What Attract Non-Motorized Trips?
Land Use/Environment Factors on Bicycle & Walking Trips

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Non-motorized transportation modes are

- Sustainable transportation modes
  - Reducing VMT and GHG emission
  - Improving both personal and community health
- Alternative transportation modes
  - 40% of trips are less than 2 miles\(^1\)
  - Biking/walking mode shares from other countries in 1995\(^2\)
    - 12% in Canada
    - 34% in Germany
    - 45% Netherland

1) 2009 National Household Travel Survey
What kinds of physical urban environments attract bicycle trips?

- Home to Work
- Home to Shopping
- Work to Shopping
- Shopping to Home
- Driving
- Walking / Biking
Study Area & Data

- Los Angeles County
- 2009 California Household Travel Survey
Research Method

- Regression analysis
- Hypothesis
  - The dependent variable will show positive linear correlation with all of independent variables.
- Variables
  - Dependent variable – number of non-motorized trips by TAZ
  - Independent variables – 13 land use and physical conditions by
Dependent Variable

2009 National Household Travel Survey (NHTS) Trip Destinations

Non-Motorized Trip Destinations aggregated by TAZ

High
Low
## Independent Variables

<table>
<thead>
<tr>
<th>Categories</th>
<th>Variables</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic &amp; socio-economic</td>
<td>Pop_Den</td>
<td>Net population density</td>
</tr>
<tr>
<td></td>
<td>Emp_Den</td>
<td>Net employment density</td>
</tr>
<tr>
<td></td>
<td>MF_Ratio</td>
<td>Multi family housing ratio</td>
</tr>
<tr>
<td></td>
<td>Med_Income</td>
<td>Median income</td>
</tr>
<tr>
<td>Land Use</td>
<td>LU_Mix</td>
<td>Mix of 5 land use types, SF, MF, retail, industry, and public</td>
</tr>
<tr>
<td></td>
<td>LU_Entropy</td>
<td>Land use diversity &amp; balance</td>
</tr>
<tr>
<td></td>
<td>Job_Pop</td>
<td>Population and job balance</td>
</tr>
<tr>
<td>Built Environment</td>
<td>Walk_Inx</td>
<td>Weighted intersection density</td>
</tr>
<tr>
<td></td>
<td>St_Den</td>
<td>Roadway density</td>
</tr>
<tr>
<td></td>
<td>Bike_Fac</td>
<td>Length of bicycle facilities (in feet)</td>
</tr>
<tr>
<td>Accessible Destinations</td>
<td>Transit</td>
<td>Number of transit stops (Bus + Rail)</td>
</tr>
<tr>
<td></td>
<td>Food</td>
<td>Number of restaurants and Groceries</td>
</tr>
<tr>
<td></td>
<td>School</td>
<td>Existence of school (K-12), dummy</td>
</tr>
</tbody>
</table>
Measuring Independent Variables

- Aggregating the variables by TAZ
- Data
  - Southern California Association of Governments (SCAG)
    - Parcel based land use
    - Socio-economic estimation
  - Metro Transit Authority (MTA)
    - Transit stops
    - Bicycle facilities
  - Info USA
  - TIGER Road
Independent Variables by TAZ
## Regression Results

<table>
<thead>
<tr>
<th>Categories</th>
<th>Variables</th>
<th>R²</th>
<th>Significance</th>
<th>Coefficient</th>
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</thead>
<tbody>
<tr>
<td>Demographic &amp; socio-economic</td>
<td>Pop_Den</td>
<td>0.015</td>
<td>0.102</td>
<td>0.039</td>
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<td>Emp_Den</td>
<td>0.164</td>
<td>*0.000</td>
<td>0.010</td>
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<td>MF_Ratio</td>
<td>0.019</td>
<td>*0.000</td>
<td>24.911</td>
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<td>Med_Income</td>
<td>0.031</td>
<td>*0.000</td>
<td>5.45E-006</td>
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<tr>
<td>Land Use</td>
<td>LU_Mix</td>
<td>0.019</td>
<td>*0.000</td>
<td>10.954</td>
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<td></td>
<td>LU_Entropy</td>
<td>0.022</td>
<td>0.994</td>
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<tr>
<td></td>
<td>Job_Pop</td>
<td>0.000</td>
<td>0.902</td>
<td>-0.039</td>
</tr>
<tr>
<td>Built Environment</td>
<td>Walk_Inx</td>
<td>0.382</td>
<td>*0.000</td>
<td>0.108</td>
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<td></td>
<td>St_Den</td>
<td>0.239</td>
<td>*0.000</td>
<td>0.662</td>
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<tr>
<td></td>
<td>Bike_Fac</td>
<td>0.007</td>
<td>0.395</td>
<td>0.072</td>
</tr>
<tr>
<td>Accessible Destinations</td>
<td>Transit</td>
<td>0.336</td>
<td>*0.000</td>
<td>0.330</td>
</tr>
<tr>
<td></td>
<td>Food</td>
<td>0.277</td>
<td>*0.000</td>
<td>0.354</td>
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<tr>
<td></td>
<td>School</td>
<td>0.016</td>
<td>*0.000</td>
<td>-5.522</td>
</tr>
</tbody>
</table>
Findings from Regression

- 8 variables (out of 13) showing positive correlations
  - Demographic & Socio-economic – 3 out of 4
  - Land use – 1 out of 3
  - Built Environment – 2 out of 3
  - Accessible destinations – 2 out of 3
- Relatively low level of linear correlation
  - The variables under the categories of built environment and accessible destinations present reliable $R^2$ values.
Variables with Strong Correlation

- Walkability Index
- Street Density
- Transit
- Food
Built environments and destinations are factors that significantly attract non-motorized transportation trips.

Land use density and diversity don’t present significant the correlation with non-motorized trip destinations.

Although the trip distance of non-motorized transportation modes is short, the non-motorized trips tend to approximate to employment rather than population.
This study confirms that the influence of land use/physical environments on non-motorized transportation trips.

This study supports location decisions on bicycle facilities.

Further research will develop a mode choice model controlling socio-economic characteristics of travelers.

Non-linear models should be considered to identify the relationship.