Potential for Transferring Short Car Trips to Active Transportation

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The 2014 Korea Institute of ITS International conference

Oct. 31st, 2014

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Introduction
Background

❑ Recent American Reform Approach

- New Urbanism
- Smart Growth / Transit-Oriented Development
- Latest example: State Bill 375, AB 32

❑ Question erased

- What policies must be implemented to encourage drivers to find alternatives to short automobile trips?

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INTRODUCTION
BACKGROUND

❑ 'Short Trip' are of particular interest because of …

- the additional emissions (CO, VOCs) generated by short car trips
- the traffic congestions on local roads
- the potential for transferring short car trips to active transportation

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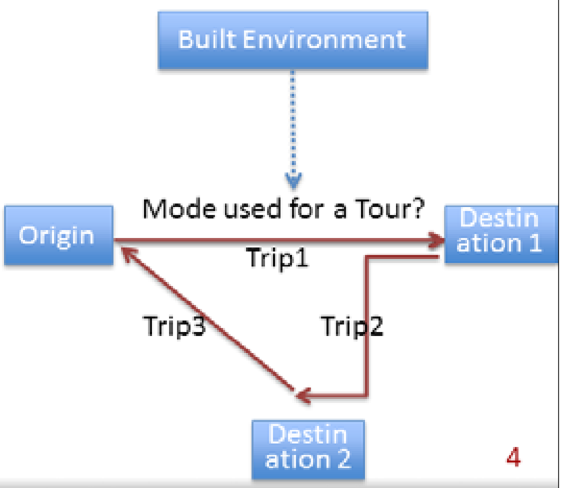
THEORETICAL BACKGROUND
TOUR-BASED APPROACH

❑ What we know

- Most empirical studies on the built environment (BE) and mode choice was Trip–based analysis

❑ What we don't know

- Trip chaining behavior
- The independent role of BE in the choice of tour mode
- Magnitude of the effect of BE with different types of tours



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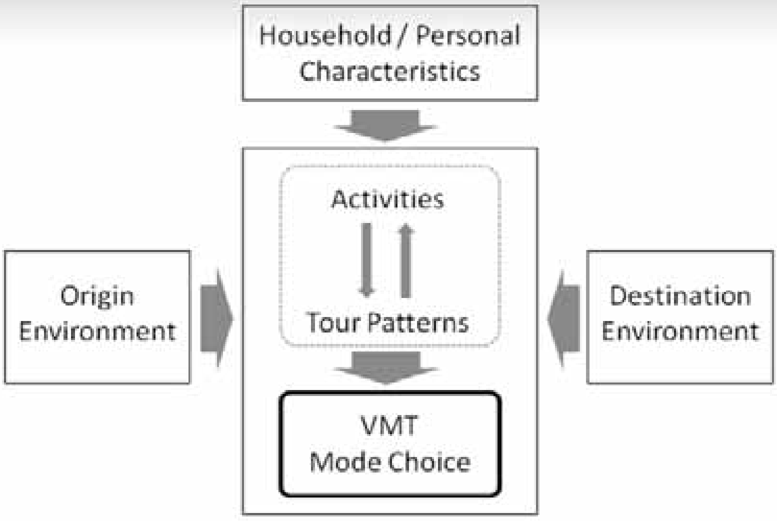
Research Design
Conceptual Framework



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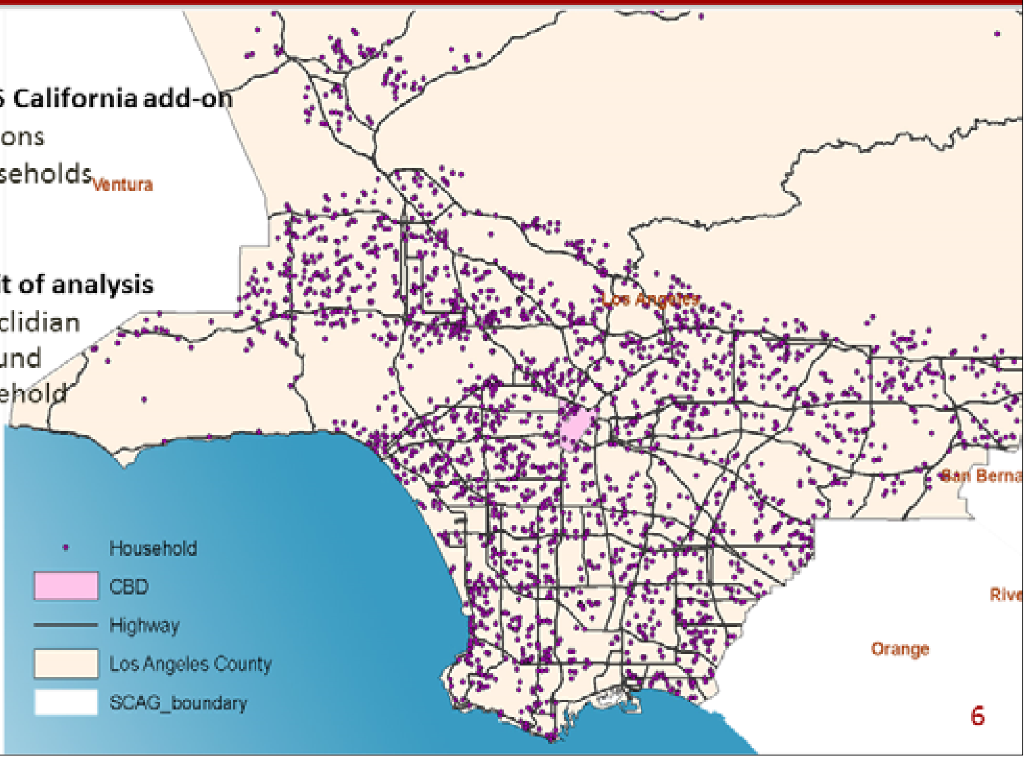
Research Design
Study Area

- 2009 NHTS California add-on
  - 5,861 persons
  - 2,989 households
- Spatial unit of analysis
  - ¼-mile Euclidian buffer around each household location



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RESEARCH DESIGN
VARIABLE DESCRIPTION

❑ Description of variables (2,171 households / 4,321 persons from 2009 NHTS-CA Data)

Class	Variable	Description	Mean / Percentage
Individual Level Variables (Monday – Friday Sample only)			
Demographics	Age	Age of respondents	16-24 years: 8.1%, 25-44: 22.8%, 45-64: 36.7%, 65 and older: 21.1%
	Gender	Gender of respondents	Male: 46.1%, Female: 53.9%
	Race	Race of respondents	White:63%, Black:6.3%, Asian:8.9% Hispanic:1.0%, Other: 20.8%
	Driver	Licensed drivers	Drivers: 81.6%, Non drivers: 7.9%
Household characteristics	Income	Household Income (K dollar)	Mean: 68.93, SD:41.23, Minimum: 2.5, Maximum: >=100
	Veh/Pers	Ratio of vehicles to persons in a household	Mean: 0.8053, SD: 0.4859 Minimum:0, Maximum:6
	Life Cycle	Households with Children	With Children: 49.8%, No Children: 50.2%
Neighborhood Level Variables			
Walkability Index	Home Walkability	Walkability of Residence Neighborhood	Mean: 0.0037, SD: 3.336, Minimum: -5.77, Maximum: 20.58
	Destination Walkability	Walkability of Destination of the tour	Mean: 0.0187, SD: 3.151 Minimum: -6.79, Maximum: 40.61

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HYPOTHESIS 1
MODEL

Hypothesis 1: Neighborhood walkability and household characteristics have association with tour complexity and generation.

The number of trip per tour (OLS): NTRIP = *f* (NW, RA, HH, PS)

The number of tours per day (Poisson): NTOUR= *f* (NW, RA, HH, PS)

NW = neighborhood walkability
RA = regional accessibility
HH = household-level travel demand variables (socio-economic, life cycle, etc.)
PS = person-level attributes (age, gender, race, work status, driver license)

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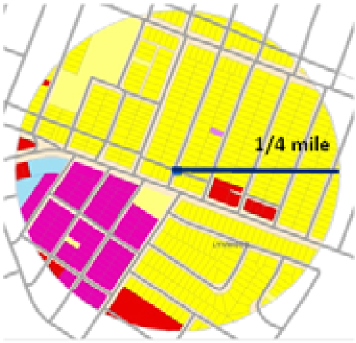
Hypothesis 1
Walkability Index

Walkability Index = 2*Z(street connectivity) + Z (residential density) + Z (land use mix) + Z (Intensity of retail employment) (Frank, 2010)



- Street connectivity: the number of intersections (4-way nodes)
- Land-use mix diversity = $\sum_{j=1}^{J} \frac{p_j \cdot \ln(p_j)}{\ln(J)}$

  P_j = proportion of land development type of the j^{th} parcel; and
  J = number of different types of land development type
- Intensity of retail employment: the number of jobs in the retail stores and commercial services within a ¼-mile radius around each household location

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USC Price
Sol Price School of Public Policy

Hypothesis 1
Results

	Work Tour		Non-Work Tour			
	Number of Trips Per Tour (OLS Regression)		Number of Trips Per Tour (OLS Regression)		Number of Tours Per Day (Poisson Regression)	
	β	P(Sig.)	β	P(Sig.)	Coefficient	P(Sig.)
Female	0.047	0.572	0.252	0.000	0.014	0.649
Driver License	-0.155	0.657	0.272	0.002	0.174	0.002
Income (kdollar)	0.004	0.002	0.000	0.671	0.001	0.027
Life Cycle (With children)	0.072	0.460	-0.030	0.641	0.148	0.000
Number of vehicles per person	0.123	0.266	0.137	0.028	-0.045	0.247
Distance to Work	-0.001	0.725	—	—	—	—
Work Walkability	0.033	0.012	—	—	—	—
Home Walkability	-0.024	0.064	-0.002	0.054	0.012	0.083
Distance to CBD	—	—	0.002	0.629	0.000	0.910
P<0.10 P< 0.05	Adjusted R^2 = 0.031 Prob>F=0.000 N = 1,076		Adjusted R^2 = 0.023 Prob>F=0.000 N = 2,582		Log likelihood Ratio Chi-Square: 60.78 (Prob > Chi^2 = 0.000) N = 2,582	

HYPOTHESIS 2
MODEL

Hypothesis 2: Neighborhood walkability matters in choosing the transit mode when travel costs and time, travelers' demographic and socio-economic factors, and tour characteristics are controlled.

$$P(ij) = \frac{\exp(\beta' X_{ij})}{\sum_{k \in C(m)} \exp(\beta' X_{ij})}$$

$P(ij)$ is the probability of a traveler i choosing a dominant mode j from a feasible choice set C.

X_{ij} is a vector of explanatory variables (i.e., tour attributes, person-level travel demand) and is the parameters to be estimated.

• The unit of analysis: a tour (home-to-home loop)

HYPOTHESIS 2
RESULTS

❑ MODE CHOICE MODEL

P<0.10 (blue) P< 0.05 (yellow)

Variables		Main Effects			Interaction Effects		
		Transit Coeff.	Bike Coeff.	Walk Coeff.	Transit Coeff.	Bike Coeff.	Walk Coeff.
Tour Purpose (rf= Work)	Shopping			0.635		-2.443	0.733
	Recreation		1.533	3.105			3.624
	Discretionary		-1.495	1.254	-4.594		1.707
Tour Complexity				-0.560			-0.532
Female			-1.630			-1.542	
Driver License			-2.195	-1.661		-2.254	-1.701
Income (rf=Below $25K)	$25K-$50K						
	$50K-$75K	-1.577			-1.634		
	$75K or above	-1.751			-1.496		
Lifecycle			-1.840	-1.094		-1.919	-1.086
Vehicle/Person ratio		-5.131	-1.389	-0.553	-5.759	-1.401	-0.536

(continued..)

Hypothesis 2
Results

❑ Mode Choice Model

P<0.10 (blue) P< 0.05 (yellow)

Variables	Main Effects			Interaction Effects		
	Transit Coeff.	Bike Coeff.	Walk Coeff.	Transit Coeff.	Bike Coeff.	Walk Coeff.
Driving	0.031		-0.027			-0.026
Transit Use Time						
Walking/Biking Time			-0.034			-0.033
H Street Connectivity (HLU1)		0.045		0.052		
H Mixed Land-Uses (HLU3)			0.805			1.257
H Retail Employment (HLU4)			0.001			0.001
D Street Connectivity (DLU1)			0.024			0.037
D Retail Employment (DLU4)						
D Transit Accessibility (DTSQ7)	3.218			2.914		
HLU3 * Discretionary				9.446		
DLU1 * Shopping					0.251	
DLU1 * Recreation					0.220	-0.033

Conclusion
Major Findings

❑ Critical factors for understanding daily active travel

1. Neighborhood walkability has association with tour complexity and generation.

- Residents who live in a more walkable neighborhood take fewer chained, albeit more frequent, non-work tours and conduct their non-work activities on foot or by public transport, enabling reduced vehicle use during the day

2. Different Plan elements of the built environment affect the choice of any particular mode for short travel, when travel costs and time, travelers' socio-economic factors, and tour characteristics are controlled.

- A key to increased travel by walking: concentration of retail shops and service destinations near people's homes
- A key to increased riding bikes: street networks with fine grids
- A key to increased transit use: good regional accessibility of destinations

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CONCLUSION
POLICY IMPLICATIONS

❑ Guidance for interventions

- Provide a concentration of business activity in the compact commercial core in the residential areas
- Develop major destination areas at much greater transit accessibility, with a corresponding impact on transit ridership
- Provide a convenient pedestrian environment, along with recreational activity sites closer to residential neighborhoods

❑ Relative importance of non-work trips

- Taken locally and amenable to more flexible scheduling and less essential
- The potential power of increasing the use of active transportation mode to reduce short car trips