Examination of Factors Determining Fault in Multi-Vehicle Conflicts Using the SHRP2 Data

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Overview

- Introduction
- Literature Review
- Data Description
- Statistical Methodology
- Results
- Research Implications
Introduction

What factors influence the **likelihood** of a driver being **at fault** when involved in a **multi-vehicle** conflict?

NHTSA Data - 2014

Literature Review

- Odds of being at fault:
  - Higher: Male drivers
    Non-vehicle owners
    Suspended or revoked license
    Unlicensed drivers
  - Lower: Older populations
    Working from home
    Daily commute less than 15 minutes
Data
SHRP 2 Naturalistic Driving Study

- 3092 drivers
- 3900 vehicle drivers
- 3 years of data
- 1600 crashes
- 2900 near-crashes
Requested Data

- 1,360 multi-vehicle conflicts
- 684 unique drivers

- Driver behavior
- Driver demographic
- Driving history
- Driving knowledge
- Risk perception
- Risk taking
- Sleep habits
- Event characteristics
- Trip information
- Vehicle information
Requested Data
Event Distribution

Near-Crash 87%
Crash 11%
Non-Subject Conflict 2%
Crash Relevant 0%

Near-Crash
Subject Driver 58%
Other Driver(s) 42%

Crash
Subject Driver 47%
Other Driver(s) 53%
## Requested Data
### Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total Sample</th>
<th>Unique Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>At-Fault Subject Driver (Yes/No)</td>
<td>0.56</td>
<td>-</td>
</tr>
<tr>
<td>Full Time Worker (Yes/No)</td>
<td>0.46</td>
<td>0.45</td>
</tr>
<tr>
<td>Unemployed (Yes/No)</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>No Children at Home (Yes/No)</td>
<td>0.74</td>
<td>0.73</td>
</tr>
<tr>
<td>Driver Feels Fatigued Nearly Every day (Yes/No)</td>
<td>0.16</td>
<td>0.15</td>
</tr>
<tr>
<td>Female (Yes/No)</td>
<td>0.48</td>
<td>0.51</td>
</tr>
<tr>
<td>Latino / Hispanic (Yes/No)</td>
<td>0.09</td>
<td>0.07</td>
</tr>
<tr>
<td>Education Beyond High School (Yes/No)</td>
<td>0.91</td>
<td>0.90</td>
</tr>
<tr>
<td>Two Parent Household (Yes/No)</td>
<td>0.59</td>
<td>0.62</td>
</tr>
<tr>
<td>Driver Rental Status is Owned (Yes/No)</td>
<td>0.74</td>
<td>0.75</td>
</tr>
<tr>
<td>Income 50,000+ (Yes/No)</td>
<td>0.63</td>
<td>0.63</td>
</tr>
<tr>
<td>No Traffic Violations in Past 3 Years (Yes/No)</td>
<td>0.58</td>
<td>0.55</td>
</tr>
<tr>
<td>No Crashes in Past 3 Years (Yes/No)</td>
<td>0.64</td>
<td>0.67</td>
</tr>
</tbody>
</table>
Requested Data
Risk Perception Survey Results

- Acceleration at onset of yellow
- Road rage
- Not using turn signals
- Bad weather
- Aggressive driving
- Engaging in a secondary task
- Being in a hurry
- Driving with worn tires
- Tailgating
- Checking rear-view mirror
- Running stop signs
- Fatigued driving
- Racing
- Thrill-seeking
- Red light running

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

1-No Greater Risk  2  3  4  5  6  7-Much Greater Risk
Statistical Methodology

- **Binary logistic regression model:**
  - Binary variable=1 if the subject driver is at fault,
  - Binary variable=0 otherwise

\[
\log \left( \frac{p_i}{1-p_i} \right) = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_k x_{ki}
\]

- **Mixed effect binary logistic regression model**

\[
p_i = \int \frac{\text{EXP}(\beta x_i + \varepsilon_i)}{1+\text{EXP}(\beta x_i + \varepsilon_i)} f(\beta | \varphi) d\beta
\]
## Results

### Logistic Regression Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pooled (Naïve) Model</th>
<th>Random Effect Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.585</td>
<td>0.117</td>
</tr>
<tr>
<td>Full Time Worker</td>
<td>-0.257</td>
<td>0.111</td>
</tr>
<tr>
<td>Driver perceives tailgating as high risk</td>
<td>-0.490</td>
<td>0.119</td>
</tr>
<tr>
<td>Driver perceives acceleration at onset of yellow as low risk</td>
<td>0.773</td>
<td>0.342</td>
</tr>
<tr>
<td>Driver feels fatigued nearly everyday</td>
<td>0.269</td>
<td>0.154</td>
</tr>
<tr>
<td>No crashes in past 3 years</td>
<td>-0.198</td>
<td>0.117</td>
</tr>
<tr>
<td>Log Likelihood at Convergence</td>
<td>-912.305</td>
<td></td>
</tr>
<tr>
<td>Restricted Log Likelihood</td>
<td>-932.027</td>
<td></td>
</tr>
</tbody>
</table>
## Results

### Odds Ratios

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pooled (Naïve) Model</th>
<th>Random Effect Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Full Time Worker</td>
<td>0.77</td>
<td>0.72</td>
</tr>
<tr>
<td>Driver perceives tailgating as high risk</td>
<td>0.61</td>
<td>0.60</td>
</tr>
<tr>
<td>Driver perceives acceleration at onset of yellow as low risk</td>
<td>2.17</td>
<td>2.32</td>
</tr>
<tr>
<td>Driver feels fatigued nearly everyday</td>
<td>1.31</td>
<td>1.36</td>
</tr>
<tr>
<td>No crashes in past 3 years</td>
<td>0.82</td>
<td>0.81</td>
</tr>
</tbody>
</table>
Research Implications

- Pricing strategy for insurance companies
- Set countermeasures
- Improve public education
- Develop programs
Thank You!

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