Factors Affecting Highway Safety in Louisiana

Conducted by the Louisiana Transportation Research Center for the Louisiana Department of Transportation and Development
Results – Fatality rates 1999-2004
Objective

• Identify and quantify factors contributing to the high crash record in Louisiana
• Identify and prioritize countermeasures that address the factors identified above
Data

• Louisiana Crash Database (1999-2006)
• Louisiana DOTD Crash Database (1999-2004)
• Louisiana DOTD segment data (1999-2004)
• Fatality Analysis Reporting System (FARS)
• General Estimates System (GES)
• LSU Highway Safety Research Group website
• NHTSA Traffic Safety Fact documentation
Methodology

• Identify crash rates of subsections of crashes distinguished by the characteristics of the drivers, occupants, vehicle, or roadway. For example, crash rates of:
  – Male and female drivers
  – Number of occupants in vehicle
  – Type of vehicle
  – Class of roadway

• Compare crash rates of subsections between Louisiana and:
  – Peer states (Alabama, Arkansas, Colorado, Kentucky, Mississippi, Oklahoma, and Tennessee)
  – Rest of the nation
Statistic to compare between datasets

\[ z = \frac{x_L - x_b}{\sqrt{p(1-p)\left(\frac{1}{n_L} + \frac{1}{n_b}\right)}} \]

where,

- \( x_L = \text{crash frequency of crash category in Louisiana} \)
- \( x_b = \text{same in peer state or nation} \)
- \( n_L = \text{total crash frequency in Louisiana} \)
- \( n_b = \text{same in peer state or nation} \)
- \( p = \frac{x_L + x_b}{n_L + n_b} \)
Measuring over-representation

• Over Representation Factor (ORF) = \[
\frac{\frac{x_L}{n_L}}{\frac{x_b}{n_b}}
\]

• Example: If 45% of all crashes in Louisiana are alcohol-related while only 38% of crashes in peer states are alcohol-related, then ORF for alcohol-related crashes in Louisiana = \[
\frac{0.45}{0.38} = 1.2
\]
Statistic to compare within a dataset

Relative Crash Involvement Ratio (RCIR)

\[
RCIR = \frac{x_{at \, fault, \, group \, i}}{n_{group \, i}} \div \frac{x_{not \, at \, fault \, in \, multi-vehicle \, crashes, \, group \, i}}{n_{multi-vehicle \, crashes, \, group \, i}}
\]

Example: Young drivers (15-17) are involved in 20,000 crashes/year in which they are at fault in 12,000. 15,000 of all the crashes of this group are multi-vehicle crashes, in which they are not at fault in 5,000. Then,

\[
RCIR_{15-17} = \frac{12,000}{5,000} \div \frac{20,000}{15,000} = 1.8
\]
Identifying problem areas

• High ORF combined with high percentage of crashes indicated a potential problem area

• Further analysis to try to identify root source of problem (e.g. high crash rate among young drivers is probably not associated with age per sé but possibly with inexperience, peer pressure, alcohol, and risk-taking)

• No one statistic adequate to determine root causes
Addressing problem areas

• Countermeasures from literature (Highway Safety Manual and other sources)
  – Crash Reduction Factors (CRFs) used to quantify effect of countermeasures to reduce incidence of crashes
  – Mixed Logit model developed to estimate change in crash severity resulting from use of countermeasures
Prioritizing countermeasures

• Premise: priority depends on-
  – Extent of the need the countermeasure addresses
  – Performance of countermeasure in alleviating need
  – The cost of the countermeasure

• Priority index = \( \frac{\text{Need} \times \text{Performance}}{\text{Cost}} \)

  where,

  \[
  \text{Need} = \sum_{i=1}^{3} \left( \frac{x_{Li}}{n_L} - \frac{x_{bi}}{n_b} \right) x_{Li} c_i \quad (i = \text{severity level})
  \]

  \[
  \text{Performance} = \text{CRF}
  \]

  \[
  \text{Cost} = \text{cost of countermeasure (\$)}
  \]
Initial identification of problem areas contributing to fatal crashes

<table>
<thead>
<tr>
<th>Area</th>
<th>ORF&lt;sub&gt;peer&lt;/sub&gt;</th>
<th>ORF&lt;sub&gt;USA&lt;/sub&gt;</th>
<th>Crash %</th>
<th>Imp&lt;sub&gt;peer&lt;/sub&gt;</th>
<th>Imp&lt;sub&gt;USA&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol-related fatal crashes</td>
<td>1.22</td>
<td>1.17</td>
<td>46</td>
<td>56</td>
<td>54</td>
</tr>
<tr>
<td>Fatal crashes by non-use of seatbelts</td>
<td>0.94</td>
<td>1.13</td>
<td>46</td>
<td>43</td>
<td>52</td>
</tr>
<tr>
<td>Fatal crashes by posted speed limit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 mph</td>
<td>2.62</td>
<td>3.52</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>35 mph</td>
<td>1.31</td>
<td>1.09</td>
<td>28</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>50-60 mph</td>
<td>1.06</td>
<td>1.21</td>
<td>38</td>
<td>41</td>
<td>46</td>
</tr>
<tr>
<td>70 mph</td>
<td>1.24</td>
<td>1.75</td>
<td>24</td>
<td>29</td>
<td>41</td>
</tr>
<tr>
<td>Fatal crashes by drivers license</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invalid CDL</td>
<td>2.81</td>
<td>2.07</td>
<td>12</td>
<td>33</td>
<td>24</td>
</tr>
<tr>
<td>Non-CDL license</td>
<td>1.43</td>
<td>1.52</td>
<td>17</td>
<td>24</td>
<td>26</td>
</tr>
</tbody>
</table>
### Initial identification of problem areas associated with injury crashes

<table>
<thead>
<tr>
<th>Area</th>
<th>$\text{ORF}_{\text{USA}}$</th>
<th>Crash %</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder seatbelt used only (driver)</td>
<td>3.57</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Running a traffic signal/stop sign</td>
<td>1.59</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Driver age 21-24</td>
<td>1.13</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Pedestrian age 0-14</td>
<td>3.82</td>
<td>34</td>
<td>129</td>
</tr>
<tr>
<td>Inattention/distraction</td>
<td>1.23</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Run off road injury crashes</td>
<td>2.43</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Light truck, pickup/SUV</td>
<td>1.75</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>Work zone</td>
<td>1.75</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>One-way traffic flow</td>
<td>1.92</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>
Initial list of problem areas

• 23 problem areas were identified from previous analysis:
  – Driver characteristics (8)
  – Occupant characteristics (2)
  – Pedestrian characteristics (2)
  – Roadway characteristics (5)
  – Crash characteristics (5)
  – Vehicle characteristics (1)

• Further analysis conducted on these problem areas to try to determine root source
Seat belt non-use

- Percent seat belt non-use
  - All drivers
  - Alcohol involved drivers

<table>
<thead>
<tr>
<th>Condition</th>
<th>All drivers</th>
<th>Alcohol involved drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>61.7%</td>
<td>75.67%</td>
</tr>
<tr>
<td>Injury</td>
<td>10.1%</td>
<td>36.83%</td>
</tr>
<tr>
<td>PDO</td>
<td>3.1%</td>
<td>9.11%</td>
</tr>
</tbody>
</table>
Occupant seatbelt non-use by age and gender

![Bar chart showing the rate of seatbelt non-use by age and gender.](chart.png)
Speeding and disregarding traffic controls

![Graph showing crash rate by driver age for speed related and disregarding traffic controls.](image-url)
Relative crash risk of 15-17 year old drivers by number of passengers
Inattention/distraction by age

Fatalities per 100,000 licensed drivers

Driver Age

Final problem areas

• Alcohol
• Young drivers
• Seatbelt use
• Licensing
• Speed
• Traffic control: stop and red signals
• Rural two-lane roads
• Motorcycle safety
## Priorities

<table>
<thead>
<tr>
<th>Problem area</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>1</td>
</tr>
<tr>
<td>Seatbelt use</td>
<td>2</td>
</tr>
<tr>
<td>Young drivers</td>
<td>3</td>
</tr>
<tr>
<td>Disregarding stop signs and red signals</td>
<td>4</td>
</tr>
<tr>
<td>Speed</td>
<td>5</td>
</tr>
</tbody>
</table>
Conclusions

• Human behavior most responsible for poor safety standard in Louisiana (alcohol, speeding, distraction/fatigue, low seatbelt use, invalid drivers license, repeat offences)

• Young drivers (<24) most culpable (3x the rate for 55-74 year olds)

• Young males twice the fatality and injury rate of females
Recommendations

- Alter human behavior with:
  - Point system that:
    - Punishes bad behavior (DUI, speeding, non-seatbelt use)
    - Rewards good behavior (lower insurance, automatic driver license renewal, letter of congratulation)
  - Extended Graduated Licensing Scheme:
    - Increased supervised driving
    - Limit passengers for young drivers (15-17)
  - Promote proper and increased seatbelt use:
    - Training of firemen, state police, and employees of state vehicle inspection facilities in proper use of child restraint systems
    - Publicize proper use of child restraint systems, assistance available, and overall benefit of seatbelt use.
Impact of occupants on young male drivers

![Bar chart showing relative crash rate for 15-17 year old male drivers across different age groups and crash severities (fatal, injury, PDO). The chart compares male, female, and both male & female occupant age groups.]

- Male occupant age groups: 18-20, 15-17, 0-14 (Fatal, Injury, PDO categories)
- Female occupant age groups: 18-20, 15-17, 0-14 (Fatal, Injury, PDO categories)
- Both male & female occupant age groups: 18-20, 15-17, 0-14 (Fatal, Injury, PDO categories)

Legend:
- 18-20
- 15-17
- 0-14
Impact of occupants on young female drivers

15-17 year old female drivers

Relative crash rate vs. fatal injury, injury, PDO for male, female, and both male & female occupant age groups.
Crashes by traffic control signal

![Bar chart showing the percentage of crashes by traffic control signals. The categories include stop, yield, red sig on, yellow, green, green to yellow, and right turn on red. The chart indicates different types of crashes: fatal, injury, andpdo.](chart.png)
Motorcycle crash rates

Crashes per million registered motor cycles per year

- Fatal
- Injury
- PDO

Years:
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
Impact of pavement width on crash rates

![Graph showing the impact of pavement width on crash rates. The x-axis represents pavement width (ft.), ranging from 18 to 26. The y-axis represents crash rates, with categories for fatal (per 50,000,000 vmts), injury (per 1,000,000 vmts), and PDO (per 1,000,000 vmts). The graph indicates that as pavement width increases, the crash rates decrease for all categories.](image-url)
Fatal off-roadway crash event

Most Harmful Event

Percent of Crashes

0.0% 10.0% 20.0% 30.0% 40.0%

Overturned Utility Pole Culvert Embankment Ditch Tree
Fatality rates with different measures

Fatality per 100 Million Miles
Fatality per 100,000 Population
Fatality per 100,000 Registered Vehicles
Fatality per 100,000 Licensed Drivers

Louisiana's relative crash rate
Injury rates

Louisiana's relative crash rate

- Injury per 100 Million Miles
- Injury per 100,000 Population
- Injury per 100,000 Registered Vehicles
- Injury per 100,000 Licensed Drivers
PDO rates

Louisiana's relative crash rate

PDO per 100 Million Miles
PDO per 100,000 Population
PDO per 100,000 Registered Vehicles
PDO per 100,000 Licensed Drivers

PDO

1999 2000 2001 2002 2003 2004

PDO rates