Long-Term Driver Adaptation

... to a Forward Collision Warning System with Automatic Braking

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Project Team

- Funding
- Technical Oversight

- Data Collection
- Subjective data analysis

- Objective data analysis
Problem


5.6 Million

1.7 Million
(30%)

Rear-End Crashes
Problem

Research suggests that FCW systems could eliminate between 2% and 53% of rear-end crashes.

5.6 Million

But...

Very few studies have been conducted using real-world data, and the longest of those lasted only 4 weeks.
Research Questions

- Does the safety impact of driving with an FCW system change over time?
  - Overall driving
  - Driving conflicts

- Additional evaluation goals that are not covered in this presentation include:
  - System performance (accuracy)
  - Driver acceptance
Field Test Details
FCW System

- Cadillac Forward Collision Alert (FCA) system
  - Forward collision warning (FCW)
  - Automatic emergency braking (AEB)

- Driver interface
  - Visual indicator light
  - Haptic warning in seat (default)
  - Auditory warning (optional)
Field Test Overview

- 24 Cadillac SRX vehicles (MY 2013)
- 1-year duration
- 38 participants: <30 years of age, 19 males/19 females, Leidos employees
- Greater Washington, DC
- 3 participant groups

Aug - Jul

- Short-Term (12 drivers)
- Medium-Term (14 drivers)
- Long-Term (12 drivers)
Data

- Collected on VBox data acquisition system
  - CAN bus
  - Forward radar
  - Vision-based sensor
  - GPS
  - FCW application
  - 4 video views
- 10,500 hours
- 300,000 miles
**FCW Exposure**

- **6,035** FCW alerts
- **58** Automatic Braking events

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**Bar Chart:**
- **Y-axis:** Number of Alerts per 1,000 miles
- **X-axis:** Individual Drivers

- **Legend:**
  - Long-term
  - Medium-term
  - Short-term

- **Statistics:**
  - **Min:** 0.7
  - **Average:** 21
  - **Max:** 101
Overall Driving
Overall Driving

- **Metrics**
  - Speed (mph)
  - Time Headway (second)
  - True FCW Alert Rate (alerts per 1,000 miles)

- Each metric calculated per driver, per week
- Linear regression performed to determine rate of change over time
Alert Rate by Gender

Long-term and medium-term males combined showed a statistically significant reduction in alert rates over time ($p<0.03$)
Alert Rate by Alert Setting

No trends observed when alert rates were broken down by alert setting
Driving Conflicts
Driving Conflict Analyses

- Rear-End Driving Conflicts (i.e. near-crashes)
  - Initial conditions
  - Driver response (braking or steering)

- Exposure Metrics
  - # of conflicts per 1,000 miles
  - # of conflicts per month

- Poisson regressions used to determine best fit curve for each driver.
Conflict Exposure by Miles

77% Decrease in predicted conflicts over 18,000 Miles
Conflict Exposure by Months

First month: 2.4 Conflicts

Last month: 0.8 Conflict

66% Decrease in predicted conflicts over 1 year
Discussion

- Potential safety benefits of this FCW system did not appear to decrease over time
- In fact, these data suggest they may even increase
- But... WHY?
  - Not due to change in speed or headway
  - Not due to driving in a way that triggers fewer alerts
- Is it due to driving a new (unfamiliar) vehicle?
- More research required to determine cause of decreased exposure to near-crash events
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