Attrition bias in before and after survey for personalized travel planning

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Soft measures

• Aiming at voluntarily changing travel behavior
  – mostly from car use to non-car transport

Personalized communication
• One of the key components of soft measures

Personalized travel planning
• Individualized marketing, travel blending, travel feedback program
Procedure of travel feedback programs

1. Questionnaire survey (data for trip before the program)

2. Customized communication: goal setting, customized information, behavior planning, etc.

3. Questionnaire survey (data for trip after the program)
Tools for personalized travel planning

Only leaflets respondents show interests are provided

Car and accident

Car and environment

Car and health

Car and urban transport

Car and cost
**Detailed travel itinerary**

**Customized information**

**Bus timetable**

**Map around nearest station**
Behavioral planning

This one for submission and keep another for you

Write how to get there in detail!
Results of experiment at Nagoya, Japan

- 15% reduction of the frequency of car use in areas within walking distance from station
- 8% reduction of the frequency of car use in areas without nearby station

- However, only less than half of recruited people responded
  - Low reachability is unresolved problem
Response rate at each step

<table>
<thead>
<tr>
<th>Type 1: 1&lt;sup&gt;st&lt;/sup&gt; Q &amp; Comm. at once</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Q</th>
<th>Comm.</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Q</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>w postcard invitation</td>
<td>—</td>
<td>46%</td>
<td>62%</td>
<td>29%</td>
</tr>
<tr>
<td>w/o postcard</td>
<td>—</td>
<td>31%</td>
<td>65%</td>
<td>20%</td>
</tr>
</tbody>
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| Type 2                                  | 35%            | 60%   | 71%            | 15%   |
| Mail                                    | 81%            | 60%   | 17%            | 17%   |
Motivation of this study

• Are **stayers** at the follow-up survey representative?
• Can we regard **drop-outs** at the follow-up survey also reduced car use the same as **stayers**?
Objective of study

• Investigate the relationship between unit non-response at follow-up survey and the change in travel behavior
• Estimate the size of attrition bias if any

Obstacle

• The change in travel behavior is observed only for stayers
Proxy for unit non-response

• Stayers who reported the travel behavior at the follow-up survey *before or after the reminder*
  – Those who reported after reminder might have not reported without reminder, thus regarded as closer to unit non-response
  – Both groups responded the follow-up survey
Reports before and after reminder

Number of reports

Reminder was sent

Accumulated reports

+10% increase

Reports on each day
Proxy for behavior change

- Strength of **behavioral intention** at the customized communication

![Diagram](image)

- Behavioral intention is observed for both stayers and drop-outs at the follow-up survey
Results of statistical tests

• Before or after reminder & behavior change: **Not significant**

• Unit non-response & behavior intention: **Significant**
  – Relationship between behavior intention & behavior change is also significant for stayers
  – Support for hypothesis that response at the follow-up survey and behavior change is positively correlated
Estimation of attrition bias

- Bivariate binary probit model of response to the follow-up survey and behavior change

Response to follow-up

\[ z_\star_i = \gamma x_i + \xi_i \]

\[ z_i = \begin{cases} 
0 & \text{if } z_\star_i < 0 \\
1 & \text{if } 0 \leq z_\star_i 
\end{cases} \]

Behavior change

for \( \{i \mid z_i = 1\} \)

\[ y_\star_i = \beta x_i + \epsilon_i \]

\[ y_i = \begin{cases} 
0 & \text{if } y_\star_i < 0 \\
1 & \text{if } 0 \leq y_\star_i 
\end{cases} \]
Estimation of attrition bias

• Bivariate binary probit model of response to the follow-up survey and behavior change

Results

• Error correlation is estimated as significant
• Those who changed behavior are calculated as 23% of drop-outs while that is observed as 46% of stayers
Conclusion

• Respondents of personalized travel planning are significantly biased

• Should take into account the bias when evaluating pilot program before larger implementation