SAFETY RESEARCH USING SIMULATION

UNIVERSITY TRANSPORTATION CENTER

The University of Iowa (Lead Institution)
University of Central Florida
University of Massachusetts – Amherst
University of Puerto Rico – Mayagüez
University of Wisconsin - Madison

Connection and Collaboration Virtual Symposium

hosted by The University of Iowa

IT's NOT JUST US

October 4, 2017

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Volpe National Transportation Systems Center

SaferSim I

SaferSim II

- Automated vehicles technology
- Connected vehicles technology
- Vulnerable road users
- Roadway infrastructure design
- Distributed simulation technology

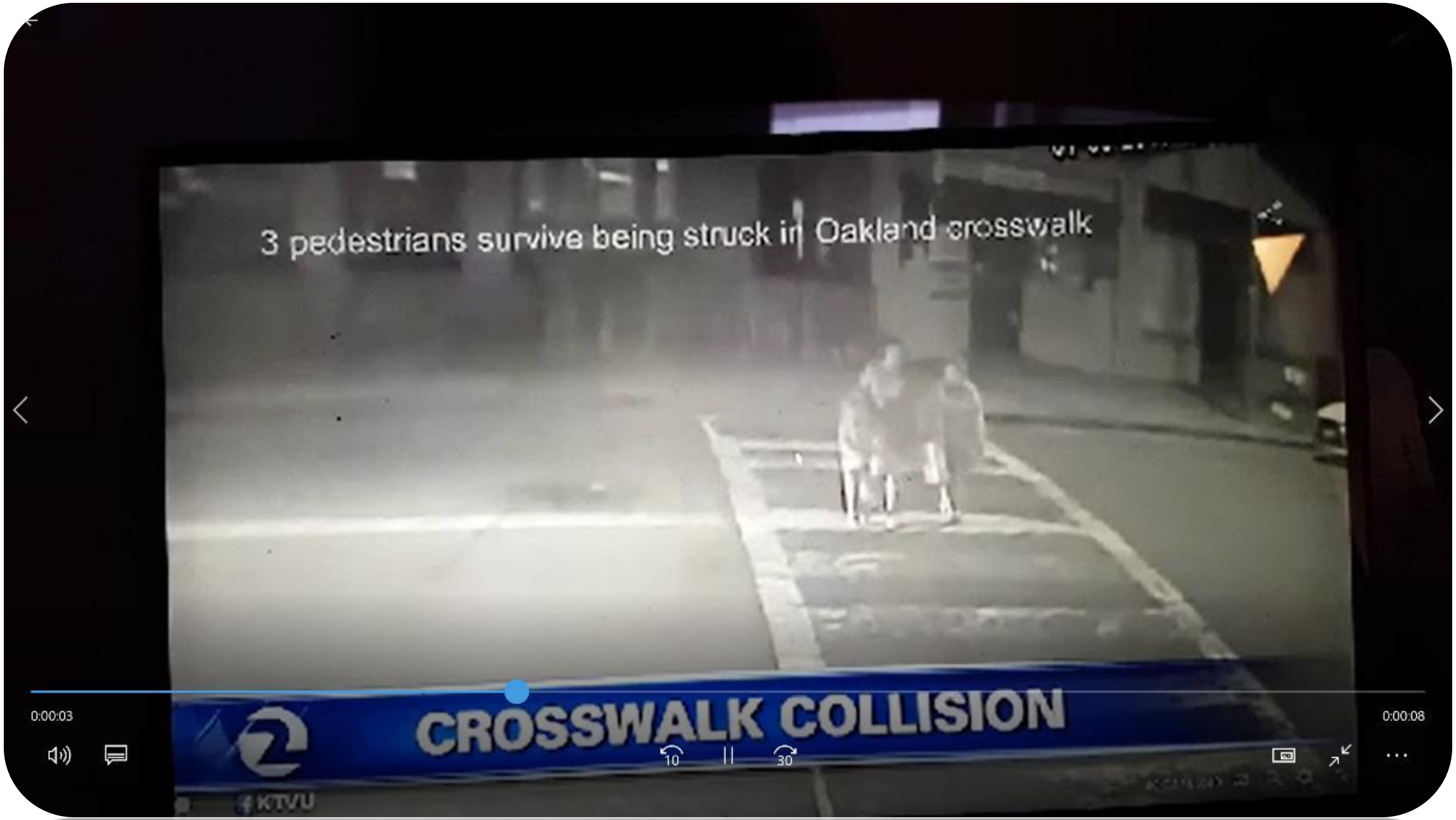
Part I

Introduction

One life

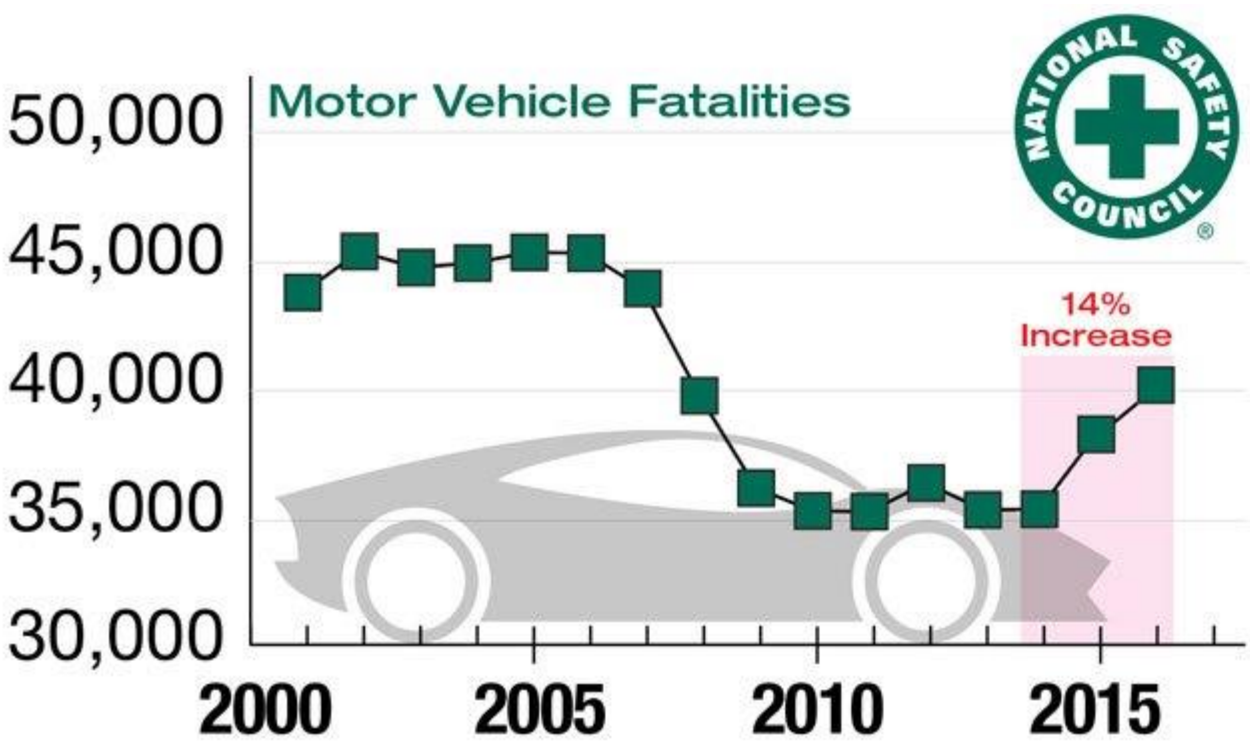
Video

Three lives



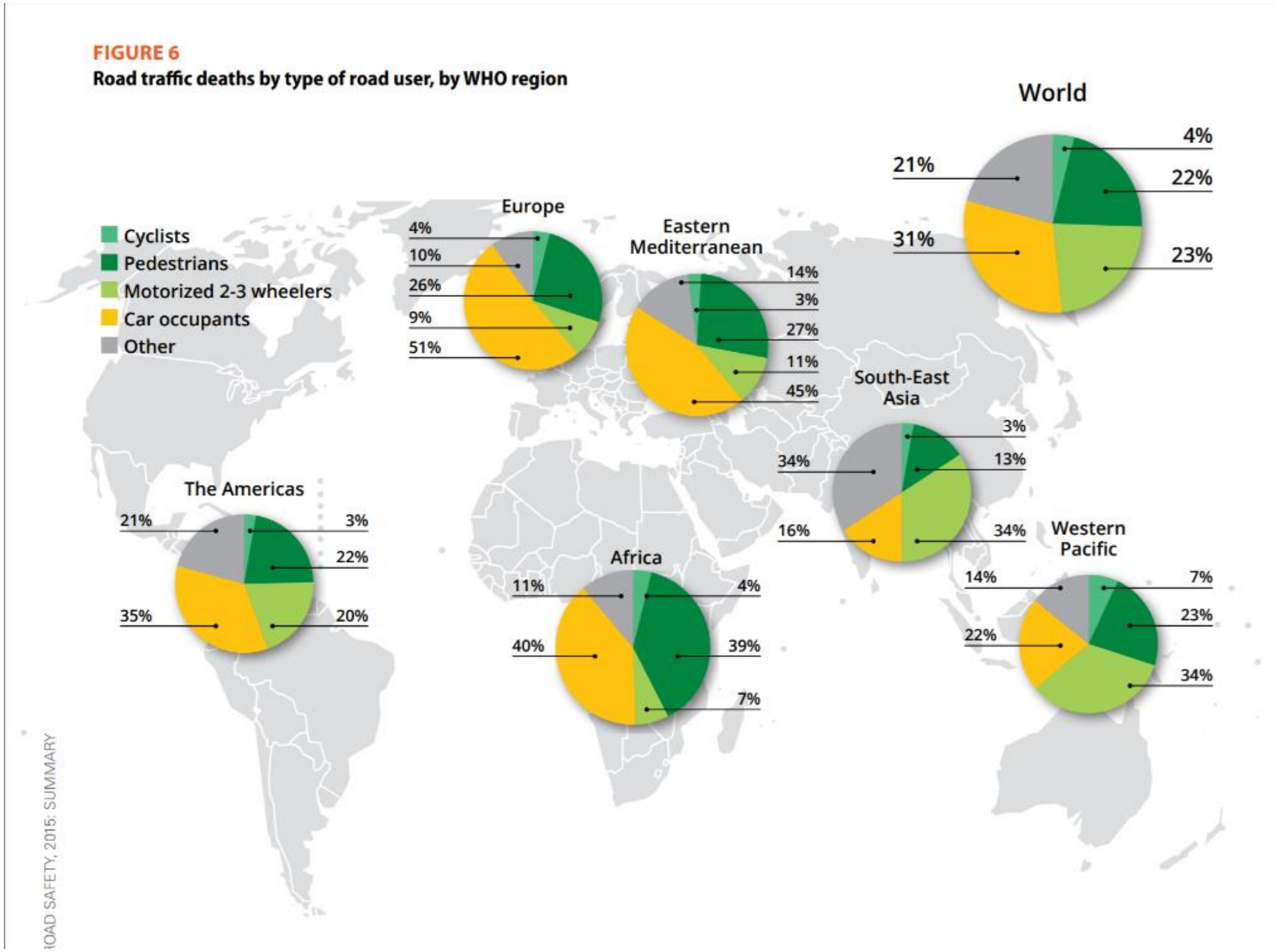
[Movie]

The United States



The world – 1,250,000

Vulnerable road users



IT's NOT JUST US

SAFER SIM

SAFETY RESEARCH USING SIMULATION

UNIVERSITY TRANSPORTATION CENTER

Part 2

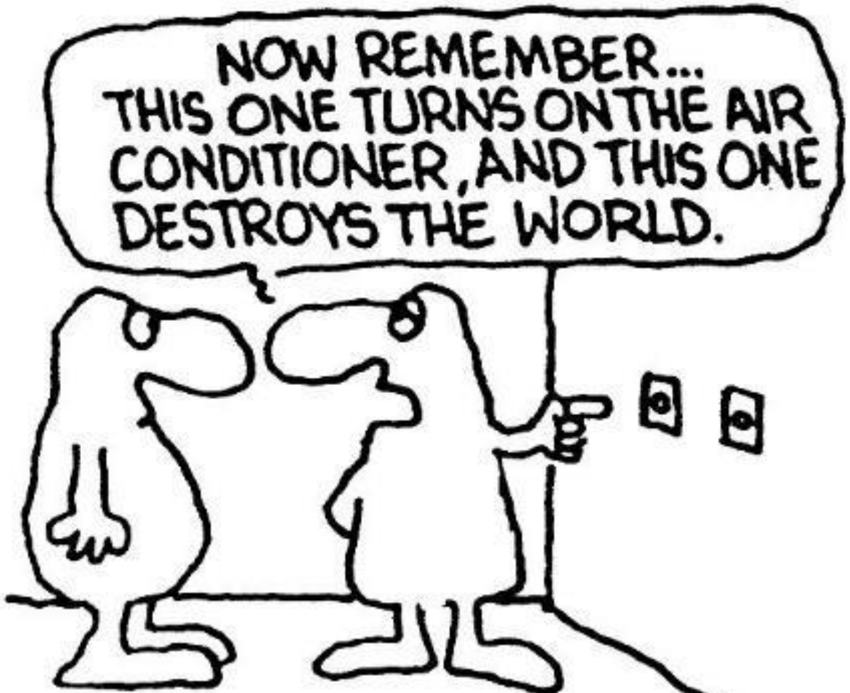
Trust and Reliance

Part 2

Engineering solutions

- Advanced driver assistance systems
  - Lane departure warnings
- Automated vehicles technology
  - Lane keeping assist
  - Lane centering assist
- Connected vehicles technology
  - Head on collision warning systems
- Roadway infrastructure design
  - Jersey barriers

Human behavior: An engineering conundrum



Lane departure warning systems

$$\frac{2}{3}$$

An ideal world

Wind gusts

The results

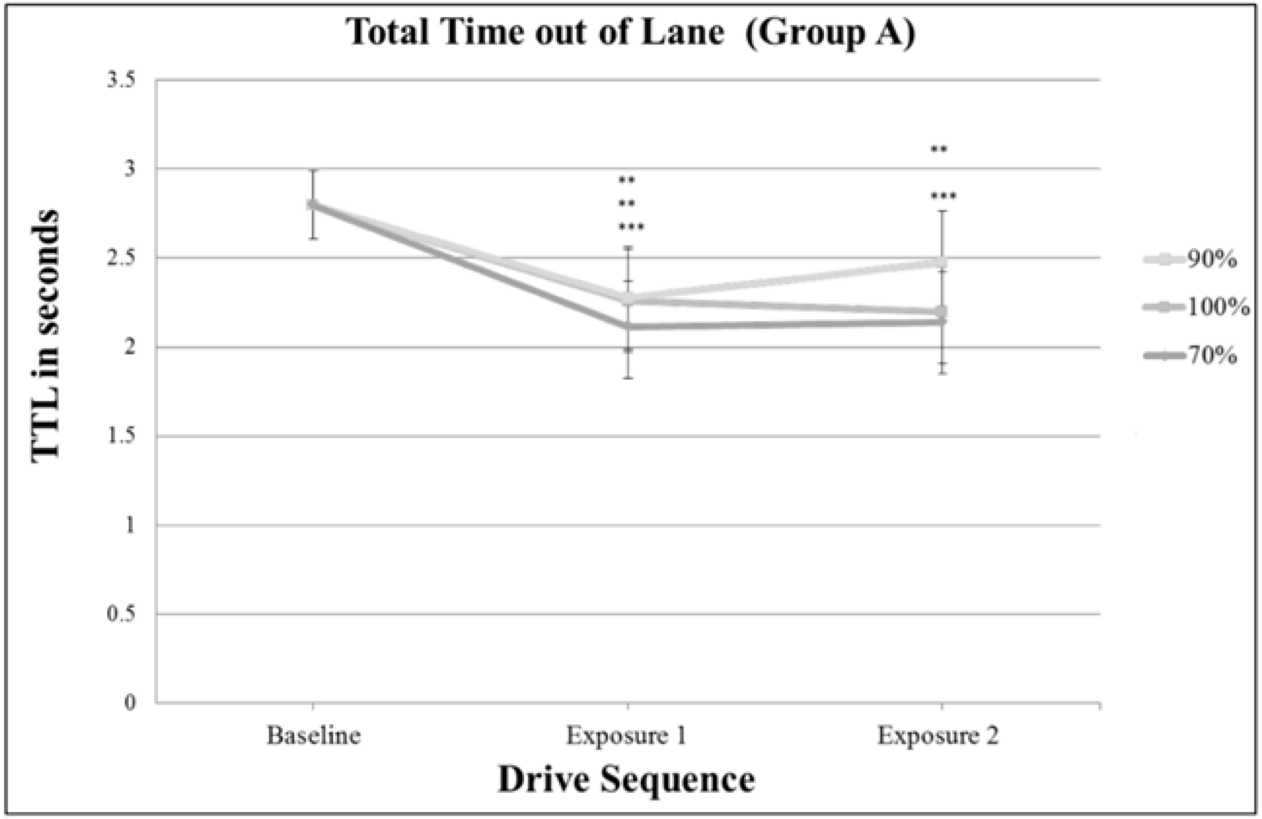


Figure 3.1. Groups A's average TTL for each set of drive by reliability level. Note: ** denotes p<.01; * denotes p<.001**

Lee and See (2004)

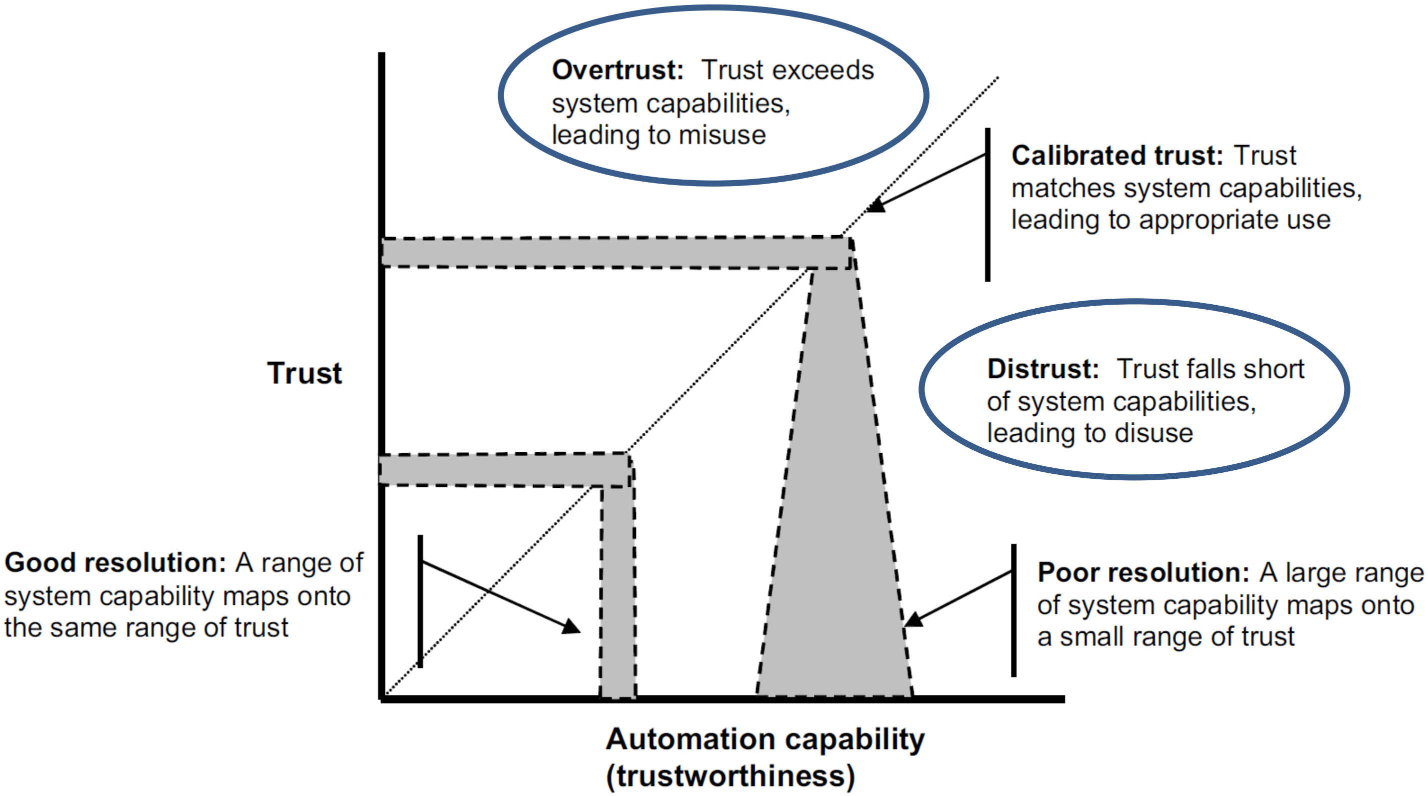


Figure 2. The relationship among calibration, resolution, and automation capability in defining appropriate trust in automation. Overtrust may lead to misuse and distrust may lead to disuse.

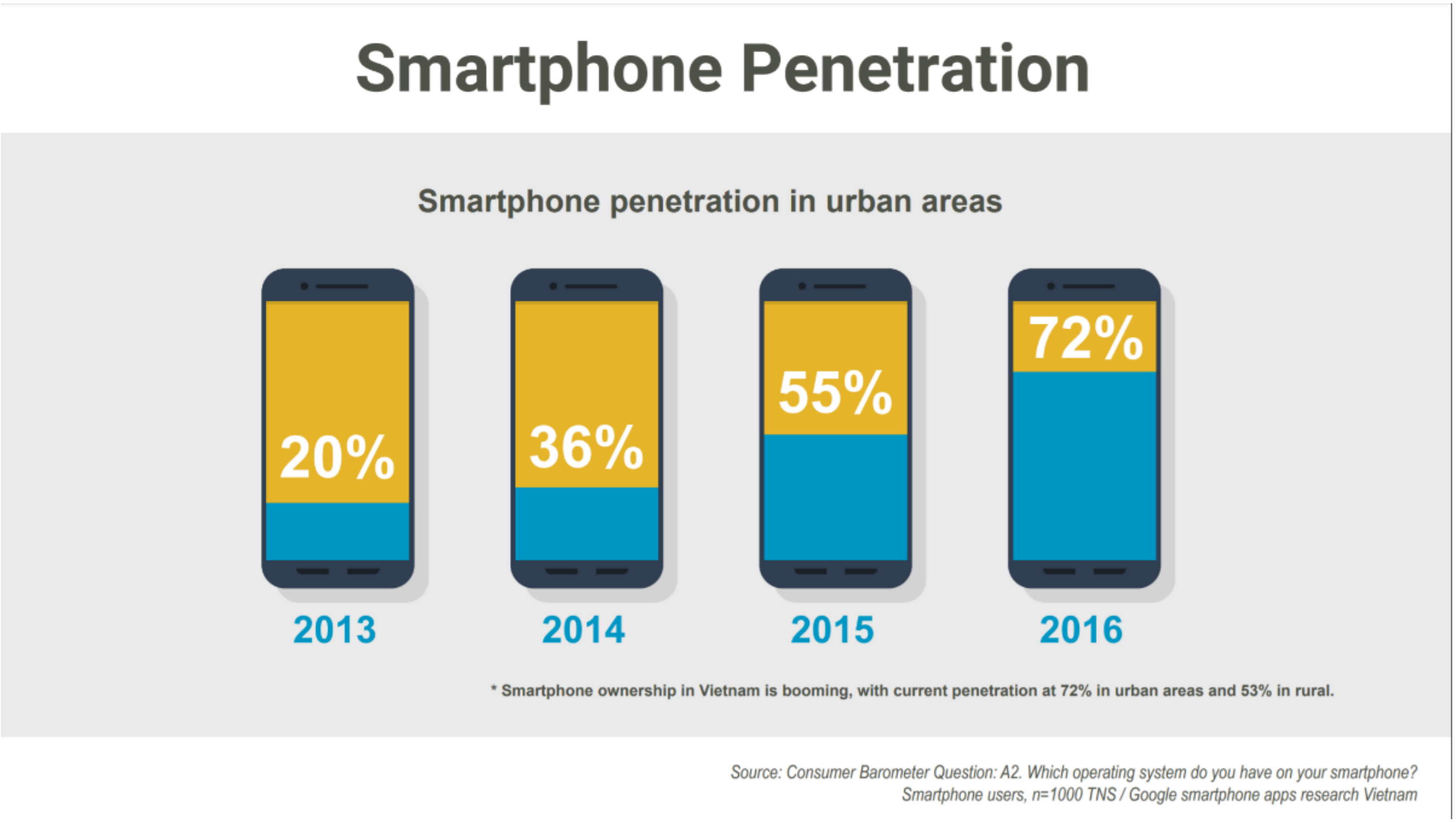
SaferSim: Trust and Reliance

And what about Vietnam

Driving in Vietnam

Movie

Vietnam


Smartphone Penetration
Smartphone penetration in urban areas
20%
36%
55%
72%
2013
2014
2015
2016
* Smartphone ownership in Vietnam is booming, with current penetration at 72% in urban areas and 53% in rural.
Source: Consumer Barometer Question: A2. Which operating system do you have on your smartphone?
Smartphone users, n=1000 TNS / Google smartphone apps research Vietnam

V2P

Pedestrian simulators

Hank Virtual Environments Lab

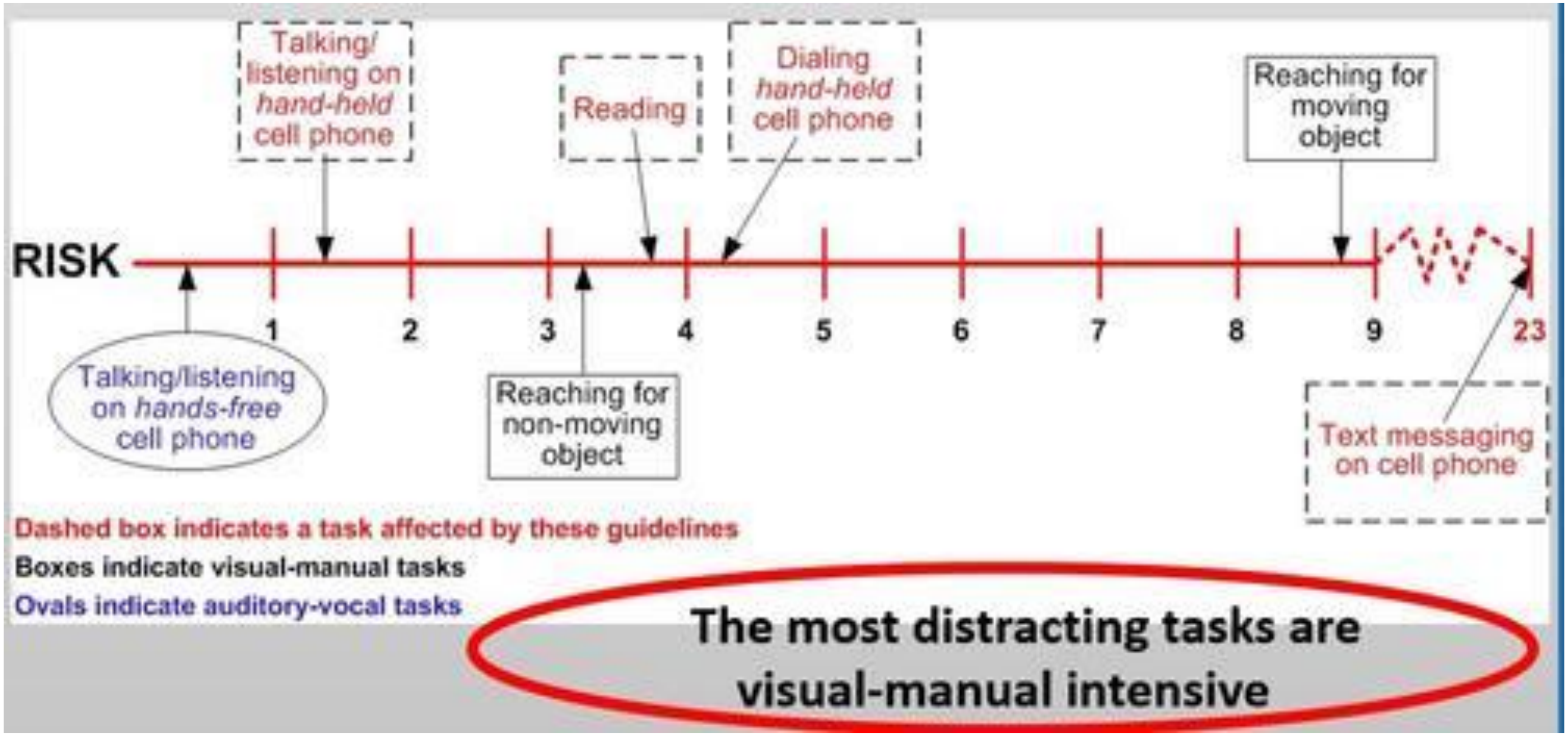
Helping others, helping ourselves

Part 3

Distraction

Distraction is deadly

Visual-manual distractions



National Highway Traffic Safety Administration

Acceptance criteria

1) Frequency of long glances
   1) For at least 21 of the 24 test participants, no more than 15 percent (rounded up) of the total number of eye glances away from the forward road scene have durations of greater than 2.0 seconds while performing the testable task one time.
2) Mean glance duration
   1) For at least 21 of the 24 test participants, the mean duration of all eye glances away from the forward road scene is less than or equal to 2.0 seconds while performing the testable task one time.
3) Total glance duration away from the forward roadway
   1) For at least 21 of the 24 test participants, the sum of the durations of each individual participant's eye glances away from the forward road scene is less than or equal to 12.0 seconds while performing the testable task one time.

Lockout criteria

Video

Voice control systems

Cognitive distractions

What’s the problem?

Evaluation of voice control systems

OSPAN Task

4/2 + 1 = 3

serene

OSPAN Task

3 + 12/4 = 7

stressed

Six infotainment systems

- Ford equipped with MyFord Touch,
- Chevrolet equipped with MyLink,
- Chrysler equipped with Uconnect,
- Toyota equipped with Entune,
- Mercedes equipped with COMAND, and
- Hyundai equipped with Blue Link

Findings

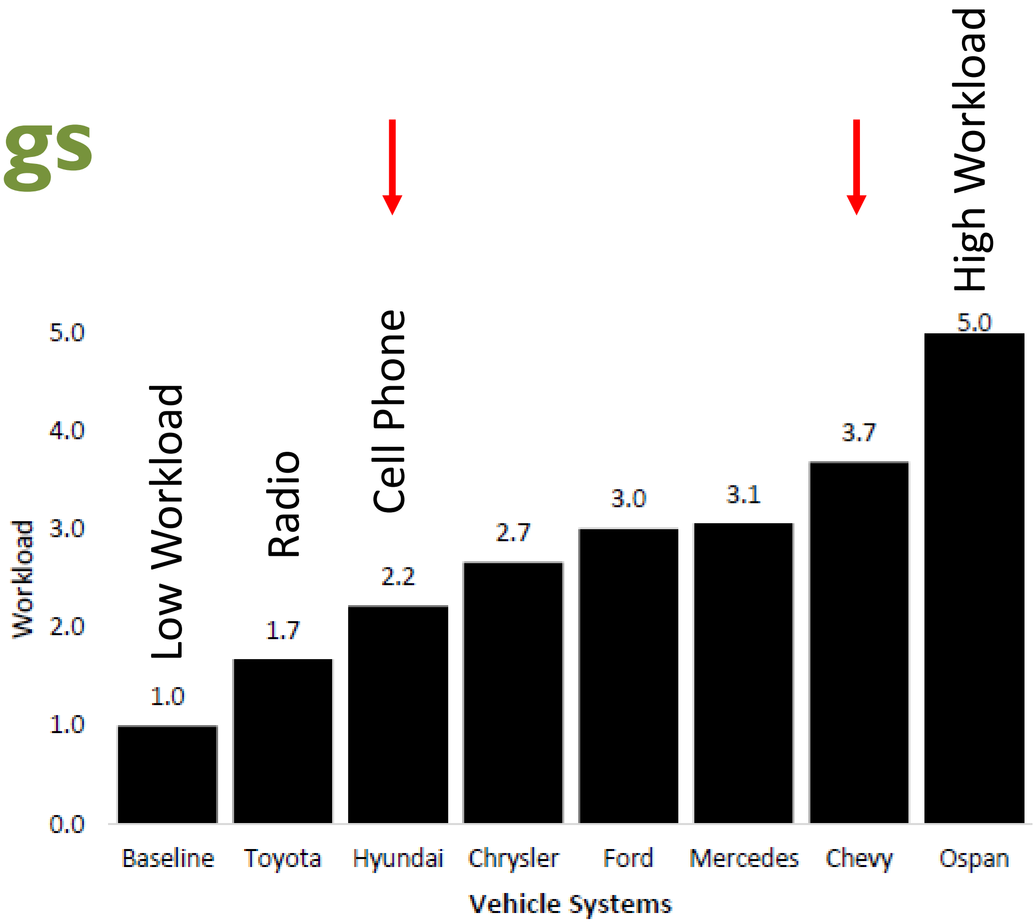
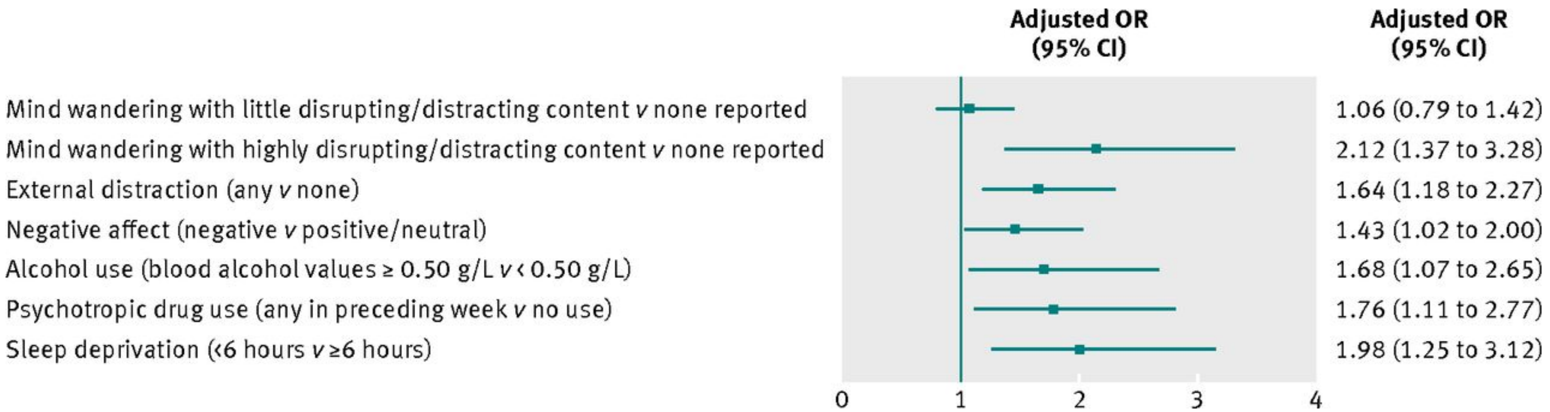


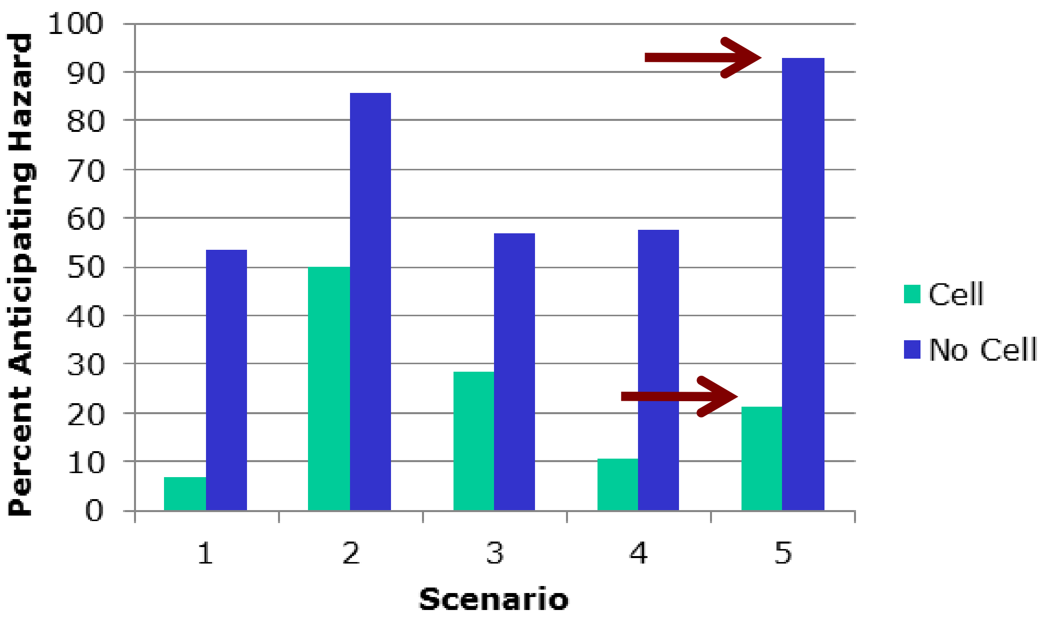
Figure 10. Mental Workload Scale for each of the 8 research conditions

But what about crashes?

SaferSim: Cognitive Distraction

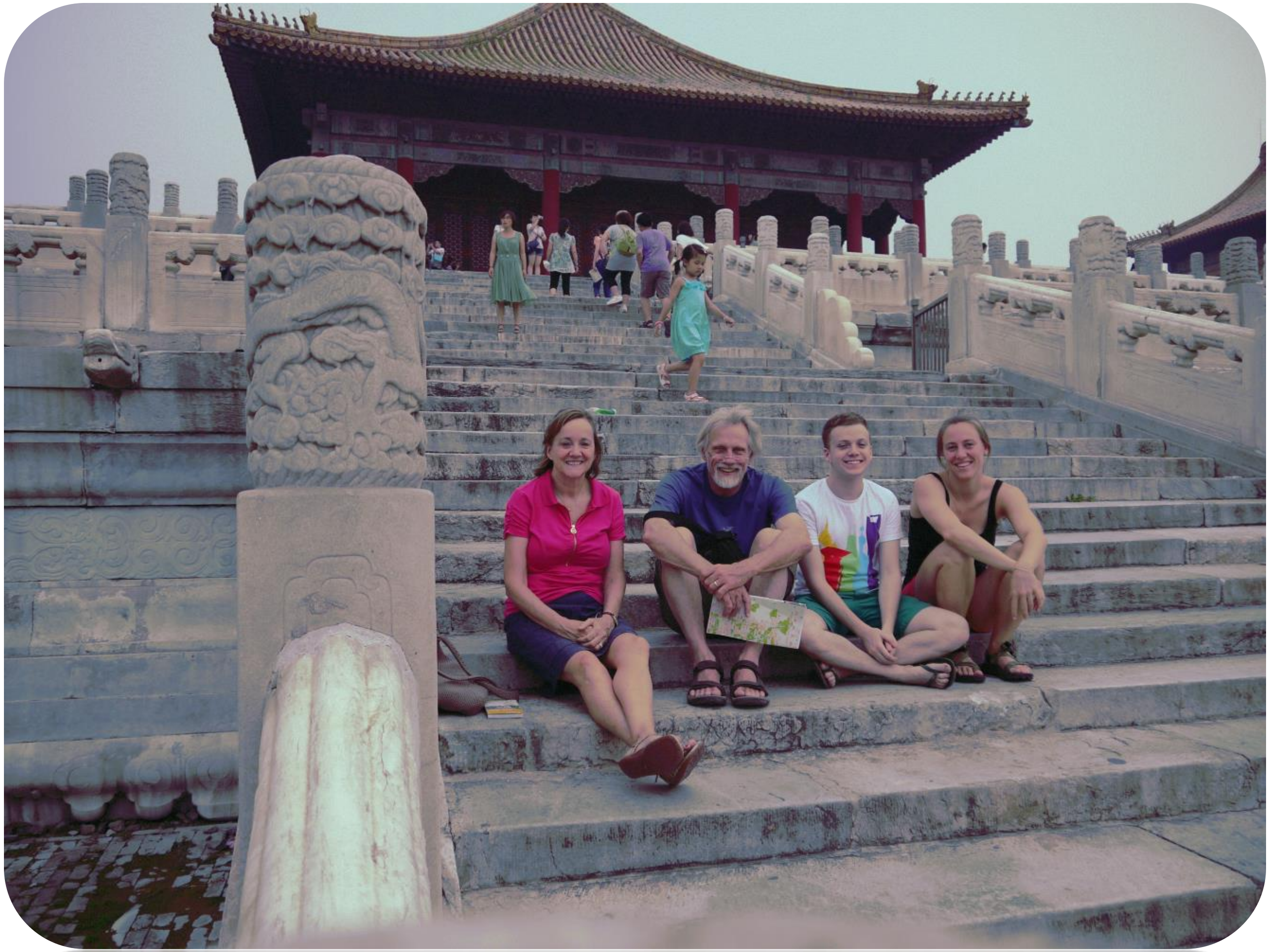


Hazard anticipation, cell phones and voice command systems



1. Pedestrian crossing obscured on right
2. Truck obscuring crosswalk
3. Hidden crosswalk after curve in school zone
4. Car obscuring crosswalk
5. Hidden crosswalk to the left

And what about China?



Around the world

Continent	**Program Name**	**Label**	**Countries**
Asia	China New Car Assessment Program (C-NCAP) – *Est.* 2006		China
	Japan New Car Assessment Program (JNCAP) – *Est.* 1991		Japan
	Korean New Car Assessment Program (KNCAP) – *Est.* 1999		Korea
	New Car Assessment Program for Southeast Asian Countries (ASEAN NCAP) – Est. 2011		***ASEAN Countries***
Australia	Australasian New Car Assessment Program (ANCAP) – *Est.* 1992		Australia & New Zealand
Europe	European New Car Assessment Program (Euro-NCAP) – *Est.* 1997		France, Germany, Italy, Spain, Sweden, The Netherlands & United Kingdom (European region as a whole)

Helping others, helping ourselves

5-Star Safety Ratings

More Stars. Safer Cars.

New Car Assessment Program (NCAP)

Non-regulatory vehicle safety program

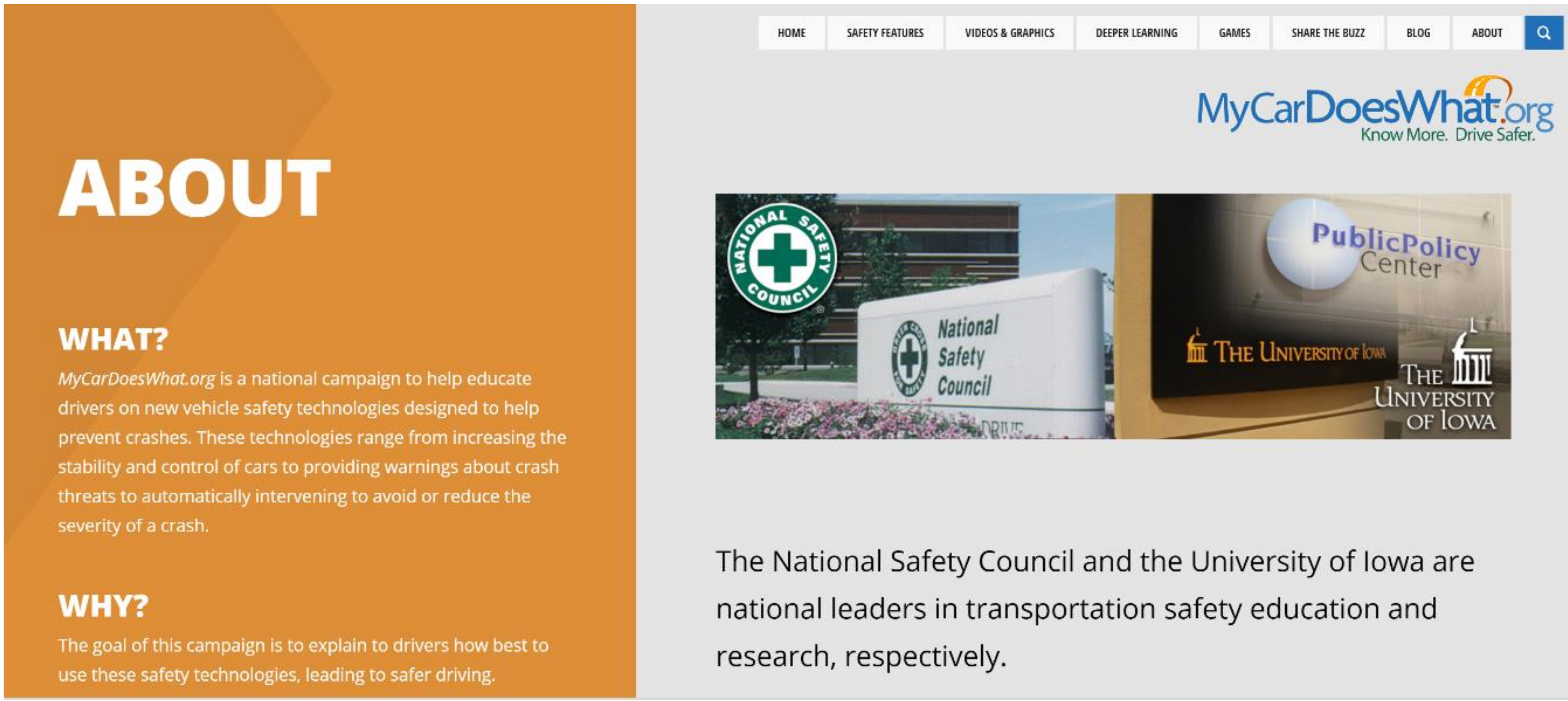
NHTSA
www.nhtsa.gov

Part 4

Training and Education

Automated vehicles

MyCarDoesWhat



Deeper learning: Understanding

WHAT IS IT?

Forward collision warning systems warn you of an impending collision by detecting stopped or slowly moved vehicles ahead of your vehicle. Forward collision warning use radar, lasers, or cameras to scan the road ahead while you drive. If there is an impending collision, the system will warn you of the danger using lights, beeps, vibrations of your seat, or a combination of these. Some systems may also tighten your seat belt and pre-charge the brakes, making it easier for you to stop as quickly as possible.

Many vehicles with forward collision warning also quickly becoming equipped with safety technologies like automatic emergency braking. If your vehicle has automatic emergency braking it will urgently apply the brakes if you fail to do so in time to avoid an impending collision. While automatic emergency braking may not prevent every crash from occurring, the technology may help lessen the severity of a crash.

HOW TO USE IT?

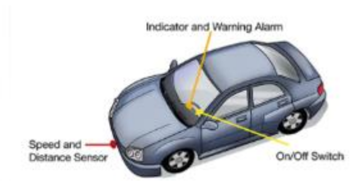
Activation/Deactivation

Most forward collision warning systems are active by default at speeds greater than 10 mph. You can deactivate the system by pressing the forward collision warning system button or by accessing your forward collision warning settings via your vehicle's information screen. Check your owner's manual for details about your specific vehicle.

What you should do

Always maintain a safe following distance from the vehicle in front of you. Your forward collision warning system is intended to warn you when you are getting dangerously close to the vehicle in front. If you receive a warning from your forward collision warning system, or if it begins braking for you, be prepared to brake or steer to safety.

HOW DOES IT WORK?



Parts of a typical forward collision warning system

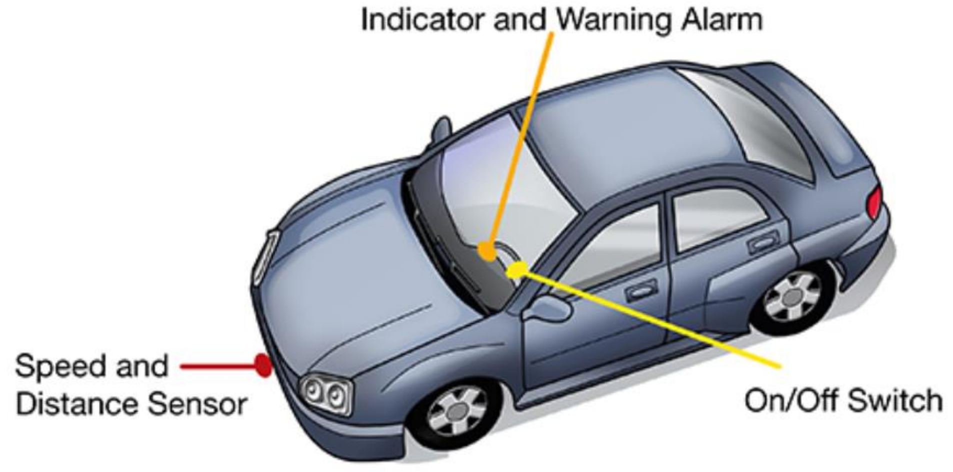
Speed and distance sensors. Forward collision warning systems use both speed and distance calculations to help keep you safe. The most common type of distance sensor uses radar to detect traffic ahead of you, but some systems use lasers, cameras, or a combination of these. These sensors detect slow or stopped vehicles in your lane and warn you if a collision is likely.

Looking under the hood: Radar-based systems. Let's look at how radar-based forward collision warning systems work. Some forward collision warning systems send radar waves that reflect off objects in front of your car. Based on the radar reflection, forward collision warning uses your speed and the changing distance to the vehicle ahead to detect if a crash is imminent.

Automatic Emergency Braking. Some forward collision warning systems work together with Automatic Emergency Braking. If your vehicle has automatic emergency braking, the system helps you avoid a crash by urgently applying the brakes when a crash is imminent if you fail to do so in time.

Deeper Learning: Understanding

HOW DOES IT WORK?

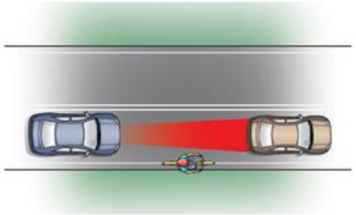


Parts of a typical forward collision warning system

Deeper Learning: Challenge

CHALLENGE #2: BICYCLES AND PEDESTRIANS

Some forward collision warning systems are not able to detect some obstacles or even vehicles because of their size or shape. When driving in areas where bicycles, motorcycles, and other small vehicles are common, you should not rely on your forward collision warning system.

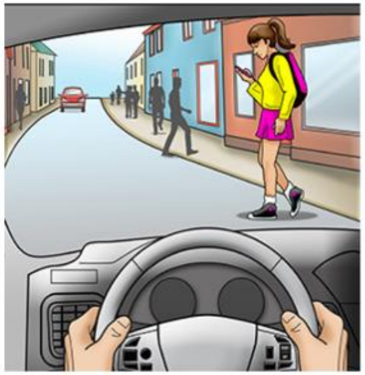


What would you do?

Imagine yourself driving the blue car on the city street to the right. Think about the questions below.

1. If the pedestrian in front of you crosses the street, how will your forward collision warning system respond?

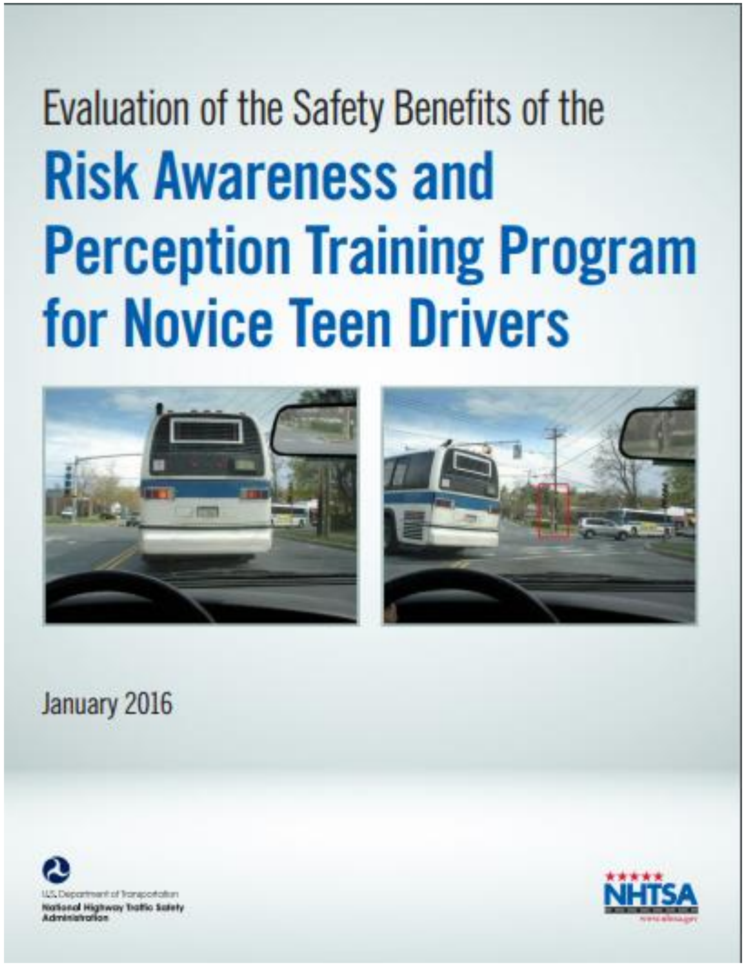
2. What should you do?



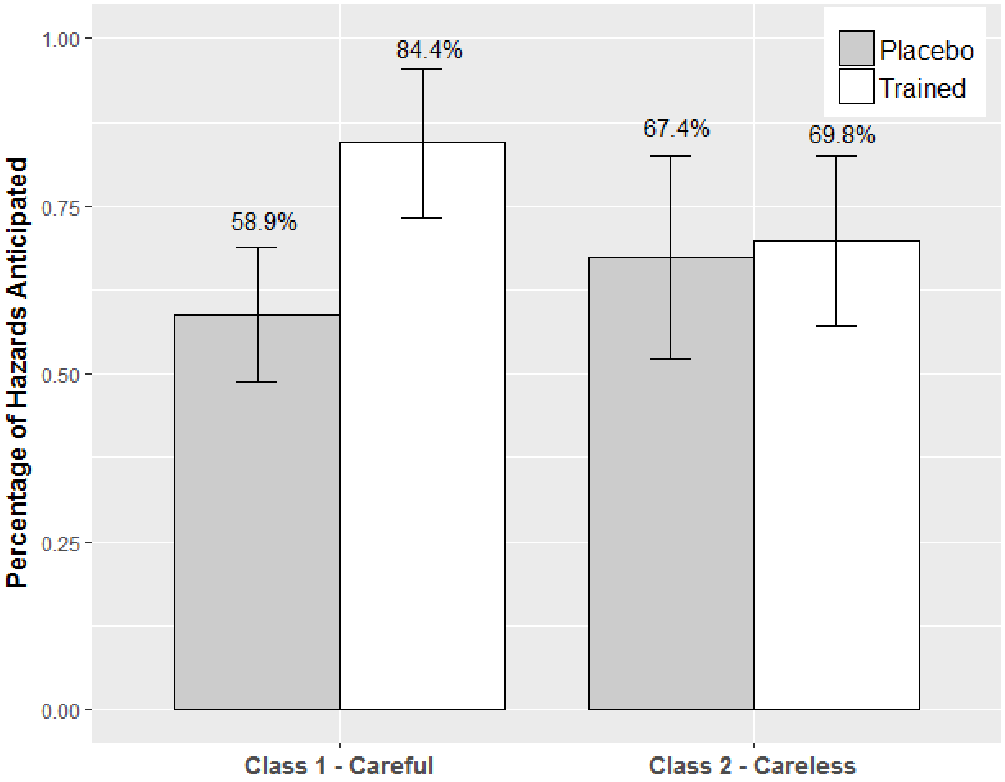
Driver education

MOTORTREND

Driver education can have an effect, but…



Driver education can have an effect, but…



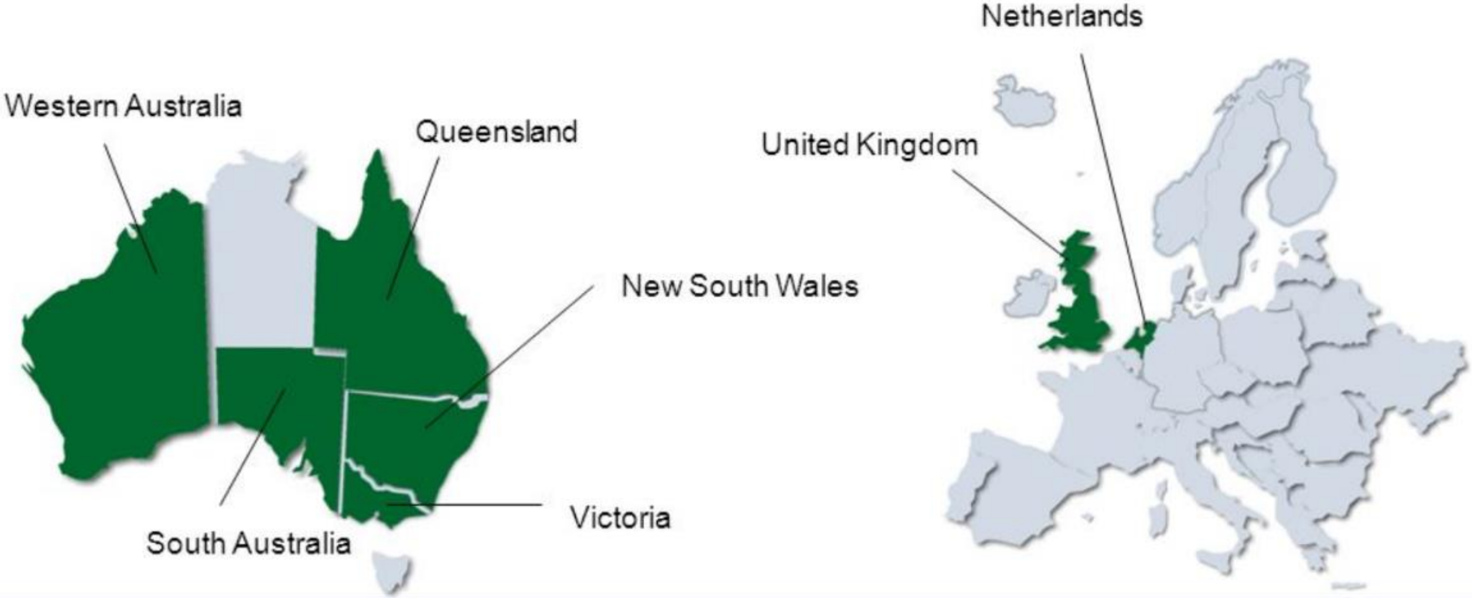
The percentage of hazards anticipated by the four groups of drivers. (The error bar represents the between-participant 95% confidence interval.)

SaferSim: Training and Education

And what about Robin Hood

Licensure

- **Internationally „Hazard Perception"-Tests are used in two European countries and in 5 Australian states:**
  → For this innovative form of testing, differences in design and also in regard of the placement in the Systems of Novice Driver Preparation can be found.

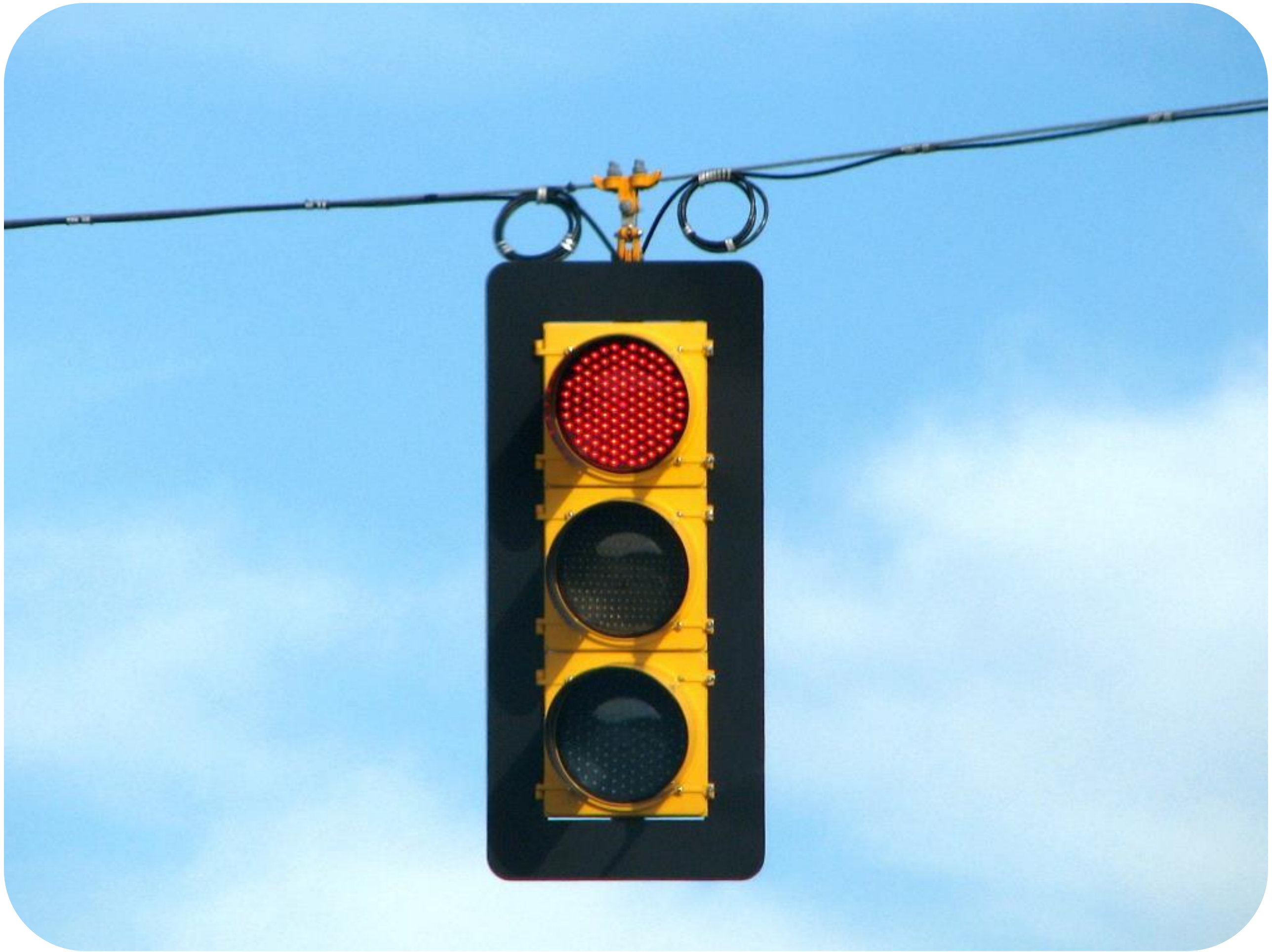


Part 5

The Environment Outside the Car

The environment outside the car

Traffic signals



Roadway geometry

Fog

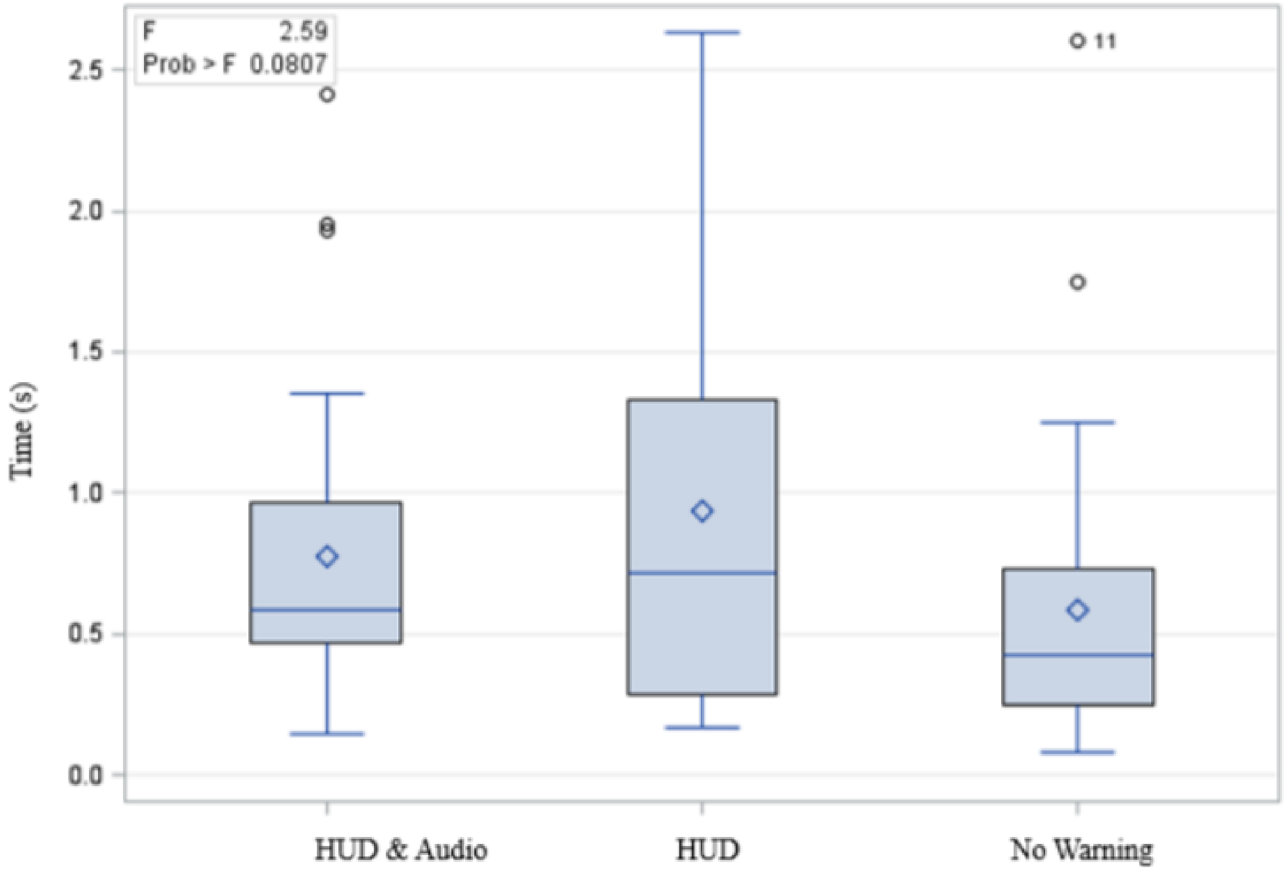
Figure 3.2 - Heavy fog level example

UCF driving simulator

Figure 4.1 - NADS MiniSim at UCF

Figure 4.1 - NADS MiniSim at UCF

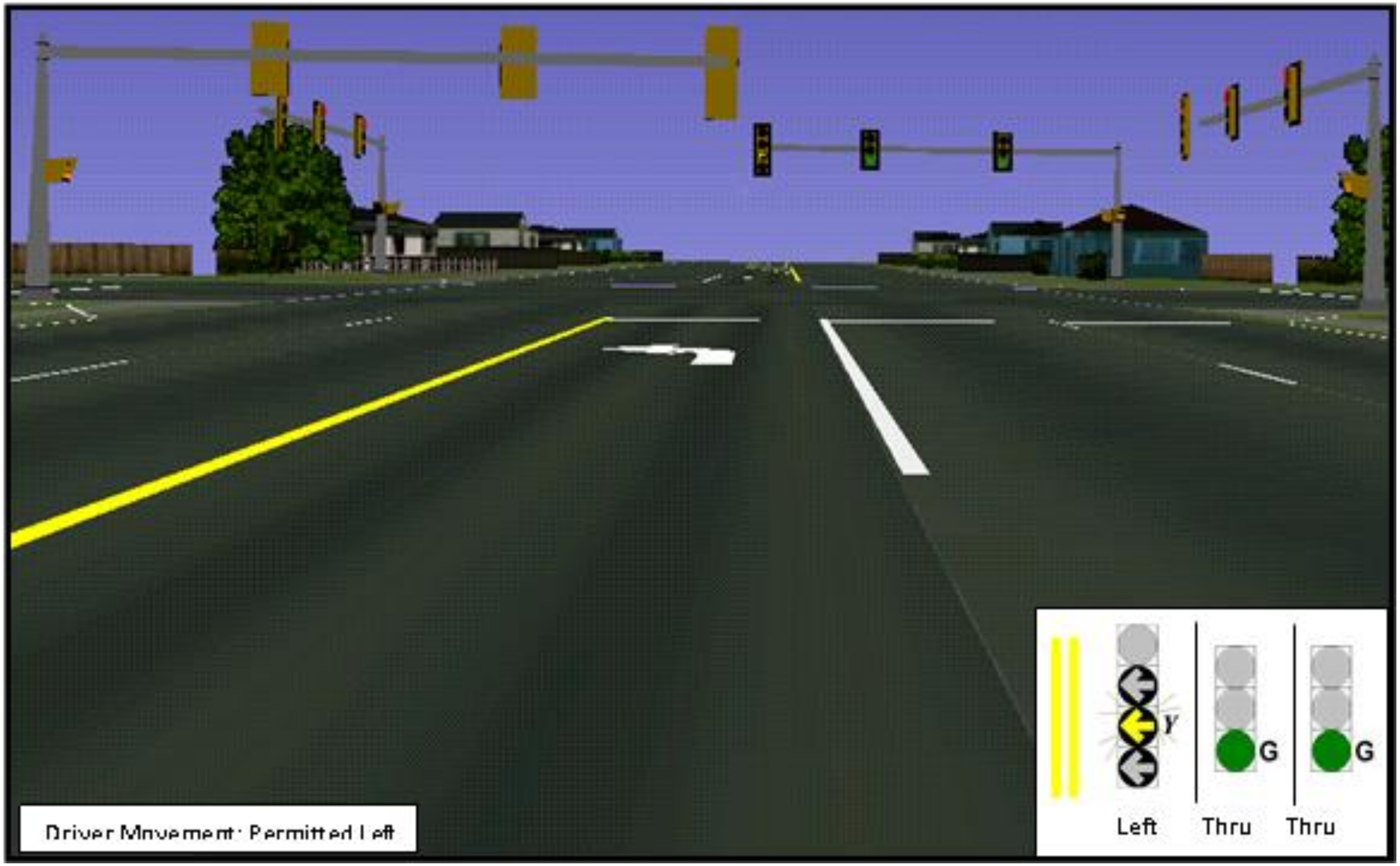
Results



F 2.59
Prob > F 0.0807
Time (s)
2.5
2.0
1.5
1.0
0.5
0.0
11
HUD & Audio
HUD
No Warning

SaferSim: How many alarms are too many?

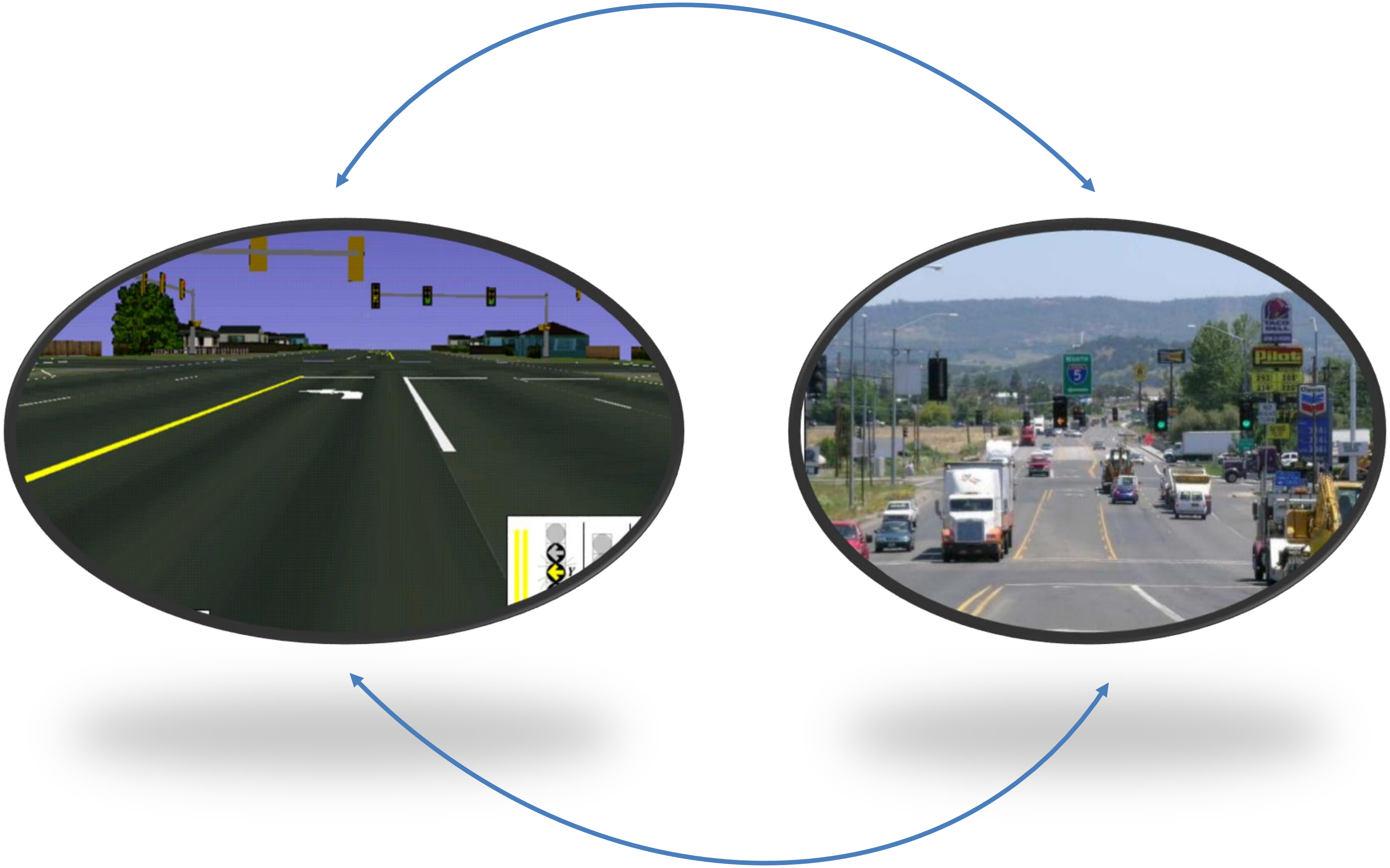
Traffic signals



Field evaluations

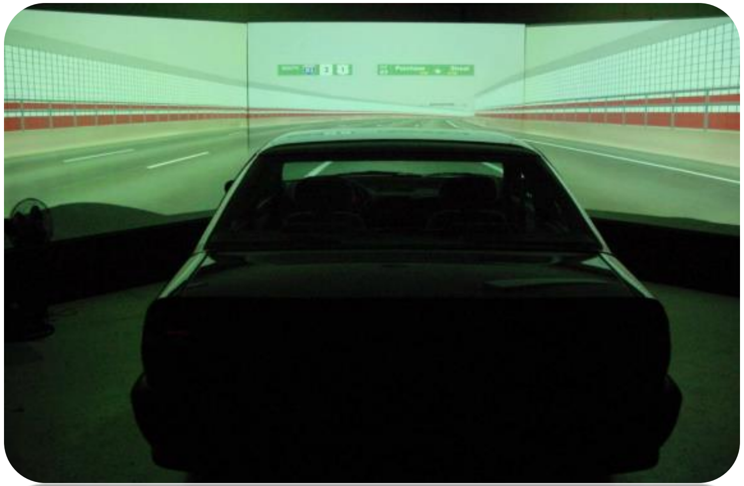
FIGURE 1 Permissive Flashing Yellow Arrow in Operation in Jackson County, Oregon

SaferSim: The cycle of research



Roadway geometry

Simulators

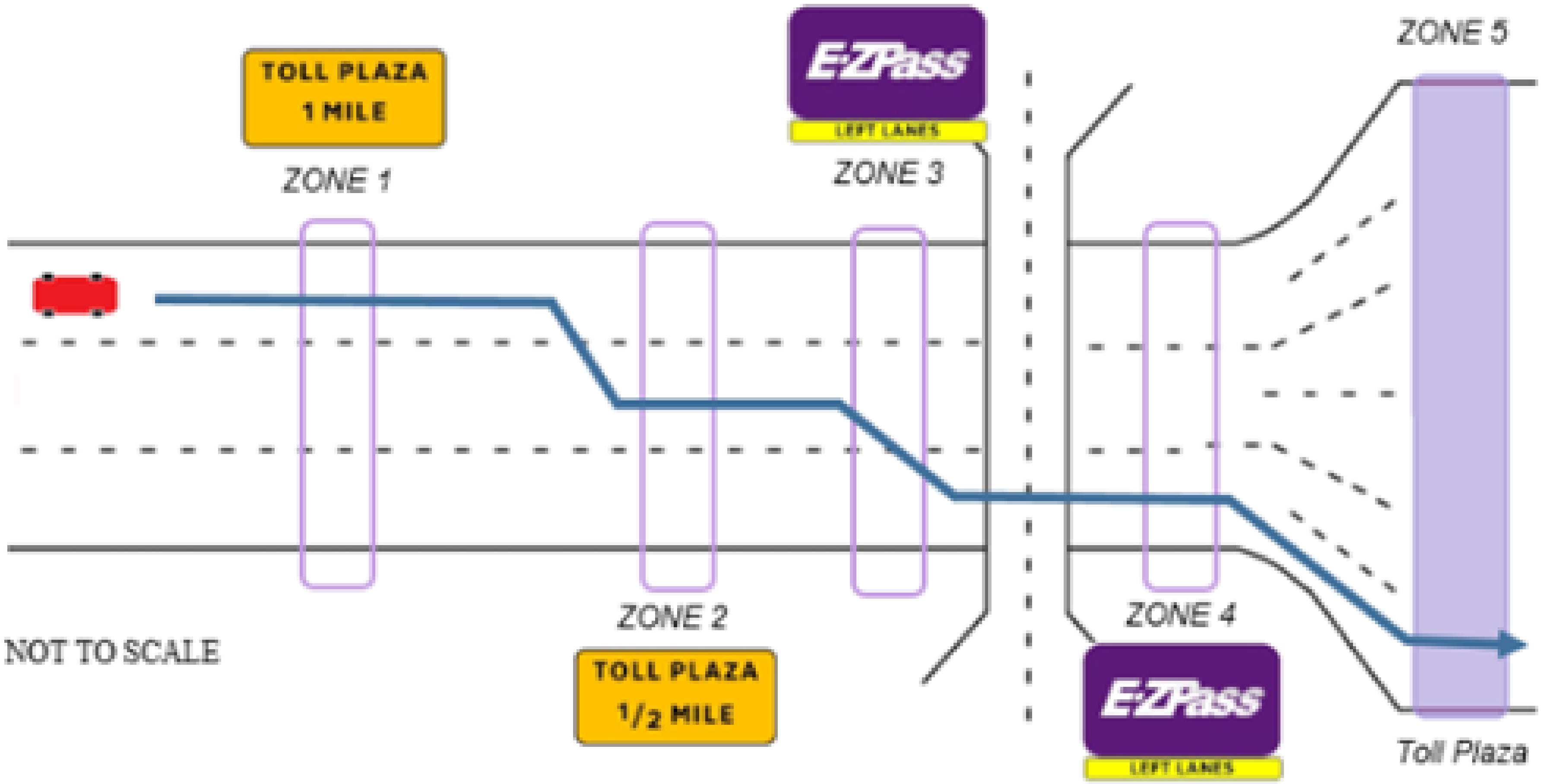


Toll plaza geometry: Massachusetts

Toll plaza geometry: Puerto Rico

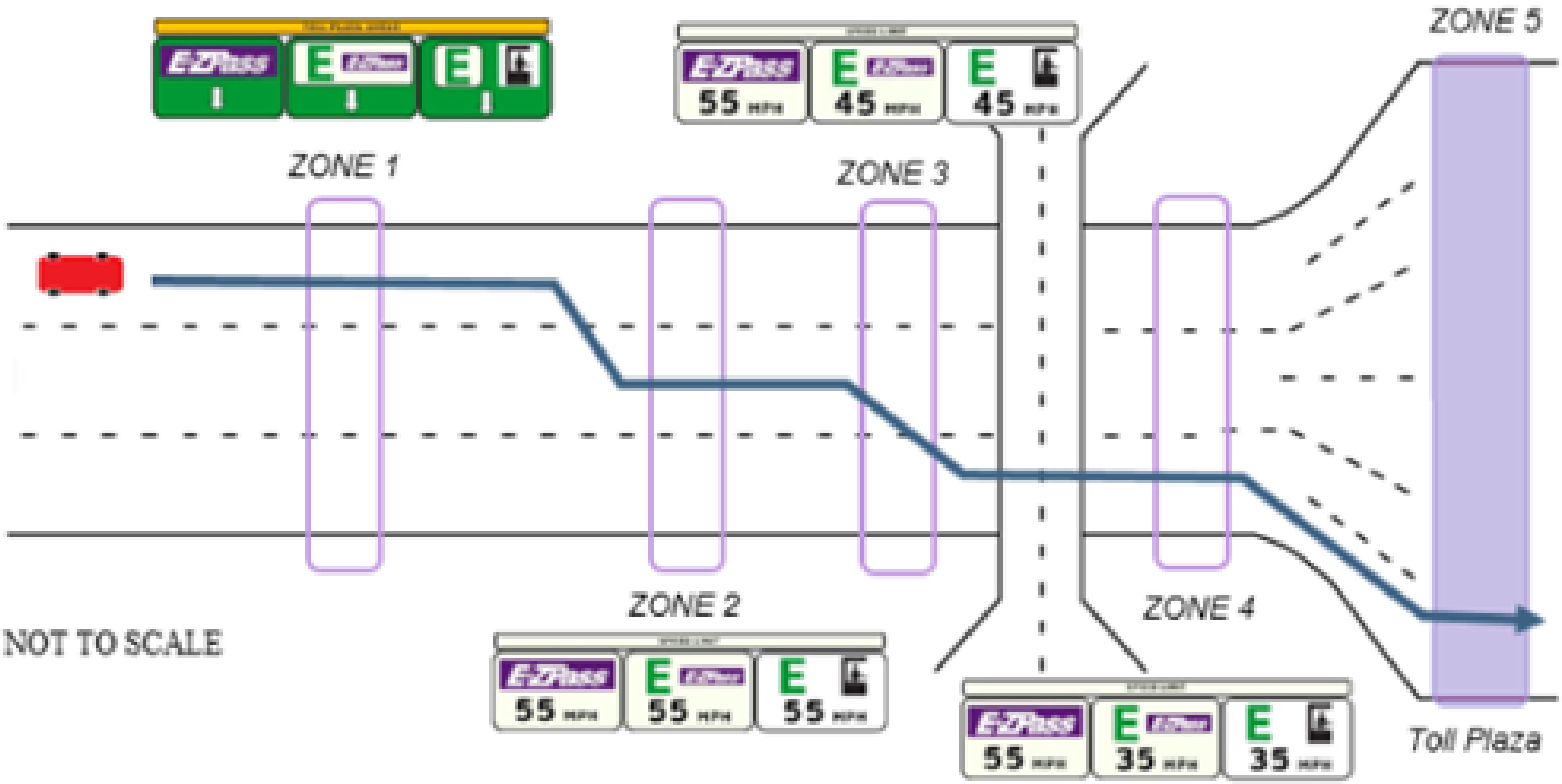
Results: Familiar and unfamiliar drivers

Baseline



TOLL PLAZA
1 MILE
ZONE 1
E-ZPass
LEFT LANES
ZONE 3
ZONE 5
ZONE 2
TOLL PLAZA
1/2 MILE
ZONE 4
E-ZPass
LEFT LANES
Toll Plaza
NOT TO SCALE

Treatment


ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
Toll Plaza
NOT TO SCALE
E-ZPass
E
55
45
45
55
55
55
55
35
35

Results

SaferSim: Unprecedented opportunity

The Big Dig

NORTH END
DOWNTOWN
CHINATOWN
I93 South
I93 North
Boston Inner Harbor
Ted Williams Tunnel
Fort Point Channel
I90 East
PIKE
I-90
Leverett Circle
World Trade Center

Simulated world

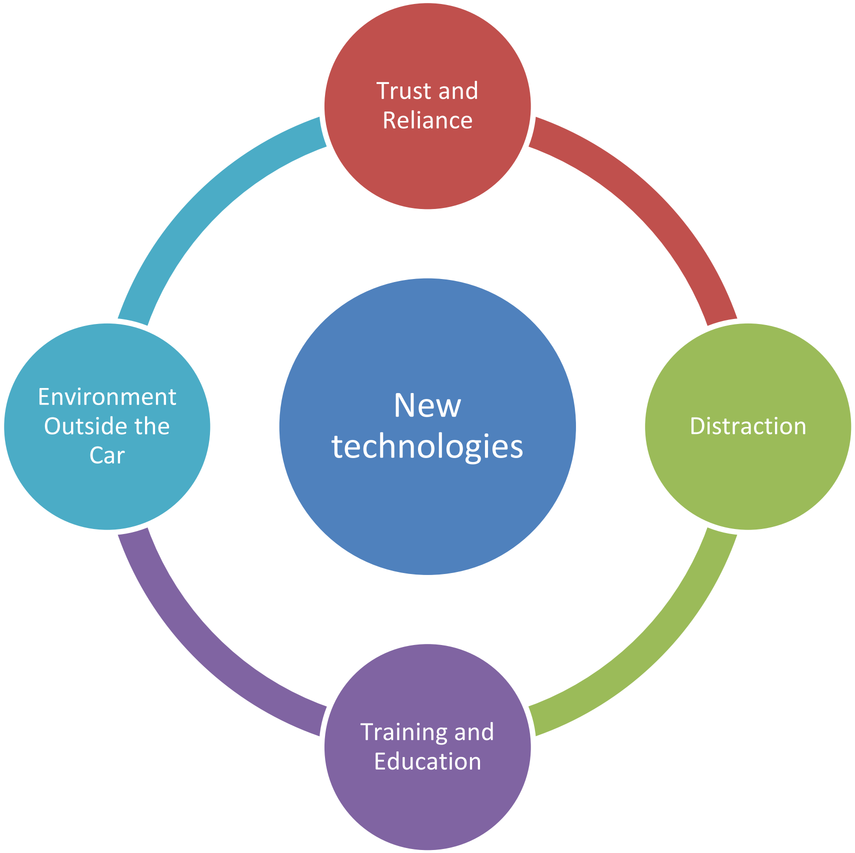
Logan International Airport

The SaferSim Challenge

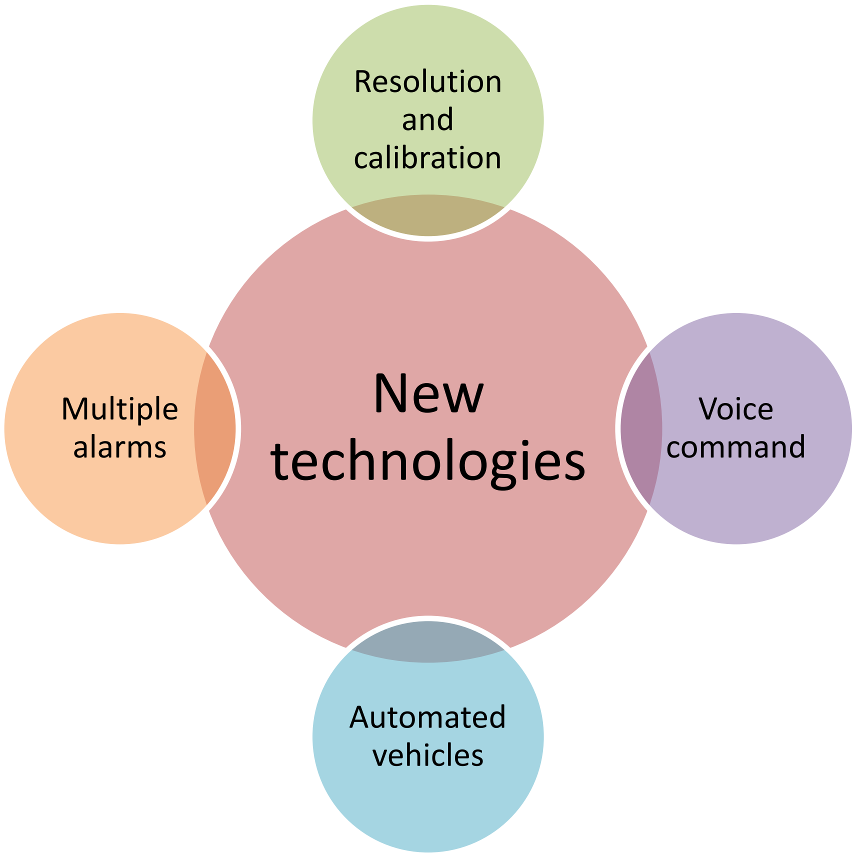
Part 6

Conclusion

Four areas of research



Next major questions



International perspective

GLOBAL
ROAD SAFETY
PARTNERSHIP

Helping others, helping ourselves