Federal Motor Carrier Safety Administration
Office of Analysis, Research and Technology

# Driver Distraction in Commercial Vehicle Operations

## PRELIMINARY RESULTS

## FMCSA Webinar


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# Presentation Overview

- Project Objectives and Background
- Key Literature
- Overview of Naturalistic Truck Studies
- Analysis Approach and Key Concepts
- Research Questions
- Summary Results
- Recommendations and Conclusions

# Project Objectives

- Characterize safety-critical events and baseline epochs (non-events) that were recorded in the Drowsy Driver Warning System Field Operational Test (DDWS FOT) and Naturalistic Truck Driving Study (NTDS)
- Focused on identifying driver tasks
  - Secondary tasks: related to the driving task (e.g., turn-signal use, checking mirrors, checking speedometer, etc.)
  - Tertiary tasks: not related to the driving task (e.g., talking on a cell phone, interacting with dispatching device, eating, etc.)
- Classify driver inattention by conducting eye glance analysis


## Texting Truck Driver Arrested After Hitting School Bus

April 08, 2009 1:35 AM
JACKSONVILLE, Fl.

Seven months after a school bus erupted into flames, killing one student aboard, the driver of an 18-wheeler that caused the crash has finally been arrested.
30-year-old Reinaldo Gonzales turned himself into the Florida Highway Patrol today. He was booked in the Marion County jail in Ocala, Florida charged with vehicular homicide and reckless driving with serious bodily injury. Gonzales admitted he was text messaging just minutes before he slammed into the stopped school bus with his 18-wheeler.

## Engineer Apparently Sent Text Message Before Crash

### Federal Investigators Say They Will Seek Cell Phone Records Of Teens & Train Engineer

Sep 14, 2008 11:42 am US/Pacific
CHATSWORTH, Calif. (CBS)

Metrolink officials Saturday put the blame squarely on the engineer of the train for the deadly crash that has claimed at least 25 lives. They say he ran a red light.

One minute before the deadliest crash in Metrolink history, one teen said he received a text message on his cell phone from the engineer, whom the teens identified as Robert Sanchez.

The text was brief, "Just two lines", reported KCAL 9 and CBS 2 reporter Kristine Lazar, exclusively.

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# Official: Trolley driver in crash texting

Published: May 8, 2009 at 11:28 PM

BOSTON, May 8 (UPI) -- The driver of a trolley that rear-ended another one Friday, injuring dozens of commuters, was texting just before the crash, an official said.
Daniel Graubaskas, general manager of the Massachusetts Bay Transportation Authority, said the stationary trolley had stopped at a red light as it headed west from the Government Center station, WCVB-TV reported.
The driver of the moving train, a 24-year-old who had been in the job for 22 months, broke his wrist in the crash.

Some passengers were trapped under the wreckage, The Boston Globe reported, and rescue workers had to use chainsaws to free them. At least 49 people were sent to local hospitals with injuries that included cuts, bruises and broken bones.

# 1 in 4 Americans is texting while driving: poll

May 20 11:46 AM US/Eastern

In the United States, where driving while using telephones without hands-free adaptor kits and texting at the wheel are not widely illegal, one in four people confesses to texting and driving, a survey found Wednesday.
"We often like to say 26 percent of people admit to driving while texting. We are sure that underestimates the problem," said Dave Grannan, of Vlingo, a mobile voice application company that polled 4,800 people.
Vlingo says it is the inventor of "voice user interface" technology allowing people to "control their mobile phones with the power of voice" instead of punching buttons. The company said the poll has a plus or minus 1.41 percent sampling error.


# Background

- 41,059 people were killed in 2007 in road crashes
  - 12% involved large trucks
  - 9% were attributed to driver inattention (LTCCS, 2005)
- Police accident reports are limited because data is retrieved after the fact
  - Drivers may not remember details or may be hesitant to report; therefore, distraction-related crashes are thought to be under-reported.


# What is Driver Distraction?

- Driver distraction may be defined in many ways:
  - “misallocated attention” (Smiley, 2005)
  - “any activity that takes a driver’s attention away from the task of driving” (Raney et al., 2000)
  - “something that distracts the attention and prevents concentrations” (Oxford Dictionary)
  - “attention given to a non-driving related activity, typically to the detriment of driving performance” (ISO, 2004)


# Driver Distraction Continued

- Pettitt, Burnett, and Stevens (2005)
  - Impact- on the driving task
  - Agent- secondary/tertiary task
  - Mechanism- compels driver to shift attention
  - Type- compromising visual, cognitive, etc. functioning
- Hanowski et al. (2001)
  - Inattention + Critical Incident = Distraction

# Key Literature

- Treat et al., 1977
  - Used police scanners to identify crashes; went to scene of crash to collect information
  - Human factors were most often cited as the cause (71 – 93% of the time), followed by environment (12 -34%) and vehicle factors (5 – 13%)
- Goodman et al., 1999
  - Investigated NC police reports from 1989 to 1995 to determine rate of cell phone use during crashes
  - Using a cell phone was the distraction reported most often during a traffic crashes
- LTCCS, 2005
  - Crash investigation to assess causal factors for fatal crashes between 2001-03 involving large trucks
  - Results indicate that 9% of crashes were attributed to driver inattention, 8% were attributed to an external distraction, and 2% were attributed to an internal distraction
- Klauer et al., 2006
  - One of the first large-scale naturalistic data collection studies
  - Collected data on 100 light vehicles over 18 months
  - Results indicate that 78% of crashes and 65% of near-crashes involved inattention

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# What About Trucking?

- Limitations of previous research
  - Conducted on light vehicles
  - Conducted using data from police accident reports
- Current study aims to fill in these holes by using heavy vehicle naturalistic data
  - Using video, able to determine what driver was doing *prior* to safety-critical events
  - “Instant replay”

# Overview of Naturalistic Truck Studies

## Drowsy Driver Warning System Field Operational Test (DDWS FOT)

- Naturalistic data collection study in which data were collected for 18 months from 103 drivers
  - Participated for an average of 12 weeks
  - 2.2 million miles of driving

## Naturalistic Truck Driving Study

- Naturalistic data collection study in which data were collected for 18 months from 100 drivers
  - Participated for an average of 4 weeks
  - 735,000 miles of driving

# Filtered Data Set

- Trigger thresholds produced a total of 4,452 safety-critical events
  - 21 crashes
  - 197 near-crashes
  - 3,019 crash-relevant conflicts
  - 1,215 unintentional lane deviations
- 19,888 baseline epochs (normal driving)

# Video Review

- All safety-critical events and baseline epochs were reviewed
- Determination made as to what driver was doing just prior to event onset (e.g., when lead vehicle began to brake)
- Some events and baseline epochs involved drivers engaged in secondary and/or tertiary tasks
    - Tertiary tasks broken down into complex, moderate, and simple (Klauer, 2006)
- Safety-critical events and baseline epochs that had an associated secondary or tertiary task were analyzed in detail

# Data Analysis Methods

- Odds Ratio – the possibility of some outcome (e.g., a crash) occurring when comparing the presence of a condition (e.g., CB use) to it's absence
- Population Attributable Risk – the incidence of a disease (i.e., a crash) in the population that would be eliminated if exposure were eliminated
  - That is, if the PAR for eating while driving were 5%, then there would be 5% fewer crashes if eating while driving never occurred

# Odds Ratio Calculations

- Odds Ratio – way of comparing the odds of some outcome (e.g., a crash) occurring given the presence of some predictor factor, condition, or classification
  - Comparison of the presence of a condition (e.g., CB use) to it's absence

| | Driver Inattention | No Driver Inattention | |
|---|---|---|---|
| Incidence Occurrence | $n_{11}$ | $n_{12}$ | $n_{1.}$ |
| No Incidence Occurrence | $n_{21}$ | $n_{22}$ | $n_{2.}$ |
| | $n_{.1}$ | $n_{.2}$ | $n_{..}$ |

*Odds Ratio* = $(n_{11})(n_{22})/(n_{21})(n_{12})$

- 95% lower and upper confidence limits calculated
- Odds ratios greater than '1.0' indicate an increased risk of safety-critical event involvement

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# PAR Calculations

- Population Attributable Risk – the "risk of disease in the total population minus the risk in the unexposed group" (Sahai and Khurshid, 1996)

$$PAR\ percentage = \frac{(P_e(OR-1))}{(1+P_e(OR-1))} \times 100$$

  - Where: $P_e$ = population exposure estimate (e.g., number of baseline epochs with complex tertiary task/total number of baseline epochs) and OR = odds ratio estimate for a safety-critical event

- Calculated on all odds ratios greater than '1.0'

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# Research Questions

- **Research Question 1:** What types of distraction tasks (or behaviors) do CMV drivers engage in? And, are these tasks risky leading to involvement of safety-critical events?
- ***Research Question 2:*** *Do environmental driving conditions impact the engagement of tasks?*
- **Research Question 3:** What is the impact of distraction tasks on drawing the driver's eyes away from the forward roadway?

# SUMMARY RESULTS

# Overview Finding: Is Distraction an Issue?

- 81% of the safety-critical events had some type of driver distraction

| Event Type | All Safety-Critical Events | All Vehicle 1 At-Fault Events |
|---|---|---|
| All safety-critical events | 81.5% | 83.4% |
| Crashes | 100.0% | 100.0% |
| Near-crashes | 79.1% | 81.1% |
| Crash-relevant conflicts | 78.7% | 83.0% |
| Unintentional lane deviations | 87.7% | 87.7% |

# RQ#1- Key Distracting Tasks (Complex)

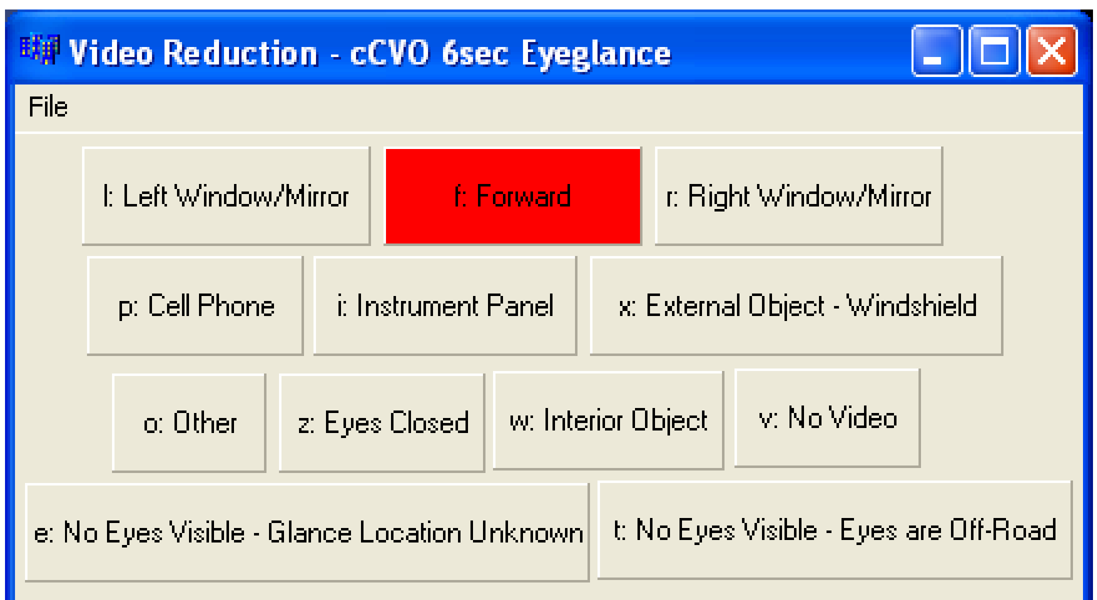
| Task | Odds Ratio | LCL | UCL | Frequency of Safety-Critical Events | Frequency of Baselines |
|---|---|---|---|---|---|
| Text message on cell phone | **23.24** | 9.69 | 55.73 | 31 | 6 |
| Other - Complex (e.g., cleaning side mirror, rummaging through a grocery bag) | **10.07** | 3.10 | 32.71 | 9 | 4 |
| Interact with/look at dispatching device | **9.93** | 7.49 | 13.16 | 155 | 72 |
| Write on pad, notebook, etc. | **8.98** | 4.73 | 17.08 | 28 | 14 |
| Use calculator | **8.21** | 3.03 | 22.21 | 11 | 6 |
| Look at map | **7.02** | 4.62 | 10.69 | 56 | 36 |
| Dial cell phone | **5.93** | 4.57 | 7.69 | 132 | 102 |

# RQ#1- Population Attributable Risk

| Task | Population Attributable Risk Percentage | LCL | UCL |
|---|---|---|---|
| All Complex Tertiary Tasks | 13.73 | 13.52 | 13.95 |
| Interact with/look at dispatching device | 3.13 | 2.84 | 3.42 |
| Dial cell phone | 2.46 | 2.02 | 2.91 |
| Read book, newspaper, paperwork, etc. | 1.65 | 0.96 | 2.34 |
| Look at map | 1.08 | 0.48 | 1.68 |
| Text message on cell phone | 0.67 | 0.29 | 1.04 |
| Write on pad, notebook, etc. | 0.56 | -0.16 | 1.28 |
| Use calculator | 0.22 | -1.00 | 1.43 |
| Other – Complex (e.g., cleaning side mirror, rummaging through a grocery bag) | 0.18 | -0.99 | 1.35 |

# RQ#3- Eye Glance Analysis Methods

- Eye glance analysis was conducted to measure inattention
  - Safety-critical events: five seconds prior to and one second after event onset
  - Baseline epochs: six seconds




# Glance Definitions

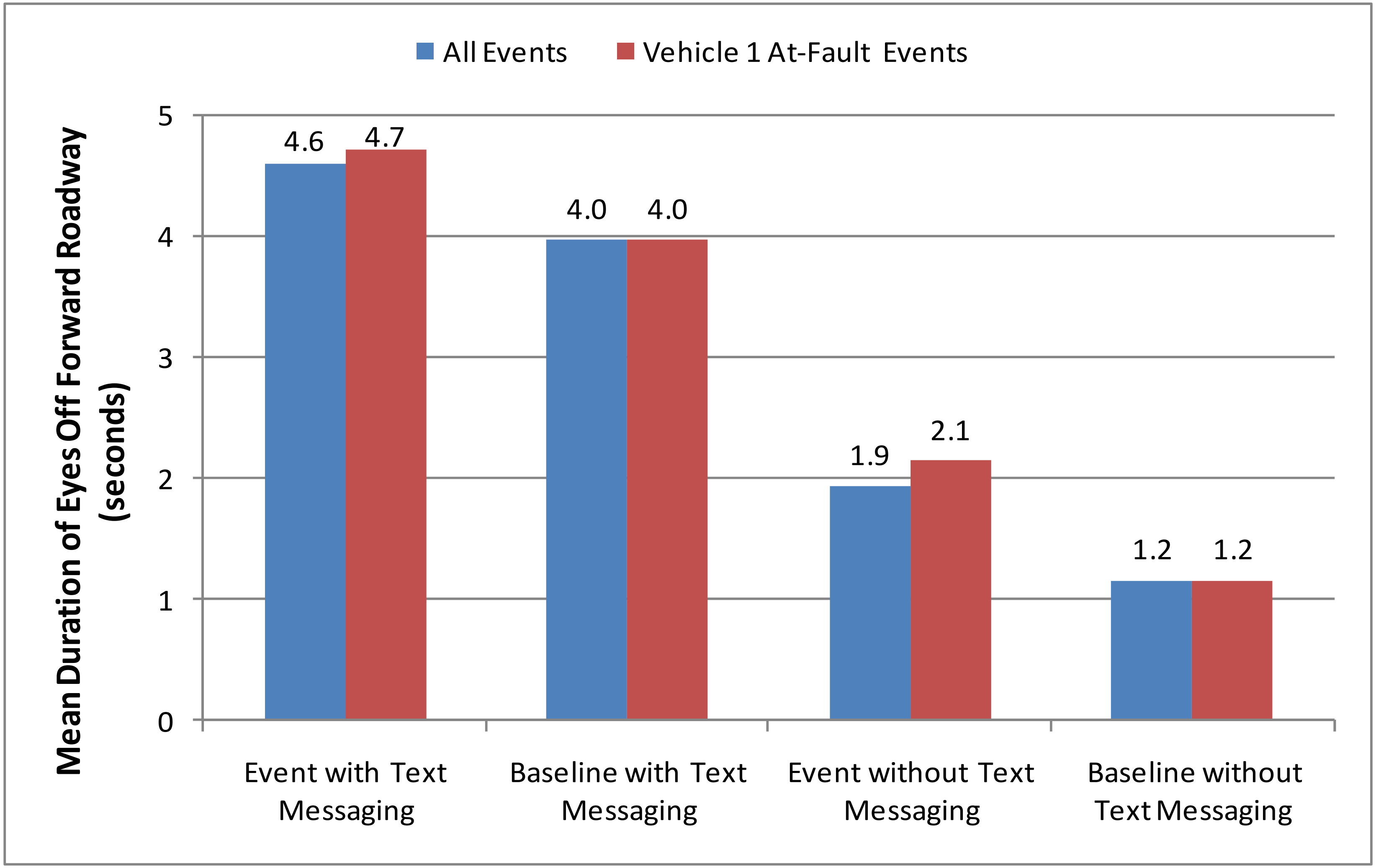
- *Eyes off forward roadway*: any time the driver is not looking forward, regardless of where he/she is looking
- *Number of glances away from forward roadway*: number of glances away from forward roadway during 6 s event/epoch period
  - Glance: any time the driver took his/her eyes off the forward roadway
- *Length of longest glance away from forward roadway*: longest glance where the driver was not looking forward during the 6 s event/epoch period

# Overview Finding: Short and Long Glances

- Short glances may be due to inappropriate/limited environmental scanning
- Long glances due to not looking forward

| Total Eyes Off Forward Roadway | Odds Ratio | LCL | UCL |
|---|---|---|---|
| Less than or equal to 0.5 s | **1.36** | 1.16 | 1.58 |
| Greater than 0.5 s but less than or equal to 1.0 s | 0.91 | 0.80 | 1.03 |
| Greater than 1.0 s but less than or equal to 1.5 s | 1.07 | 0.94 | 1.23 |
| Greater than 1.5 s but less than or equal to 2.0 s | **1.29** | 1.12 | 1.49 |
| Greater than 2.0 s | **2.93** | 2.65 | 3.23 |

# Text Messaging on Cell Phone



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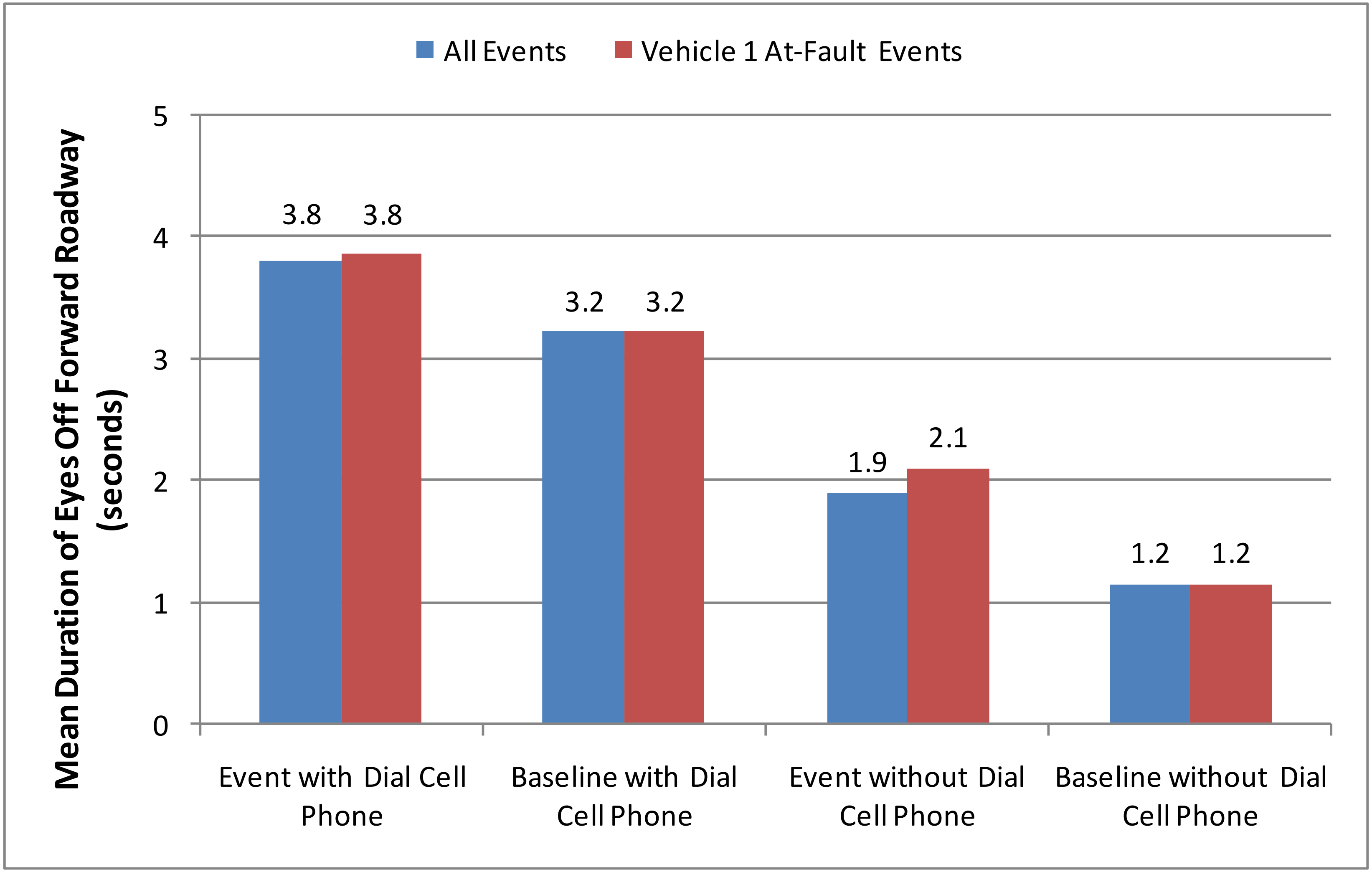
# Dialing Cell Phone

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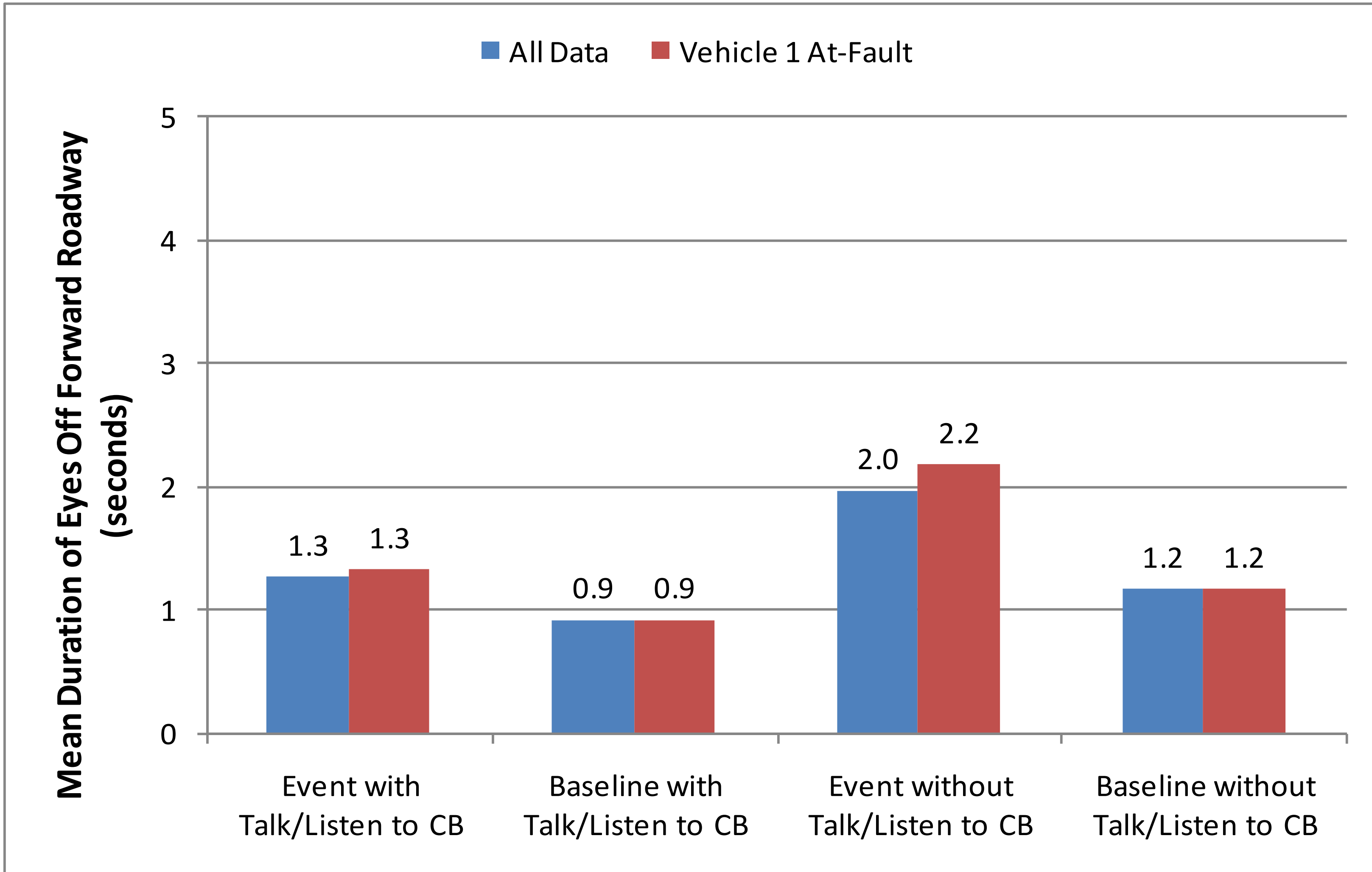
# Talk/Listen to CB Radio

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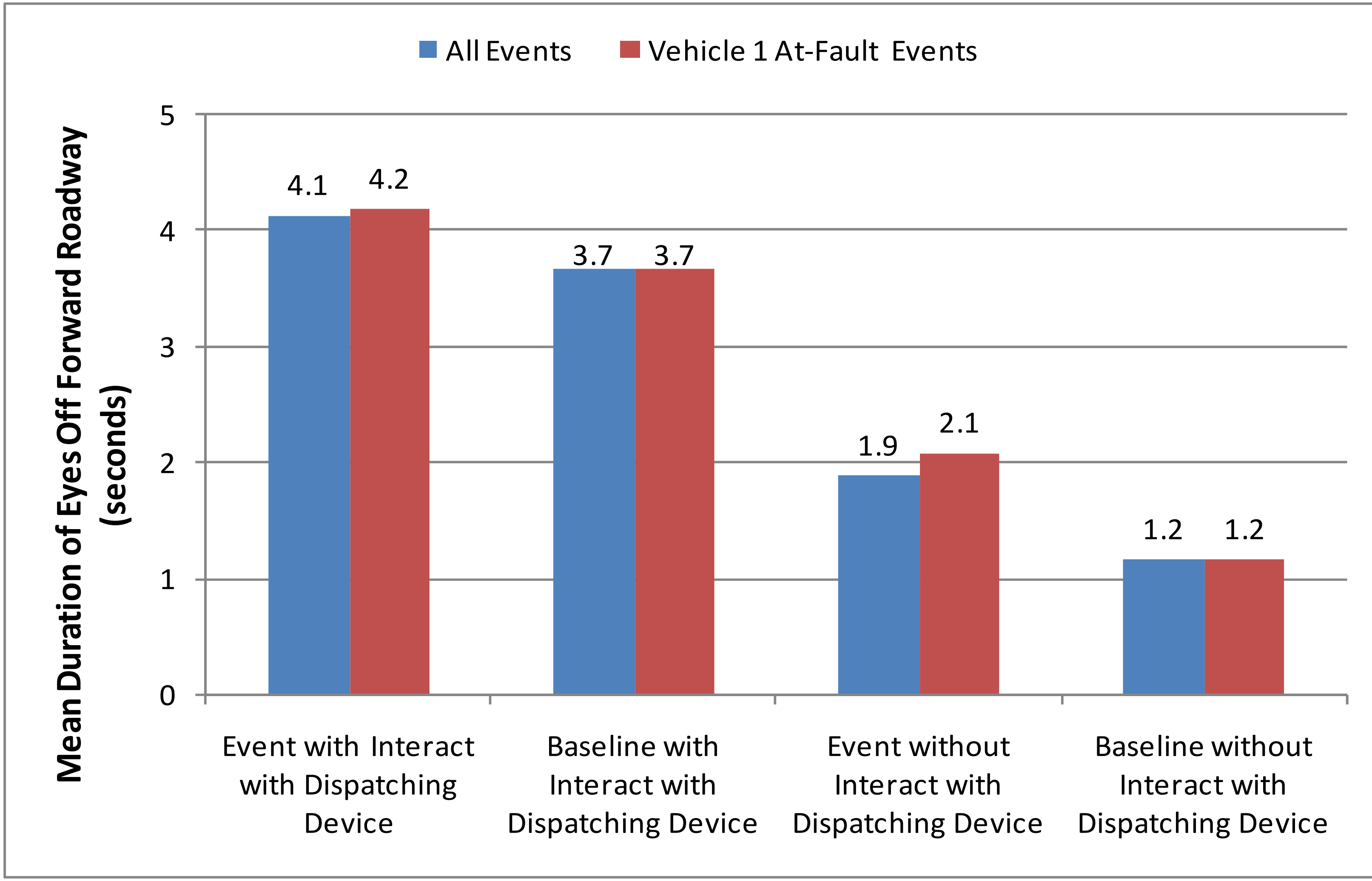
# Interact with Dispatching Device

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# 100-Car Comparisons

- Percent of safety-critical events and baselines
  - Both Klauer et al. (2006) and the current study found that tertiary events had the highest percentage of occurrence in safety-critical events and baseline epochs
- Total time *eyes off forward roadway*
  - Klauer et al. (2006) reported that drivers were 2.19 times more likely to be involved in a crash/near-crash when total time *eyes off forward roadway* was greater than 2 seconds
  - Current study found that drivers were 2.9 times more likely to be involved in a safety-critical event when total time *eyes off forward roadway* was greater than 2 seconds

# Conclusions

- Generally consistent with research with light vehicles; current study found distraction plays a major role in heavy vehicle critical incidents
- The 100-Car study found “driver distraction” in 78% of crashes and 65% of all near crashes
- The current study found “driver distraction” in 81.5% of all critical incidents

# Vision is King

- Several tasks were associated with very high odds ratios and PAR estimates
- Eye glance analyses provided the *why* certain tasks were high risk
- For example, texting had the highest OR (across all tasks) and also involved drivers looking away from forward for 4.7s, out of 6s (77% of time interval)

# Recommendations

1. Education to highlight the importance of eyes on forward roadway and scanning
2. Reading, writing, and maps
3. Policies to curb use of in-vehicle devices that draw attention away from forward roadway
4. No texting
5. No manual dialing of phones


# Recommendations

6. Talking is okay
7. No use of dispatching device while driving
8. Re-design of dispatching devices
9. Instrument panel re-design
10. Further research on protective effects

# Recommendations Summary

- Several recommendations were presented
- Some recommendations involve fleet policy/driver education (e.g., eyes forward)
  - http://www.fmcsa.dot.gov/about/outreach/education/driverTips/index.htm
- Others may provide support for regulation (e.g., texting ban, hands-free requirement)
- Others suggested re-design of in-vehicle systems (e.g., dispatching devices, instrument panel)
- As technologies become more complex and involve more interaction from drivers, expected that distraction-related crashes will increase


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