EFFECTIVENESS OF ENHANCED SEAT BELT REMINDERS (ESBRs) IN INCREASING OBSERVED SEAT BELT USE

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Seat belt non-use remains a problem
Current FMVSS 208 required reminder is minimal

- Various studies indicated limited effectiveness of “basic” reminders
- NHTSA/Westat field observational study (2005) observed substantial increase for ESBRs
  - 3-4% increase in seat belt use rate
Much wider use of ESBRs in the past 10 years
Map-21 Act allows NHTSA to consider requirements for ESBRs

Current study
• Provides high quality data to support NHTSA
• Provides recommendations for ESBR system design
• Based on 2005 methodology
Study Overview

Collect Observational Data

Collect ESBR System Details

Map Observational Data to ESBR System

Modeling of Seat Belt Use/Analysis
Determining ESBR System Features

- LICENSE PLATES
- VINs
- VEHICLE MAKE AND MODEL
- ESBR SYSTEM FEATURES
What is different now?
• Substantially more observations
What is different now?

- “Baseline” issue: few non-ESBR systems, older vehicles
  - 96% of 2014 models have ESBR systems
- Very high observed seat belt use rate, particularly in primary belt use law states
- Many unique, complex ESBR systems
  - Issues of how to collapse across systems
- OEM provision of ESBR details
  - Good industry response rates
  - Some weaknesses in terms of detail
Sample Design

Divided the U.S. into four quadrants by combining NHTSA Regions
8 PSUs, 2 from each quadrant
  • One primary law state
  • One secondary law state

Used as many sites from the 2005 survey as possible
Sites selected for VOLUME
Not a proper statistical sample
• Convenience sample
Goal → variety of locations with a high volume of traffic
448 sites total
Teams of two observers

- One Spotter
  - Called out vehicle information, driver and passenger characteristics, and the license plate characters and state

- One Recorder
  - Entered everything into the tablet

Observed belt use for up to two front-seat occupants

Tablet data collection program
Data Collected

Site
- Weather
- Area type

Vehicle
- Color
- Type
- License plate state
- License plate characters

Driver & passenger
- Age
- Gender
- Belt status
Data Transmission and Editing

Data
• Transmitted after each site directly to SQL database

Initial QC Checks (within 24 hours)
• Sites scheduled versus sites received
• File completeness
• GPS verification that data collection occurred at assigned location
• Data collectors were following protocol (not moving during data collection)
• Data collection lasted for the correct duration (2 hours)
• Volume of observations per site
Data Processing

Clean License Plates

- Dropped 2,423 errors

Convert License Plates to VINs

- Contacted and worked with DMVs
  - 6,487 unmatched

Convert VINs to Make/Model/Year

- 2,863 unmatched

58,208 total matched
Received information from 15 OEMs
36 vehicle brands
46 ESBR systems
High response rate from OEMS but quality of data inconsistent and incomplete
Combining Observational and ESBR System Data

<table>
<thead>
<tr>
<th>Observations</th>
<th># of Problem Observations</th>
<th>Total # of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Raw Observations</td>
<td></td>
<td>69,984</td>
</tr>
<tr>
<td># Excluded From Analysis</td>
<td>9,780</td>
<td>60,204</td>
</tr>
<tr>
<td>Model Year &lt;2006</td>
<td>19,173</td>
<td>41,031</td>
</tr>
<tr>
<td>Not Linked or No ESBR</td>
<td>5,678</td>
<td>35,535</td>
</tr>
</tbody>
</table>
### Final Observations for Analysis

<table>
<thead>
<tr>
<th>Occupant</th>
<th>Seat Belt Law</th>
<th>N</th>
<th>Total</th>
<th>Belt Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Driver</strong></td>
<td>Secondary</td>
<td>16,659</td>
<td>35,175</td>
<td>0.882</td>
</tr>
<tr>
<td></td>
<td>Primary</td>
<td>18,516</td>
<td></td>
<td>0.976</td>
</tr>
<tr>
<td><strong>Passenger</strong></td>
<td>Secondary</td>
<td>4,084</td>
<td>8,896</td>
<td>0.894</td>
</tr>
<tr>
<td></td>
<td>Primary</td>
<td>4,812</td>
<td></td>
<td>0.971</td>
</tr>
</tbody>
</table>
Analyses focused on the difference between observed seat belt use rates vs. predicted rates

Accounting for covariates

- Occupant characteristics
- Vehicle characteristics
- Situational determinants
Decided on groupings because

- Drivers and passengers significantly more often belted in primary law states
- ESBR designs for drivers not always identical to those for passengers

Four parallel assessments of ESBR systems

1. Primary law/driver
2. Secondary law/driver
3. Primary law/passenger
4. Secondary law/passenger
Analysis Steps

1. Estimated the belt use probability for each occupant as a function of the combined effects of all covariates
   - SAS used to fit 4 separate logistic regression models

2. Calculated difference between observed belt use and corresponding belt use probability estimate

3. Produced summary difference statistics for each ESBR system

4. Identified ESBR systems with significantly positive or negative sets of differences between observed and predicted belt use
   - $U = \text{ESBR performed above expectations}$
   - $L = \text{ESBR performed below expectations}$
   - $M = \text{ESBR performed no different than expected}$
Five derived variables were developed as a basis for feature classification

- Compliance with Euro NCAP requirements
- Number of warning stages
  - Driver → 1 to 3
  - Passenger → 0 to 3
- Combination of sound, icon, and text elements regardless of stage
  - Separate variables for driver and passenger

Examined two-way associations between ESBR system performance (L/M/U) and Predicted belt use using Euro NCAP, number of stages, and presence of sound/icon/text elements along with other covariates
Positive association between Euro NCAP compliance and ESBR system performance
Among drivers having under-performing ESBR systems in secondary law states, observed belt use rates were higher for Euro NCAP compliant vehicles
Inverse relationship between number of driver stages and ESBR system performance

• Better systems had fewer stages

No clear pattern for number of passenger stages
Limited variation among systems in presence of sound/icon/text elements

- All ESBR systems analyzed had icons for driver and passenger
- None of these systems had a text feature in the absence of a sound feature
- For both drivers and passengers, the presence of additional elements was positively associated with ESBR system performance
Observed seat belt use rates are very high

Ceiling effect
- Limited the magnitude of potential ESBR benefits
- Limited the ability to detect ESBR system feature benefits statistically because we observed a limited number of unbelted occupants

<table>
<thead>
<tr>
<th>State Belt Use Law</th>
<th>Occupant</th>
<th>ESBR Belt Use Rate (%)</th>
<th>NOPUS Belt Use Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Drivers</td>
<td>97.6</td>
<td>92.1</td>
</tr>
<tr>
<td></td>
<td>Passengers</td>
<td>97.1</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>Drivers</td>
<td>88.2</td>
<td>83.0</td>
</tr>
<tr>
<td></td>
<td>Passengers</td>
<td>89.4</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions- System Features Associated with Seat Belt Use Rates

Euro NCAP compliant ESBR systems

- Higher belt use rates for drivers and passengers in secondary belt use law states
- Supported by literature
- Desirable harmonization of design requirements
Conclusions- System Features Associated with Seat Belt Use Rates

**Systems with sound, icon, and text**

- Higher belt use rates than systems with icon only
- Significantly higher belt use rates for drivers in secondary belt use law states
Conclusions - System Features Associated with Seat Belt Use Rates

Number of stages

• Systems with better than expected driver belt use rates tended to have fewer driver stages
  − Particularly for drivers in secondary belt use law states
• No obvious relationship between passenger belt use and number of passenger stages
Future Work

Examine vehicles MY <2006
Manually link unmatched observations to ESBR systems
Work with OEMs to obtain missing ESBR system details
  • Examine more refined features
Alternatively, collect additional observational data in secondary law states
Questions?

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