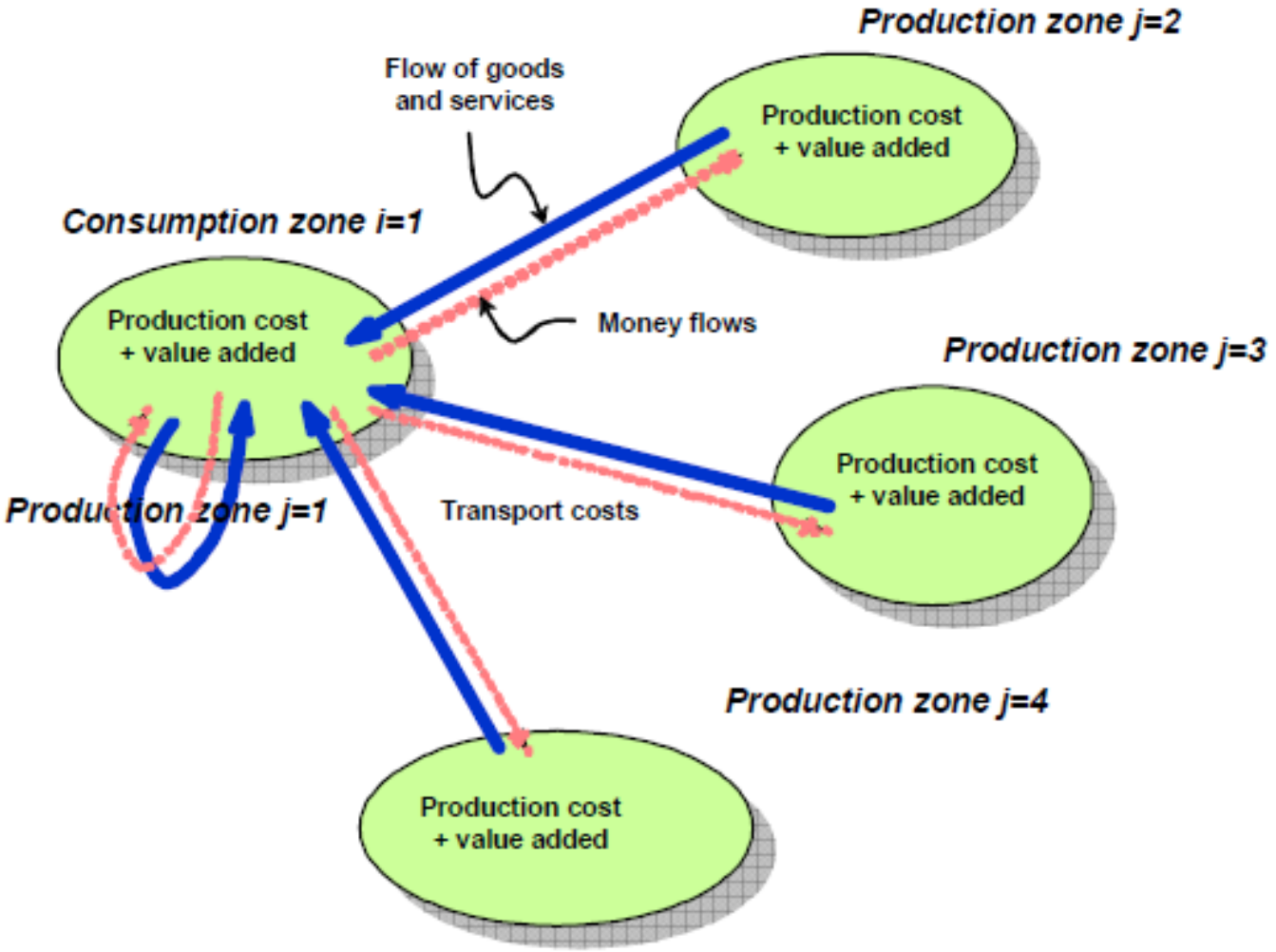
Land Use Transportation Interaction Model: LUTIM



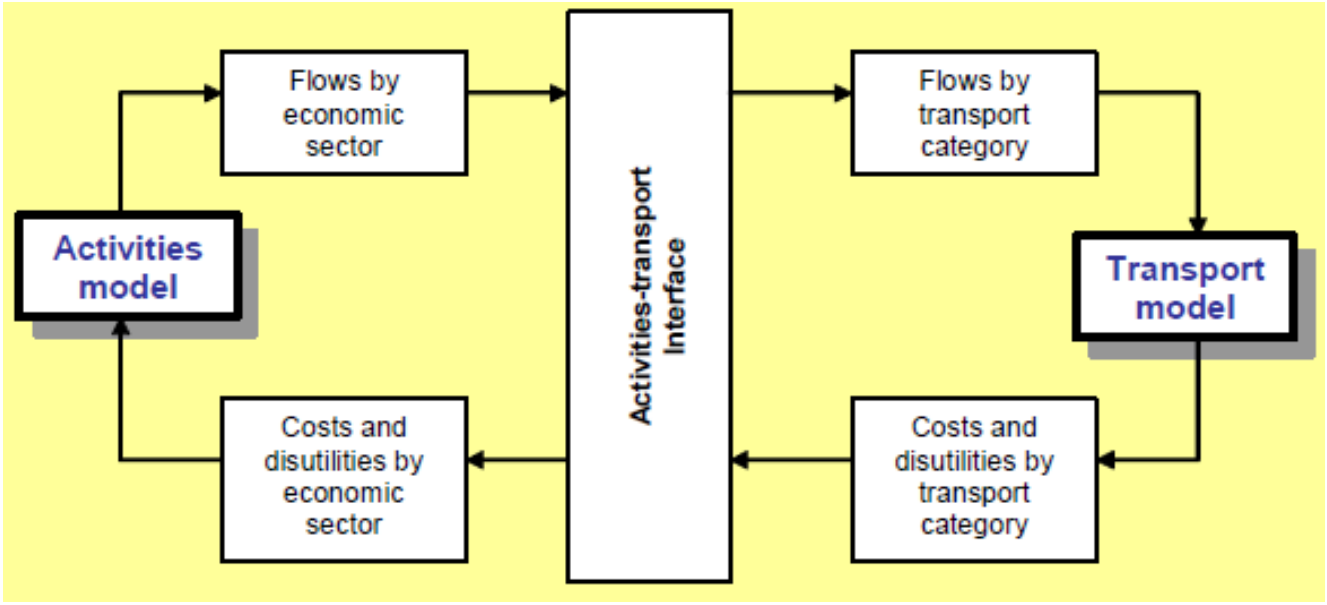
LUTIM- Sequence of Calculation

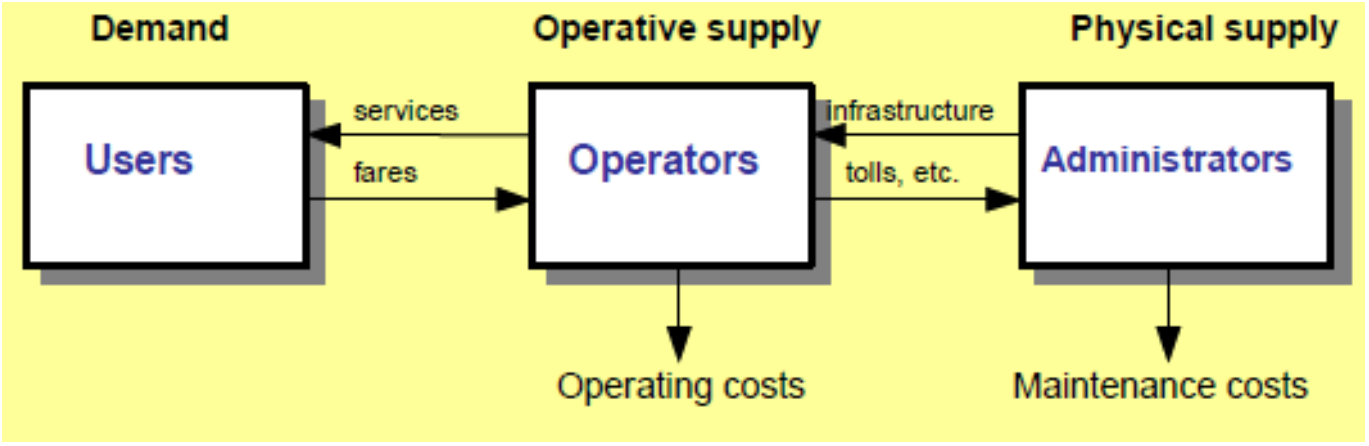


LUTIM-Production Consumption Relationship



LUTIM-Activity Transport Interactions





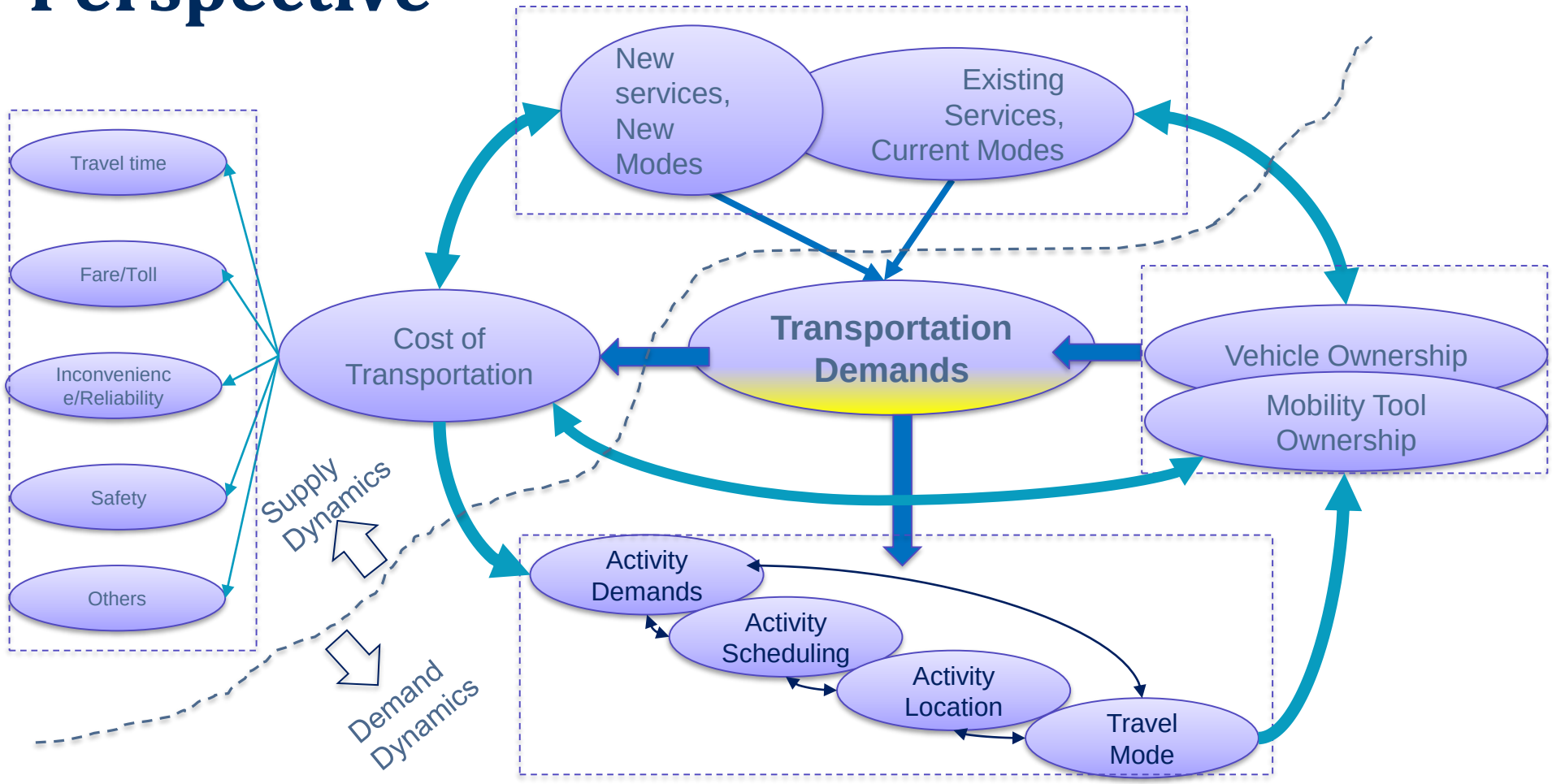
Modelling Systems

- Rich in theory
- Poor in Data:
  - We need real observations to estimate model parameters
  - This means models can reproduce what happened in the past
  - How about the uncertain future?

Potential Impacts of Transformative Transportation Technologies/Policy

- **Increase** VKT?
- **Increased** in number of trips?
- **Reduced** Transit Modal Share?
- **Reduced** Privacy?
- **Better** Land Use?
- **Increased** Social Equity?
- **Reduced** Car Ownership?
- **Reduced** Stress?
- **Increased** Safety?
- **Reduced** Emissions?
- And many more…!

Transformative and Automated Transportation: Impact Measurement Perspective



Uncertain Future

- Uncertainty:
  - Conventional ownership versus ridehail/rideshare service?
  - How much these services will cost?
  - Will AVs have a noticeable positive impact on traffic flow and by extension travel time?
  - Will people be willing to share AVs or are SOV trips going to continue to be the norm?

Problems:

- Massive set of potential impacts and large amount of uncertainty

- We have no way of predicting what will happen without prior observation:

- No guarantee that existing modelling systems will give accurate prediction of the future:
  - **If models use only revealed information**

Research Challenge

- New Modelling System or New Data ?
- Answer:
  - Data: measurement of responses (people and firms) in contexts of new options, new technologies.
  - Policy sensitive model components of activity-based travel demand modelling system
  - Policy sensitive model components of land use transportation interaction modelling system

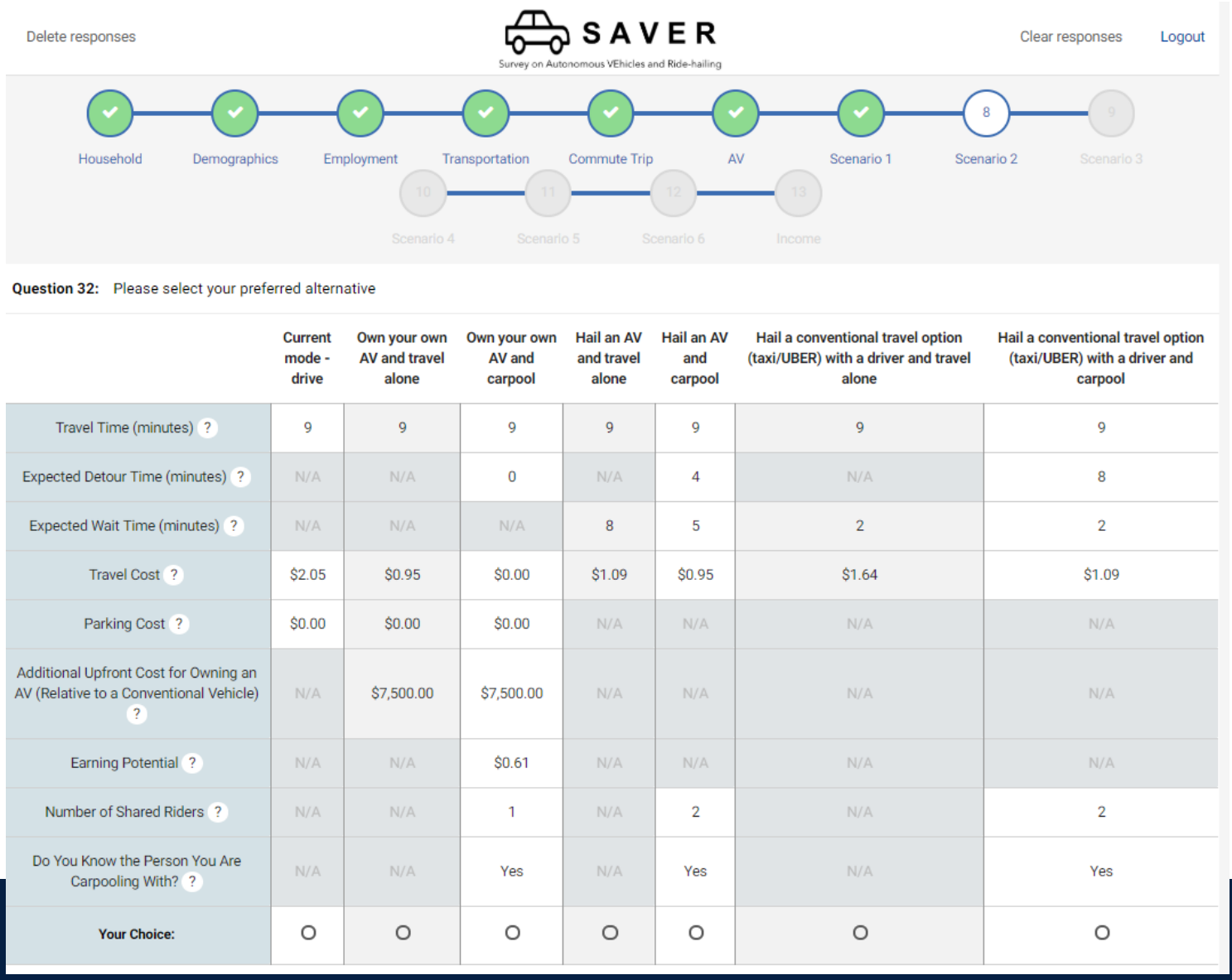
Projects on Measuring Demand Impacts

1. 2018 Experiment on Travel Mode Choice in Context of Shared and non-Shared AV (SAVER)-Adam Weiss & Faizus Salehin
2. 2019 Experiment on Willingness-to-pay for Automation- Kaili Wang& Faizus Salehin
3. 2019 Experiment on AV impacts on Vulnerable road users: People with vision impairment in an era of AV- Sina Azizisoldouz
4. 2019 Experiment on Travel Mode Choice in Context of Flexible mobility options (SPRINT)-Patrick Loa & Jason Hawkins

1. Mode Choice Impacts

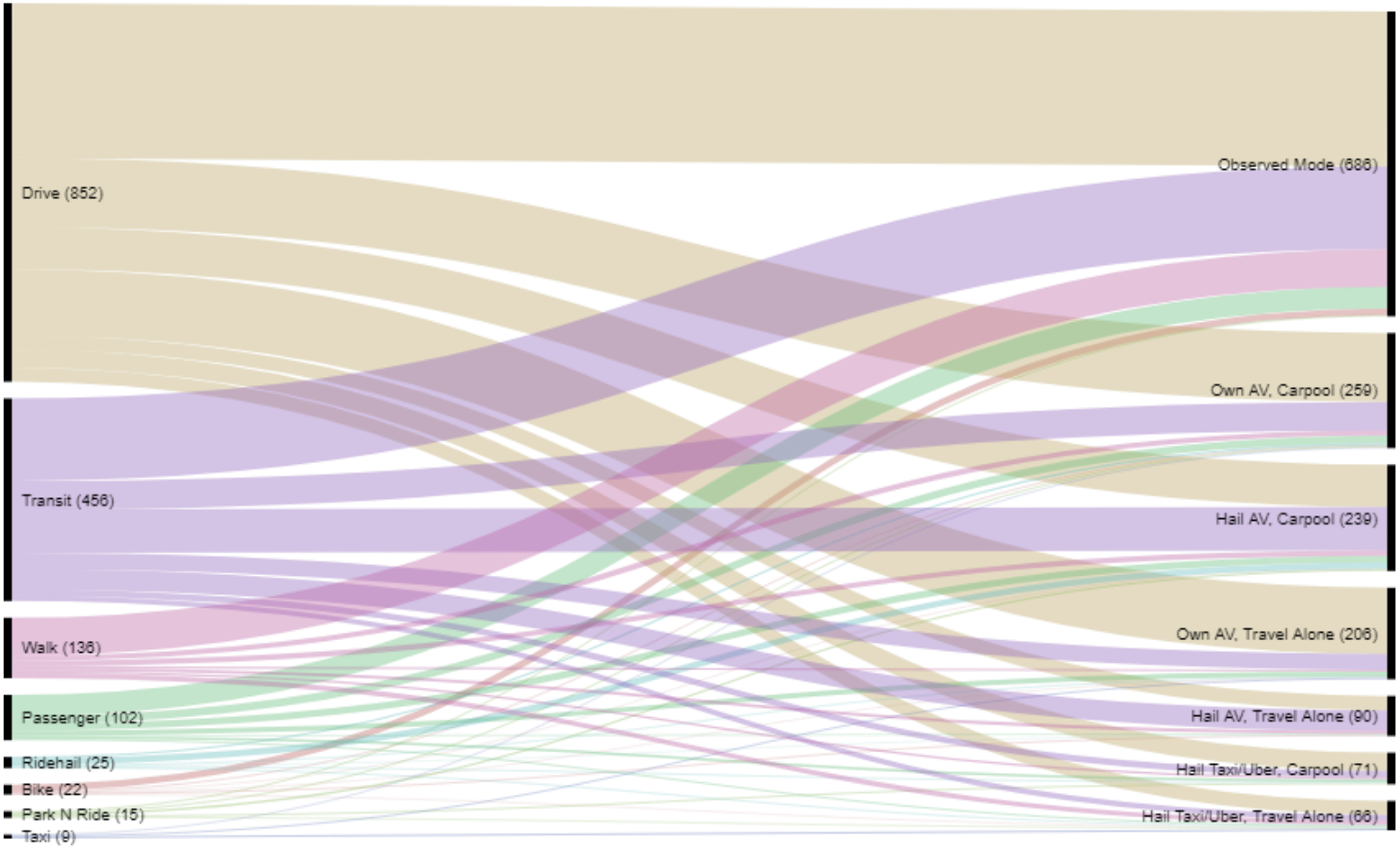
- An SP-pivoted on-RP survey on travel mode choices of the residents of the GTHA in 2018.
- Sample size of 1617 (833 commuting and 784 non-commuting trips).
- Objective was to investigate mode switching behaviour.
- Survey includes measurements of:
  - ✓ Personal and household socio-economics variables
  - ✓ Chosen mode of latest commuting and non-commuting modes
  - ✓ SP experiment
  - ✓ Attitudes and perceptions towards AV options

1. Mode Choice Impacts



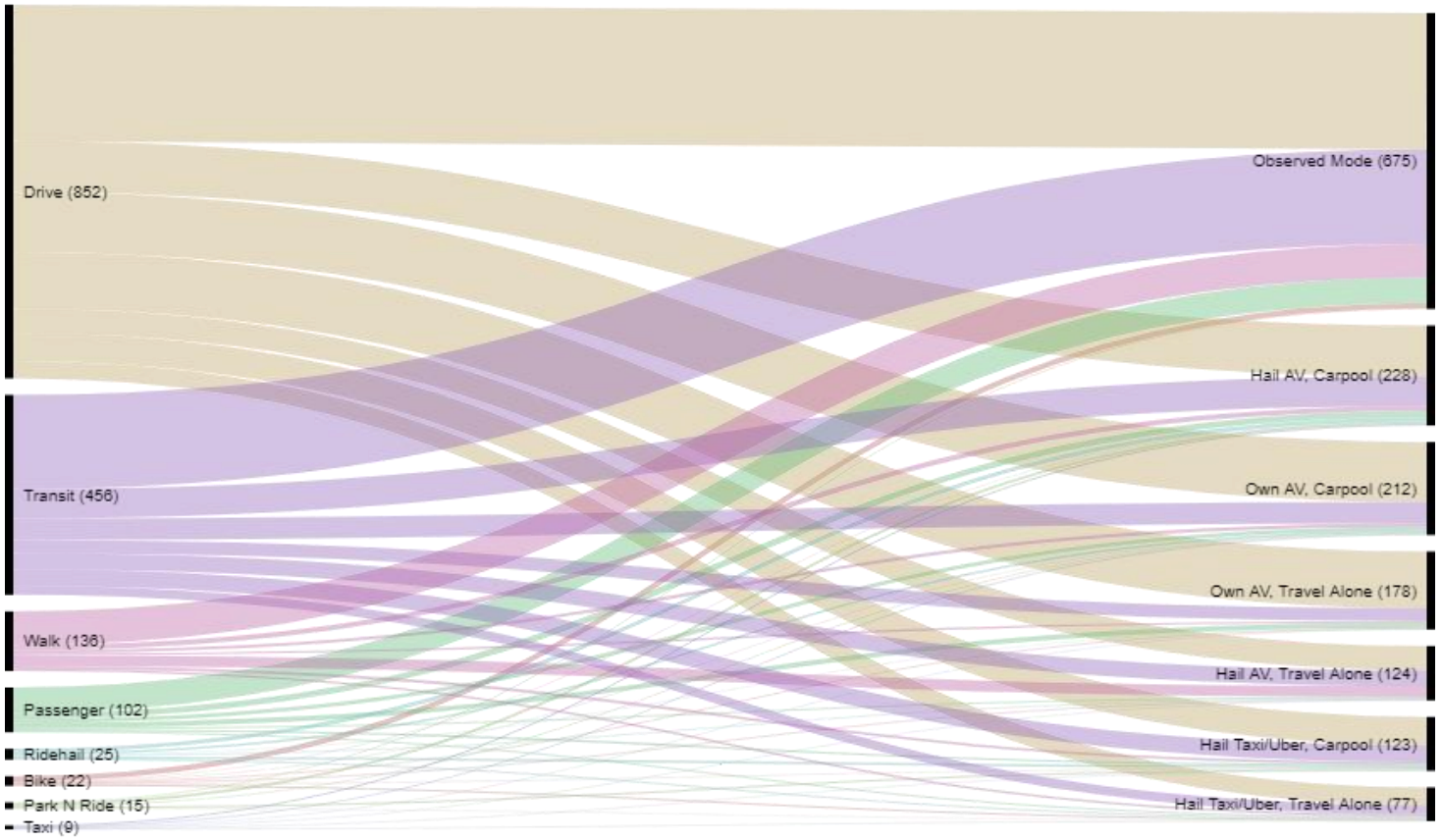
	Current mode - drive	Own your own AV and travel alone	Own your own AV and carpool	Hail an AV and travel alone	Hail an AV and carpool	Hail a conventional travel option (taxi/UBER) with a driver and travel alone	Hail a conventional travel option (taxi/UBER) with a driver and carpool
Travel Time (minutes) ?	9	9	9	9	9	9	9
Expected Detour Time (minutes) ?	N/A	N/A	0	N/A	4	N/A	8
Expected Wait Time (minutes) ?	N/A	N/A	N/A	8	5	2	2
Travel Cost ?	$2.05	$0.95	$0.00	$1.09	$0.95	$1.64	$1.09
Parking Cost ?	$0.00	$0.00	$0.00	N/A	N/A	N/A	N/A
Additional Upfront Cost for Owning an AV (Relative to a Conventional Vehicle) ?	N/A	$7,500.00	$7,500.00	N/A	N/A	N/A	N/A
Earning Potential ?	N/A	N/A	$0.61	N/A	N/A	N/A	N/A
Number of Shared Riders ?	N/A	N/A	1	N/A	2	N/A	2
Do You Know the Person You Are Carpooling With? ?	N/A	N/A	Yes	N/A	Yes	N/A	Yes
Your Choice:	○	○	○	○	○	○	○

1. Mode Choice Impacts



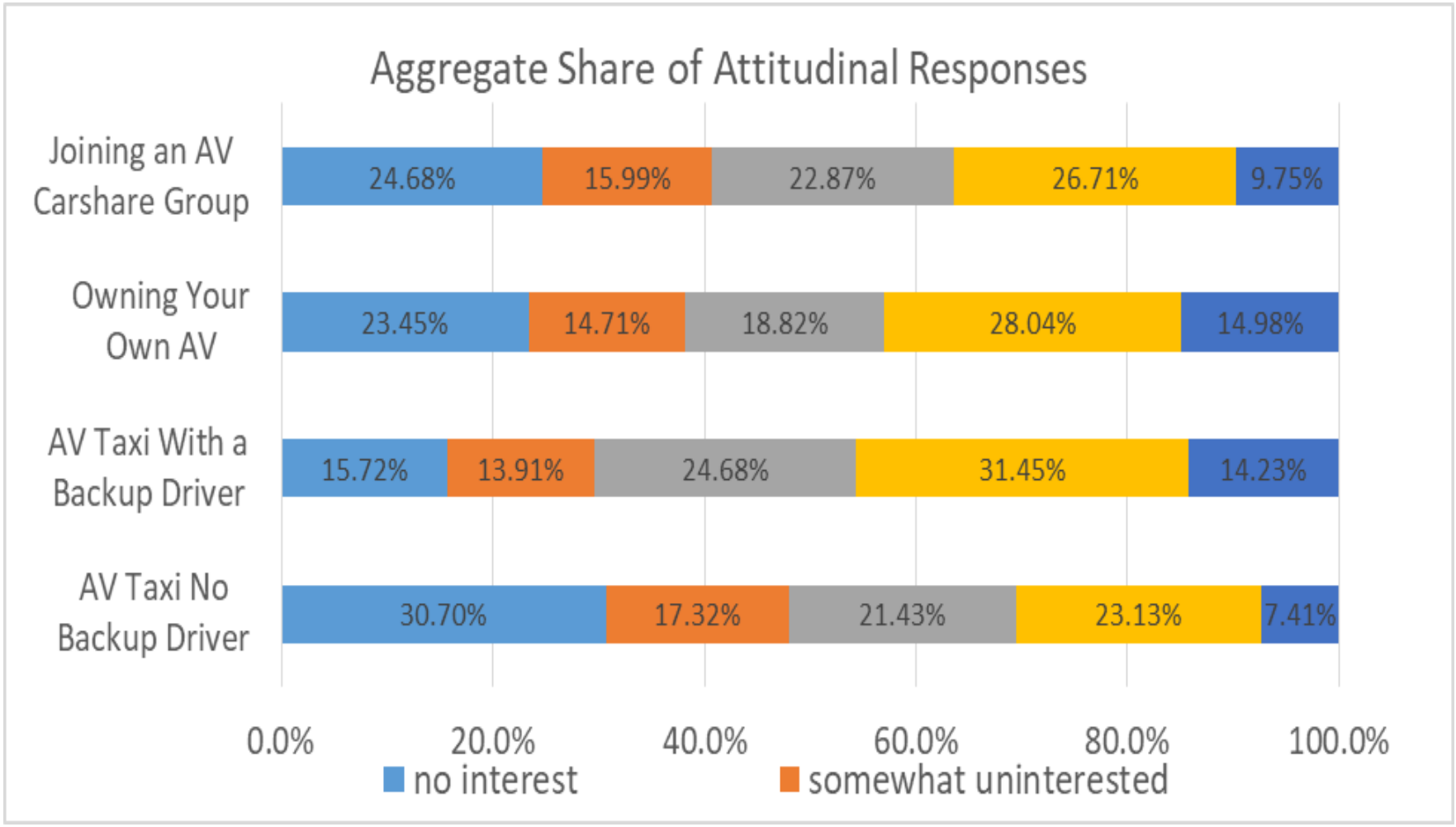
SP Modal Distribution (Commuting Trips)

1. Mode Choice Impacts



SP Modal Distribution (Non-Commuting Trips)

1. Mode Choice Impacts



1. Mode Choice Impacts

- On-Going Research:
  - ✓ Joint RP-SP GEV mode choice modelling
  - ✓ Structural Equation Modelling to identify latent constructs/traits that drive behaviour/habit/attitude
  - ✓ Discrete mode choice model with latent perception/attitude variable

2. Willing-to-Pay for Automation

- A survey on vehicle choice.
- Survey question includes:
  - Personal and household information
  - Current car information
  - Contingent valuation of different features of automation
  - SP survey on new vehicle type choice
- Sample size: 238 individual distributed across the GTA

2. Willing-to-Pay for Automation

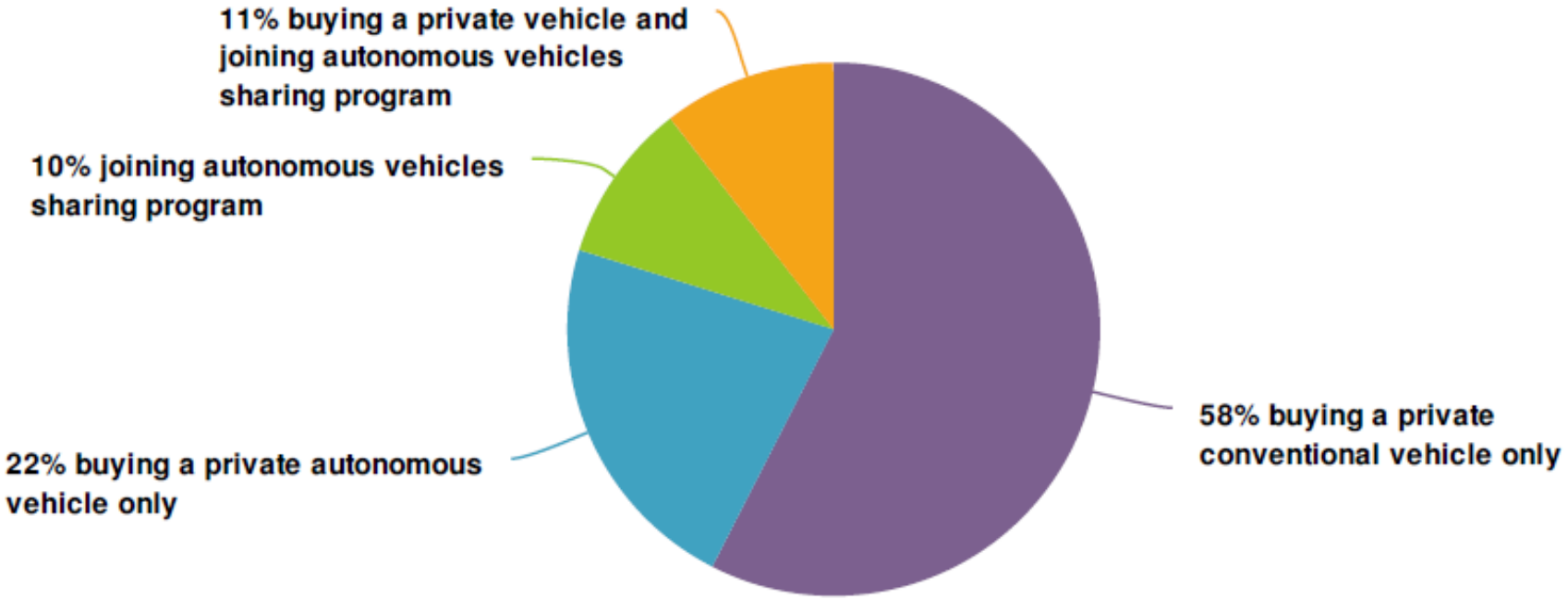
	Mean	Standard deviation
Driver Assistance	$1,042	3080
Partial Automation	$1,667	3828
Conditional Automation	$2,197	5588
High Automation	$2,642	6027
Full Automation	$3,351	7593

- Direct question about how much you'd be willing to pay for?
- This will be compared against estimated willingness-to-pay based on SP data

2. Willing-to-Pay for Automation

	Private Conventional Vehicle	Private Autonomous Vehicle	Autonomous vehicle sharing membership	Private vehicle + Autonomous vehicle sharing membership	
				Your Private Vehicle	Your Sharing Membership
Automation level	No Automation	Conditional Automation	Conditional Automation	Conditional Automation	Full Automation
Additional cost	No additional cost	$8000 higher	N/A	$1000 higher	N/A
Driving rate	N/A	N/A	$15 per hr	N/A	$25 per hr
Driving cost	$40 per 100km	$40 per 100km	N/A	$30 per 100 km	N/A
Membership application fee	N/A	N/A	$150	N/A	$0
Monthly parking + insurance	$450	$450	N/A	$230	N/A
Monthly subscription fee	N/A	N/A	$10	N/A	$0
Monthly mileage limit	Unlimited	Unlimited	4400 km	Umlimited	1350 km
General traffic condition	Below Speed Limit	Below Speed Limit	Stop and go	Stop and go	

2. Willing-to-Pay for Automation



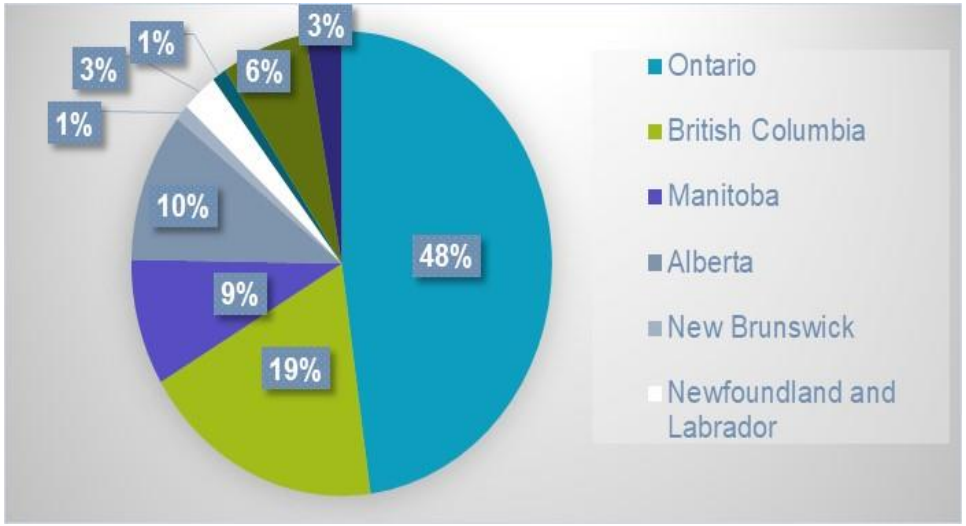
2. Willing-to-Pay for Automation

- On-going research:
  - ✓ Econometric modelling of vehicle choice to estimate willingness-to-pay
  - ✓ Comparing estimated values against elicited values

3. Impacts on Vulnerable Users

- Understanding the impact of connected and automated vehicles for pedestrians with sight loss
- A behavioural survey on perception and potential impact of AV/CAV on pedestrian with sight loss
- Sample size:406

- Survey includes measurements of:
  - ✓ Personal attributes
  - ✓ Perception and Attitude towards AV/CAV
  - ✓ Opinion about possible policy options



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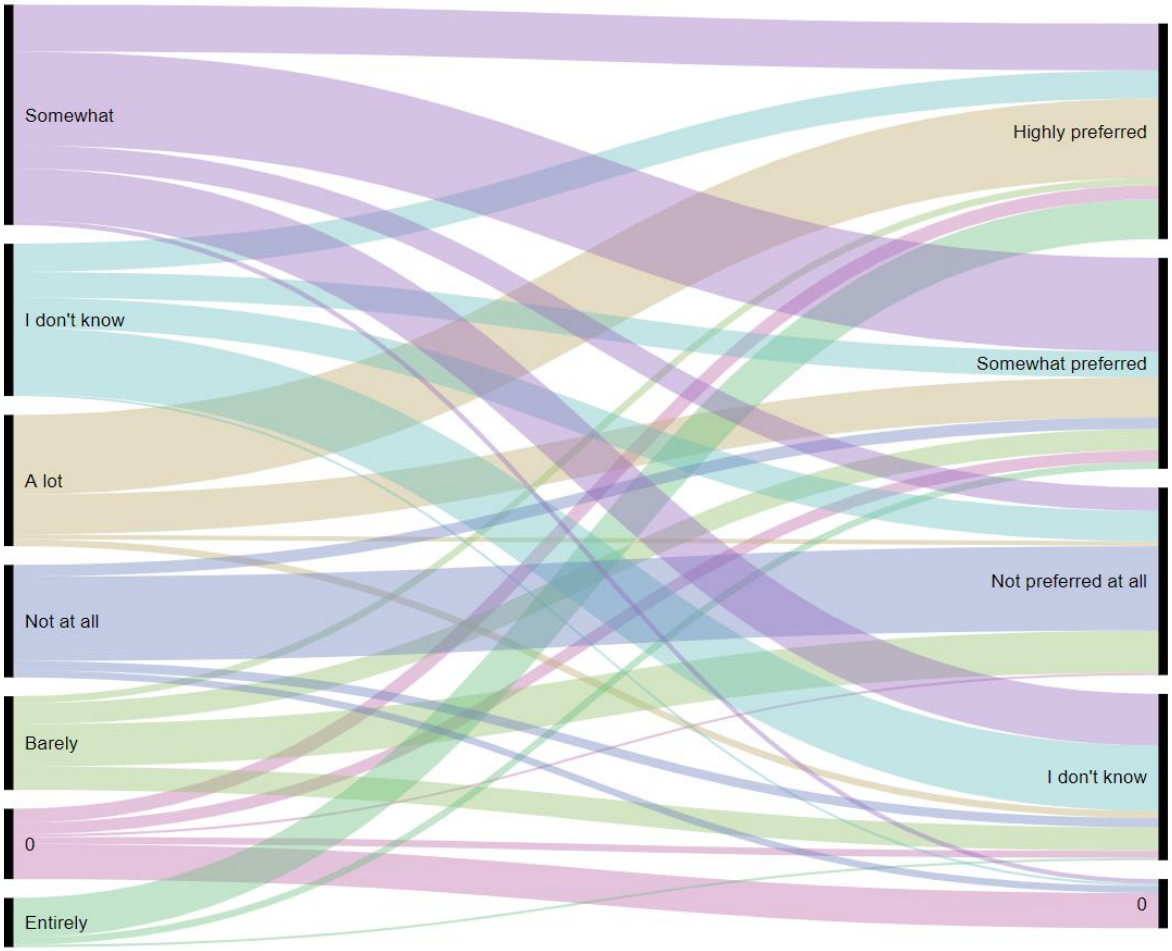
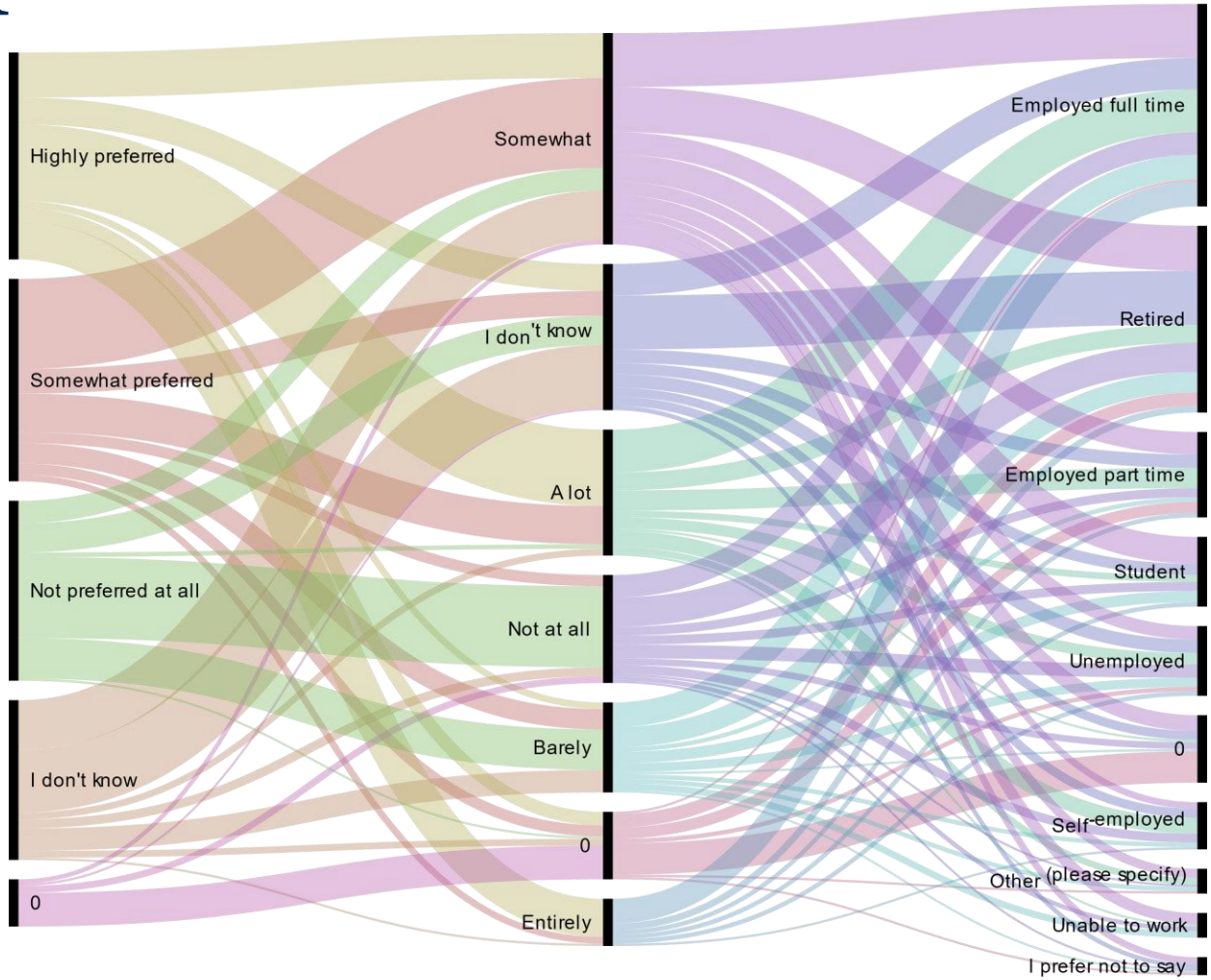


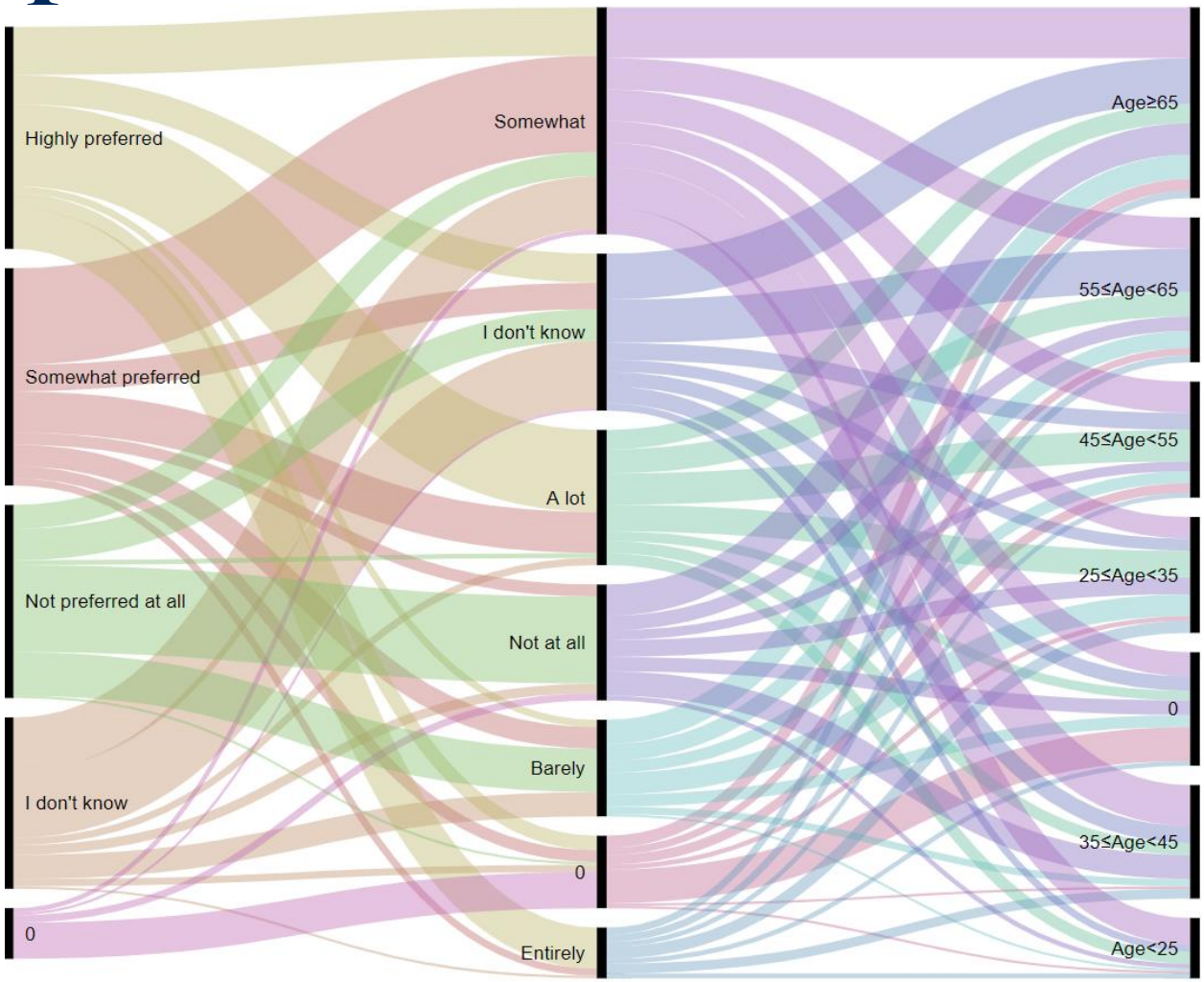
Trust to CAV versus preference for using CAV

3. Impacts on Vulnerable Users



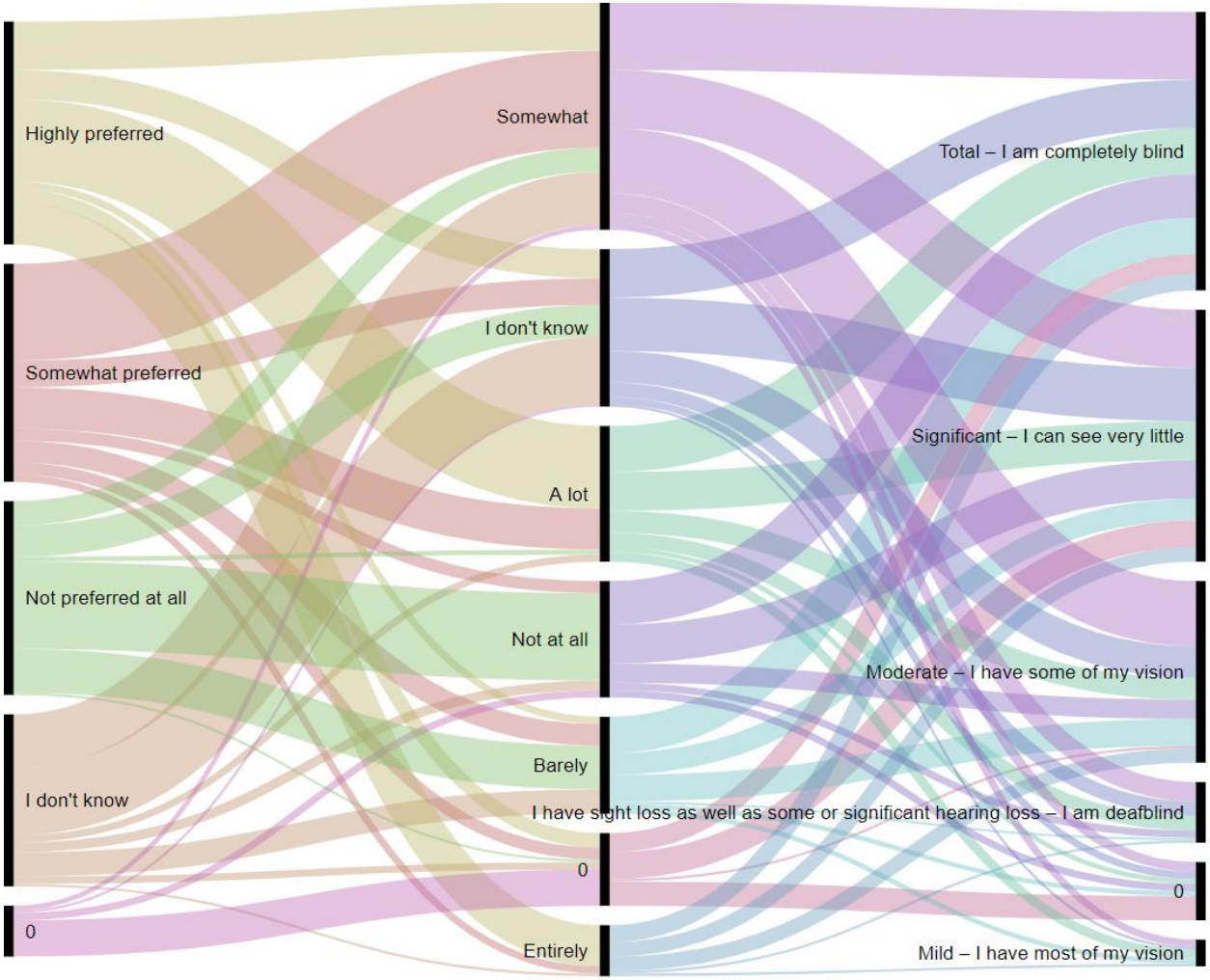
Preference for using CAV versus level of trust and employment status

3. Impacts on Vulnerable Users



Preference for using CAV versus level of trust and age categories

3. Impacts on Vulnerable Users



Preference for using CAV versus level of trust and sight loss experiences

3. Impacts on Vulnerable Users

- On-going research:
  - ✓ Statistical analysis of factors influencing perceptions/opinions towards AV/CAV
  - ✓ Policy options to mitigate negative impacts

4. Mode choice in Flexible/New Mobility Context

- An SP-pivoted on-RP mode choice experiment to capture tradeoff involved in mode choices in context of TNC service options in the City of Toronto.
- Sample size: 800+
- Survey includes measurements of:
  - ✓ Personal and household socio-economics variables
  - ✓ Chosen mode of latest commuting and non-commuting modes
  - ✓ SP experiment
  - ✓ Attitudes and perceptions towards TNC services

4. Mode choice in Flexible/New Mobility Context

Question 41: Please choose the alternative that you would prefer to use **for your typical commuting trip**.

	Drive yourself	Driven by someone you know	Public Transit	Exclusive Ride Hailing	Shared Ride Hailing	Taxi	Bicycling	Walking
Travel Time (mins) ?	6	6	29	6	7	6	6	14
Travel Cost ($) ?	$0.22	$0.11	$ 3.10	$1.94	$1.30	$7.39	-	-
Waiting Time (mins) ?	-	-	7.5	2	5	2	-	-
Walking Time (mins) ?	-	-	5	-	-	-	-	-
Parking Cost ($) ?	$ 15	-	-	-	-	-	-	-
Other Passengers ?	-	-	-	-	1	-	-	-
Delay Time (mins) ?	-	-	1	-	4	-	-	-
Level of Crowding ?	-	-	Moderately crowded (50% chance of getting a seat)	-	-	-	-	-
Frequency of Delays over 5 mins ?	-	-	Once a month	-	-	-	-	-
Your Choice:	○	●	○	○	○	○	○	○

4. Mode choice in Flexible/New Mobility Context

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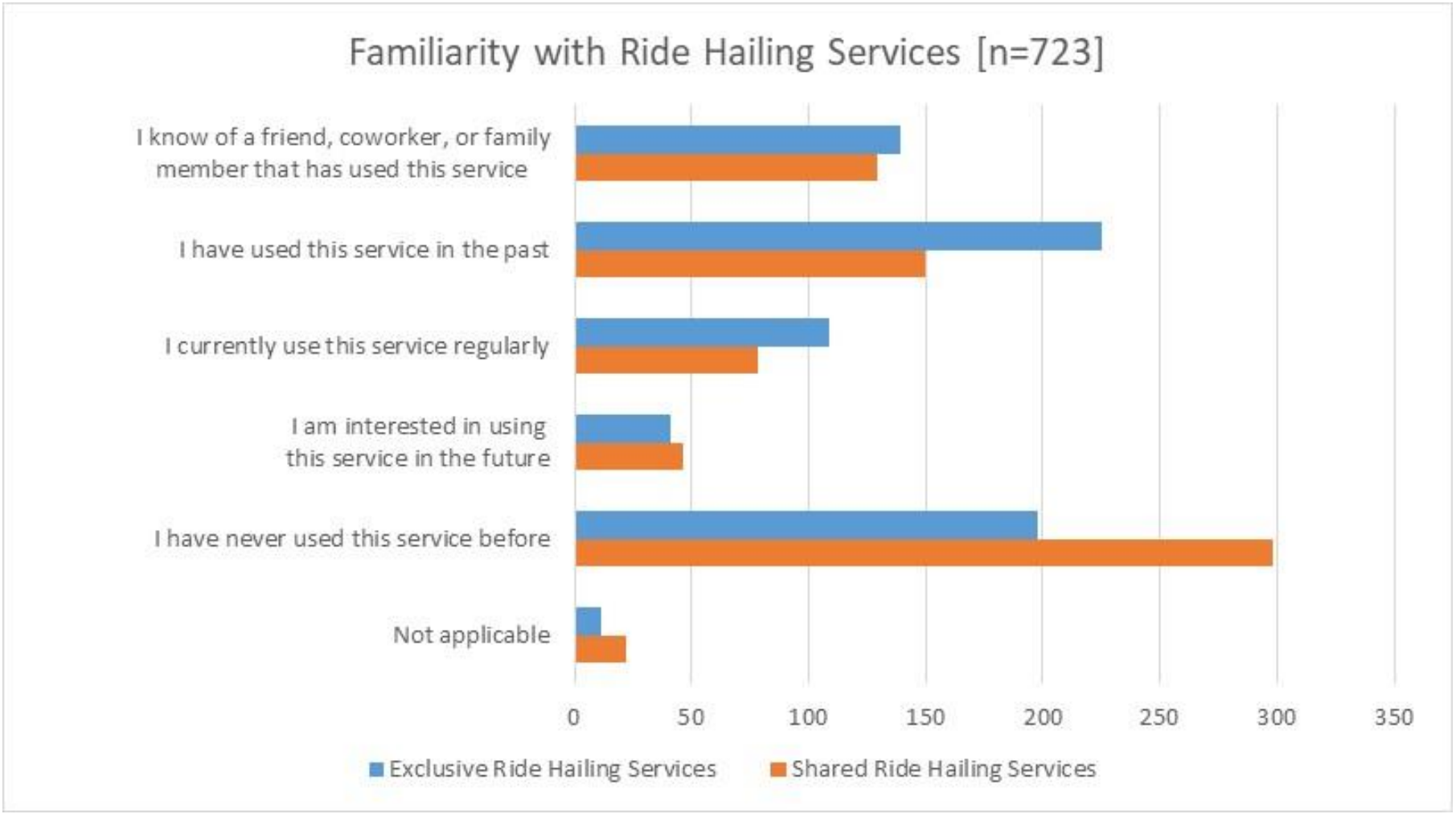

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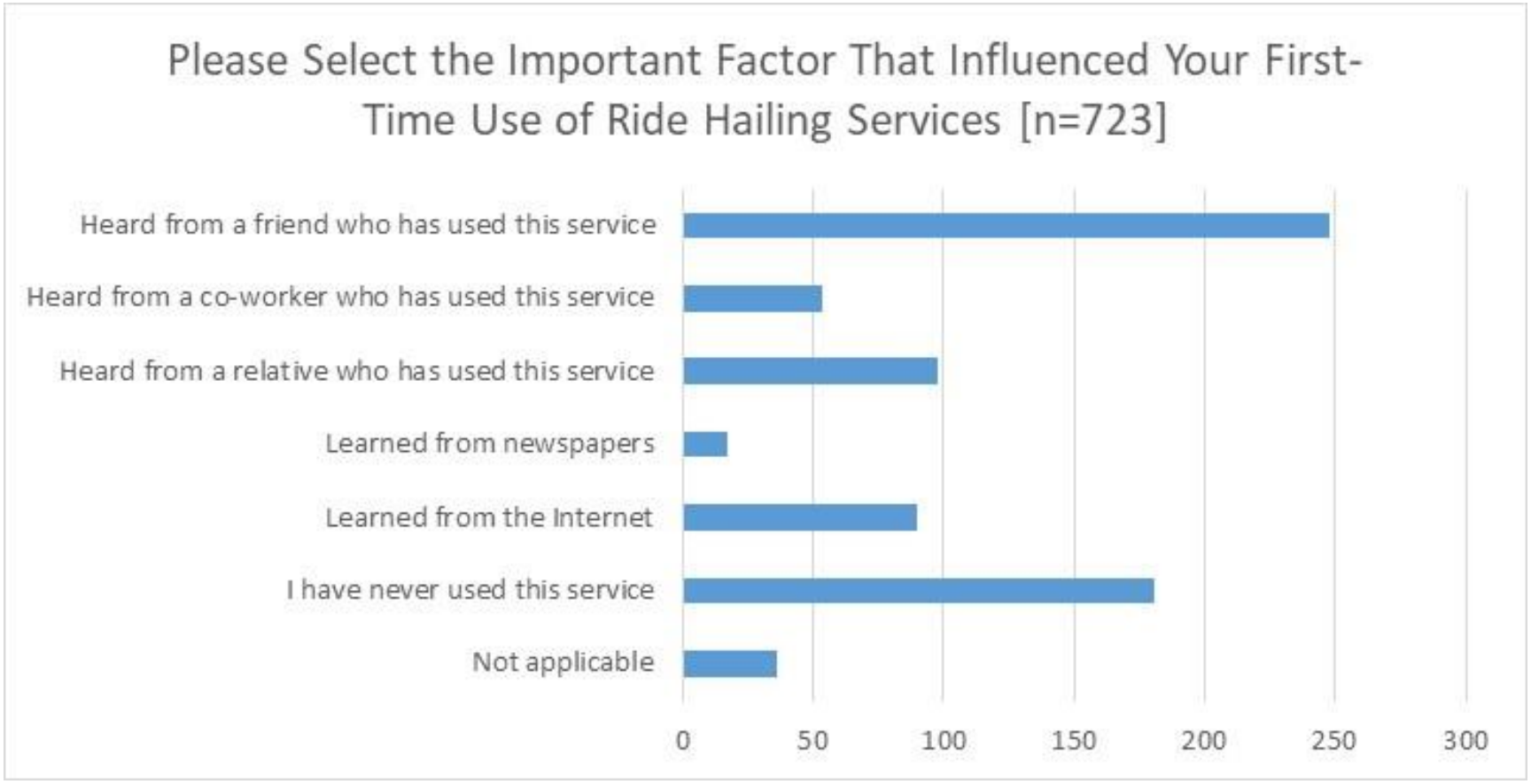
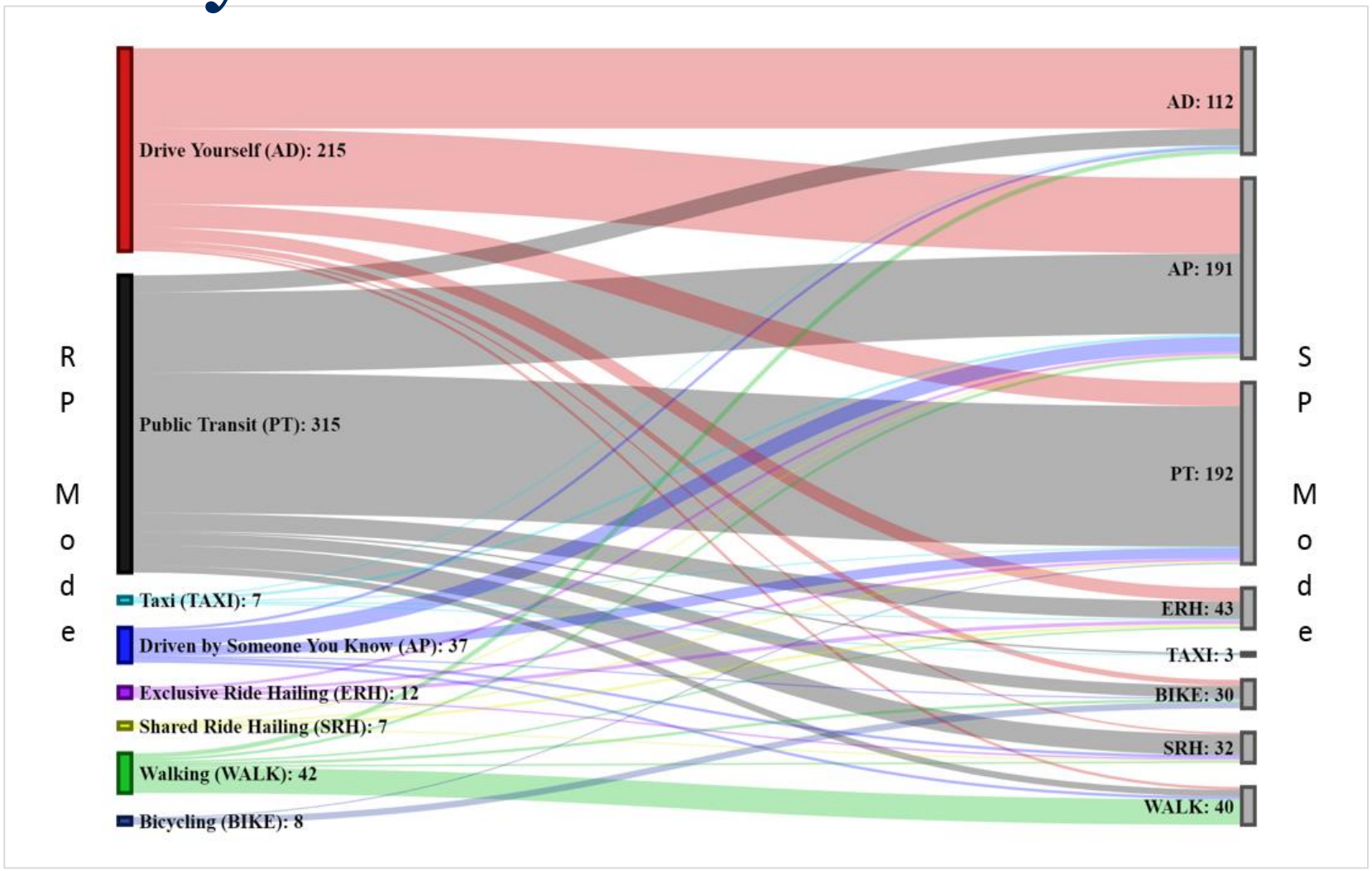


4. Mode choice in Flexible/New Mobility Context



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Q&A

Thank you for listening

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