Designing an Instrument to Measure No-notice Emergency Evacuations: The Case of the Emergency Evacuation Response Survey

Rene Bautista, NORC at the University of Chicago
Angela Fontes, NORC at the University of Chicago, Illinois State University
Joshua Auld, Argonne National Laboratory
Vadim Sokolov, Argonne National Laboratory
Emergency Evacuation Response Survey

• Background and motivation of the survey
• Objective of the survey
  • Focus of the survey
• Challenges in survey design
  • Survey design features
  • Trade-offs
  • Using a web-based survey
• Conclusions
Background

• Emergency evacuation surveys

Existing literature on:

• Advance-notice events
  – Natural disasters (e.g., hurricanes, tsunamis)

• Post event studies
  – Natural disasters (e.g., earthquakes, flooding)

Less research conducted on no-notice events:

– Unanticipated man-caused disasters (e.g., Industrial accidents, terrorist attacks)
Motivation of the survey

• Need in the field of transportation studies:
  – Predict response of a transportation network to the demand induced by evacuation warnings
  – Improve an existing emergency evacuation transportation model
    – Transportation model was developed by Chicago Metropolitan Agency for Planning, AECOM, and Argonne National Laboratory
  – Calibrate existing model to account for intended evacuees’ reaction to an emergency
Focus of the survey:

- People’s intended or stated reactions to different hypothetical emergency scenarios in the City of Chicago area
  - Argonne National Laboratory (ANL)
    - Non-profit research laboratory operated by the University of Chicago for the Department of Energy (DOE)
  - NORC at the University of Chicago
    - Non-profit academic research organization affiliated with the UofC
  - Summer 2011

Challenges in the survey design

- Cost and time constraints
- Randomly allocate hypothetical emergency scenarios
  - Time of the event
  - Location of the event
  - Severity of event
  - Event Radius
  - Government recommendation
- Geo-reference intended behavior in case of an emergency
  - Collect specific data on *travel* behavior in Chicago Metropolitan Area
Survey Design Features

Web-based survey

• Trade offs
  • Limits:
    – Coverage error
    – Low response rates
  • Benefits:
    – Relatively lower costs
    – Automated random allocation of scenarios
    – Flexibility in visual design features
    – Use of *Google Maps*
Survey Design Features (Cont’d)

• Given costs and time constraints:
  • 39,000 emails purchased from third party vendor
  • 324 responses were received

• Invitation email sent along with survey link
  • One email blast sent, no follow-ups

• Google Maps
  • Application programming interface (API)
  • Intensive JavaScript customization
Emergency Evacuation Response Survey

We thank you in advance for your help. We are conducting this survey to find out how people would react in the event of an emergency evacuation. Your answers are very important for planning and scientific research.

The survey is completely anonymous and will not take too long to complete. We will ask you for demographic information of you and other household members. Importantly, we will ask you about the decisions that you would make in the event of a city emergency.

Please answer the best you can, as your responses are extremely valuable for the successful completion of this study. Please begin now.

For more information about the Transportation Research and Analysis Computing Center (TRACC) at Argonne National Laboratory, please visit our website at www.tracc.anl.gov

Please press 'Begin' to start the survey:

Begin
Emergency Evacuation Response Survey

Please enter a name or nickname for each household member. These can be anything such as “John”, “First son”, “Friend 1”, etc. as long as it is meaningful to you.

After entering names, select the relationship of each household member to you.

<table>
<thead>
<tr>
<th>Adult 2</th>
<th>Enter a nickname for use in survey</th>
<th>Relationship Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jane</td>
<td>Spouse</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Child 1</th>
<th>Sally</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Child 2</th>
<th>Tom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What was your approximate household income in the past year?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $25,000</td>
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<tr>
<td>[ ]</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Do you own or rent your home (primary residence)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own</td>
</tr>
<tr>
<td>Rent</td>
</tr>
<tr>
<td>no response</td>
</tr>
<tr>
<td>[ ]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Are there any disabled individuals under your care / in your household?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>no response</td>
</tr>
<tr>
<td>[ ]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Are there any pets in your home? Check all that apply:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
</tr>
<tr>
<td>Cat</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>no response</td>
</tr>
<tr>
<td>[ ]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicate whether the following technologies are used by your household members (check all that apply):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellphone</td>
</tr>
<tr>
<td>Smartphone or PDA</td>
</tr>
<tr>
<td>Internet</td>
</tr>
<tr>
<td>In-vehicle Navigation</td>
</tr>
<tr>
<td>no response</td>
</tr>
<tr>
<td>[ ]</td>
</tr>
</tbody>
</table>
For each map shown below, move the marker for each family member to their locations *Yesterday at each time* shown. If you (or other household members) are generally traveling at the times shown, move the marker to your destination location.

To pick the locations, drag the location pins with the mouse or use the search boxes with address, city/state, zipcode, etc. Try to place the location markers are accurately as possible.

For a quick tutorial on how to use Google Maps in this survey click [here](#).

Please indicate locations at 2:00 P.M. (*Yesterday*)

**You:**
- Chicago Midway International Airport, S Cicero Ave

**Jane (Adult 1):**
- Des Plaines Ave, Forest Park

**Sally (Child 1):**
- Morgan Dr, Chicago

**Tom (Child 2):**
- Burkhardt Dr, Chicago
SCENARIO 1 DESCRIPTION:

An emergency event has occurred at 7PM within 10 miles of Jane. Government authorities have determined that there is high risk present to individuals in the area and have ordered that individuals evacuate immediately. Authorities have set up evacuation shelters as shown.

At this time you and your other household members are at the locations shown below and you have NO ACCESS to a vehicle.

Considering the current locations of you (and members of your household) and your knowledge of the event, please answer the following questions describing how you would respond.

Emergency Hazard Level:
- Severe
- Moderate
- Low
- Shelters

Scenario 1 Response:

Considering the scenario presented above where the government has ordered that individuals evacuate, how likely would you be to:

- Go about your day as usual
- Stay where you are and seek shelter
- Make additional trips and / or evacuate
- Evacuate if you heard others were evacuating
- Evacuate if people near you were evacuating

- Time
- Location
- Severity
- Radius
- Government recommendation

- Intended behavior
Add any stops you would make below, select the purpose for making the stop, and write any location information (i.e. address, city/state, zipcode).

- To add new trips press the Add Trip button.
- When finished press the Search Location button and move the markers if needed.
- Press the Next button if you would not make any trips before evacuating.

**Trip Purpose**

1st stop: Pick up Jane
2nd stop: Pick up Sally
3rd stop: Stop at home
4th stop: Meet with others

Enter stop location (address, cross-streets, city/state, zipcode, etc.)

- S Naperville Plainfield Rd, Naperville
- W 135th St, Palos Heights
- S Independence Blvd, Crete

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**Intended behavior**

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**Emergency Hazard Level:**

- Severe
- Moderate
- Low
- Shelters
Finally, where would your final evacuation destination be:

Go to a hotel / motel

To EVACUATE to one of the SHELTERS, simply CLICK it with the mouse pointer.

OTHERWISE, Enter location in the box below, press the button and move the marker to your final destination.

Search for Location

Emergency Hazard Level:
Lessons learned

- Internet-based tools facilitate allocation of complex scenarios randomly
  - Dynamic tools seem to help convey the intention of the researchers
    - Visualize emergency scenarios geospatially
- Intensive specialized programming is needed
  - Google Maps API & KeySurvey API
- Coverage issues: validity of sample frame
- Weighting methods needed to match known population totals
- Data can provide general trends on intended behavior
- More research is needed to improve web-based surveys
Thank You!

Bautista-Rene@norc.org
Selected results from the survey

Mean Evacuation Likelihood by Government Recommendation

- Suggest Evacuation: 3.65
- Recommend Evacuation: 3.84
- Order Evacuation: 4.05

Bar chart showing mean evacuation likelihood by government recommendation:

- No other info: 3.65
- Hear about other evacuating: 3.84
- See others evacuating: 4.05

Legend:
- Very Likely
- Very Unlikely
Selected results from the survey (Cont’d)

Evacuation Destination by Level of Risk

% of Respondents

<table>
<thead>
<tr>
<th>Level of Risk</th>
<th>Evacuation Shelter</th>
<th>Friends/Family</th>
<th>Return home</th>
<th>Hotel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>51%</td>
<td>31%</td>
<td>17%</td>
<td>1%</td>
</tr>
<tr>
<td>Moderate</td>
<td>61%</td>
<td>27%</td>
<td>10%</td>
<td>2%</td>
</tr>
<tr>
<td>High</td>
<td>49%</td>
<td>32%</td>
<td>9%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Evacuation Shelter • Friends/Family • Return home • Hotel
Selected results from the survey (Cont’d)

Cumulative Distribution of Evacuation Distance by Level of Risk

- Low
- Medium
- High

<table>
<thead>
<tr>
<th>Level of Risk</th>
<th>Avg. Distance (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>85</td>
</tr>
<tr>
<td>Moderate</td>
<td>124</td>
</tr>
<tr>
<td>High</td>
<td>153</td>
</tr>
</tbody>
</table>