Which Station: Access Trips and Bike Share Route Choice

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Objectives
This study considers how people integrate bike share into their daily travel by:
• Developing a theoretical model of how people choose bike share stations at the start of their trip
• Analyzing trip records from about 600 Nice Ride Minnesota bike share users in the 2012 season
• Empirically testing the effects of directness, total travel distance, and relative walking and biking time on users’ choice of origin station
• Control for environment and personal factors, such as proximity to parks, neighborhood income and crime statistics, and trip purpose

Background
Bike share trips, like public transit trips, are composed of three primary segments:
• Station access walking segment
• On-bicycle segment(s) between stations
• Station egress walking segment

Research about transit suggests that people value time spent in each of these segments differently, and station area amenities affect the station’s utility.

Theoretical Model
This figure shows the relative value of retrieving a bicycle from the closest station versus walking farther in the direction of travel. An individual traveling from TO (true origin) to TD (true destination) will experience equal travel time retrieving a bicycle from anywhere along the kite-shaped boundary that corresponds with their speed. Depending on station placement, the individual may reduce their travel time by walking in the opposite direction from their destination to pick up a bicycle.

Empirical Methodology
The data come from an online survey of Nice Ride Minnesota bike share subscribers. We geocoded the stations used, route, purpose, and walking access/egress segments for 506 trips. The choice set was defined as the five closest stations to the respondent’s true origin.

Trip characteristics were calculated using OpenTripPlanner assuming 5kph walking and 16kph biking. They included:
• Total travel time using each station in the choice set (assuming shortest network distance path)
• Ratio of walking time to biking time
• Deviation from a shortest straight line path

A conditional logit model was used to predict which station each respondent used as a function of trip characteristics and built environment features around each station.

Key Findings
People prefer stations that don’t require long detours to access, but parks and low crime rates increased utility. Commuters value shorter trips and tend to choose stations that minimize overall travel time, while recreational users choose stations that allow them to spend more of their time biking.

Conditional Logit Model Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Work Trips Coefficient (SE)</th>
<th>OR</th>
<th>Sig.</th>
<th>Non-work Trips Coefficient (SE)</th>
<th>OR</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>W Minutes walking to Station</td>
<td>-0.557 (0.263)</td>
<td>0.573 **</td>
<td></td>
<td>-0.113 (0.092)</td>
<td>0.893</td>
<td></td>
</tr>
<tr>
<td>R Walking to trip time ratio</td>
<td>-0.036 (0.045)</td>
<td>0.964 *</td>
<td></td>
<td>-0.089 (0.018)</td>
<td>0.915 ***</td>
<td></td>
</tr>
<tr>
<td>D Deviation (100 meters)</td>
<td>-0.212 (0.107)</td>
<td>0.809 ***</td>
<td></td>
<td>-0.296 (0.047)</td>
<td>0.744 ***</td>
<td></td>
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<tr>
<td>T Trail within 400 meters</td>
<td>0.267 (0.550)</td>
<td>1.306</td>
<td></td>
<td>0.129 (0.272)</td>
<td>1.138</td>
<td></td>
</tr>
<tr>
<td>P Distance to Park (100 meters)</td>
<td>-0.411 (0.108)</td>
<td>0.663 **</td>
<td></td>
<td>-0.118 (0.082)</td>
<td>0.888</td>
<td></td>
</tr>
<tr>
<td>V Crime (outside CBD)</td>
<td>-0.007 (0.004)</td>
<td>0.993 *</td>
<td></td>
<td>-0.003 (0.002)</td>
<td>0.997 **</td>
<td></td>
</tr>
<tr>
<td>M Median Income ($1,000)</td>
<td>-0.013 (0.015)</td>
<td>0.987</td>
<td></td>
<td>-0.011 (0.007)</td>
<td>0.989 *</td>
<td></td>
</tr>
<tr>
<td>N Chosen (Choices)</td>
<td>97 (485)</td>
<td>394 (1,970)</td>
<td>0.758</td>
<td>0.708</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significance: ** *: p < 0.01, **: p < 0.05, *: p < 0.1

Conclusions and Future Research
While spacing stations along typical routes provides some level of access to destinations along the route, users’ strong preference for time spent biking (versus walking) suggests that clustering stations near trip generators and attractors may serve users better. Additionally, the pricing structure that discourages longer bike segments may undermine the system’s utility.

Network congestion is not a problem in the Nice Ride MN system, but uncertainty about bicycle availability may inform station choice for users in larger cities. Future research should consider station capacity and probability of a station having no bicycles.

Future research will piece together the station access, on bicycle, and station egress segments to model bike share route choice in full.

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