TCRP H-37: *Characteristics of Premium Transit Services that Affect Choice of Mode*

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Overview

1. Objectives
2. Surveys
3. Transit Service Characteristics
4. Awareness and Consideration
5. Traveler Attitudes
6. Mode Choice
7. Implementation

Project Goals

1. To improve the transit industry's understanding of mode choice determinants

2. To offer practical insights to the forecasting community so that mode choice models and transit path-builders can better represent and distinguish important mode characteristics

Methods to Improve Practice and Achieve Project Goals

- Include measurable variables that potentially distinguish premium transit services

- Include latent variables that impact modal choice

- Consider which transit paths are represented in choice sets

Project Overview

| | Phase 1 | Phase 2 | |
Project Tasks	Salt Lake City	Charlotte	Chicago
Surveys	✓	✓	✓
Traveler Attitude Models	✓	✓	✓
Service Characteristics Models	✓	✓	✓
Awareness and Consideration Models		✓	✓
Mode Choice Models	✓	✓	✓
Implementation and Testing	✓		

Transit Service Characteristics
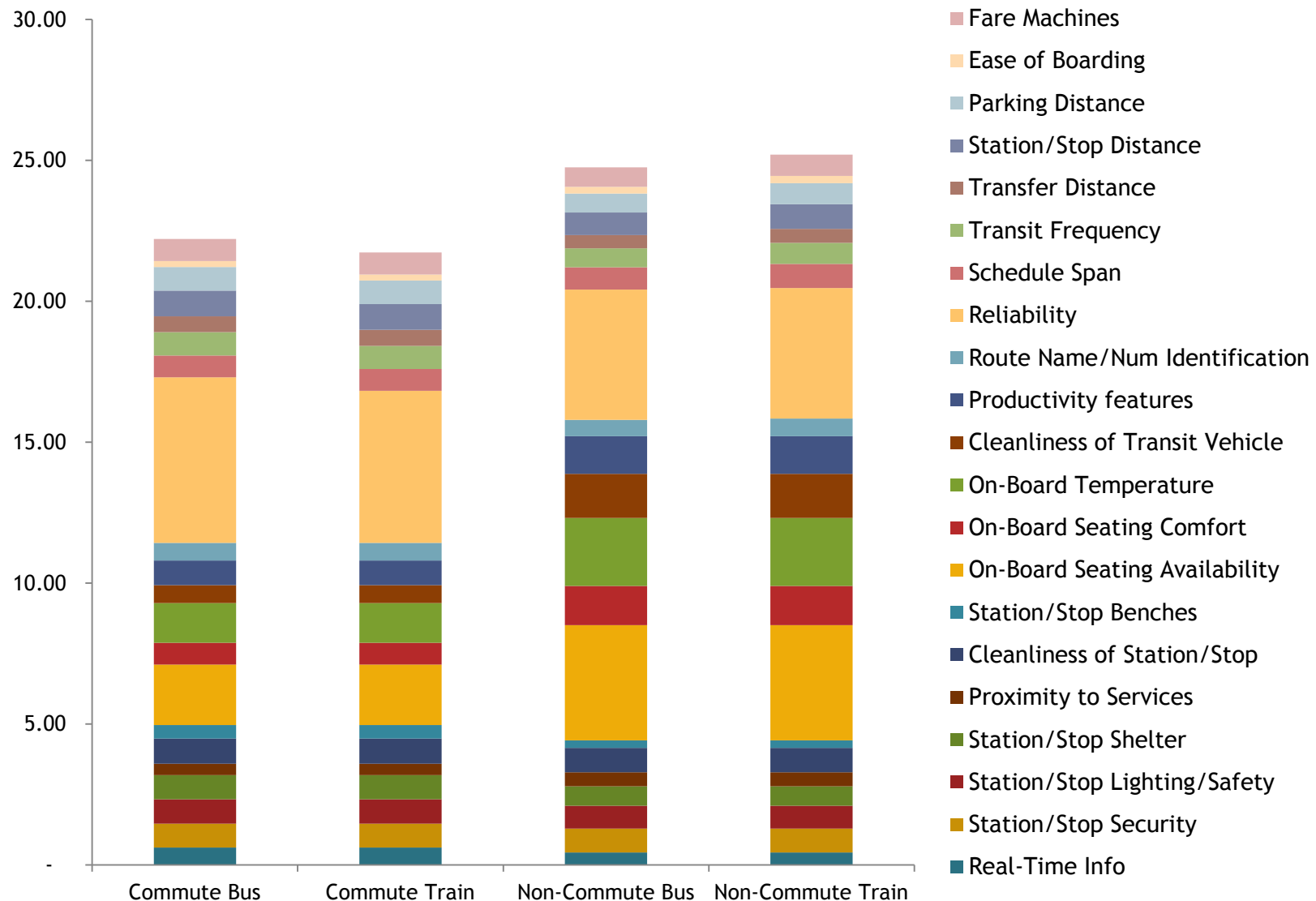
Transit service attributes

| Attribute bundle	Attribute	Premium Attributes	Standard Attributes
Station/stop design features	Real-time info about next transit arrival/departure	Real-time info available	No real-time info available
	Station/stop security	Enhanced (e.g., emergency call-buttons, surveillance cameras, security personnel)	No added security features
	Station/stop lighting/safety	Well-lit with police presence	Normal lighting and no police presence
	Station/stop shelter	Effectively protects you from bad weather	Limited or no shelter
	Proximity to services	Close to coffee shop, dry cleaners, grocery, etc.	Not close to coffee shop, dry cleaners, grocery, etc.
	Cleanliness of station/stop	Well-maintained and clean	Not well maintained
	Station/stop benches	Clean and comfortable	Some benches
On-board features	On-board seating availability	Always available seats	Often crowded; you might not get a seat
	On-board seating comfort	Seats are comfortable and a good size	Seats are standard
	On-board temperature	Effective air-conditioning and heating	Some air-conditioning and heating
	Cleanliness of transit vehicle	Very new and clean	Maintained, but not new
	Productivity features	Wi-Fi, power outlets, etc. available	Productivity features not available

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Transit service attributes

Attribute bundle	Attribute	Premium Attributes	Standard Attributes
Not part of a bundle	Route name/number identification	Easy to identify on outside of transit vehicle	Difficult to immediately identify on outside of transit vehicle
	Reliability	1 in 10 trips are 5 minutes late or more	1 in 10 trips are 15 minutes late or more
	Schedule span	Transit runs from 4 AM until 11 PM	Transit runs during rush hours only
	Transit frequency	Arrives every 10 minutes in rush hour and every 20 minutes in non-rush hour	Arrives every 20 minutes in rush hour and every 60 minutes in off-peak
	Transfer distance	Convenient (short walking distance or on same platform)	Several minute walk
	Station/stop distance	Within 10 minutes walk of your home/work	Not within 10 minutes walk of your home/work
	Parking distance	Within 10 minutes walk from station/stop	Not within 10 minutes walk from station/stop
	Ease of boarding	Easy to board; doors are level with platform/curb	Must step up to board
	Fare machines	Fast and easy to use	Slow and somewhat confusing

Equivalent Minutes of In-Vehicle Time Chicago

Traveler Attitudes

Approach to Mode Choice Modeling

- **Transit Service Attributes**
  - Maximum difference models have been used to incorporate detailed transit service attributes

- **Traveler Attitudes**
  - Factor analysis and latent variable modeling have been used to estimate attitudinal factors

- **Awareness and Consideration**
  - Joint bivariate binary probit model have been used to predict the choice sets for awareness and consideration of transit modes

- **Mode Choice**
  - Multinomial logit and integrated choice latent variable models have been used to predict modal choices

Factor Analysis

Factor	Salt Lake City	Charlotte	Chicago
1		Pro-Car Attitude	
2	Availability (Transit Users Only)	Pro-Transit Attitude	
3		Transit Averse	
4	Convenience (Transit Users Only)	Privacy and Comfort	
5		Environment and Productivity	
	Based on 6 Attitudinal Statements	**Based on 18 Attitudinal Statements**	

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Adding Latent Variables to Mode Choice Models

Pro-Car Attitude

- Retired
- Female
- Vehicles
- Income
- Mobility
- Drivers

Pro-Transit Attitude

- Students
- Retired
- Female
- Younger
- Vehicles
- Income
- Mobility
- Drivers

Transit Advantages Attitude

- Workers
- Income
- Younger
- Vehicles

Privacy and Comfort Attitude
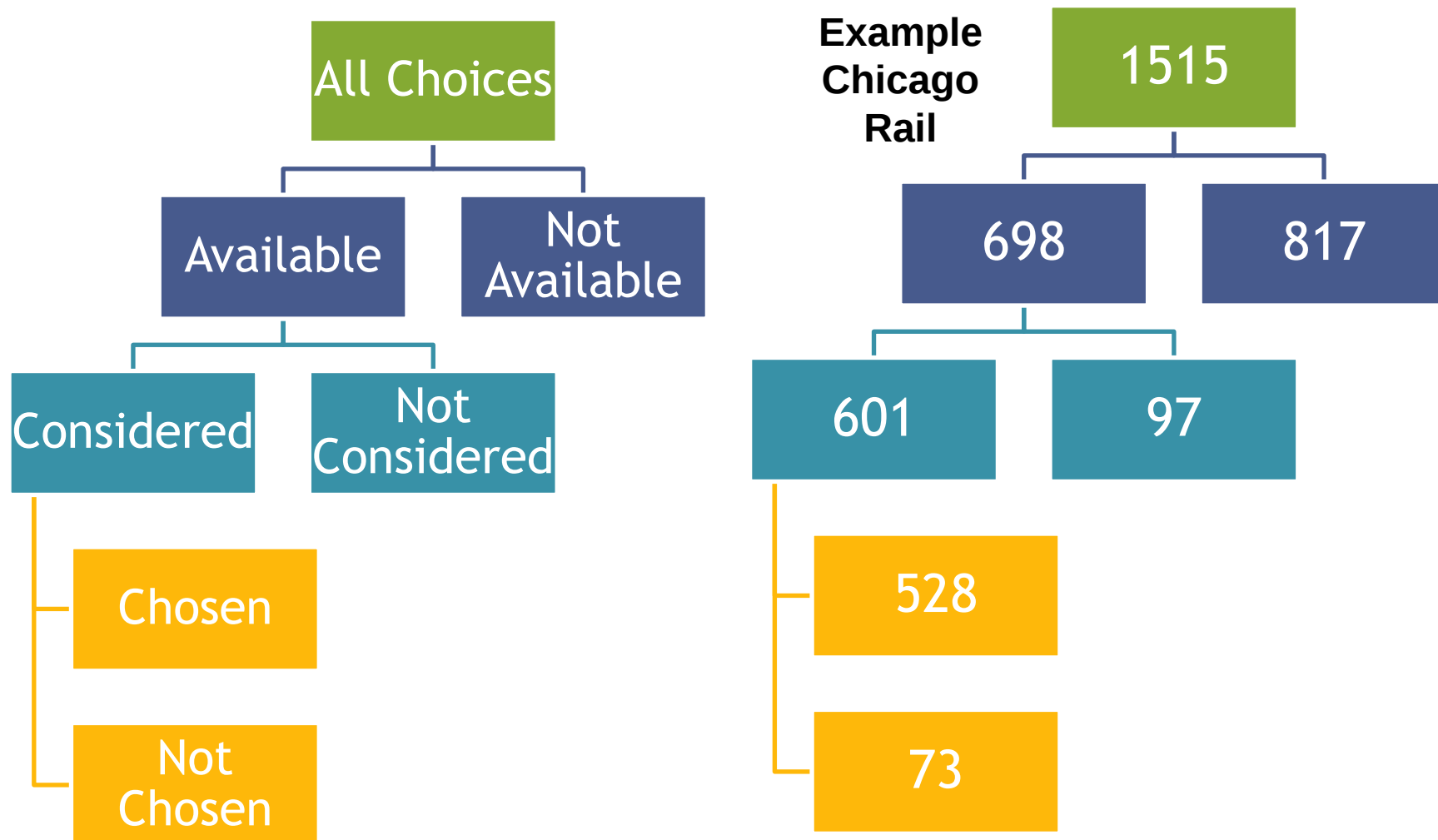
- Female
- Vehicles
- Kids

Awareness and Consideration

Consideration and Availability of Transit Modes

All Choices
- Available
  - Considered
    - Chosen
    - Not Chosen
  - Not Considered
- Not Available

Example Chicago Rail

1515
- 698
  - 601
    - 528
    - 73
  - 97
- 817

Awareness and Consideration Models Findings

- **Separating Awareness and Consideration diluted the choices and didn't add anything to the final choice sets**

- **Awareness/Consideration can be include directly in Latent Variable models**

- **Path building needs to be improved to adequately account for awareness**
  - Constraints can be problematic (walking, driving distance, etc.)
  - Competition within modes not represented

- **Limiting choice sets is useful if the choices are adequately represented**
  - Path building
  - Definition of choices
  - Nesting

Mode Choice Models

Multinomial Logit Choice Models

- **Accounts for traveler attitudes**
  - Relies on factor analysis to produce traveler attitudes as input to MNL models
  - Forecasts of traveler attitudes would require separate or integrated models
- **Uses Revealed Preference (RP) and Stated Preference (SP) data**
  - Developed joint RP-SP models that included a RP-SP scaling coefficient
  - Low values of time led to estimation of a SP-only choice model which produced a ratio of in-vehicle travel time to cost that was used to constrain the joint RP-SP model coefficients; this was employed in a 2-step model estimation process for all model testing
- **Incorporates awareness and consideration of transit modes**
  - All models were constrained based on the awareness and consideration choice sets produced by these models i.e. a feasible transit mode was only included in the choice set if a traveler is both aware of the alternative and willing to consider the alternative
- **Multinomial model structure**
  - Nested modeling structures were tested in the first phase but did not yield significant differences so was not tested (yet) for this phase

Mode Choice Non-Traditional Variables

New Level of Service

- Premium on-board amenities
- Premium station amenities
- Reliability
- Interaction with in-vehicle time and on-board amenities

Demographics

Trip Characteristics

- Group Travel
- Weekend Travel
- Makes Stops for Groceries
- Makes Stops for Other Purpose

Traveler Attitudes

- Pro-Car Attitude
- Pro-Transit Attitude
- Transit Averse
- Privacy and Comfort
- Productivity and Environment
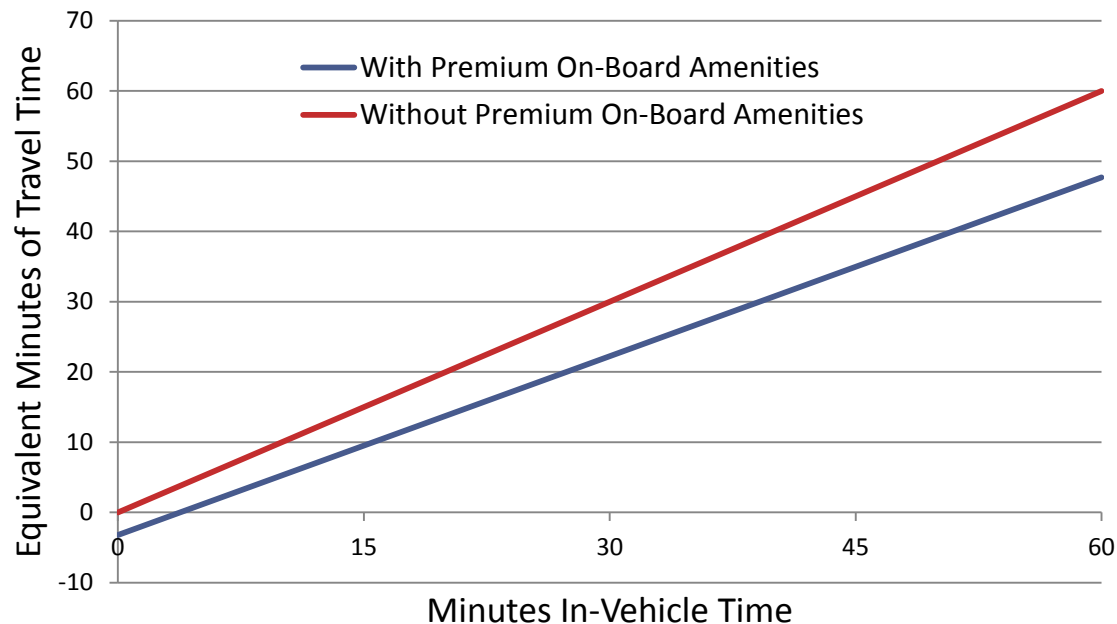
Latent Variables

- Willingness to Walk
- Informed about Transit

- **The longer the trip, the more important premium on-board amenities become:**
  - At 30 minutes, premium on-board amenities are worth 12 minutes of travel time
  - At 60 minutes, premium on-board amenities are worth 18 minutes of travel time

Difference in IVTT with Premium On-Board Amenities
(Work Trips)

Integrated Choice and Latent Variable Models

- **Simultaneous estimation of latent variables and modal choices produce a more comprehensive result**
  - Incorporate traveler attitudes in a simultaneous way where prior factor analysis and multinomial logit models incorporates attitudes in a sequential way
  - Both latent variables and traveler/trip characteristics contribute to the estimation of modal choices

- **Explicitly allow for the impact of attitudes on mode choice**
  - Attitudes are unobserved (latent) and represented by indicators of the attitudes
  - Directly incorporating the indicators in utility functions would create measurement error and endogeneity bias

- **Provide a means to apply and forecast attitudinal variables**
  - Attitudes are a function of demographic variables
  - More reliable measures of latent variables, since these are interacted with mode choice

- **Coefficients similar to MNL mode choice models**

- **Latent variables are derived from socioeconomic variables**

Implementation

Test different path building assumptions

- Add premium characteristics and cost into path building
- Create hundreds of path choices each for walk and drive access
- Use onboard survey to
  - Identify aspects of path building that don't fit observed behavior (bike access to transit, kiss-and-ride, schedules that don't fit time modeled time periods, etc.)
  - Identify the best fit for path building choice sets

Calibrate the models in Salt Lake City

- Has 5 modes (local and express bus, BRT, LRT, commuter rail)
- Can be used to test the transferability of coefficients
- Represents a mid-range of size and transit system
- Has validated networks and a currently calibrated mode choice model

Apply path building process

- Add premium characteristics and cost into path building
- Create hundreds of path choices each for walk and drive access
- Use onboard and household surveys to identify the best fit for path building choice sets

Estimate mode choice models for Chicago
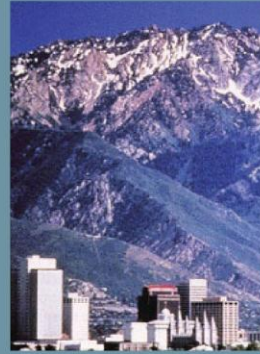
- Attach premium service characteristics to household or TCRP surveys
- Create path building choice sets
- Estimate new mode and path choice models
  - Nested logit choice (NL)
  - Integrated choice and latent variable (ICLV)

Contact

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