Propensity to Use Public Transportation

The Role of Perception & Neighborhood Type

Jeongwoo Lee

Sol Price School of Public Policy

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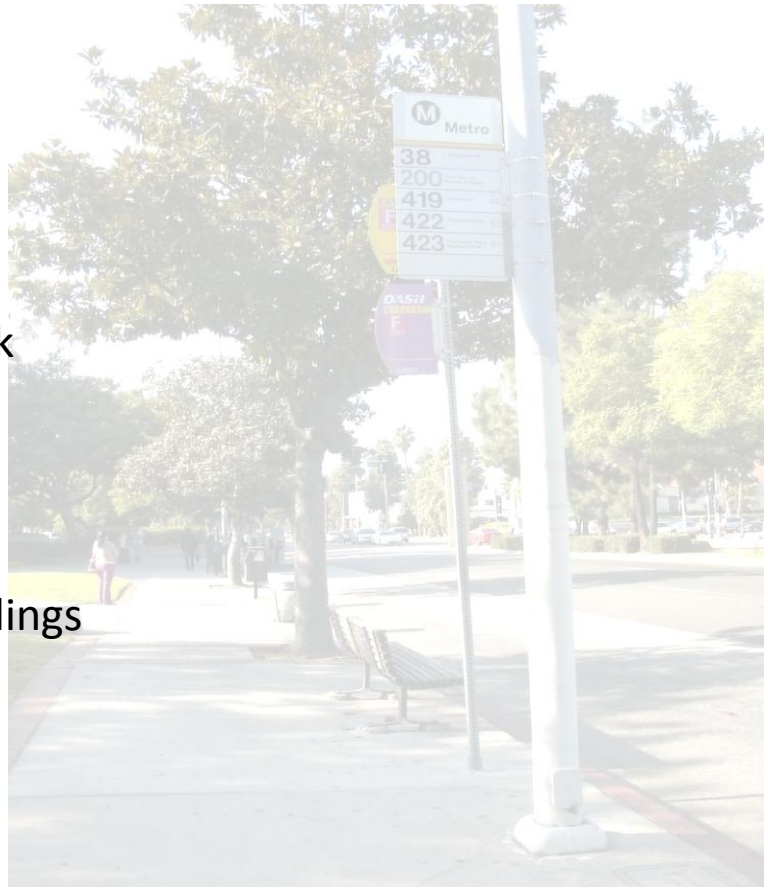
Presentation Overview

- **Introduction**
  - Background
  - Research questions
  - Literature review
- **Methods**
  - Conceptual framework
  - Research design
- **Results**
  - Results and major findings
- **Discussion**
  - Implications
  - Limitation



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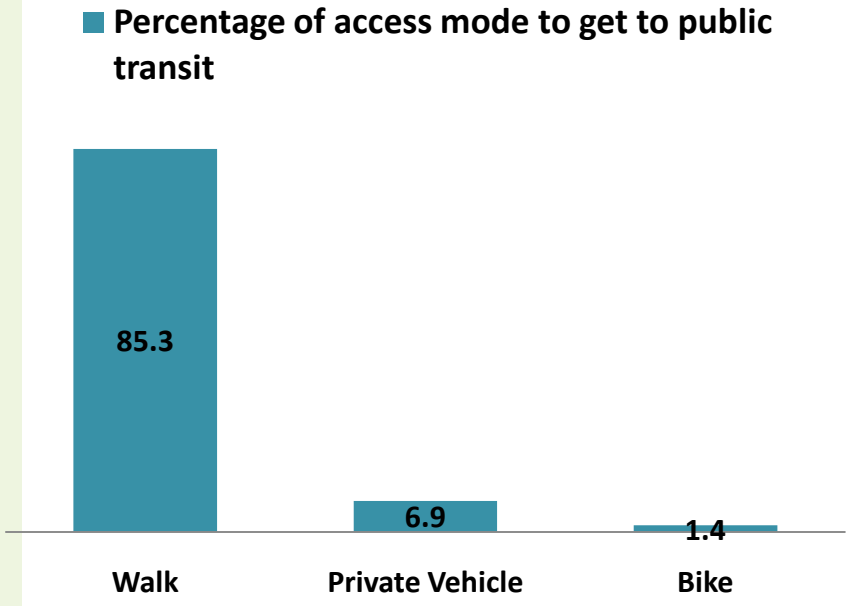
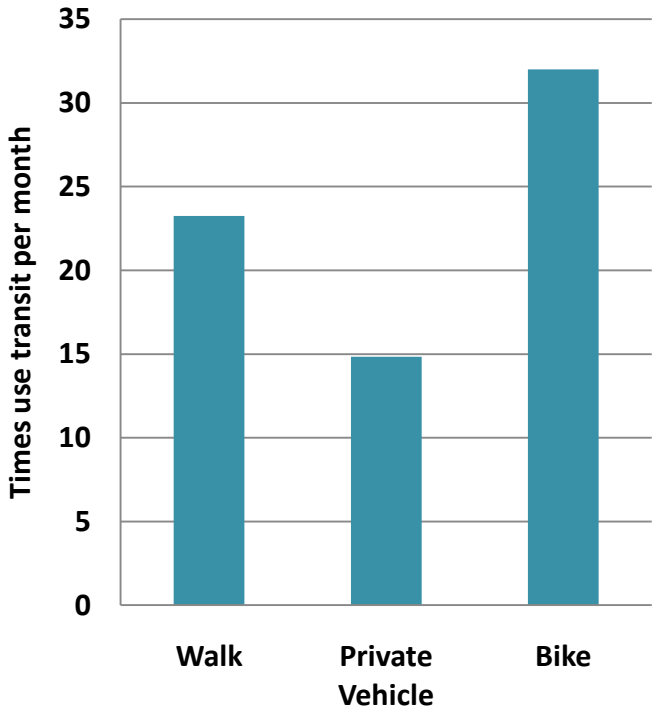
What do we know?

The majority of transit trips are accessed by walking (85.3%).





Data source: 2009 National Household Travel Survey California

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What do we know?

The regular transit users are more sensitive about their walking environment than non-regulars.

Data source: 2009 National Household Travel Survey California

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Past research with transit pedestrian access

- Urban form
- Transit service
- Socio-economic status
- Perception

(El-Geneidy et al., 2010, Agrawal et al., 2008; Alshalafah and Shalaby, 2007; Cervero, 2007; Ryan and Frank, 2009; Besser and Dannenberg, 2005; Werner et al., 2009; Hess 2009, Loukaitou-Sideris, 2006)

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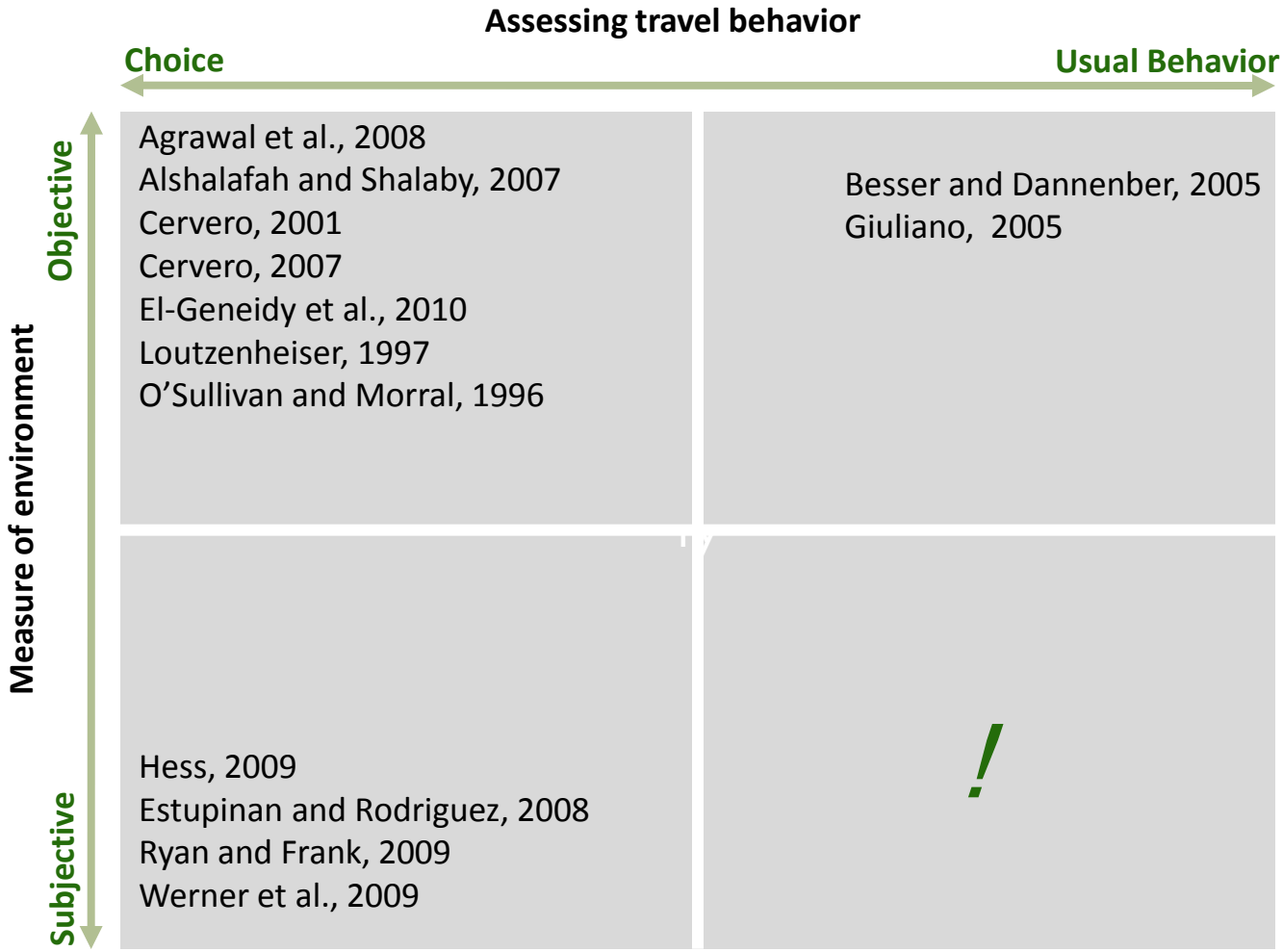
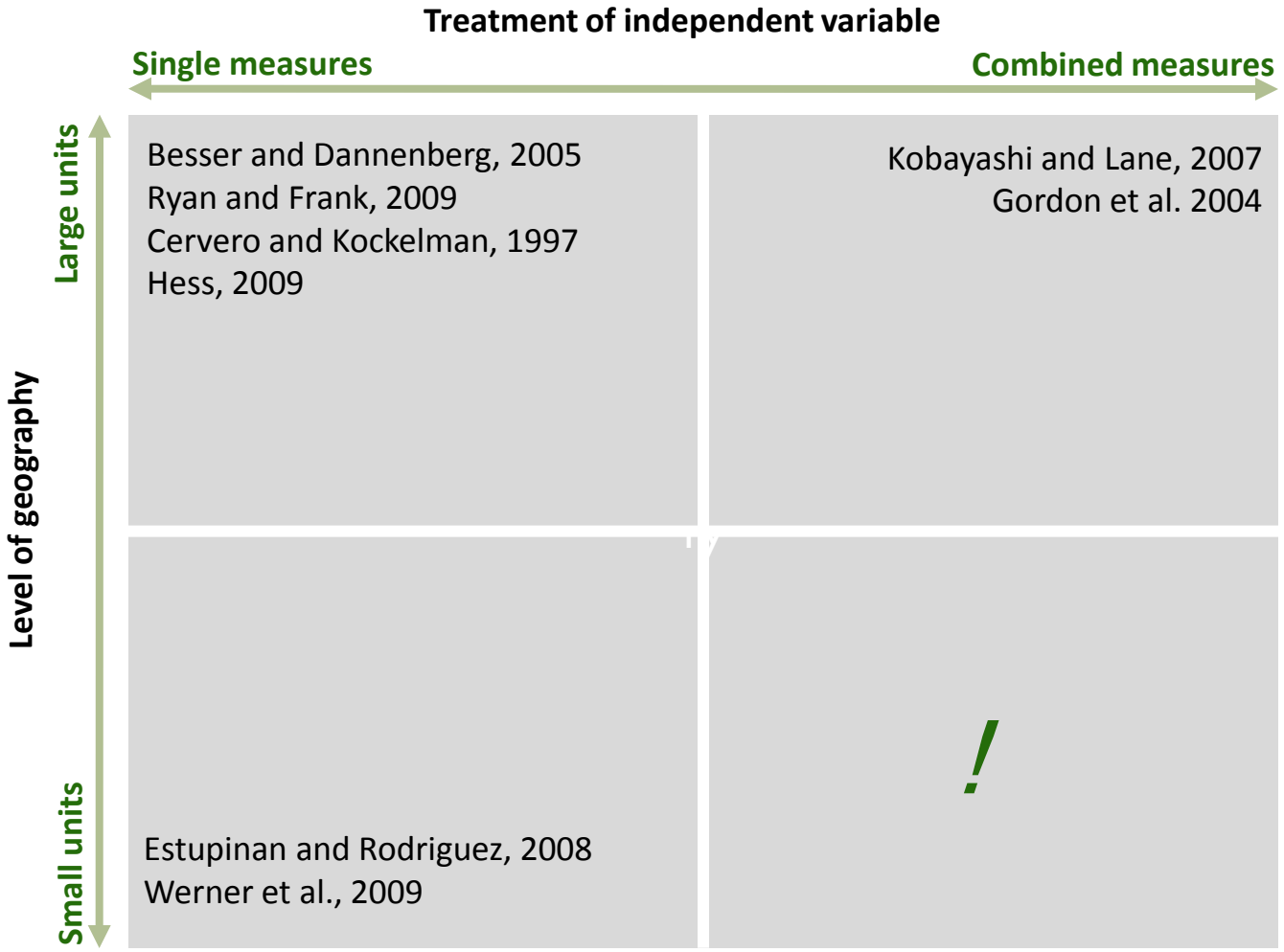
Landscape of literature

My study analyzes usual behaviors of transit use and focuses on the subjective aspects of environments.



Landscape of literature

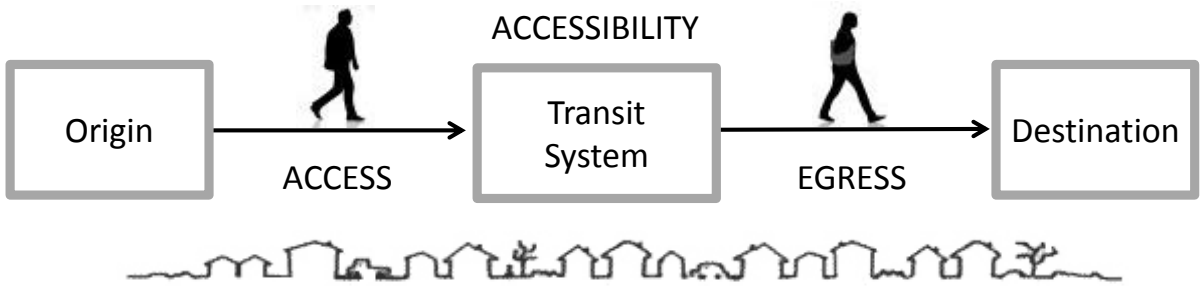
My study measures land-use attributes in combined dimensions and uses the most detail unit of analysis.



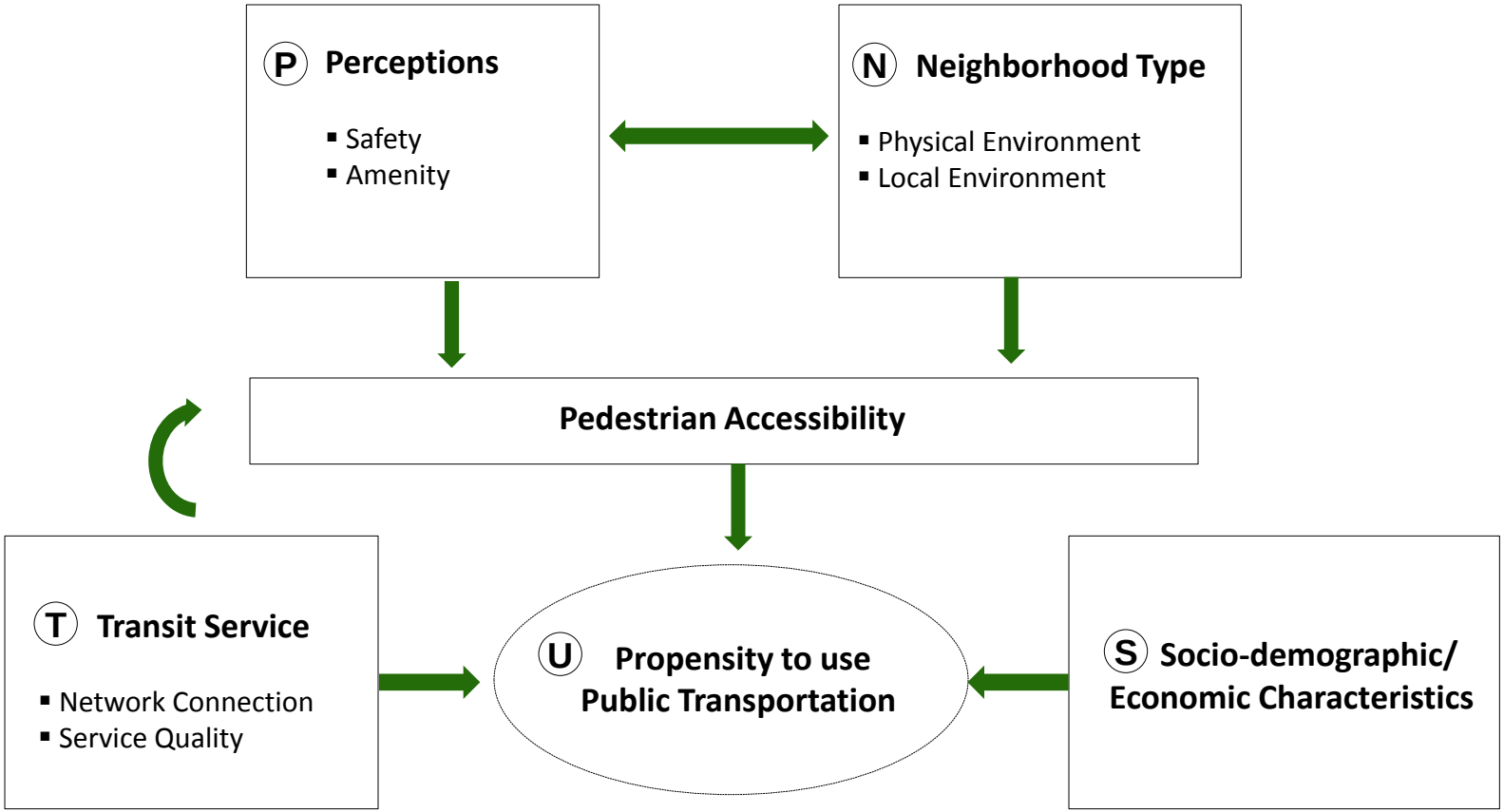
Research questions

How does each perception combine to represent different neighborhood type?

Given that transit use varies with the attributes of neighborhood environments even when transit service level is constant. Does perception also play a role?



Conceptual framework



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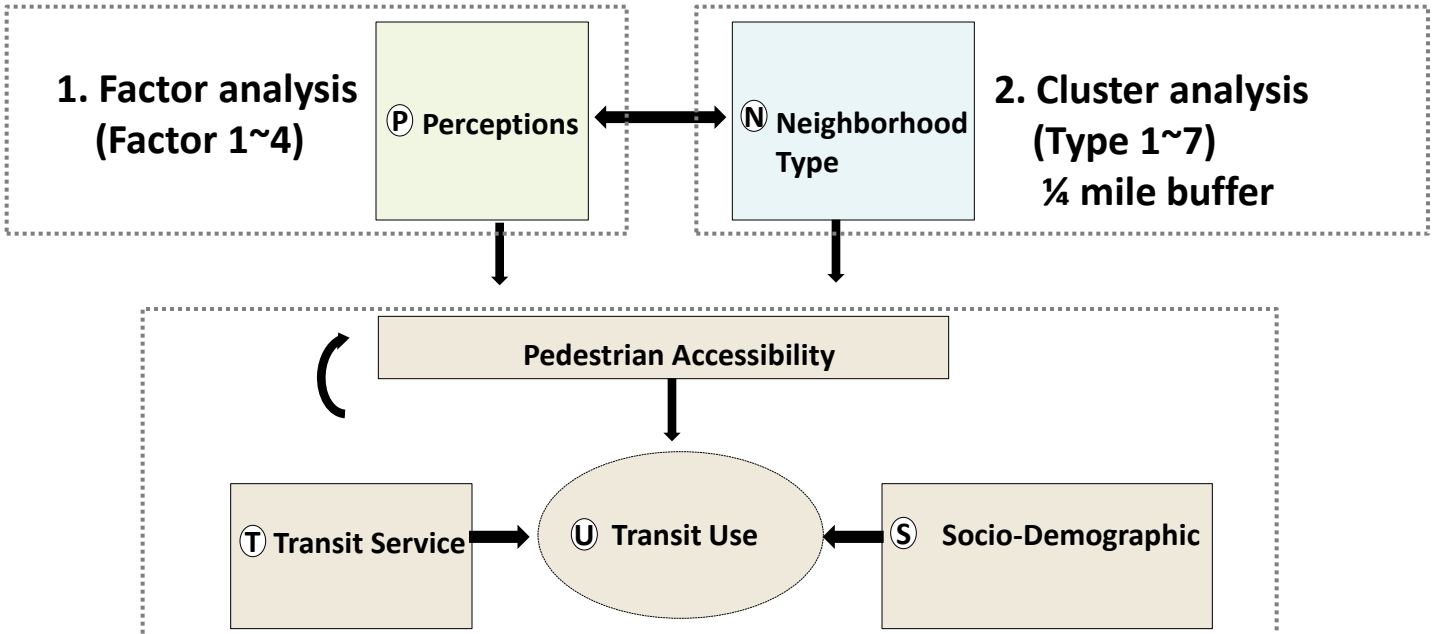
Analytic method



3. Ordered logit model

U = f (N, P, T, S, I)

Where
U = Type of transit user (1=non-user; 2=occasional user; 3=regular user)
N = Neighborhood Type (Type 1~7)
P = Perceptions (Factor 1~4)
T = Transit Service
S = Socio-demographic/Economic Characteristic
I = Interaction terms (Neighborhood Type * Perceptions)

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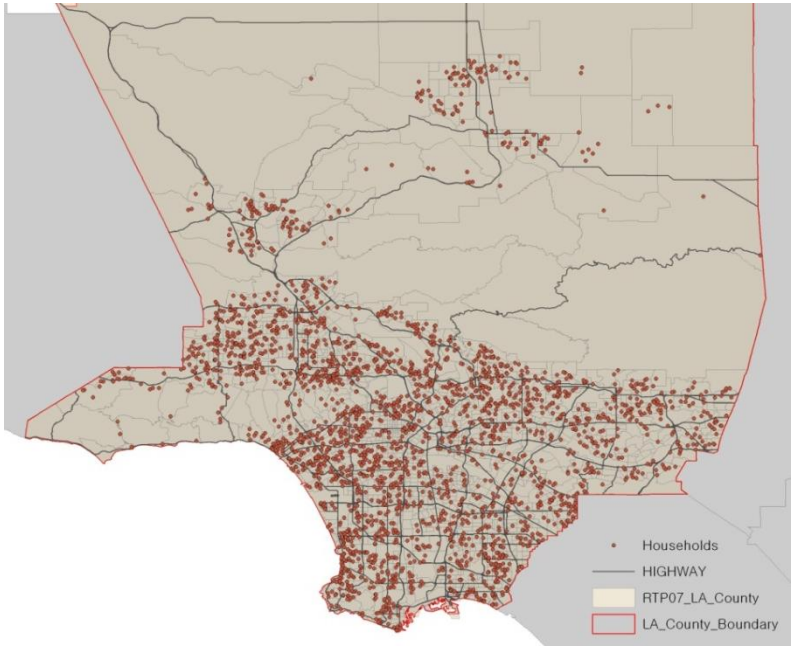
Data Source

- **Individual level: 2008-2009 National Household Travel Survey California add-on**
  - Total 5,861 persons (Los Angeles County)
  - Observation: 5,266 (595 persons are excluded due to missing data)

- **Neighborhood Level (1/4 mile buffer of household location)**
  - 2008 Southern California Association of Government (SCAG) model data (local street network, highway and transit network)
  - 2008 SCAG land-use data (parcel level)
  - 2010 Census data (socio economic characteristics, housing structure, population, poverty)
  - 2012 Crime data (1/25/12 ~ 2/8/12) https://www.crimereports.com



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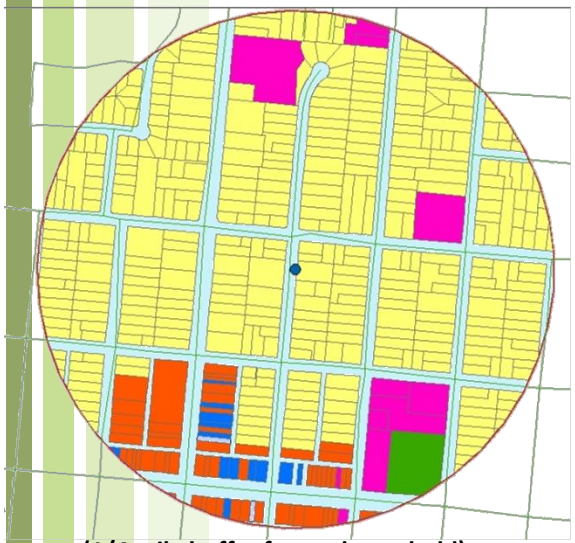
Variables

		Variable	Description	Data Source
Individual Level	Dependent Variable	UserType	Type of transit user (1=non-user; 2=occasional user; 3=regular user)	NHTS-CA (2009)
	Socio-Demographic and Economic (S)	Age	Age of respondents (1=18-34, 2=35-64, 3=65+)	NHTS-CA (2009)
		Education	Education level (1=less high school, 2-=college, 3=Bachelor+)	NHTS-CA (2009)
		Race	Race of respondents (Asian/Black/Latino)	NHTS-CA (2009)
		Veh/Pers	Ratio of vehicles to persons in household	NHTS-CA (2009)
	Perceptions (P)	Walk_A	Too many cars	NHTS-CA (2009)
		Walk_B	Street crossings unsafe	NHTS-CA (2009)
		Walk_C	Fast traffic	NHTS-CA (2009)
		Walk_D	Fear street crime	NHTS-CA (2009)
		Walk_E	No one to walk with	NHTS-CA (2009)
		Walk_F	Enough light	NHTS-CA (2009)
		Walk_G	No shops or interesting places to go	NHTS-CA (2009)
		Walk_H	No nearby parks	NHTS-CA (2009)
		Walk_I	No nearby paths or trails	NHTS-CA (2009)
		Walk_J	No sidewalks	NHTS-CA (2009)
	Access to Stops (T)	PedAccess	Shortest walking distance from each household to the nearest bust stop (measured along the street network)	SCAG (GIS parcel)
	Transit Service (T)	TransAccess	Transit Accessibility	SCAG (model 2008)

Variables (continued)

Neighborhood attribute measures used in the two step cluster analysis

		Variable	Description	Data Source
Neighborhood Level	Transit Service (T)	StopNum	Stop density	SCAG (model data)
	Density and Accessibility (N)	Popden	Population density	2010 Census
		Empden	Employment density	2008 InfoUSA
		HighAccess	Highway Accessibility	SCAG (model data)
		Stden	Street density	SCAG (model data)
	Land Use (N)	Entropy	Mixed land-use entropy	SCAG (GIS parcel)
		Heavylnd	Heavy industry land-use (percent)	SCAG (GIS parcel)
		Lightlnd	Light industry land-use (percent)	SCAG (GIS parcel)
		Open	Openspace land-use (percent)	SCAG (GIS parcel)
		Commer	Commercial land-use (percent)	SCAG (GIS parcel)
	Housing Structure (N)	1attached	1attached unit (Percent)	2010 Census
		2to4attached	2to4attached units (percent)	2010 Census
		5+attached	5 or more units (percent)	2010 Census
		BuiltYr	Age of housing stock (median year housing built)	2010 Census
	Socio-Economic Characteristics (N)	Poverty	Poverty (percent)	2010 Census
		Income	Household median income	2010 Census
	Crime (N)	CrimeNum	Number of crimes for past two weeks	2012 CrimeReports



(1/4 mile buffer from a household)

Dimensions of perception factors

What prevents you from walking more…

	Factor1	Factor2	Factor3	Factor4
Too many cars	.780	-.042	-.046	-.072
Street crossings unsafe	.497	.399	-.113	.235
Fast traffic	.492	-.087	.402	-.033
Fear street crime	-5.652E-5	.637	-.003	.060
No one to walk with	-.158	.604	.077	-.061
Enough light	.243	.406	-.030	-.063
No shops or interesting places to go	-.045	.006	.686	-.115
No nearby parks	.013	.020	.565	.251
No nearby paths or trails	.054	.137	.321	.726
No sidewalks	.121	.269	.342	-.595
Eigenvalues	1.466	1.110	1.033	1.010
% of variance	12.010	11.954	11.926	10.297
% of cumulative variance	12.010	23.964	35.890	46.187

Results of principal components factor analysis and varimax rotation of the four factors of walking environment (Anderson-Rubin method was used)

Factor1 **Physical Safety**
Factor2 **Personal Safety**
Factor3 **Destinations**
Factor4 **Paths**

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Neighborhood attributes

Mean values by each neighborhood type (clustered by two step cluster analysis)

NAME	FREQ	Popden (densest=1)		Empden (densest=1)		HighAccess (highest=1)		detached (highest=1)		1attached (highest=1)		2to4attached (highest=1)		5+attached (highest=1)		StopNum (highest=1)	
		Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
TYPE1	678	657.57	7	44.81	7	0.26	6	62.02	4	6.60	4	6.81	4	21.80	4	1.27	6
TYPE2	1855	2,240.88	1	564.73	1	0.51	1	54.22	6	6.69	3	7.74	2	29.52	2	4.01	2
TYPE3	544	2,071.49	2	498.87	2	0.50	2	58.61	5	7.99	1	6.92	3	25.22	3	4.63	1
TYPE4	319	706.32	6	57.36	6	0.20	7	71.97	3	4.69	6	3.04	6	18.24	5	0.73	7
TYPE5	293	1,521.30	4	234.02	5	0.46	4	74.41	2	6.23	5	4.99	5	13.48	6	3.57	3
TYPE6	1490	1,468.63	5	285.76	4	0.45	5	34.37	7	7.98	2	12.09	1	43.75	1	2.81	4
TYPE7	87	1,569.40	3	438.06	3	0.50	2	85.34	1	2.89	7	1.85	7	9.62	7	2.47	5

NAME	FREQ	Stden (densest=1)		CrimeNum (highest=1)		LanduseMix (highest=1)		LightInd (highest=1)		Commer (highest=1)		BuiltYr (oldest=1)		Poverty (highest=1)		Income (lowest=1)	
		Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
TYPE1	678	24.63	6	0.17	6	0.23	6	1.45	6	0.03	6	1,959.41	2	12.82	3	58296.28	2
TYPE2	1855	35.24	1	0.27	3	0.41	1	3.74	1	0.09	1	1,961.71	4	13.84	2	58591.03	3
TYPE3	544	35.21	2	0.38	1	0.40	2	2.74	4	0.09	1	1,965.04	5	8.58	4	84458.31	5
TYPE4	319	23.23	7	0.21	4	0.23	6	0.93	7	0.02	7	1,965.29	6	6.47	6	84096.99	4
TYPE5	293	30.69	4	0.28	2	0.33	5	1.73	5	0.06	5	1,966.01	7	6.99	5	110738.14	6
TYPE6	1490	31.29	3	0.21	4	0.34	4	2.99	2	0.07	3	1,959.84	3	26.11	1	36984.57	1
TYPE7	87	29.87	5	0.08	7	0.35	3	2.83	3	0.07	3	1958.88	1	5.35	7	139762.76	7

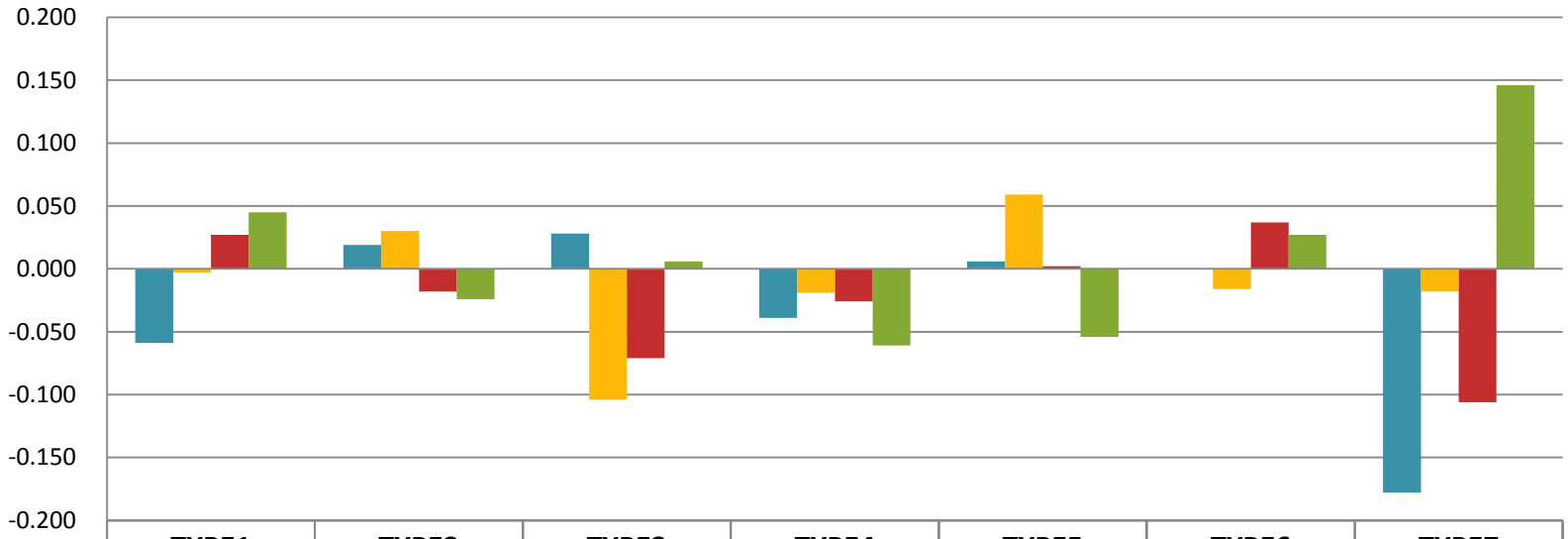
Neighborhood attributes

Labels and descriptions for different neighborhood type

	Label	Socio-demographic/economic/risk characteristics	Land use characteristics	No. of persons	% of persons
Type 1	**Exurban with the lowest density**	Low-middle income low crime number	Lowest density, low accessibility, low street density, single land use, relatively old buildings	678	12.88
Type 2	**Densest urban with low-middle income**	High poverty, low-middle income, high crime number	Highest density, highest accessibility, densest street network, highest mixed land-use, high industry use	1855	35.23
Type 3	**Dense urban with middle income**	Middle income, high crime number	Most 1 attached units, highest commercial land use, high mixed land-use, high density, high accessibility, dense streets, highest stop number	544	10.33
Type 4	**Exurban with the lowest accessibility**	Middle income	Lowest accessibility, lowest street density, low density, many detached units, fewest stops, single land-use	319	6.06
Type 5	**Suburban with high accessibility**	High income, high crime number	Newest building, relatively high accessibility, many detached units, low density, relatively high stop number	293	5.56
Type 6	**Suburban with the lowest income**	Lowest income, highest poverty level	Most multi-family units, least detached units, low density, high industry land use, old buildings, relatively low stop number	1490	28.30
Type 7	**Suburban with the highest income**	Highest income, lowest crime number	Most detached units, most openspace, oldest buildings, high accessibility, relatively high employment	87	1.65

Results

Perception Factor values by each neighborhood type



	TYPE1 Exurban with the lowest density	TYPE2 Densest urban with low-middle income	TYPE3 Urban with middle income	TYPE4 Exurban with the lowest accessibility	TYPE5 New suburban with high accessibility	TYPE6 Suburban with the lowest income	TYPE7 Old Suburban with the highest income
Factor1 Physical Safety	-0.059	0.019	0.028	-0.039	0.006	0.000	-0.178
Factor2 Personal Safety	-0.003	0.030	-0.104	-0.019	0.059	-0.016	-0.018
Factor3 Destination	0.027	-0.018	-0.071	-0.026	0.002	0.037	-0.106
Factor4 Path	0.045	-0.024	0.006	-0.061	-0.054	0.027	0.146

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Results

	Model 1			Model 2			Model 3			Model 4		
	β	S.E.	Sig.	β	S.E.	Sig.	β	S.E.	Sig.	β	S.E.	Sig.
Transit Accessibility	1.113	0.189	0.000	1.125	0.210	0.000	1.104	0.210	0.000	1.131	0.211	0.000
Walking distance	0.096	0.029	0.001	0.105	0.031	0.001	0.091	0.031	0.003	0.101	0.032	0.002
Veh/Pers	-0.977	0.136	0.000	-0.965	0.136	0.000	-0.922	0.136	0.000	-0.917	0.137	0.000
Race (white)	0.008	0.137	0.953	-0.021	0.137	0.878	-0.016	0.138	0.906	0.004	0.139	0.977
Race (black)	-0.157	0.230	0.495	-0.174	0.231	0.452	-0.189	0.232	0.415	-0.162	0.234	0.489
Race (asian)	-0.489	0.210	0.020	-0.530	0.211	0.012	-0.564	0.213	0.008	-0.560	0.214	0.009
Race (hispanic)	0.468	0.437	0.284	0.422	0.437	0.334	0.410	0.439	0.350	0.387	0.442	0.382
Education (less high school)	0.399	0.179	0.026	0.383	0.180	0.033	0.354	0.181	0.050	0.377	0.182	0.039
Education (some college)	-0.299	0.108	0.006	-0.301	0.108	0.006	-0.302	0.109	0.006	-0.294	0.109	0.007
Age (18-34)	0.868	0.161	0.000	0.877	0.162	0.000	0.849	0.163	0.000	0.862	0.163	0.000
Age (35-64)	0.533	0.134	0.000	0.544	0.135	0.000	0.534	0.136	0.000	0.541	0.136	0.000
Type2				0.082	0.178	0.646	0.090	0.179	0.613	0.089	0.179	0.618
Type3				0.194	0.216	0.369	0.176	0.217	0.418	0.172	0.219	0.431
Type4				0.363	0.267	0.174	0.361	0.268	0.179	0.364	0.268	0.175
Type5				0.494	0.261	0.059	0.520	0.263	0.048	0.514	0.263	0.050
Type6				0.306	0.179	0.087	0.310	0.180	0.085	0.312	0.180	0.083
Type7				0.343	0.454	0.450	0.295	0.455	0.518	0.289	0.676	0.650
Factor1							0.051	0.041	0.216	0.046	0.042	0.272
Factor2							0.088	0.043	0.042	0.091	0.063	0.149
Factor3							0.160	0.040	0.000	0.170	0.040	0.000
Factor4							-0.049	0.041	0.234	-0.067	0.043	0.121
Factor2*Type2										-0.056	0.095	0.557
Factor2*Type3										0.374	0.162	0.021
Factor2*Type5										-0.170	0.198	0.390
Factor4*Type4										0.141	0.183	0.439
Factor4*Type7										0.177	0.176	0.093
No. of observation		5266			5266			5266			5266	
log likelihood		3083.759			3075.698			3111.472			3099.894	
Initial log-likelihood		3286.832			3286.832			3342.706			3342.706	
Chi-square		203.073			211.133			231.234			242.812	
Prob > Chi-squared		0.000			0.000			0.000			0.000	
Pseudo R-squared		0.101			0.105			0.114			0.120	

Major findings

- **Perceived environments have significant effects on transit use**
  - Personal safety
  - Destination-rich environments
- **Neighborhood type matters**
  - The lowest income residents in suburban areas
  - New suburban residents with high accessibility
- **Effects of perceptions on transit use differ by neighborhood type**
  - Personal safety in the neighborhoods with the densest and high industry land-use
  - Urban design factors (paths) in high-income suburban neighborhoods

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Implications

- **Perceived environments are a direct modifier for travel behavior**
  - More significant and greater than the effects of neighborhood type
- **Highly populated areas alone do not influence the propensity to use transit**
  - Socioeconomic and design aspects should be considered simultaneously.
  - Neighborhood type includes much more information than a single land-use factor alone.
- **Land-use and transportation policy should be adopted locally based on each neighborhood context**
  - Spatial variations in the relationship between individual perceptions and their transit use.

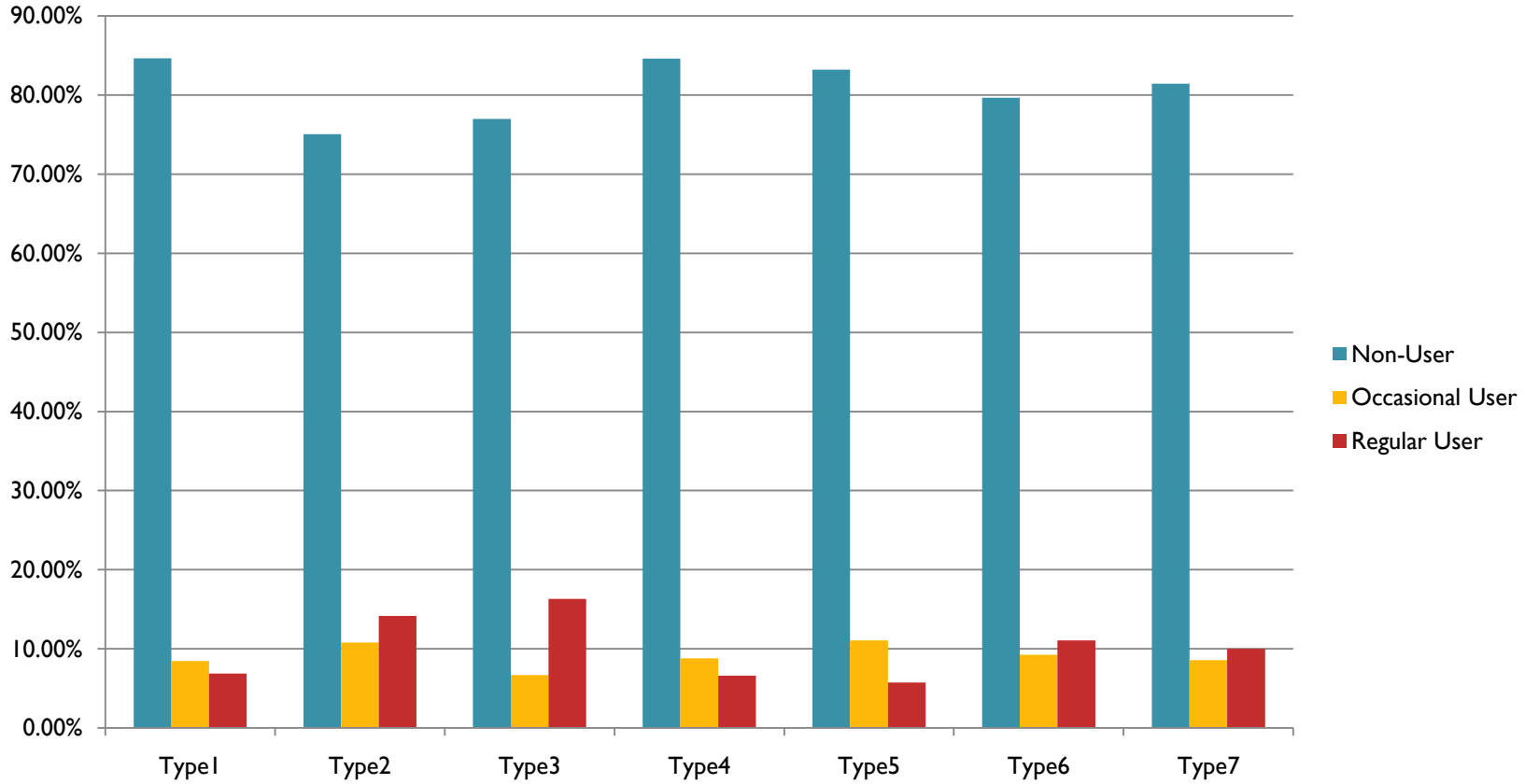
Limitations for future study

- **Data limitation**
  - Crime data (1/25/12 ~ 2/8/12, 2012)
  - Without detailed sidewalk network information
- **Self-selection**
  - Cross-sectional data
- **Differences in the perceptions of subpopulations**
  - Women, children, the elderly etc.

Questions!

Appendix

Histogram of type of transit user



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