Understanding Impact of Transformation on Travel Demand and Travel Behaviour

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UTTRI

Presentation Overview

- Travel demand in the context of AV
- What we know and what we don't know about AV and travel demand
- The problem that AV presents (and the solution!)
- Stated preference backgrounder
- Preliminary analysis of survey data
- Next steps

What are the Potential Impacts of AV

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

Uncertainty of Outcomes

- Most of these impacts are **hypothetical** and depend on a number of different factors:
  - 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?

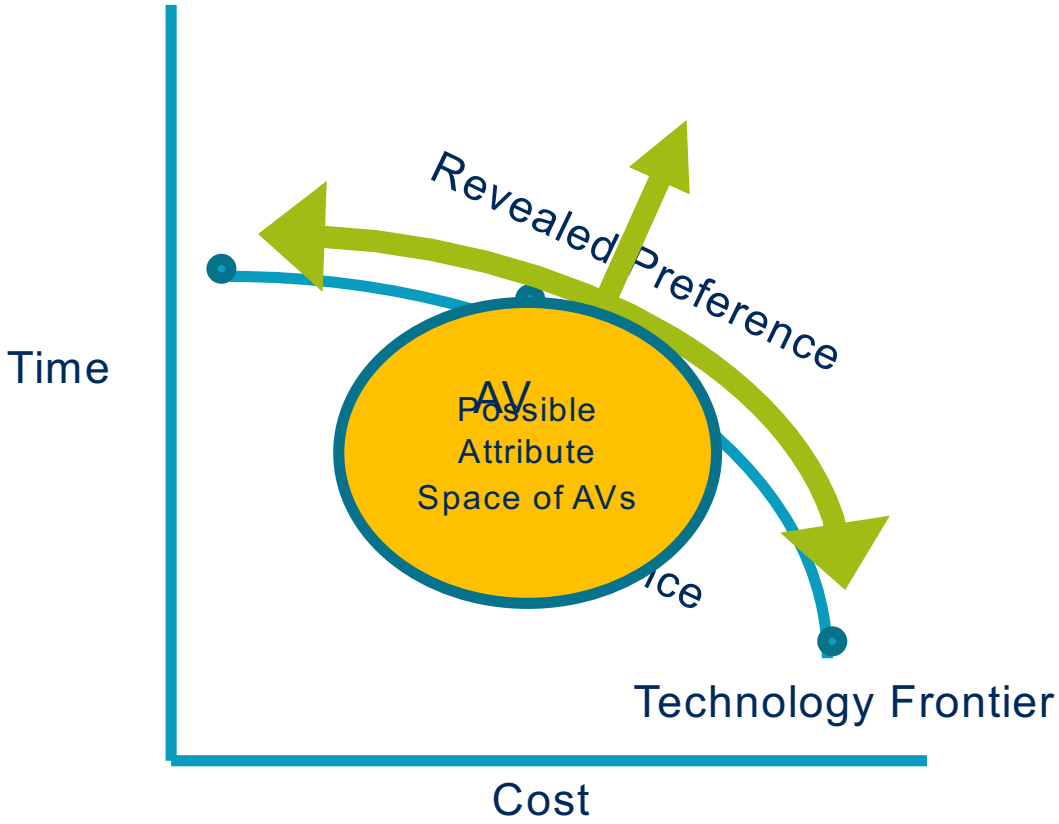
Problem for Planners

- Massive set of potential impacts and large amount of uncertainty
- We have no way of predicting what will happen
- We can't begin to start planning and coordinating to control the paradigm shift towards positive impacts
- We need a comprehensive analysis tool to understand what are the potential impacts

Comprehensive Planning and Analysis Tool

- Needs for developing a comprehensive planning and analysis tool:
  - Data (behavioural data in response to new technology)
  - Policy sensitive models of travel demand
  - Policy sensitive land use transportation interaction models
  - Policy sensitive integrated urban freight model

Technology Frontier



Stated Preference Survey in a Nutshell

Attributes\ Alternatives	Alt 1	Alt 2	….	Alt M
Attribute 1	$Level_{11}$	$Level_{12}$	…	$Level_{1M}$
Attribute 2	$Level_{21}$	$Level_{22}$	…	$Level_{2M}$
….	…	…	…	…
Attribute N	$Level_{N1}$	$Level_{N2}$	…	$Level_{NM}$
Choice				

- Alternatives are the labels defining the set of options a respondent picks from
  - e.g. carpooling in an AV, riding alone in an AV
- Attributes are the specific measures by which we distinguish an one alternative from another
  - e.g. **travel time** and **travel cost**
- Levels are the specific values of an attribute for a given alternative
  - e.g. carpooling has a travel time of 12 minutes where as riding in an AV alone has a travel time of 10 minutes

Stated Preference vs. Revealed Preference Data

- Data sources are generally complementarity:
  - Weaknesses of one are compensated by the strengths of the other
    - **RP** data provides actual preferences but generally does not provide great insight into behavioural response to new technology
    - **SP** data provides biased hypothetical preferences but gives a much better understanding of shifting technology frontiers
  - Joint modelling of both RP and SP provides deeper insights than modelling only one alone

Consumer Survey vs. Stated Preference

- Simpler approach could be just to ask:
  - Would you take an autonomous vehicle at a given price point?
  - Would you buy an autonomous vehicle at a given price point?
- These sorts of questions represent **consumer surveys**
  - Asks general and vague questions about the willingness to pay for different features
  - Features are often poorly defined (only considers price, not changes to other attributes)
  - Results have limited behavioural interpretability (no ability to develop comprehensive analysis tool)

SP in the Context of Automation

- Generally we have a set of main questions when it comes to AV impacts:
  - How will AVs be used (**owned** versus **ride hail**)?
  - Will AVs be shared (**HOV**) or will they be used as single (or zero) occupancy vehicles (**S/ZOV**)?
  - How much will AVs **cost** relative to conventional vehicles?
  - How much **faster** will our roadways be compared to today?
- Our challenge is to define alternatives, attributes and levels that will specifically allow us to capture potential outcomes

Summary of SP Design (alternatives)

- Captured choice between conventional **ownership** and **ridehail** and **HOV** versus **S/Z OV** through creating **4 new modal alternatives**
  - Own your own AV and travel alone
  - Own your own AV and carpool
  - Ride Hail an AV and travel alone
  - Ride Hail an AV and carpool
- We also included conventional (with a driver) ride hail options to account for resistance to automation amongst consumers

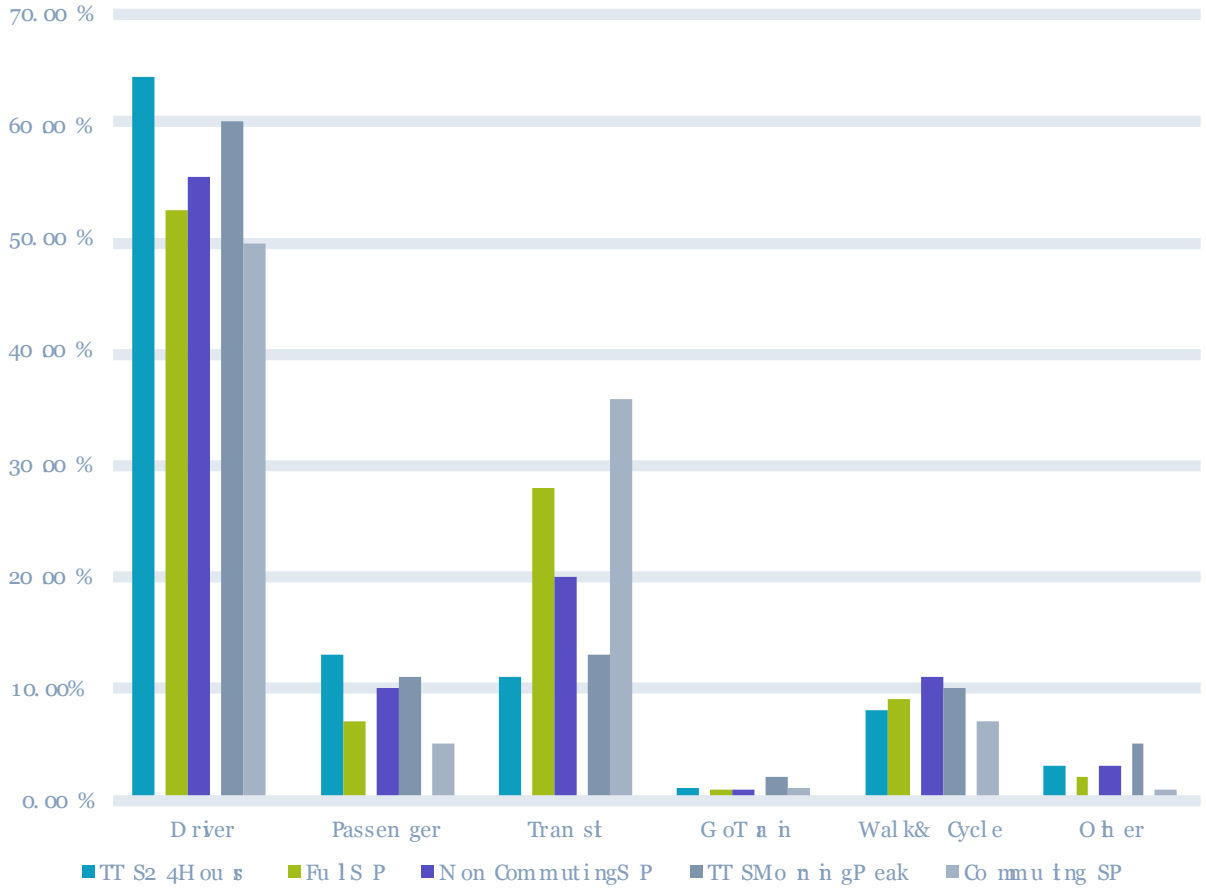
Summary of SP Design (Attributes and Levels)

- **Travel time** ranges were determined based on key findings from literature (ranging from **no travel time savings** to **20% reduction in travel time**)
- **Travel cost** was set between on **existing travel costs** and forecasted lower end cost **($0.30/km for ride hail**, **$0.20/km for owned AV**s).
  - Owning your own AV and carpooling also potentially acted as an income generator
- Other attributes examined include:
  - Reduced parking cost
  - Number of individuals carpooling with you
  - If you know the individual with who you are carpooling
  - Wait time for pick up
  - Detour times for pick up and drop off of carpool passengers
  - Upfront ownership cost of owning an AV

Data Collection Progress Thus Far

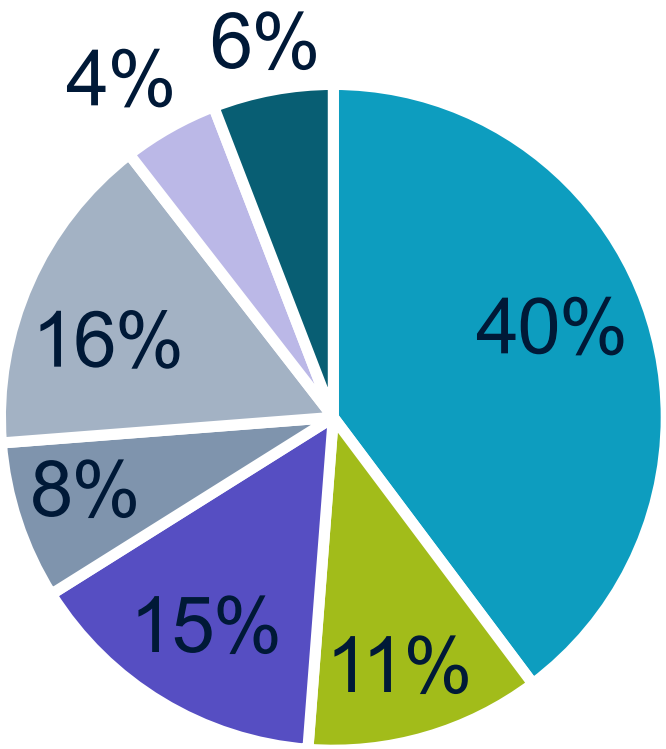
- Funding partnership with MTOs Highway Infrastructure Innovation Funding Program
- Joint RP and SP data set has been collected
- Examined both **commuting** and **non-commuting** trips
- Sample taken from the Greater Golden Horseshoe
- A total of 1894 usable records were collected
- Preliminary analysis of the data looks promising

RP Modal Share Against 2016 TTS



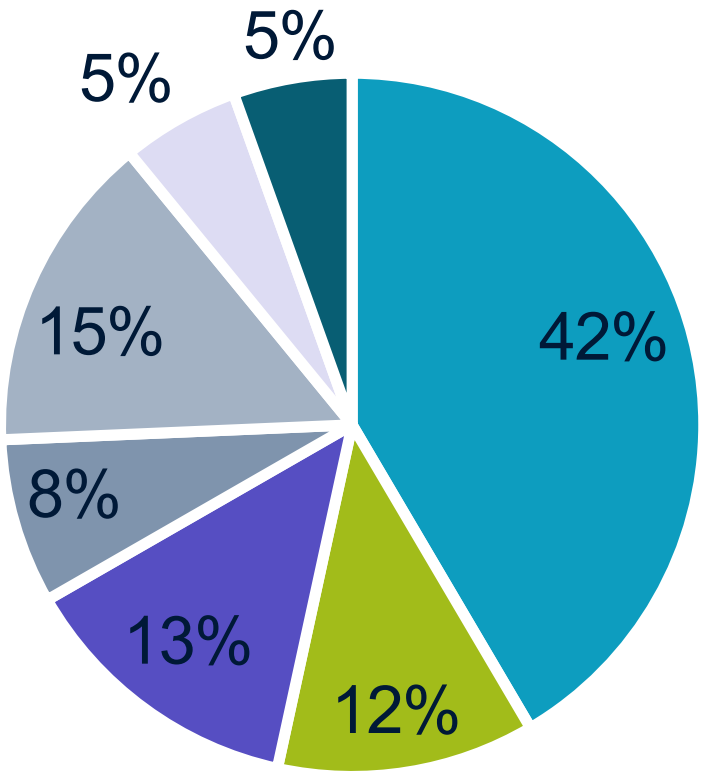
- Generally a higher than expected Transit Share for SP relative to ground truth of TTS
- Not ideal as not entirely a representative sample
- Corrections can be applied for modal share when model used for forecasting

SP Modal Share Commuting Trips



- Observed RP Mode
- Own AV with No Other Passengers
- Own AV Carpool
- Ride Hail AV No Other Passengers
- Ride Hail AV Carpool
- Ride Hail Conventional No Other Passengers
- Ride Hail Conventional Carpool

SP Modal Share Non-Commuting Trips



- Observed RP Mode
- Own AV with No Other Passengers
- Own AV Carpool
- Ride Hail AV No Other Passengers
- Ride Hail AV Carpool
- Ride Hail Conventional No Other Passengers
- Ride Hail Conventional Carpool

General Comments

- Generally similar behavioural patterns between commute and non-commute trips
- Resistance and uncertainty about AVs apparent:
  - Strong reluctance to switch away from observed mode
  - Some interest in ride hailing with a driver despite these modes not being as fast or cheap as autonomous options
- Further modelling of the data is required

Plans for Future Work

- Currently only looking at AV as a stand alone option
  - No integration with **transit** (first mile last mile solution)
- Value of travel time information can inform land use choice
  - **Further data** is needed to provide definitive link between AV adoption and land use changes
  - Choice of place of residence and place of work may change drastically as a result of AVs
- Initial data needs to be applied to the development of robust **behavioural sensitive models** to direct further research (in progress)
- Move towards more complex experimental design procedures (stated adaptation)

Q&A

Thank you for listening

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