Capturing Personal Modality Styles Using Multiday GPS Data

FINDINGS FROM THE SAN FRANCISCO BAY AREA

YANZHI (ANN) XU, PH.D. & RANDALL GUENSLER, PH.D. (TRANS/AQ, INC.)

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Overview

Analysis of individuals' modality styles based on the three-day wearable GPS sample from the San Francisco Bay Area

- Demographic
- Socioeconomic
- Transit access

Presentation structure

- Background
- Data & methodology
- Results
- Conclusions

Motivation

Usefulness of modality styles

- Desire to change one's modal balance (Diana & Mokhtarian, 2009a)
- Socioeconomics characteristics alone do not explain modal clusters (Diana & Mokhtarian, 2009b)

Existing studies

- Kuhnimhof, et al. (2006): data from Germany
- Vij et al. (2011): data from Germany
- Buehler & Hamre (2014): U.S. 2001 and 2009 National Household Travel Surveys

Background

Small share of alternative modes

- 17% walk, 3% bike & 7% transit in the San Francisco Bay area

Drawback of one-day samples - modes that are used only occasionally or with high variability are often missed

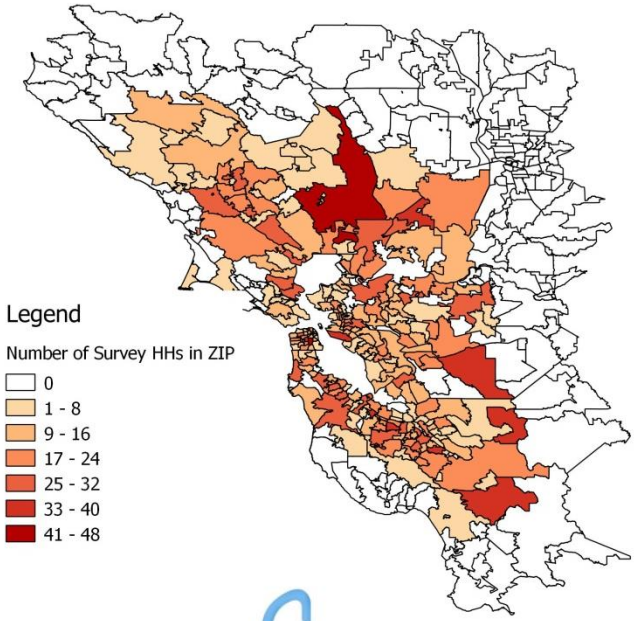
Value of multi-day GPS travel data in modality studies

Data

Three-day GPS subsample primarily sponsored by the Metropolitan Transportation Commission (MTC) of the San Francisco Bay Area

3,429 households

9,141 respondents



TSDC@NREL

Methodology

Data Screening

- QA/QC re: trip distance, duration, etc.
- Define scope of analysis

Mode Typologies

- Aggregate modes
- Identify main mode for each trip chain

Modality Styles

- Defined in Vij, et al. (2011)
- Four modality styles

Modality Styles

Unimodal auto	Unimodal green	Multimodal auto	Multimodal green
• a person that is predominantly an automobile user, with an auto mode share of 90% or above	• a person that travels predominantly by alternative modes, with a walk mode share of 80% or above, or a bike mode share of 80% or above, or a transit mode share of 80% or above	• a person, who is not unimodal, with an auto mode share of 10% or above (but less than 90%)	• a person, who is not unimodal, with an auto mode share of less than 10%

Mutually exclusive

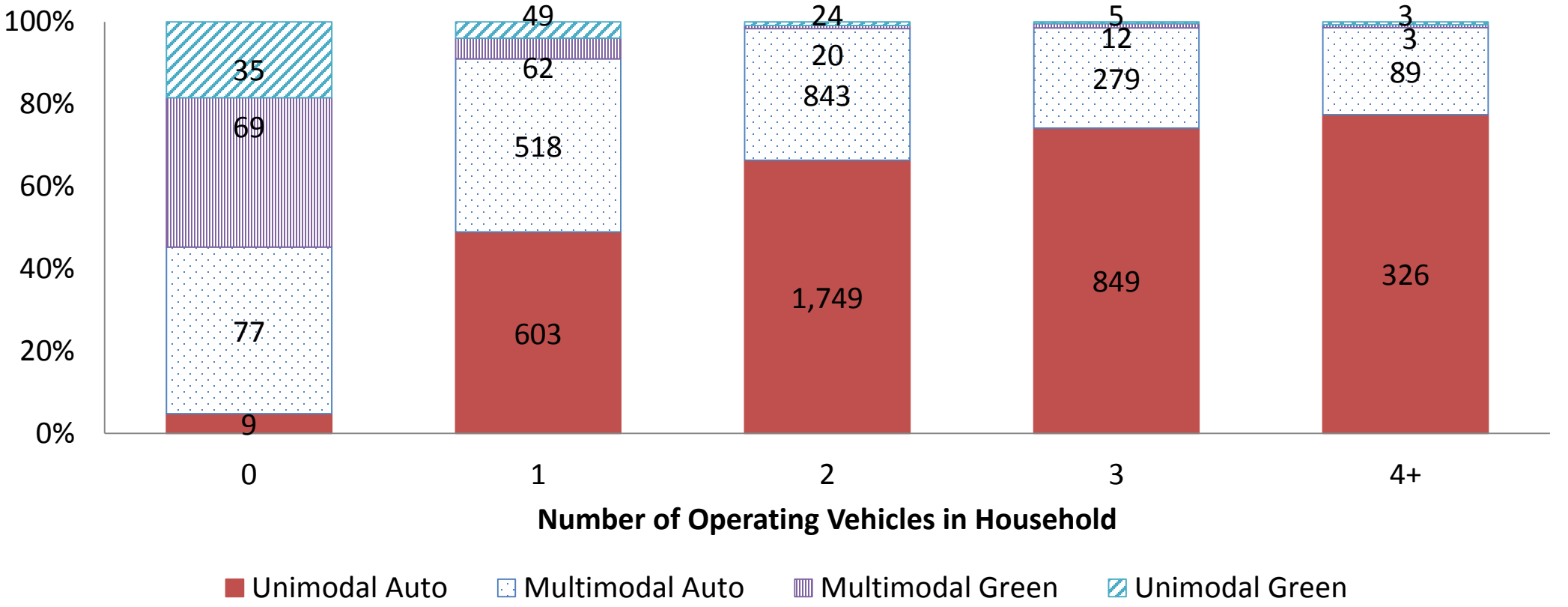
Results

DESCRIPTIVE ANALYSIS

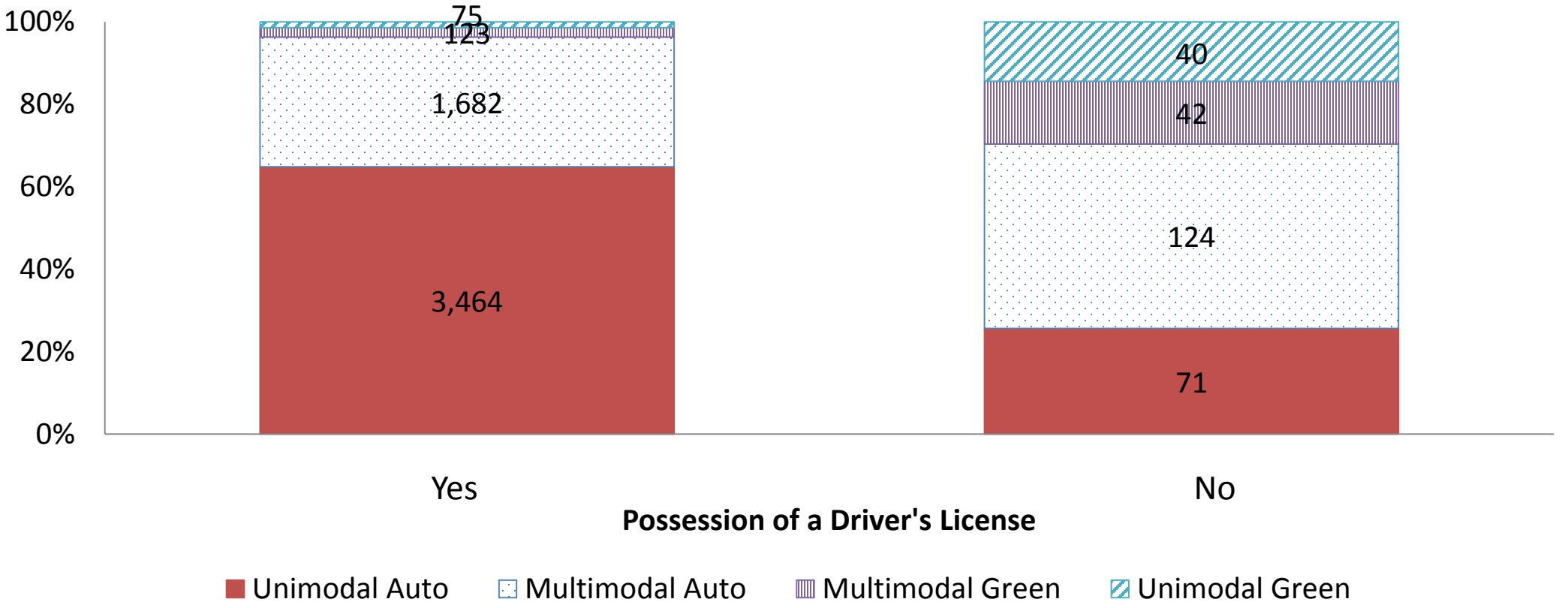
MODELING OF GROUP MEMBERSHIP

MODELING WITH ONE-DAY SAMPLE

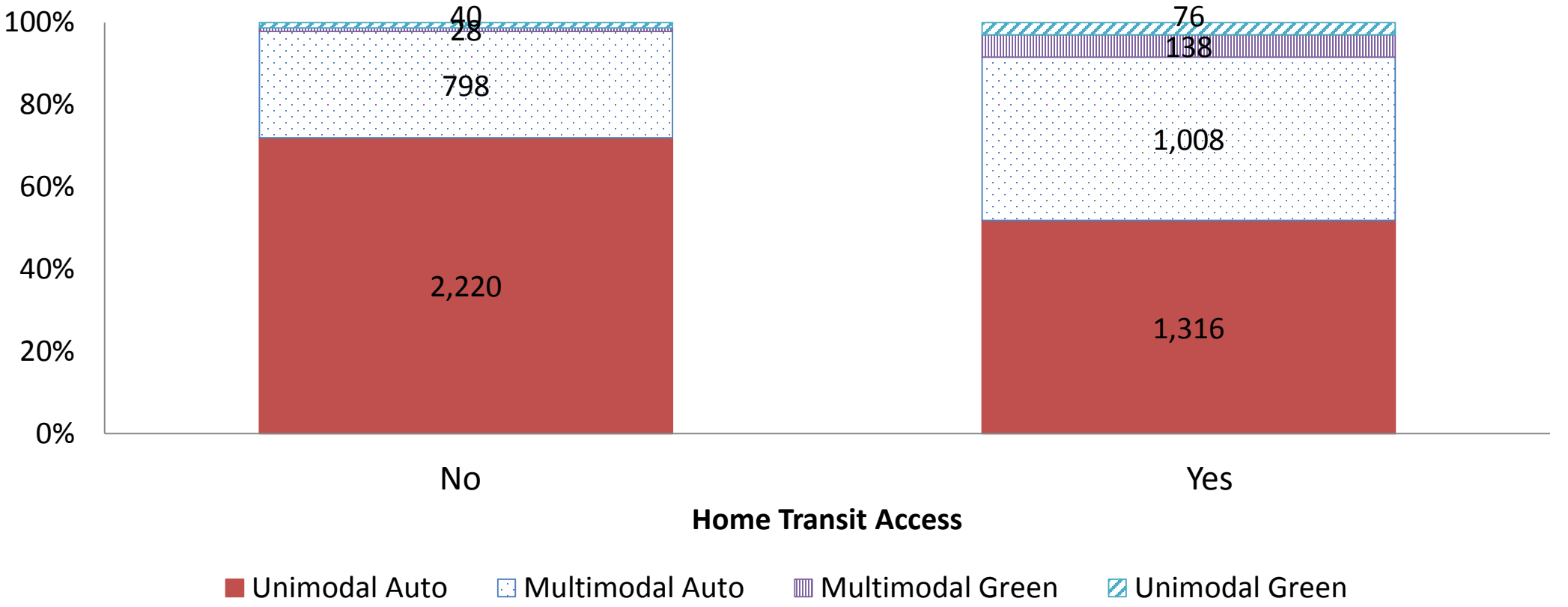
Household Vehicle Ownership



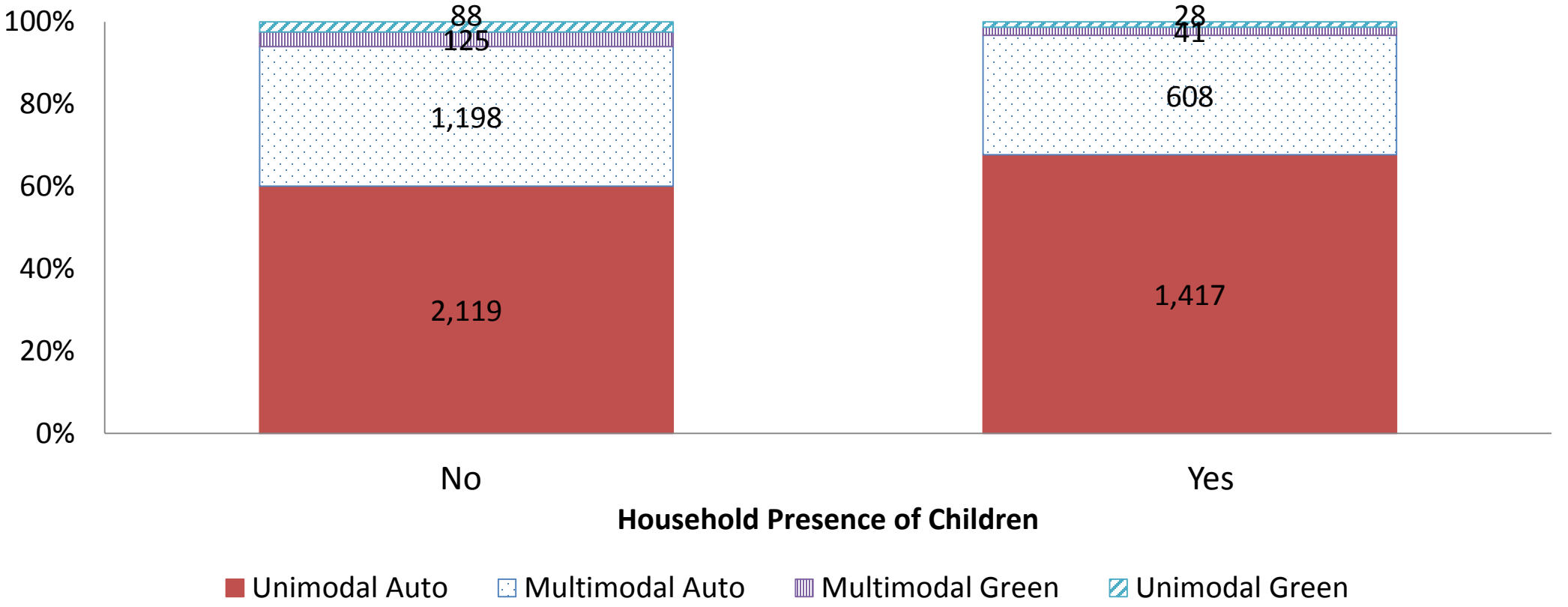
Possession of A Driver's License



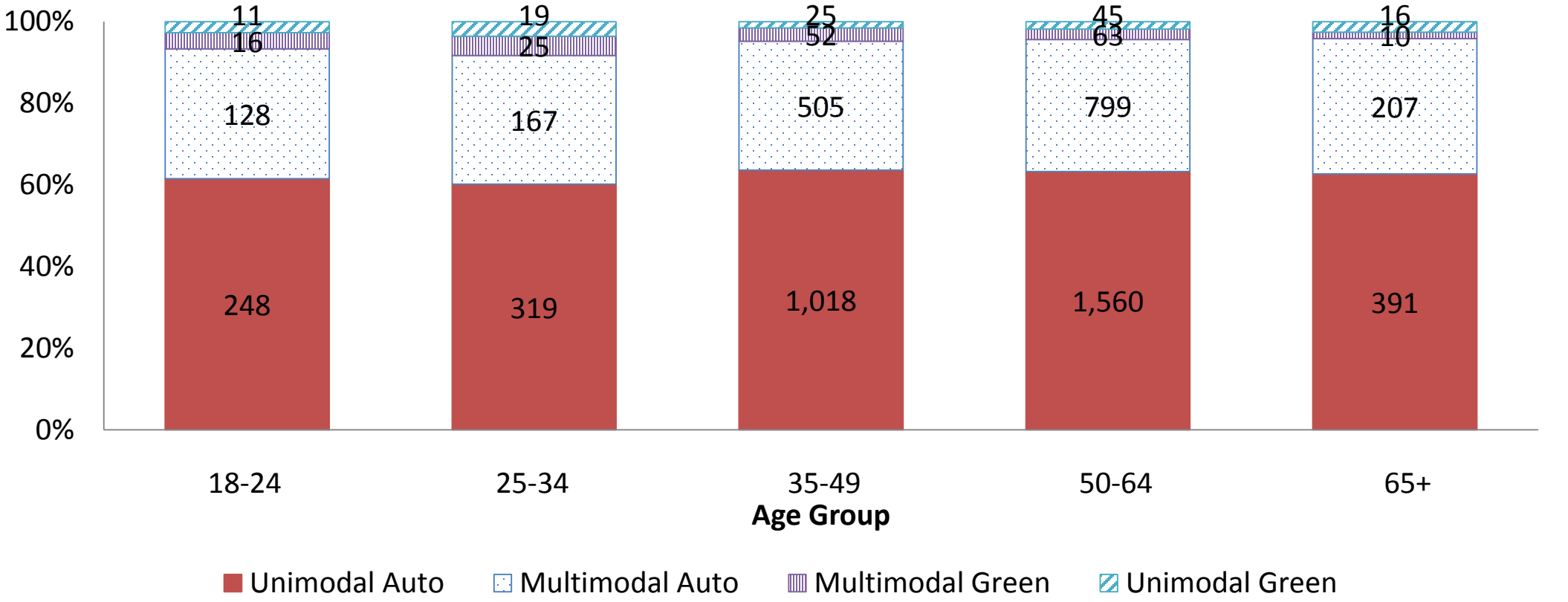
Transit Access



Household Presence of Children



Age


100%
80%
60%
40%
20%
0%
11
16
128
248
19
25
167
319
25
52
505
1,018
45
63
799
1,560
16
10
207
391
18-24
25-34
35-49
50-64
65+
Age Group
Unimodal Auto
Multimodal Auto
Multimodal Green
Unimodal Green

Modeling of Group Membership

Multinomial logit regression

Independent variables with high significance

- Possession of a driver's license
- Household operating vehicles
- Home transit access

		Multimodal Auto		Multimodal Green		Unimodal Green	
	(Intercept)	1.213	***	-1.275	.	0.314	
Gender	Female	-					
	Male	0.178	*	0.711	**	0.594	*
License	No	-					
	Yes	-1.324	***	-2.410	***	-2.536	***
Age Group	Senior	-					
	Middle	0.041		0.477		0.043	
	Middle Young	0.105		0.752		-0.261	
	Young	0.204		1.484	**	0.500	
Education	Graduate	-					
	Undergraduate	-0.341	***	-0.695	*	-0.326	
	High School	-0.594	***	-1.067	*	-0.096	
Employed	No	-					
	Yes	-0.025		0.020		-0.647	*
Household with Children	No	-					
	Yes	-0.289	**	-0.163		-0.361	
Household Income	Very High	-					
	High	-0.029		-0.154		-0.134	
	Medium	-0.371	***	-0.182		-0.700	.
	Low	-0.578	***	-1.038	*	-1.458	**
Household Operating Vehicles	1	-					
	2	-0.532	***	-2.262	***	-1.739	***
	3	-0.879	***	-1.911	***	-2.607	***
	4+	-0.938	***	-1.956	*	-2.059	*
	zero	2.124	***	4.290	***	3.880	***
Home Transit Access	No	-					
	Yes	0.606	***	1.227	***	0.471	.

Modeling Observations

Females are less likely to be multimodal than are males

Older individuals are less likely to be multimodal

Individuals from households with children are less likely to be multimodal

the higher the education level, the more likely a person is to be multimodal auto or multimodal green, compared to unimodal auto

The possession of a valid license is significant in all comparisons

Employment status is a significant variable when comparing unimodal green to unimodal auto

Higher income is associated with higher likelihood of being multimodal

Vehicle ownership is negatively associated with multimodality

Home transit access is positively associated with an individual's likelihood to be multimodal

Modeling with One-Day Sample

One-day sample shows a higher percentage of unimodal individuals

Slight modeling improvement by using three-day sample

Even longer sampling period is desired

- 20-day sampling period considerably improves modeling efficiency (Xu, 2010)

Conclusions

Key Findings

- Household vehicle ownership
- Possession of a driver's license
- Transit access
- Household presence of children

Areas of Analytical Uncertainty

- GPS data screening
- Underlying GIS data
- Survey coding

Recommendations for Further Study

- Survey questions related to modality styles
- Data quality regarding slow modes
- A few questions for further analyses

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Thank you!

PLEASE SEND YOUR QUESTIONS AND COMMENTS TO ANN XU AT YANZHI.XU@GMAIL.COM