

Long-Term Driver Adaptation

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

5th International Symposium on Naturalistic Driving Research

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Project Team



- ❑ Funding
- ❑ Technical Oversight

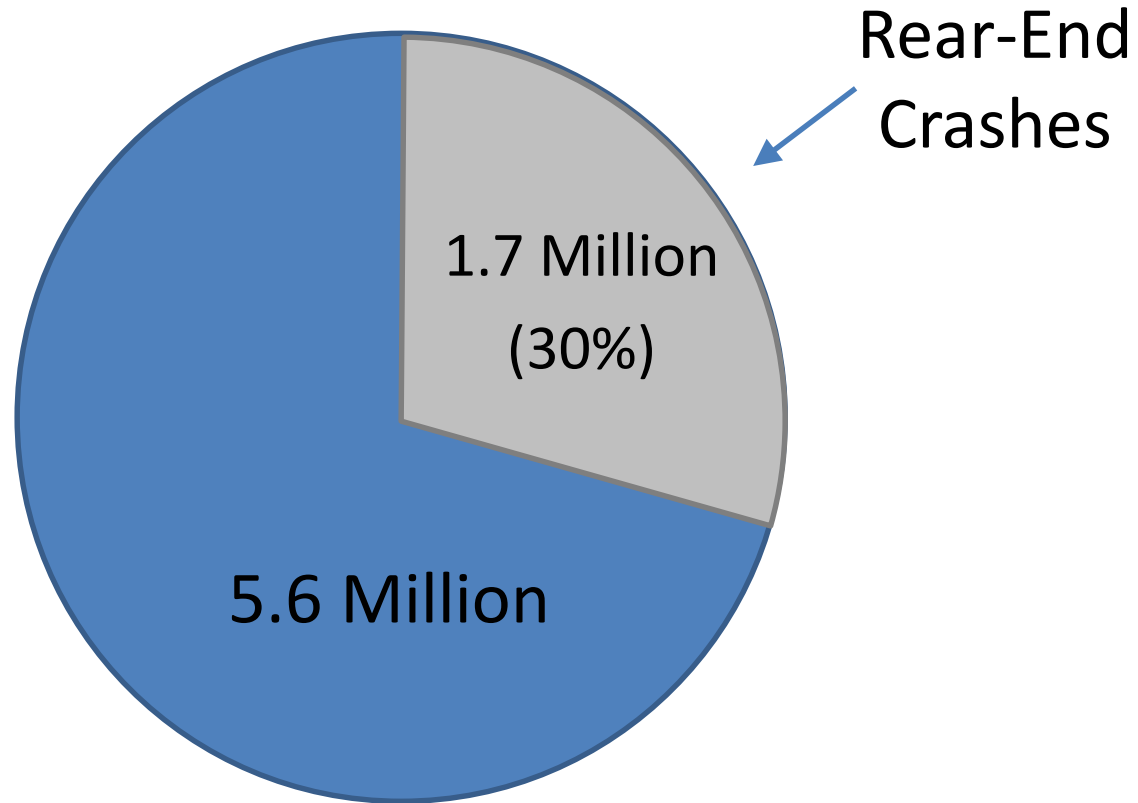


- ❑ Data Collection
- ❑ Subjective data analysis



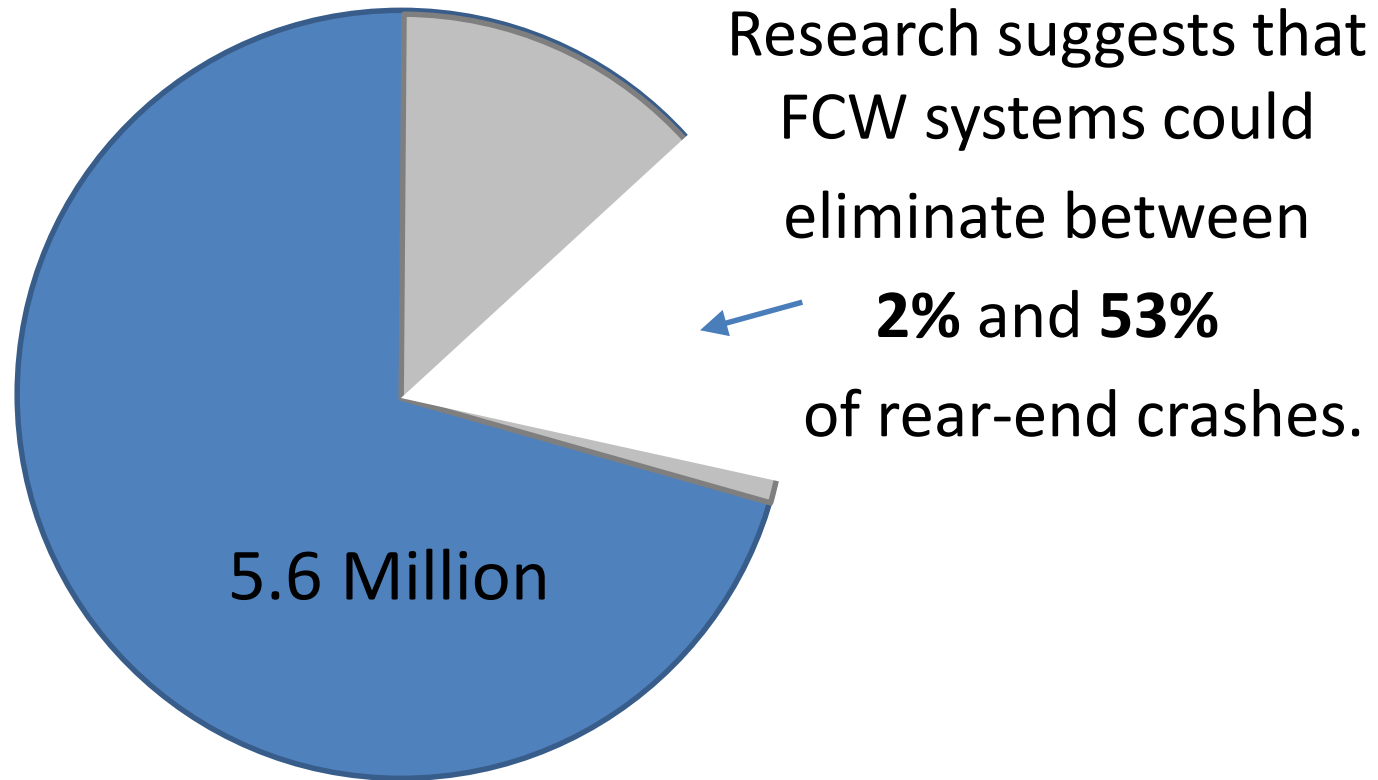
- ❑ Objective data analysis

Problem



Annual Police-Reported U.S. Crashes
(2011-2014 General Estimates System)

Problem



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

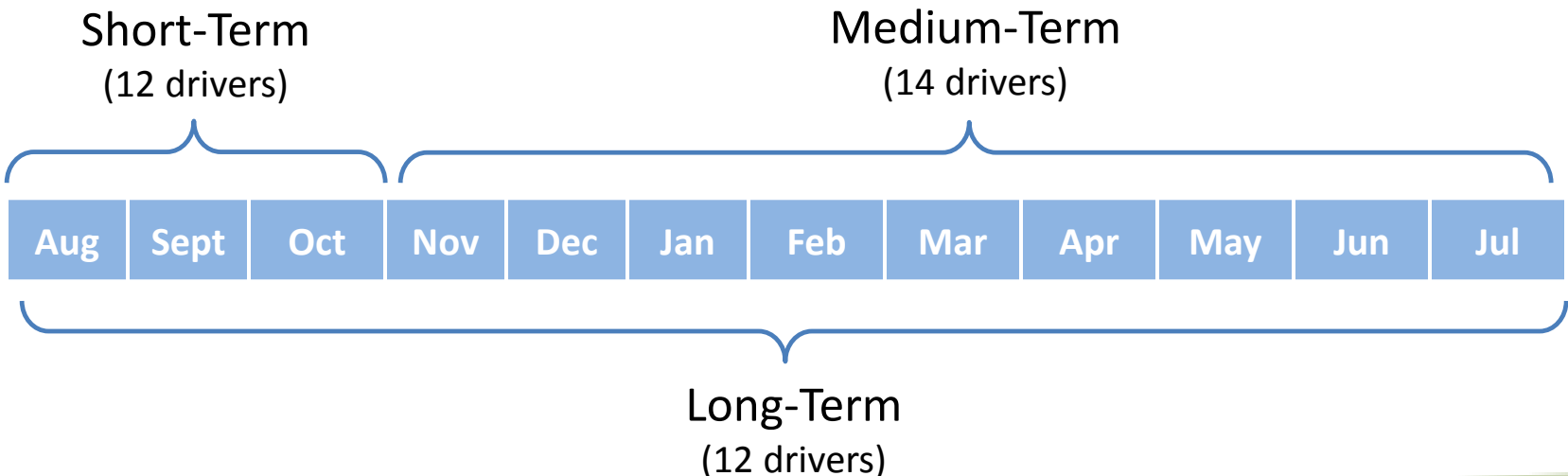
FCW System

- ❑ 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



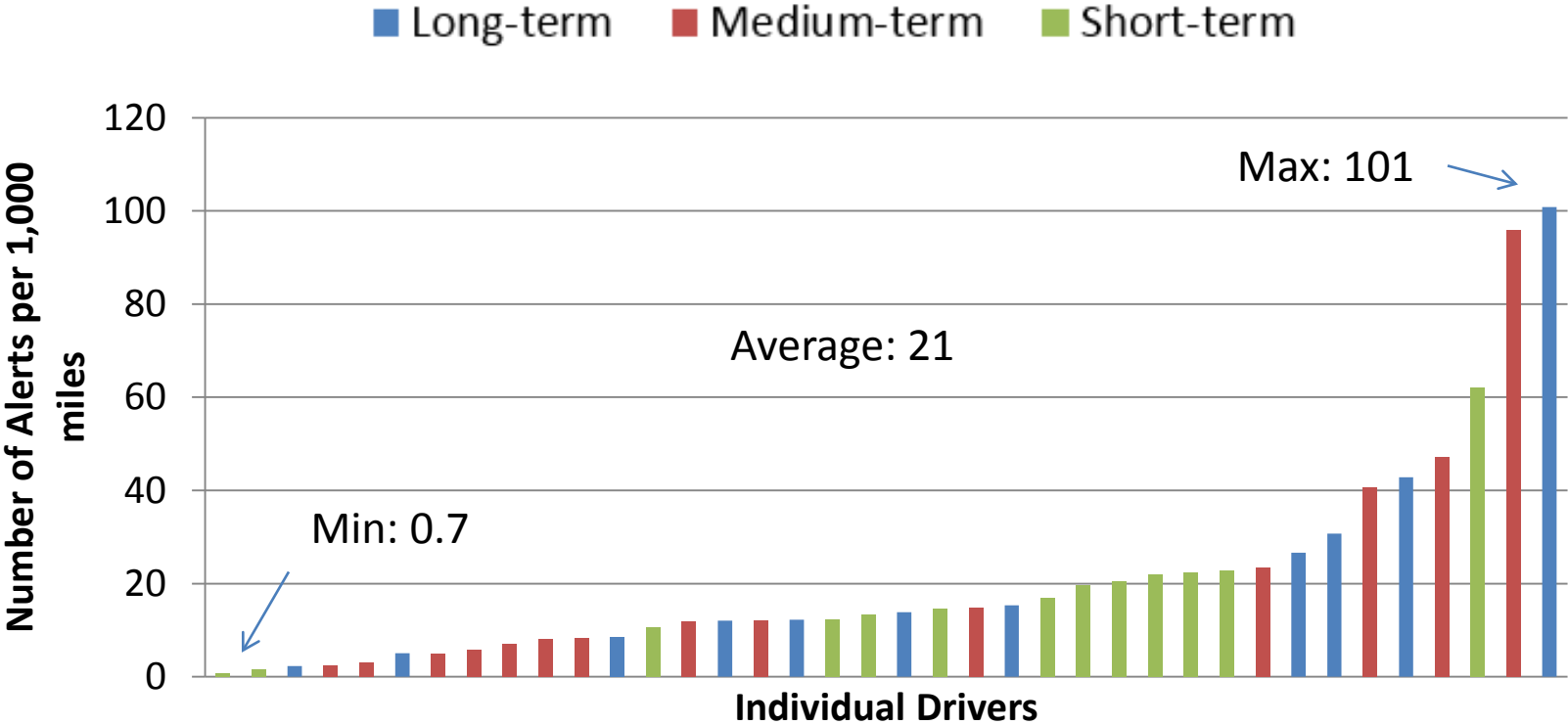
Data

- ❑ 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



Overall Driving

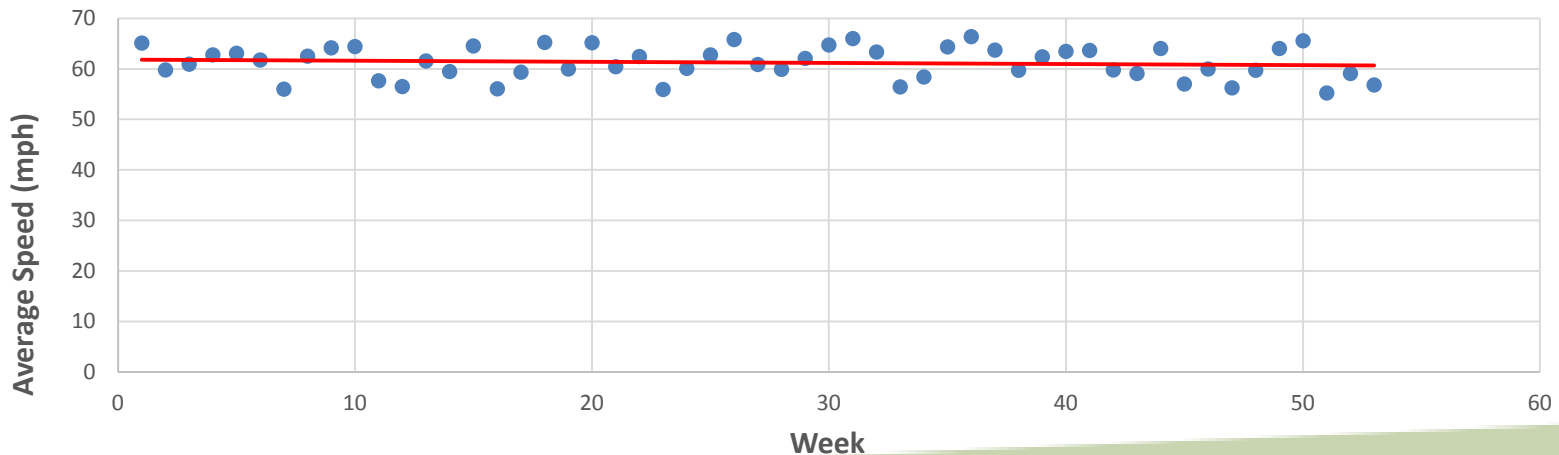
Overall Driving

□ Metrics

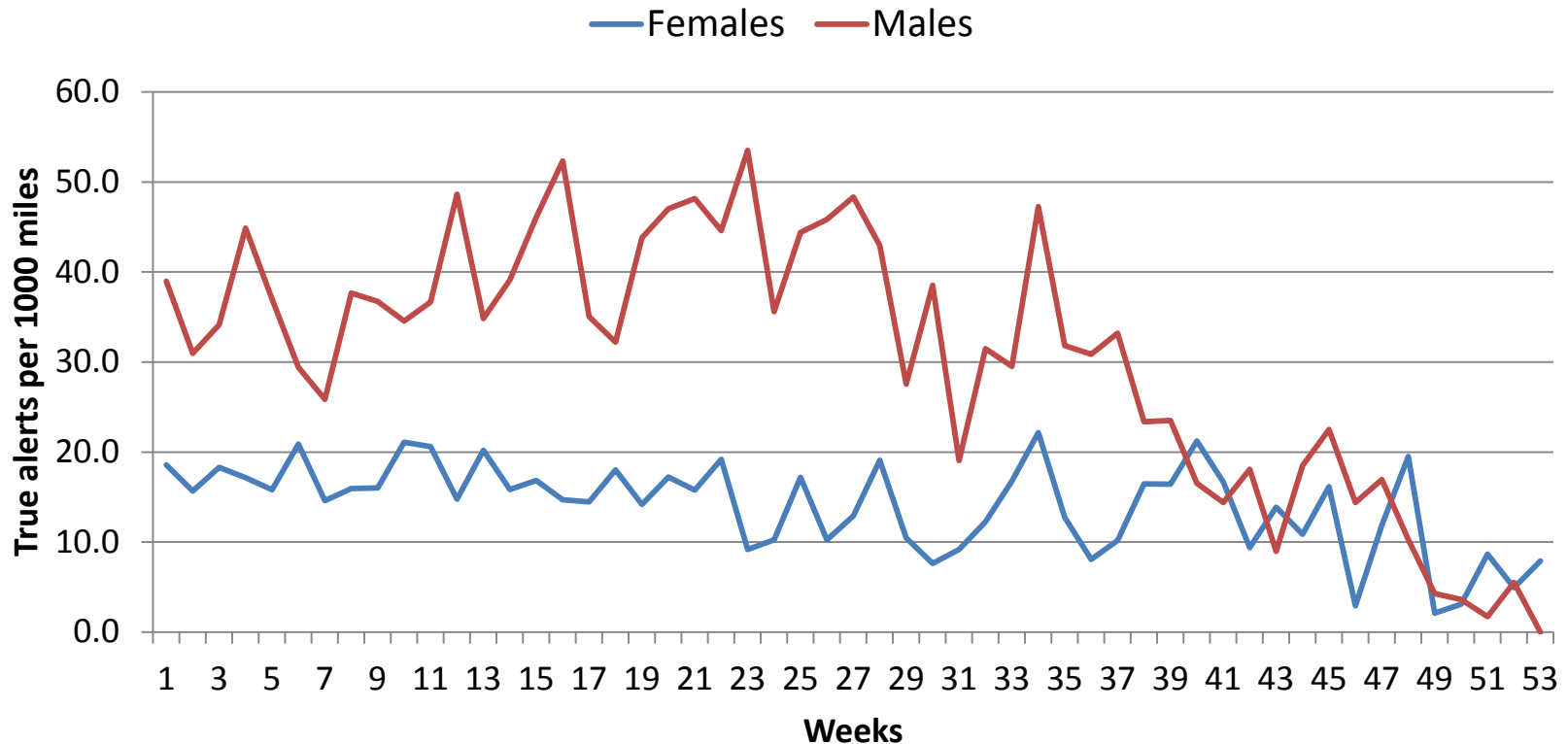
- Speed (mph)
- Time Headway (second)
- True FCW Alert Rate (alerts per 1,000 miles)

□ Each metric calculated per driver, per week

□ Linear regression performed to determine rate of change over time

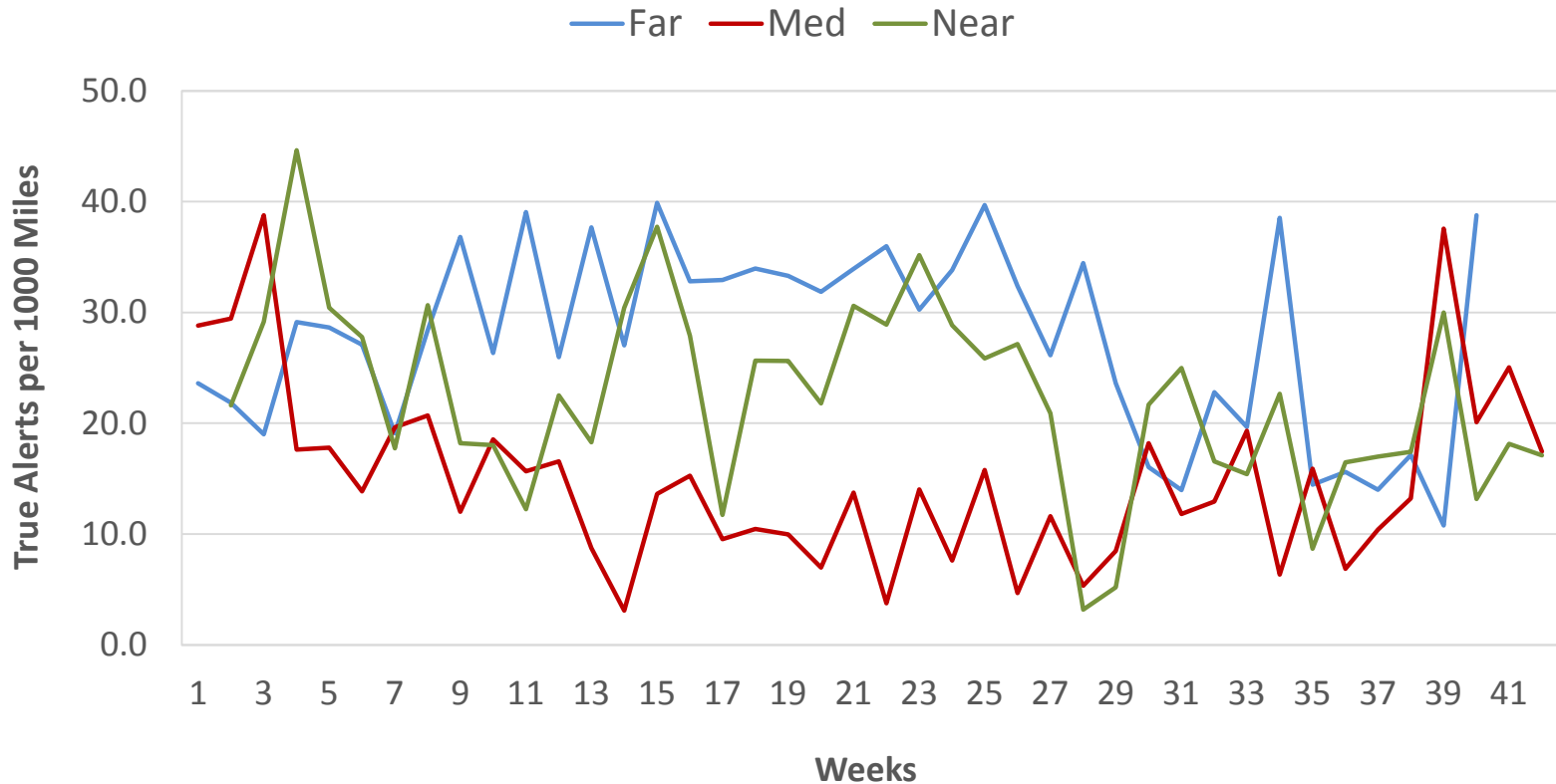


Alert Rate by Gender



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

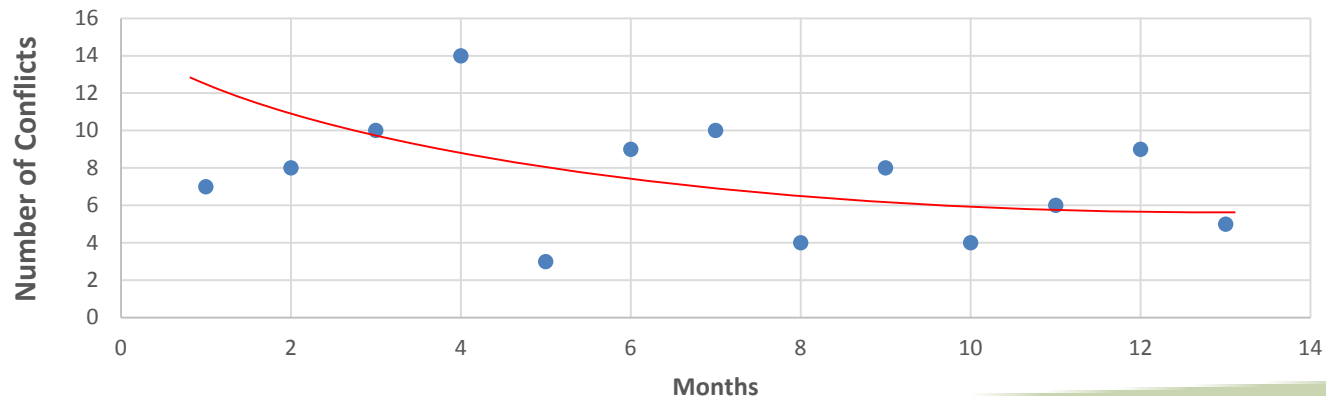


No trends observed when alert rates were broken down by alert setting

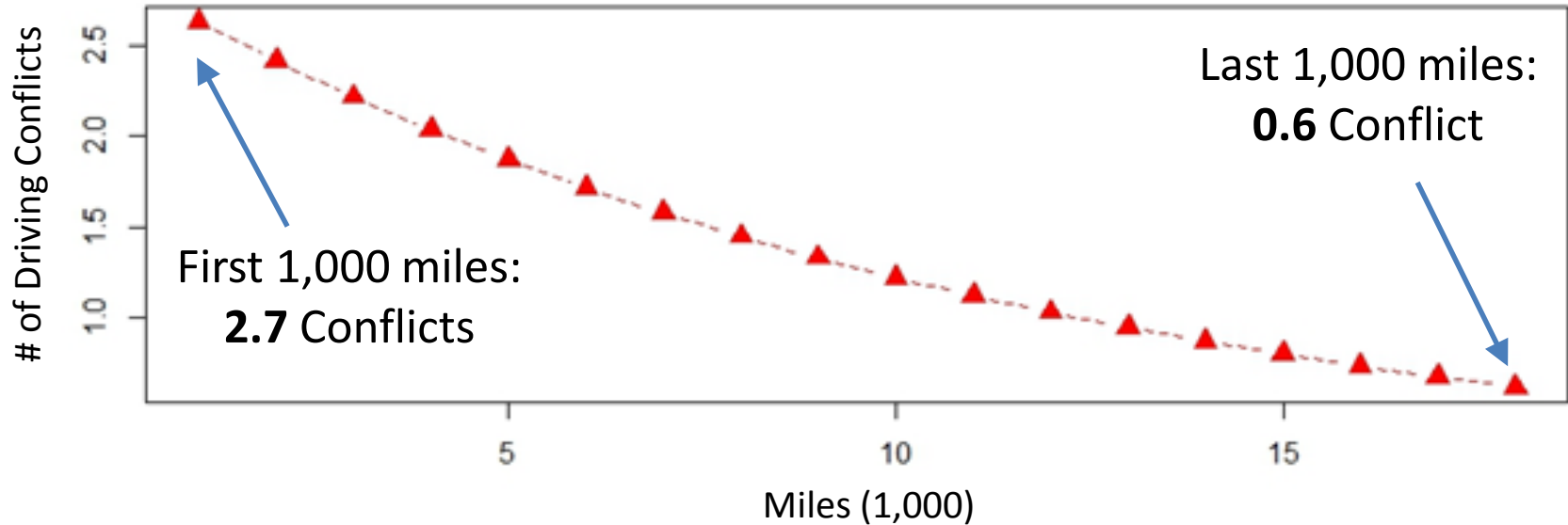
Driving Conflicts

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.

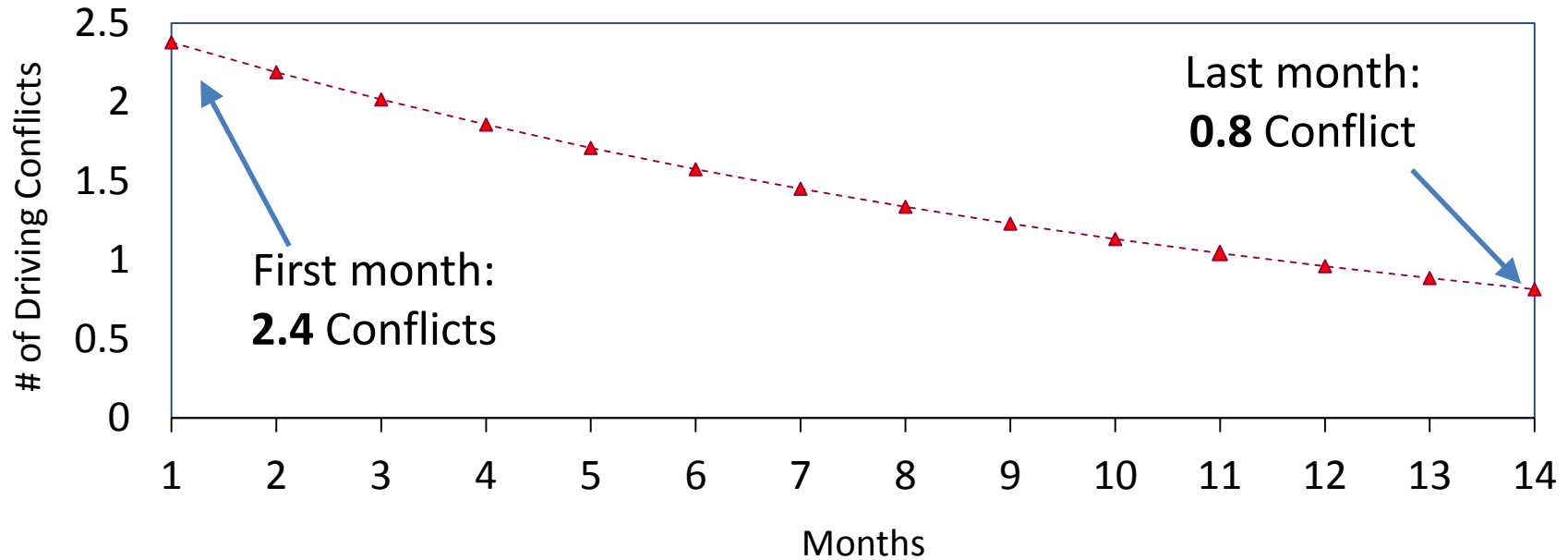


Conflict Exposure by Miles



77% Decrease in predicted conflicts over 18,000 Miles

Conflict Exposure by Months



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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