

# **The Effect of CEVMS on Driver Eye Glance Behavior**

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Federal Highway Administration

Department of Transportation

# Overview

- 2009 Update Report highlights
- Study rationale
- Study objectives
- Major activities
- Independent and dependent variables
- Brief characteristics of routes, research vehicle, and data analysis
- Revised schedule



# Update Report Objectives

- Identify and analyze prior studies
- Identify key independent and dependent variables
- Develop alternate research strategies
- Outline future research program
- **Recommend study**
- Provide master bibliographic list



<http://www.fhwa.dot.gov/realestate/cevms.htm>



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# Identify & Analyze Prior Studies

## Research Review

- New studies, experiments, evaluations
- New CEVMS technologies

## Review literature by study type

- Post-hoc crash studies
- Field investigations
- Laboratory investigations
- Literature reviews
- Reviews of practice



# Independent Variables

## Summary

- 60 types & 185 subtypes

## Selected Types and Subtypes

- CEVMS
  - Size, luminance, contrast, change rate
- Roadway
  - Lanes, curves, intersections, traffic
- Driver
  - Age, experience, route familiarity
- Environment
  - Visual clutter, lighting, signage



# Dependent Variables

## Summary

- 65 types & 105 specific subtypes

## Selected Types and Subtypes

- Vehicle
  - Speed, acceleration, and lane position
  - Headway, conflicts, errors, and gaps
- Driver/vehicle interactions
  - Steering, throttle and braking
- Driver attention/distraction
  - Eye glance, distracting task, and workload
  - Errors, reaction time, and search patterns
- Crashes
  - Frequency and type



# Develop Research Strategies

- Crashes – field & lab
- Safety surrogates – field
  - Unobtrusive observation
  - Naturalistic driving
  - On-road instrumented vehicle
  - Closed course test track
  - Commentary driving
- Safety surrogates – lab
  - Driving simulator
  - Non-simulator
- Surveys & analytic studies



# Rationale Behind Study Design

## Conflicting Results (Recent research studies)

- 5 studies showed adverse effects on all measures
- 1 study showed no adverse effects
- 4 studies showed adverse effects on some measures and not on others

## Deficient Methodologies in Earlier Studies

- Insufficient measurement accuracy
- Insufficient statistical power



# Selected Study Methodology

## On-Road Instrumented Vehicle

- High degree of experimental control
- Efficient – high data rate

## Eye Glance Measurements

- Objective behavioral measure
- Related to attention and distraction, but not the same



**Fact of Research  
Single Study  
Cannot Answer  
All Questions**



# Study Objectives

Determine whether:

- Commercial Electronic Variable Message Signs (CEVMSs) are associated with long duration eye fixations which exceed accepted safety criteria
- Presence of CEVMSs changes distribution of eye glances



# Major Study Activities

- Site Selection and Vehicle Preparation
- Site Preparation
  - Map routes
  - Identify and catalog objects
- Participant Recruitment and Qualification
- Data Collection Runs
  - 20 minute orientation with field research vehicle
  - Three 30-minute drives of route
- Data Reduction
  - Manual, using software tool
- Data Analysis and Report



# Independent Variables

- 2 Locations
  - Urban and suburban
- 2 Routes per location
- 3 Drives per participant (same route and time)
- Drive Time
  - 4 daylight
  - 2 night



# Selected Dependent Variables

- Frequency & rate of eye glances toward an object
- Duration of eye glances toward an object
- Duration of eye glances toward the road ahead
- Frequency and type of potentially unsafe driving behaviors (safety surrogate measures)



# Selected Measured Variables (Non-Billboard)

- Driver Characteristics
  - Age, gender, familiarity with route, driving experience
- Weather
- Route Characteristics
  - Traffic flow, access control, lane width, roadway configuration



# Selected Measured Variables (Billboard)

- Location, orientation, distance from roadway
- Size, height and spacing along roadway
- Average luminance and average contrast ratio
- Message content
- Change rate of CEVMS



# Characteristics of the Routes

- Roughly 30-minute duration
- Mixtures of urban and suburban areas
- Combination of both freeway and non-freeway roadways
- 5 to 7 CEVMSs per route
- 5 to 7 SBBs per route



# Selected Capabilities of Field Research Vehicle

- Roadway ahead video (wide angle)
- Eye tracking video (head and eye position)
- Eye gaze data (1-2 degrees resolution)
- 30 frames per second
- Vehicle location (GPS)
- Vehicle speed
- Vehicle acceleration
- Inputs for event markers



# Data Analysis Demonstration



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# Eye-Tracker 1.5° & 5° Visual Angles

James Lick Fwy Exit Photo



# Sample Raw Data

Fixation Number	Entry Time	Exit Time	Duration	Road Ahead	Parked Car	Pedestrian
1	0	1.42	1.42		PC	
2	1.42	1.58	0.16			PED
3	1.58	2.63	1.05	RA		
4	2.63	3.58	0.95			PED
5	3.58	4.71	1.13		PC	



# Revised Schedule for Project

<b>Task</b>	<b>Start Date</b>	<b>Completion Date</b>
<b>Conduct pilot test</b>	<b>August 2009</b>	<b>August 2009</b>
<b>Collect data at first site</b>	<b>August 2009</b>	<b>October 2009</b>
<b>Collect data at second site</b>	<b>November 2009</b>	<b>January 2010</b>
<b>Write interim report on first site</b>	<b>November 2009</b>	<b>December 2009</b>
<b>Conduct data analysis</b>	<b>August 2009</b>	<b>February 2010</b>
<b>Prepare/deliver presentation at TRB</b>	<b>December 2009</b>	<b>January 2010</b>
<b>Submit final report/internal review</b>	<b>November 2009</b>	<b>March 2010</b>
<b>Submit final report</b>	<b>March 2010</b>	<b>April 2010</b>



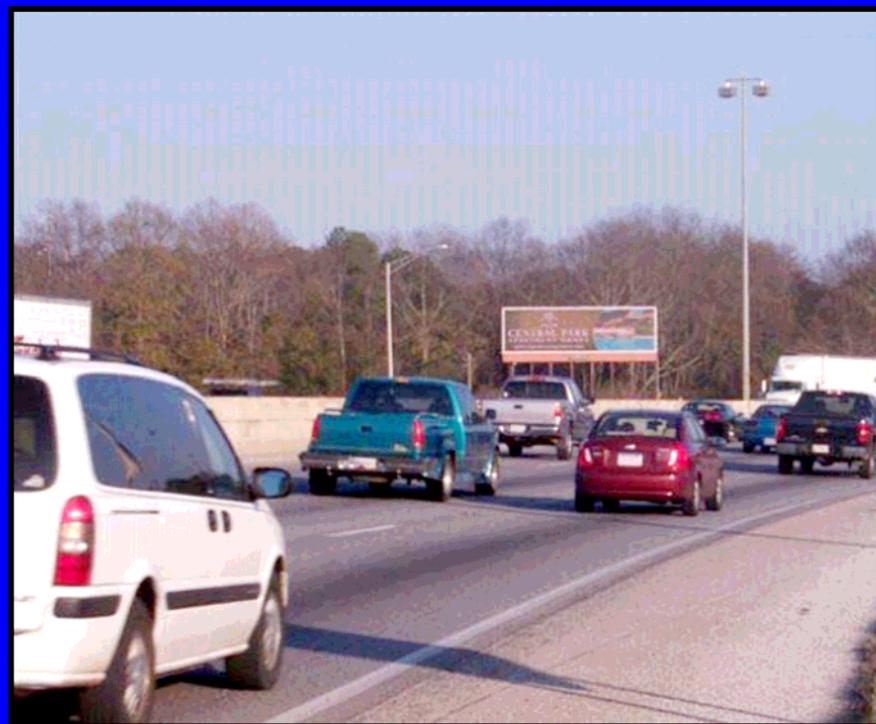
# Advantages of Study

## Measurement Accuracy

- State of art eye tracking equipment
- Non-intrusive gaze measurements
- Robust calibration and validation procedures

## Statistical Power

- 25 different CEVMS and 25 different SBB
- 96 research participants
- 2 locations



# Questions?

