Do Millennials Value Travel Time Differently?
A Segmented Mode Choice Model Accounting for Travel-Based Multitasking

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motivation

study design

model results

segmentation outcomes

takeaways
study context

A stream of our studies addressing the phenomenon of multitasking (MTing) in travel behavior:
why does travel-based MTing matter?

A way to endure even longer commutes:
- sustainability effects: sprawl, resource consumption
- improved quality of life: increased job, housing choices

Competitive advantage to public transportation:
- preferring a longer transit commute to a shorter driving one, if they can use the time productively

Autonomous vehicles – a game changer:

“I rode 500 miles in a self-driving car and saw the future. It’s delightfully dull”

[Wired, 01/07/15]
this study

Dependent variable:
  commute mode choice (MNL model)

Key explanatory variable:
  propensity for travel-based multitasking behavior
  (i.e. to use laptop while commuting)

Heterogeneity:
  age-based segmentation (millennials, non)

Main interests:
  value of travel time savings
  willingness to pay for mode “multitaskability”
data collection

Mode-specific:
- SacRT
- Capital Corridor (Amtrak)
- BART
- Yolobus
- UCD & Bay Area carpoolers

Organization-specific:
- Google
- Commuter Club
- UC Davis staff, students

Email blast:
- Infogroup

Mail blast:
- Random addresses along the Amtrak corridor

Online panel:
- Survey Analytics

3 weeks of paper survey distribution (~3,000)
3 months of online surveys (~30 varieties)
sample description (N = 2216)

Paper surveys = 21%
Females = 61%
Average car ownership = 2.06
Average HH size = 2.68
Median income = $75,000-$100,000
Millennials (yob: 1980 or later) = 22%

Primary commute mode

- Driving alone (39%)
- Transit* (9%)
- Shared ride (16%)
- Bicycle (29%)
- Rail** (8%)

* Bus, light rail, and metro rail (BART)
** Commuter rail (Amtrak & Caltrain)
survey contents (800 original variables)

A. Attitudes and personality
B. Multitasking attitudes ("polychronicity")
C. Time use expectations and preferences
D. Attitudes toward waiting
E. Perceptions of four commute modes (plus externally-obtained objective characteristics)
F. A recent commute trip (primary commute mode, and activities conducted during the commute)
G. "Internet access on-the-go"
H. Daily commute
I. Socioeconomic traits
mode-specific propensity to use laptop

Chosen mode

Driving alone

Explanatory variables

Transit

Binary logit models

Shared ride

Est. propensities, for

Rail

DA  TR  SR  RL  BK

Bicycle
## Laptop/tablet/netbook usage by *primary commute mode* (N=2123)

<table>
<thead>
<tr>
<th>Mode</th>
<th>N</th>
<th>Used laptop</th>
<th>% users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td>174</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Rail</td>
<td>171</td>
<td>83</td>
<td>48.5</td>
</tr>
<tr>
<td>Transit</td>
<td>641</td>
<td>62</td>
<td>9.7</td>
</tr>
<tr>
<td>Shared ride</td>
<td>338</td>
<td>63</td>
<td>18.6</td>
</tr>
<tr>
<td>Driving alone</td>
<td>799</td>
<td>29</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Binary logit models (by mode) of choice to use “laptop”

Socio-economic variables; general, time-use, multitasking, and waiting attitudes
Descriptive statistics of the variable
\textit{Propensity to Use Laptop/Tablet/Netbook}

<table>
<thead>
<tr>
<th>Mode</th>
<th>N*</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td>394</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Rail</td>
<td>791</td>
<td>0.259</td>
<td>0.240</td>
</tr>
<tr>
<td>Transit</td>
<td>1992</td>
<td>0.101</td>
<td>0.099</td>
</tr>
<tr>
<td>Shared ride</td>
<td>2012</td>
<td>0.176</td>
<td>0.244</td>
</tr>
<tr>
<td>Driving alone</td>
<td>2073</td>
<td>0.047</td>
<td>0.105</td>
</tr>
</tbody>
</table>

* No. of respondents reporting perceptions for that mode, and, therefore, assumed to have it in their choice set.
$N = 2216$
$\mathcal{L} \hat{A} = -1156.654$
$\mathcal{L} \hat{A} c \hat{A} = -1587.107$
$\mathcal{L} \hat{A} 0 \hat{A} = -2641.483$
$. \ . = 21$
$-2[\mathcal{L} \hat{A} 0 \hat{A} - \mathcal{L} \hat{A} _\hat{A}]$
$= 0.56$
$= 0.55$

**Significant variables:**

*Socio-economic characteristics*

*Objective mode attributes*

General attitudes

Mode perceptions

Propensity to use laptop
<table>
<thead>
<tr>
<th>Variable</th>
<th>Bicycle</th>
<th>Rail</th>
<th>Transit</th>
<th>Shared ride</th>
<th>Driving alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headway, min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total travel time, min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly commuting cost, $</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significance: --- < 1%
## Mode Perceptions (Generic Variables)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bicycle</th>
<th>Rail</th>
<th>Transit</th>
<th>Shared ride</th>
<th>Driving alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convenience</td>
<td></td>
<td></td>
<td>+ + + +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benefit/cost</td>
<td></td>
<td></td>
<td>+ + + +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfort</td>
<td></td>
<td></td>
<td>+ + + +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to multitask</td>
<td></td>
<td></td>
<td>+ + + +</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significance: +++ < 1%
### Socioeconomic Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bicycle</th>
<th>Rail</th>
<th>Transit</th>
<th>Shared ride</th>
<th>Driving alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver's license</td>
<td></td>
<td></td>
<td></td>
<td>++</td>
<td>--</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td>--</td>
<td>++</td>
<td>--</td>
</tr>
<tr>
<td>Income, $</td>
<td>++</td>
<td></td>
<td>--</td>
<td></td>
<td>--</td>
</tr>
</tbody>
</table>

**Significance:**
- **+++** < 1%
- **** < 5%
### General Attitudes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bicycle</th>
<th>Rail</th>
<th>Transit</th>
<th>Shared ride</th>
<th>Driving alone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pro-active modes</strong></td>
<td></td>
<td>+++</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Necessity of travel</strong></td>
<td></td>
<td></td>
<td></td>
<td>--</td>
<td></td>
</tr>
<tr>
<td><strong>Pro-transit</strong></td>
<td></td>
<td></td>
<td>++++</td>
<td>++++</td>
<td></td>
</tr>
</tbody>
</table>

**Significance:**
- *** < 1%
- ** < 5%
### ability to travel MT & constants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bicycle</th>
<th>Rail</th>
<th>Transit</th>
<th>Shared ride</th>
<th>Driving alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propensity to be productive</td>
<td></td>
<td>+</td>
<td></td>
<td>+++</td>
<td>-</td>
</tr>
<tr>
<td>(Propensity to be productive)^2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significance:
- *** < 1%
- * < 10%
Does the propensity to use a laptop while commuting reduce the willingness to pay for shorter travel times?

Does this influence differ by population segment?

In particular, is it stronger for millennials?
## Millenials (yob: 1980+)

<table>
<thead>
<tr>
<th></th>
<th>Millennials</th>
<th>Non-millenials</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample size</strong></td>
<td>496</td>
<td>1720</td>
<td>2216</td>
</tr>
<tr>
<td><strong>IVTT, min</strong></td>
<td>-0.017</td>
<td>-0.016</td>
<td>-0.026</td>
</tr>
<tr>
<td><strong>OVTT, min</strong></td>
<td>-0.052</td>
<td>-0.049</td>
<td>-0.046</td>
</tr>
<tr>
<td><strong>Log of one way cost, $</strong></td>
<td>-1.263</td>
<td>-1.170</td>
<td>-1.164</td>
</tr>
<tr>
<td><strong>Propensity to use laptop</strong></td>
<td>2.306</td>
<td>0.823**</td>
<td>1.150</td>
</tr>
</tbody>
</table>

**Significance:**
- * < 10%
- ** < 5%
- else <1%
value of travel time savings, $/hr

\[
\frac{\partial V}{\partial c} = \frac{\partial}{\partial c} \frac{\partial V}{\partial \frac{\partial}{\partial c}} = (\_ \ast \_ \ast \_ \ast \ast) \ast 60 \_ \_h
\]
What are commuters willing to pay per trip to achieve commuter-rail levels of desired “MTability”?

- **Time**
  - While driving alone (AV): [Data Chart]
  - While on transit: [Data Chart]

- **Cost**
  - While driving alone (AV): [Data Chart]
  - While on transit: [Data Chart]

The equation for the willingness to pay is:

\[ \text{WTP} = \text{Cost} \times \left( \frac{\text{Time}}{\text{Time}_{\text{rail}}} \right) \]
multitasking & mode choice

Travel MT has a statistically **significant** and (in our view) **non-trivial** impact on mode choice.
- first time demonstrated with revealed preference data

Millenials are **more sensitive** to mode conduciveness towards travel MT: they value it more highly and are **willing to pay** more for it.

Millenials’ value of time for OVTT is lower than non-millennials’, probably due to their higher **proclivity for ICT devices** that makes OVTT less burdensome.
future research

**Same data**
- Identify and analyze groups of people with similar polychronicity profiles
- Further explore the role of population heterogeneity (with respect to multitasking propensity and behavior) in mode choice
- Develop structural equations models reflecting multiple directions of causality

**New data**
- Undertake international comparisons

**Ultimately**
- Use information from this dataset to inform scenario-testing at a regional scale, with demand forecasting models that are already in use
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Transportation Center

UC Davis Sustainable
Transportation Center

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Berliner, Rosaria M., Aliaksandr Malokin, Giovanni Circella, and Patricia L. Mokhtarian (2015) Travel-based multitasking: modeling the propensity to conduct activities while commuting. Presented at the 94th Transportation Research Board Meeting, Washington, DC.


