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

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Background

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

Reasons for Current Study

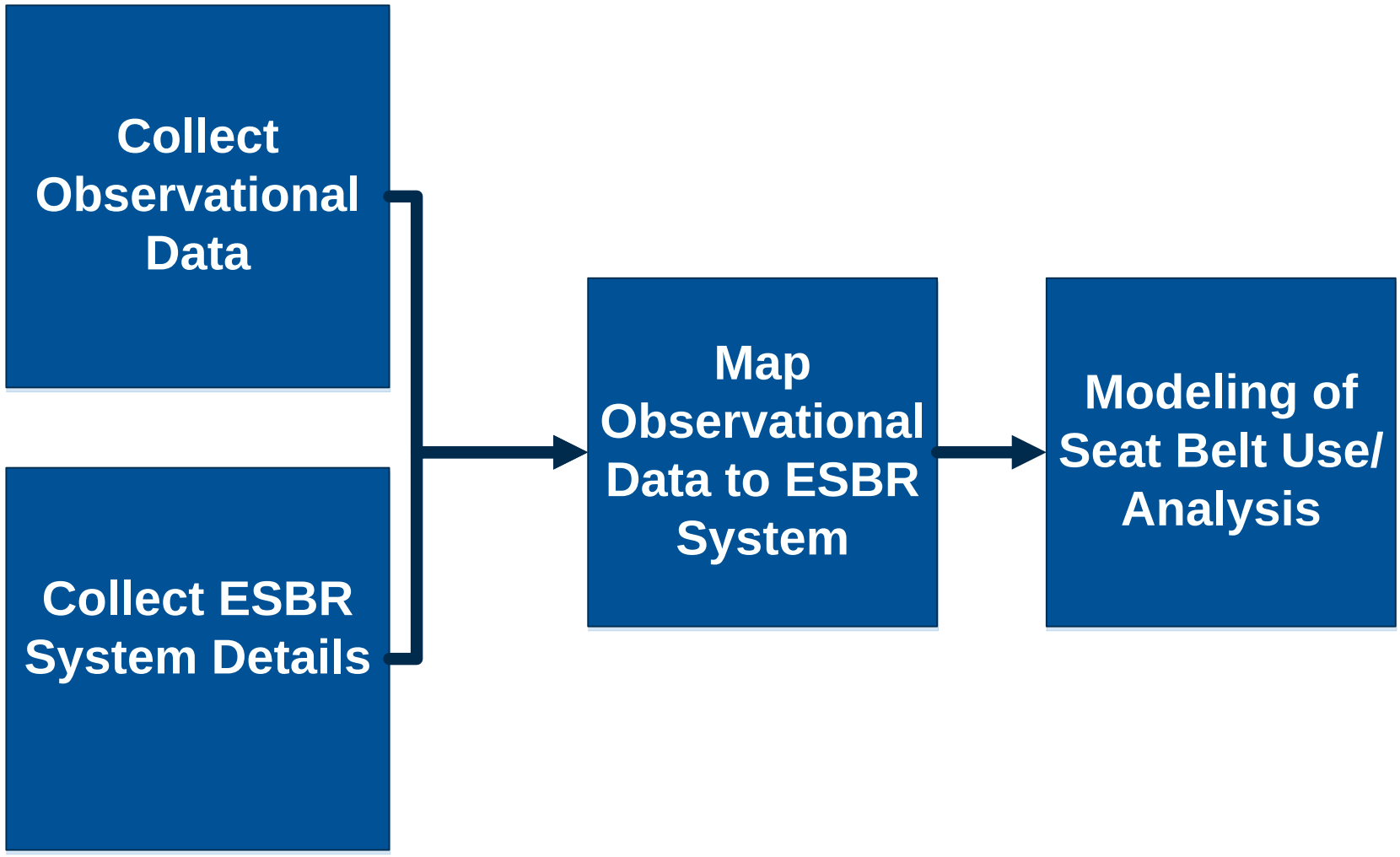
Much wider use of ESBRs in the past 10 years

Map-21 Act allows NHTSA to consider requirements for ESBRs

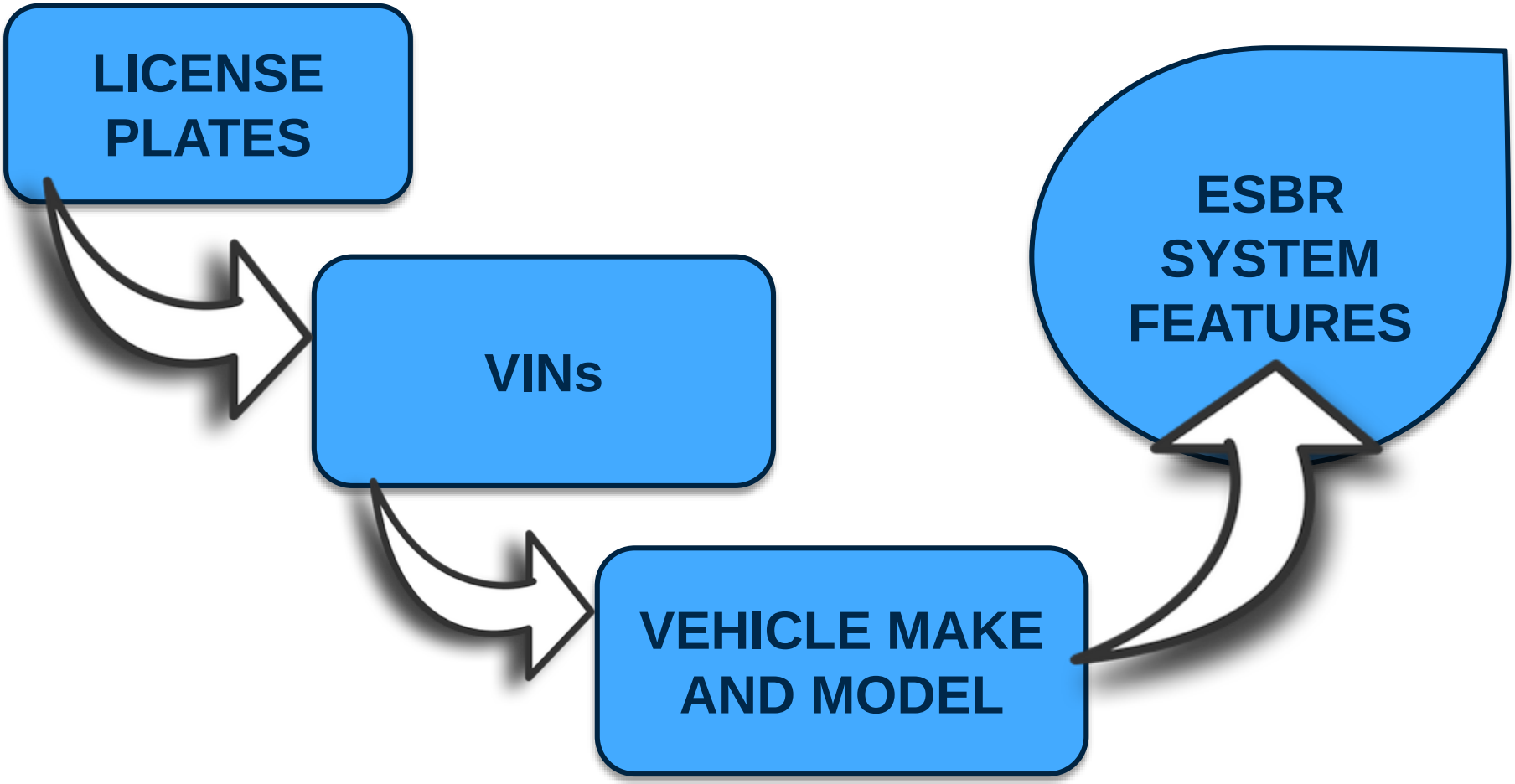
Current study

- Provides high quality data to support NHTSA
- Provides recommendations for ESBR system design
- Based on 2005 methodology

Study Overview



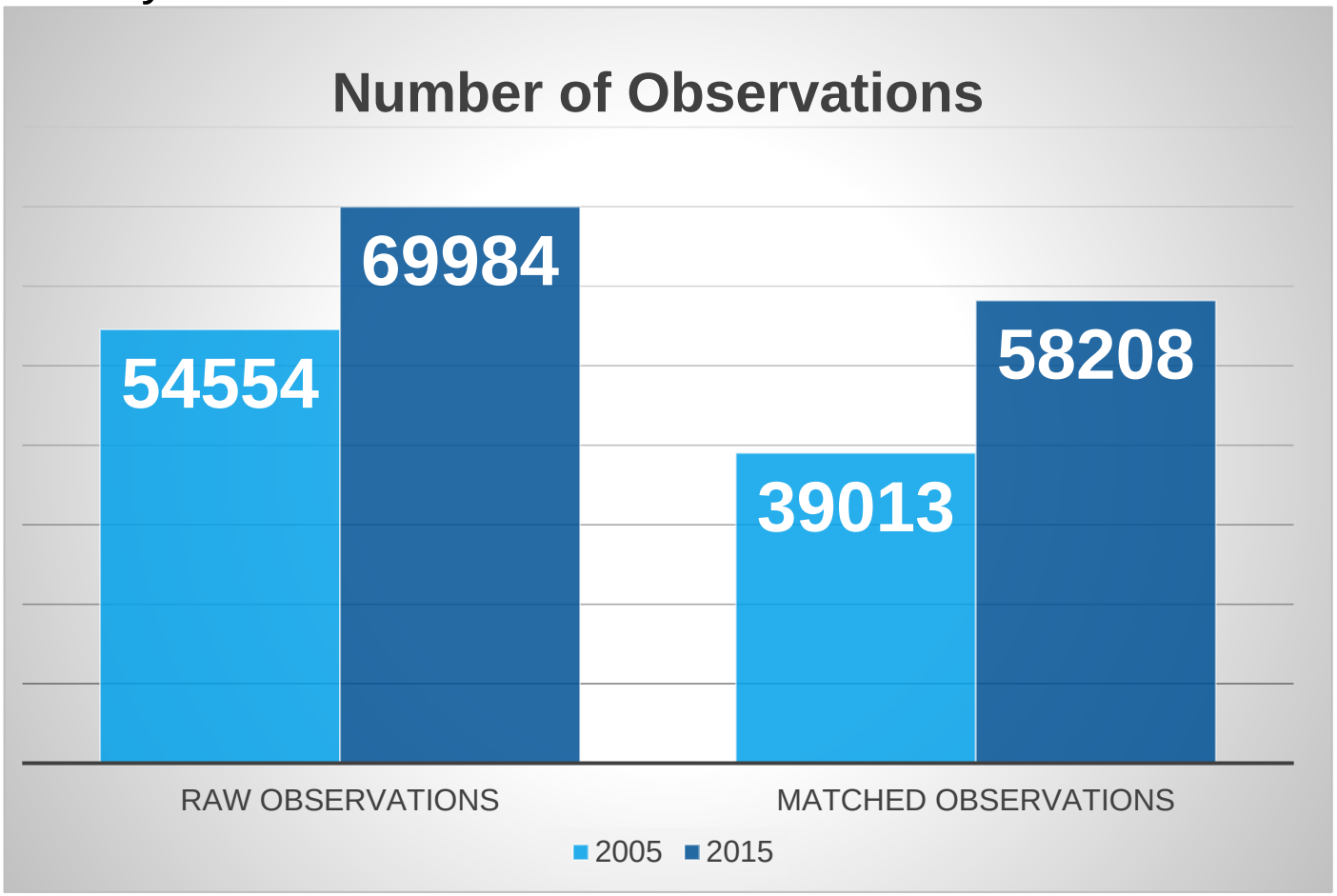
Determining ESBR System Features



Changes Since 2005 Study

What is different now?

- Substantially more observations



Changes Since 2005 Study

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

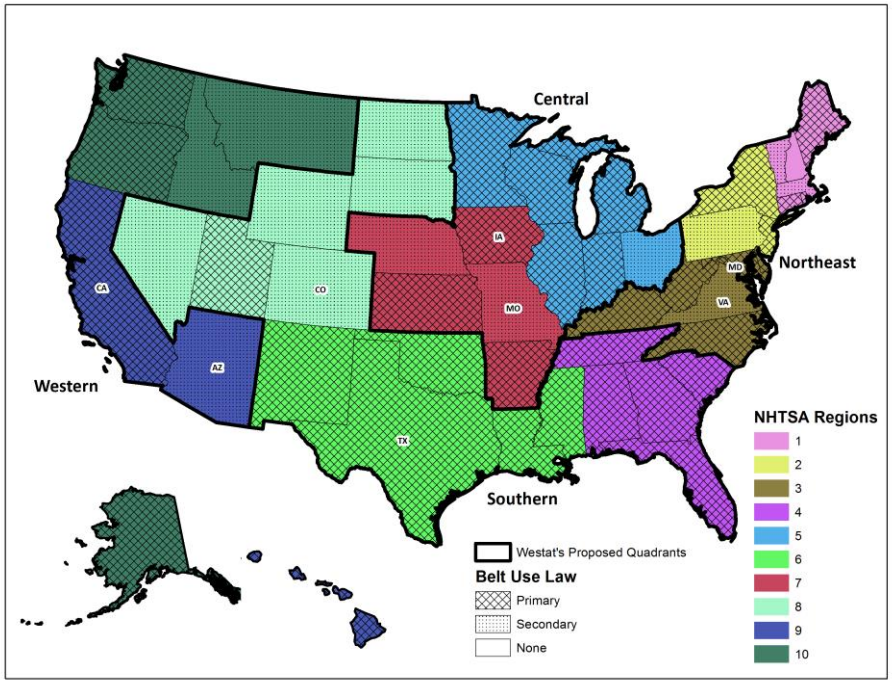
Sample Design

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



Sample Design

Sites selected for VOLUME

Not a proper statistical sample

- Convenience sample

Goal → variety of locations with a high volume of traffic

448 sites total

Study Protocol

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

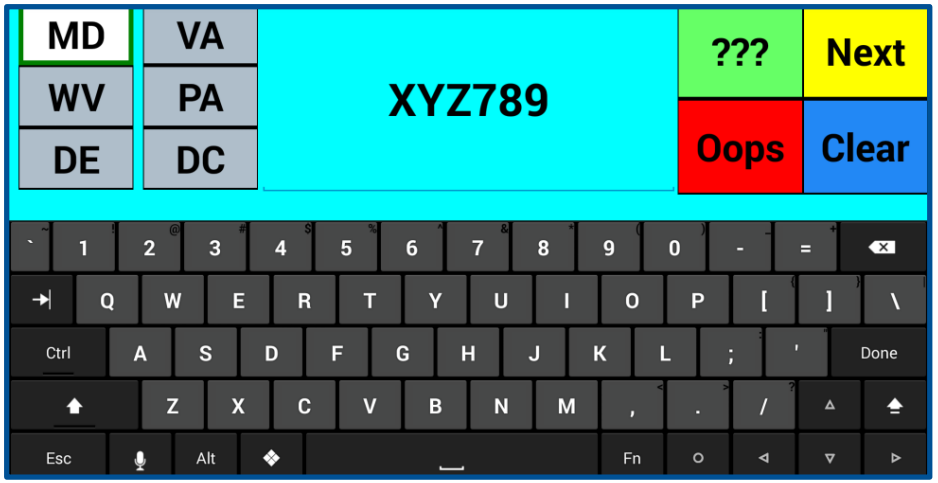
- Weather
- Area type

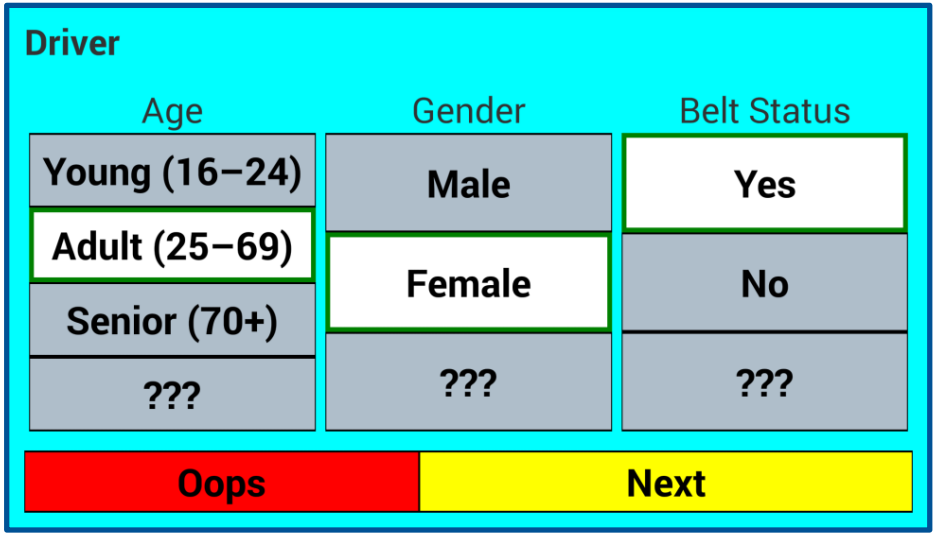
Vehicle

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

Driver & passenger

- Age
- Gender
- Belt status





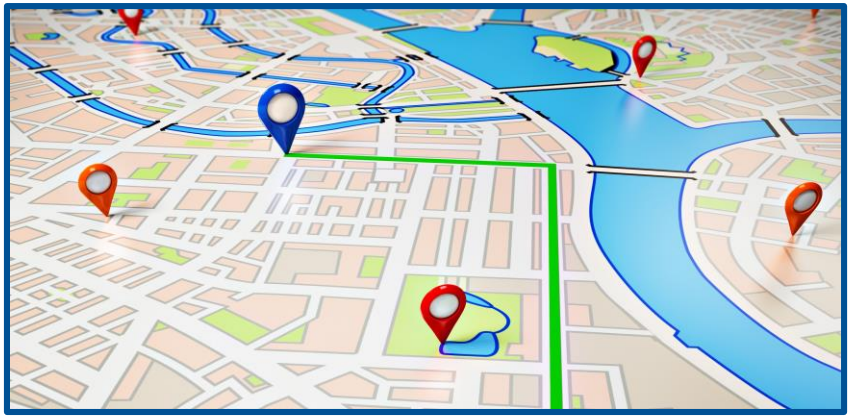
Data Transmission and Editing

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**

58,208 total matched

Convert License Plates to VINs

- **Contacted and worked with DMVs**
- **6,487 unmatched**

Convert VINS to Make/Model/Year

- **2,863 unmatched**

ESBR Feature Details

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

Observations	# of Problem Observations	Total # of Observations
# of Raw Observations		69,984
# Excluded From Analysis	9,780	60,204
Model Year <2006	19,173	41,031
Not Linked or No ESBR	5,678	35,535

Final Observations for Analysis

Occupant	Seat Belt Law	N	Total	Belt Use
Driver	Secondary	16,659	35,175	0.882
	Primary	18,516		0.976
Passenger	Secondary	4,084	8,896	0.894
	Primary	4,812		0.971

Analysis Challenge

Analyses focused on the difference between observed seat belt use rates vs. predicted rates

Accounting for covariates

- Occupant characteristics
- Vehicle characteristics
- Situational determinants

Analysis Groupings of ESBR Systems

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 = ESBR performed above expectations
   • L = ESBR performed below expectations
   • M = ESBR performed no different than expected

ESBR Feature Analyses

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

ESBR Feature Analyses

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

ESBR Feature Analyses

Inverse relationship between number of driver stages and ESBR system performance

- Better systems had fewer stages

No clear pattern for number of passenger stages

ESBR Feature Analyses

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

Conclusions

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

State Belt Use Law	Occupant	ESBR Belt Use Rate (%)	NOPUS Belt Use Rate (%)
Primary	Drivers	97.6	92.1
	Passengers	97.1	
Secondary	Drivers	88.2	83.0
	Passengers	89.4	

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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