

Understanding Mode Choice Behavior of People with Disabilities: A Case Study in Utah

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Rationale and Justification



Figure 1 : Travel modes used by various group of population

- ♦Travel limited disability population: 8-10% in US & Utah
- ♦People with Disabilities (PwDs) have unique travel needs compared to the People without Disabilities (PwoDs)
- ♦Existing transportation models failed to capture different travel behavior of PwDs
- ♦Models for general population may not be suitable for PwDs
- ♦Comparison of mode choice behavior among groups (PwDs vs PwoDs)

Objectives

- ♦Development of Multinomial Logit (MNL) mode choice model for PwDs & comparison to PwoDs
- ♦Identification of key factors influencing the disability mode choice behavior
- ♦Value of Travel Time (VOTT) estimation using revealed preference (RP) survey dataset
- ♦Policy Implications for inclusive and equitable transportation system planning

Data & Methodology

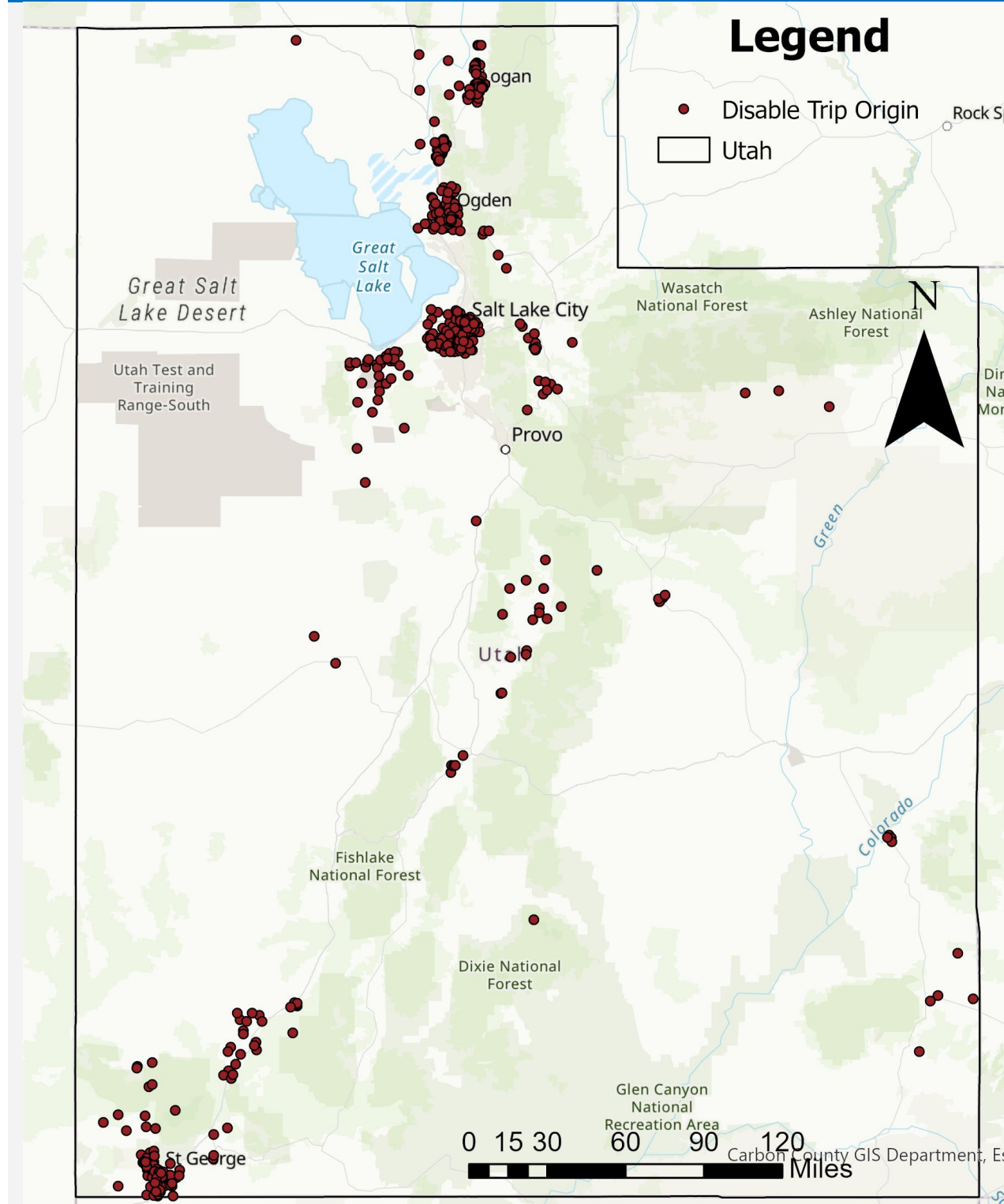


Figure 2 : Study area and Disabled trip

Choice Sets

- ♦Drive alone: Binary [Household (HH) car >0 and driving License=Yes]
- ♦Carpool: For All
- ♦Transit: Binary [For all except person revealed no transit use]
- ♦Nonmotorized: Binary [HH bike >0 or Walk distance <5 miles]

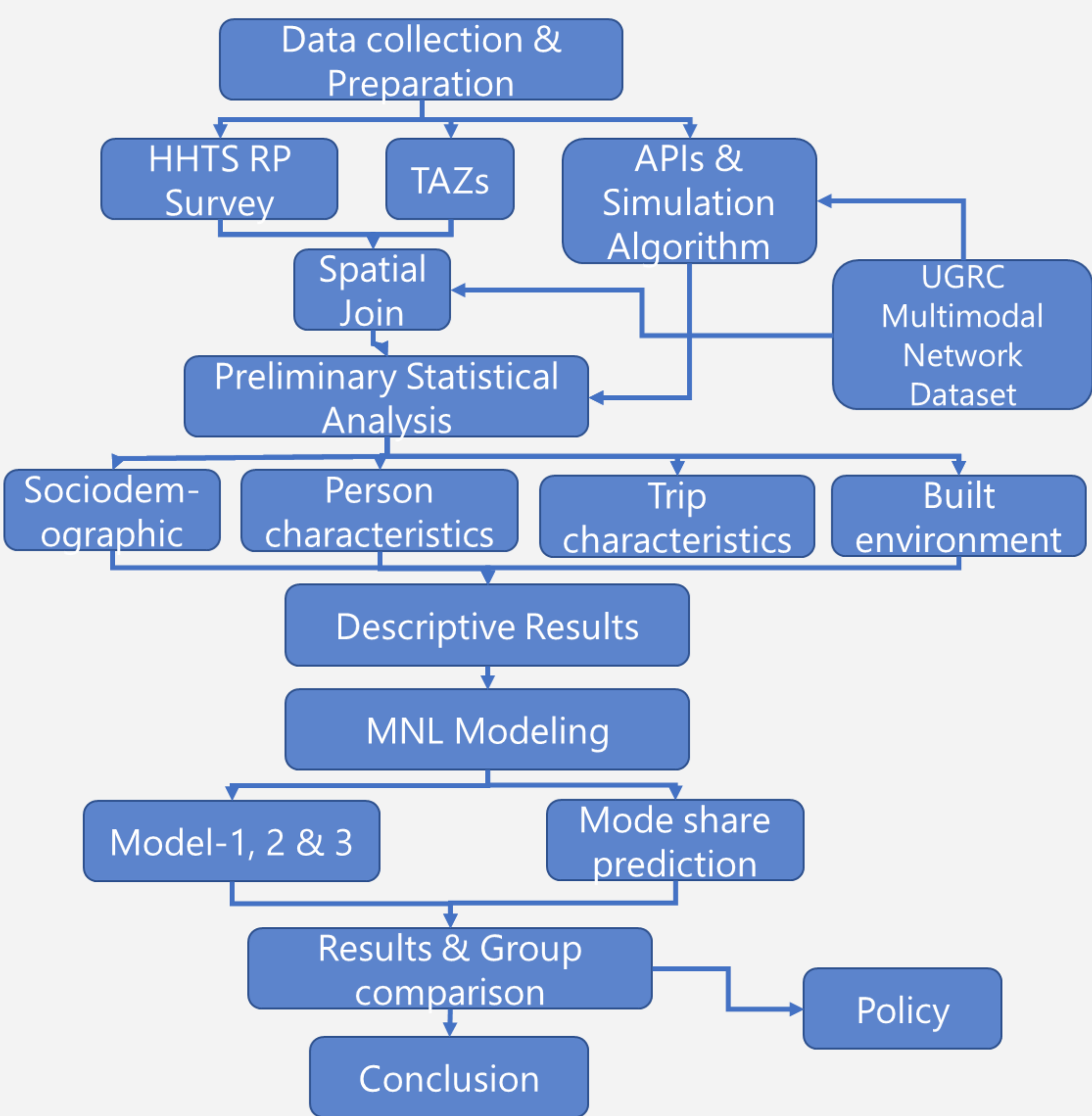


Figure 3 : Methodological Flowchart

Modeling

Three Multinomial Logit Models

1. General Population model: To account the effect of disability
2. PwoDs
3. PwDs

Modal Specification

- ♦Drive alone (reference) & ASCs for other available modes
- ♦Travel time & travel costs are generic

Utility Functions for all modes

$$U_{Auto} = \beta_{time} * T_{Auto} + \beta_{co} * Co_{Auto}$$
$$U_{cp} = ASC_{cp} + \beta_{time} * T_{cp} + \beta_{co} * Co_{cp} + \beta_{cp_ind} * Var_{ind}$$
$$U_{tr} = ASC_{tr} + \beta_{time} * T_{tr} + \beta_{co} * Co_{tr} + \beta_{tr_ind} * Var_{ind}$$
$$U_{nm} = ASC_{nm} + \beta_{time} * T_{nm} + \beta_{nm_ind} * Var_{ind}$$

Modal correctness check

1. $-2LL = -2(LL_{base} - LL_{estimated})$
 χ^2 value from χ^2 distribution table
2. McFadden rho-squared (ρ^2) value

Results

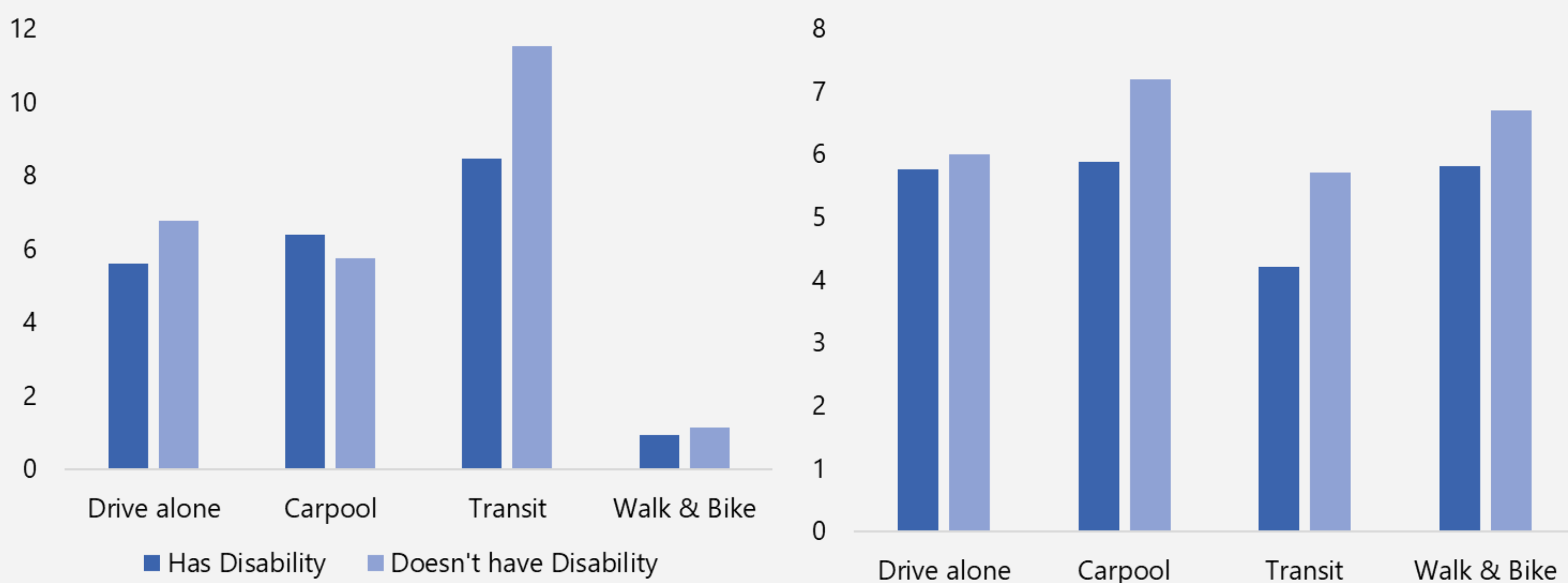


Figure 4 : Average trip length and average trip frequency for travel by different modes

- ♦PwDs use Carpool trips 25% more than PwoDs group
- ♦PwDs take shorter trip for all modes except carpool trip distance [6.39 vs 5.76 miles/trip]
- ♦Transit use: PwDs trip length 36% shorter than PwoDs
- ♦PwDs make fewer trips (all modes): 18.6% lesser trips

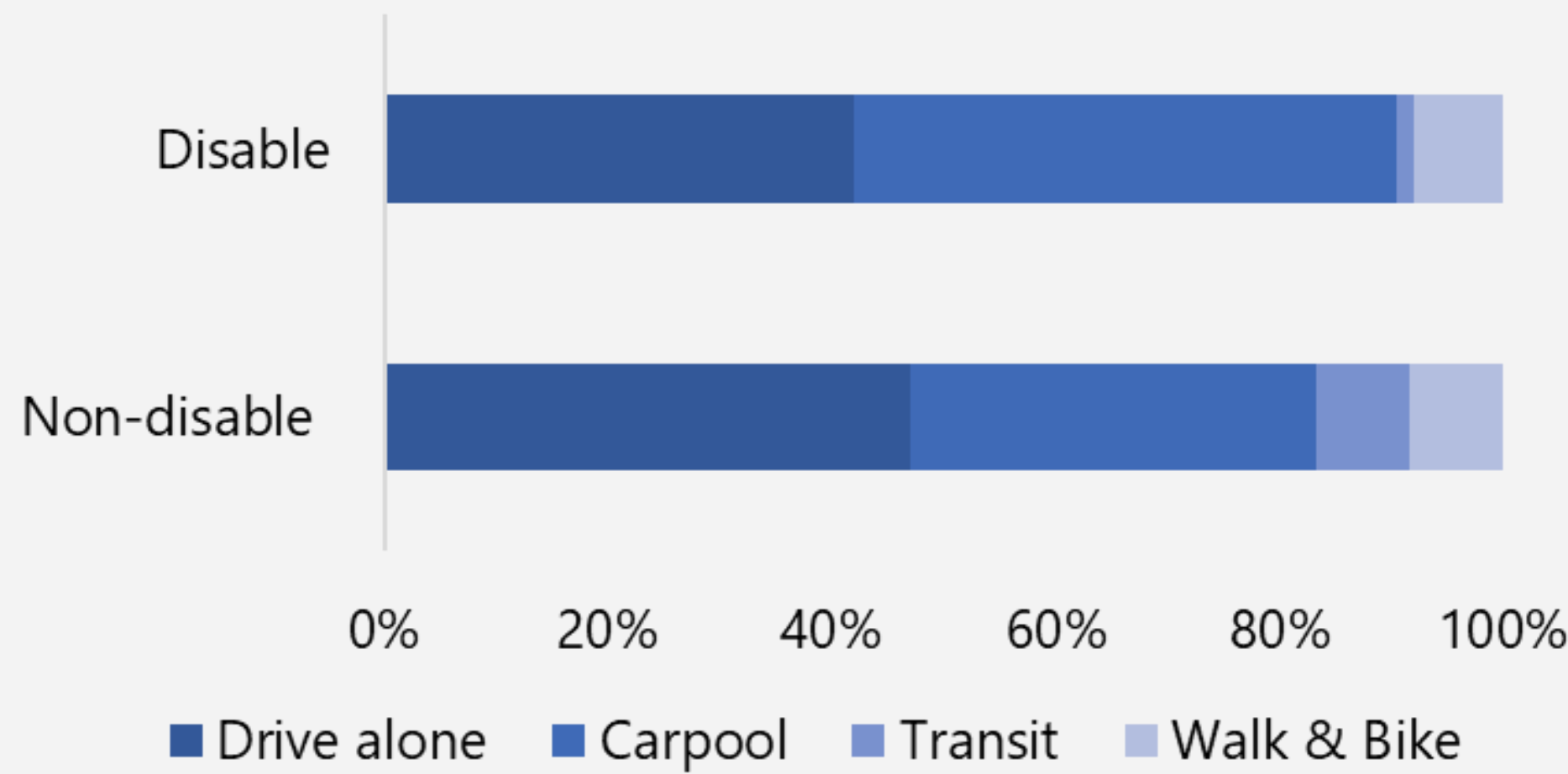


Figure 5 : Mode Share Distribution among Groups

MNL Model Results

Variable	Model2– PwoDs			Model3– PwDs		
	Carpool	NM	Transit	Carpool	NM	Transit
ASC	1.24 ***	0.959 ***	-	-	-0.031*	-
Gender (Ref: Male)	0.467 ***	0.067 **	-	0.776 ***	-	0.799 **
Employment						
Fulltime	-0.793 ***	-0.41 ***	0.428 ***	-	0.922 **	-
Parttime	-0.415 ***	-	0.624 ***	0.139 *	-	-
Age						
Age 16-64	0.125 ***	0.557 ***	-	-0.517 ***	-	-
Household Income						
Low (<35k)	0.0486 *	0.112 **	0.171 *	0.901 ***	0.602 **	-
Medium (35-50 k)	-	0.204 ***	-	0.457 **	-	-
Very High (> 100k)	-0.189 ***	-0.076 *	-0.297 ***	-	-	-0.721 *
Residential Location						
CBD	-	-	0.767 ***	0.816 **	-	-
Urban	0.051 **	0	-	0.373 **	0.573 *	-
License (Ref: Yes)	0.444 ***	0.93 ***	1.54 ***	1.44 ***	1.77***	2.33 ***
Vehicle ownership						
0	1.42 ***	2.71 ***	1.58 ***	1.03 ***	0.906 ***	1.206 ***
1	0.333 ***	0.574 ***	-	-	-	-
Household size						
1	-1.87 ***	-0.77 ***	-0.414 ***	-1.82 ***	-	-0.33 ***
2	-0.847 ***	-0.25 ***	-0.194 *	-1.29 ***	-1.22 ***	-1.3 **
4	0.296 ***	-	0.205 *	-	0.948 **	1.44 ***
6	0.536 ***	-	0.378 ***	1.75 ***	1.04 **	1.48 **
Household Adult worker						
0	0.213 ***	0.463 ***	0.615 ***	-	-	-
1	0.049 **	0.206 ***	0.374 ***	0.505 **	-	-
Transit Frequency						
Daily	-	0.477 ***	1.15 ***	2.22 ***	2.78 ***	3.15 ***
few times a month	-0.312 ***	-1.00 ***	-3.24 ***	0.618 *	-	-2.04 ***
Goodness-of-fit statistics						
Sample size:	67505			1337		
Likelihood ratio test:	48122			1212		
Rho-square-bar:	0.305			0.314		
χ^2 (df)	112.329 (df=80)			112.329 (df=80)		

Variable	Model1- General Population			Variable	Model2– PwoDs			Model3– PwDs		
	Carpool	NM	Transit		Car-pool	NM	Transit	Car-pool	NM	Transit
Disability (ref: no disability)				Time						
				Cost						
				VOTT (\$/hr)						
	0.066 *	-0.318 ***	0.364 **		-0.0458 ***			-0.0515 ***		
					-0.00225 ***			-0.0088 ***		
					12.21			3.50		

- ♦Overall, PwDs tend to use transit over Drive alone than PwoDs

- ♦PwDs have lower consideration for value of travel time over PwoDs
- ♦PwDs use carpool the most, has 50% fare reduction in transit trips, mostly works parttime

Conclusions

- ♦VOTT for disable group has lower consideration over travel time whereas strong for counterpart group
- ♦General model showed disability is associated with increased transit & decreased NM mode over Drive alone than counterpart group
- ♦Variables that share **similar** mode choice behavior among both groups are: **Income, Vehicle ownership & Driving license**
- ♦**Contrasting** variables among groups in mode choice behavior are: **Gender, Employment, Age, Residential location & Transit use**
- ♦PwDs having HH size>3, no vehicle ownership & no driving license had strong preference for transit compared to other available modes

Policy Implications

- ♦Metropolitan Planning Organizations should include nonmotorized mode in their travel demand modeling as they have significant share in trip behavior
- ♦Contrasting mode choice behavior among diverse group suggests consideration of PwDs in travel demand modeling
- ♦General model & PwDs model results suggests we explicitly need to address inclusive transit policy

Limitations & Future Works

- ♦Uneven distribution of sample among disability groups
- ♦Travel time was not disintegrated in to access, egress, and waiting times or in-vehicle time & out of vehicle times

⇒Consideration of different types of disabilities, their severity & duration of disability
⇒Inclusion of panel effects using more sophisticated models like mixed logit model

Acknowledgement

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