3D Spatial Visualization Analysis of Safety Related Driving Events of Newly Licensed Teens in Proximity of Home and School

Tika Ram Adhikari, Dan McGehee, Michelle Reyes, Cher Carney
August 19, 2011
Background

• For teens, crashes are the leading cause of death and injury in the US (NHSTA, 2011)
• In 2009, there were 2,336 fatalities and 196,000 injuries (aged 14-19) (NHSTA, 2011)
• First six months is the most dangerous and crash prone
Where and when do crash rates differ?

- Crash rates vary geographically
  - Rural 56.6%; urban 42.4% (NHSTA, 2011)
- 52% of crashes occur within a five mile radius of home (NHSTA, 2011)
- Crashes rates are higher close to school in the morning and afternoon (Abdek-Aty et al., 2007)
Previous research

• All studies (Abdek-Aty et al., 2007) related to driver crashes utilize straight line distance (Euclidean space) to understand the proximity distance of crashes from home or school.
How this study is different?

- Extension of previous work by Carney et al. (2010) and McGehee et al. (2007) who used Event Triggered Video Recorders (ETVR) to study driver errors of newly licensed teens.

- This study examines the **spatial distribution and density of driving errors** within the proximity of home and schools.

- Also compares the variation of spatial patterns of driving errors with reference to license type using network distance.
Research Questions

1. Are there differences in the number of driver errors in proximity to school and home?

2. Does the relative mean distance of driver errors in proximity to home and school differ by license type?

3. Are there differences in driver errors location by license type?

4. What percentage of driver errors occur within 5 miles from home and school?
Participants

- 34 newly licensed drivers aged 14-16 years from three rural high schools of eastern Iowa
- Installed ETVRs on first day of license
  - School License: 14 years old independent drivers
  - Intermediate License: Traditional 16 year old drivers
  - Both: Teens that held a school license before intermediate license
- Students must be the primary driver of their car
Event triggered video recorders

Source: McGehee et al. 2007
Spatial analysis and visualization

• Created spatial distribution maps of driver errors using the lat/long recorded by the ETVR
• Geocoded home and school addresses
• Visualized location of home, school, and driver error location
Spatial Analysis and Visualization (Cont.)

• Estimated the shortest route distance from home to school using network distance (ND)
• Estimated the shortest distance from home and school to driver error location using (ND)
• Calculated the relative distance for each driver error location from home and school

Relative Distance

$$R_{ijH} = \frac{D_{ij} \cdot E_{iH}}{D_{jH,S}}$$

$$R_{ijS} = \frac{D_{ij} \cdot E_{iS}}{D_{jH,S}}$$
Spatial Patterns of Driver Errors by License Types
Driving Errors of Individual Teens
## Driving Errors by License Types

<table>
<thead>
<tr>
<th>License Type</th>
<th>Number of Subjects</th>
<th>Number of Driver Errors</th>
<th>Average Number of Driver errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both</td>
<td>14</td>
<td>316</td>
<td>23</td>
</tr>
<tr>
<td>Intermediate License</td>
<td>14</td>
<td>342</td>
<td>24</td>
</tr>
<tr>
<td>School License</td>
<td>6</td>
<td>113</td>
<td>19</td>
</tr>
</tbody>
</table>
Driving Errors by License Types and Distance

Proportion of Driving Errors From Home and School

Distance Interval

- Both License From Home
- Intermediate License from Home
- School License From Home
- Both License From School
- Intermediate License From School
- School License From School
Driver Errors in Proximity to Home
Driver Errors in Proximity to School
Driving Errors by License Types
Results

• The difference for the number of driver errors by the three license types in proximity (1 Mile) to home is higher than school $p < 0.0001$.

• The relative mean distance from home and school location to driver error location is also statistically significant ($P < 0.05$).

• The proximity of location of driver error is significant by all license types with $P < 0.05$. 

![Bar chart showing average distance for different license types](chart.png)
Conclusions

- The number of teen driving errors vary
  - Geographically: proximity to school and home
  - Age: license types difference
  - Age and Proximity: the difference in driver errors is more significant within 1 mile.
- If closer you are from school the higher the driver errors
- The driver errors clustered by license types
- The driver errors within 5 miles from school and home is 79.3% and 73.4% respectively.
- The proportion of driver errors is higher compared to crashes within 5 miles from homes and schools
Thank you

Questions and Comments?