Engineering Safer Cars in a Fast Paced - Technology Rich - Increasingly Automated Environment

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The Future is Larger Screens

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The Future is More Devices

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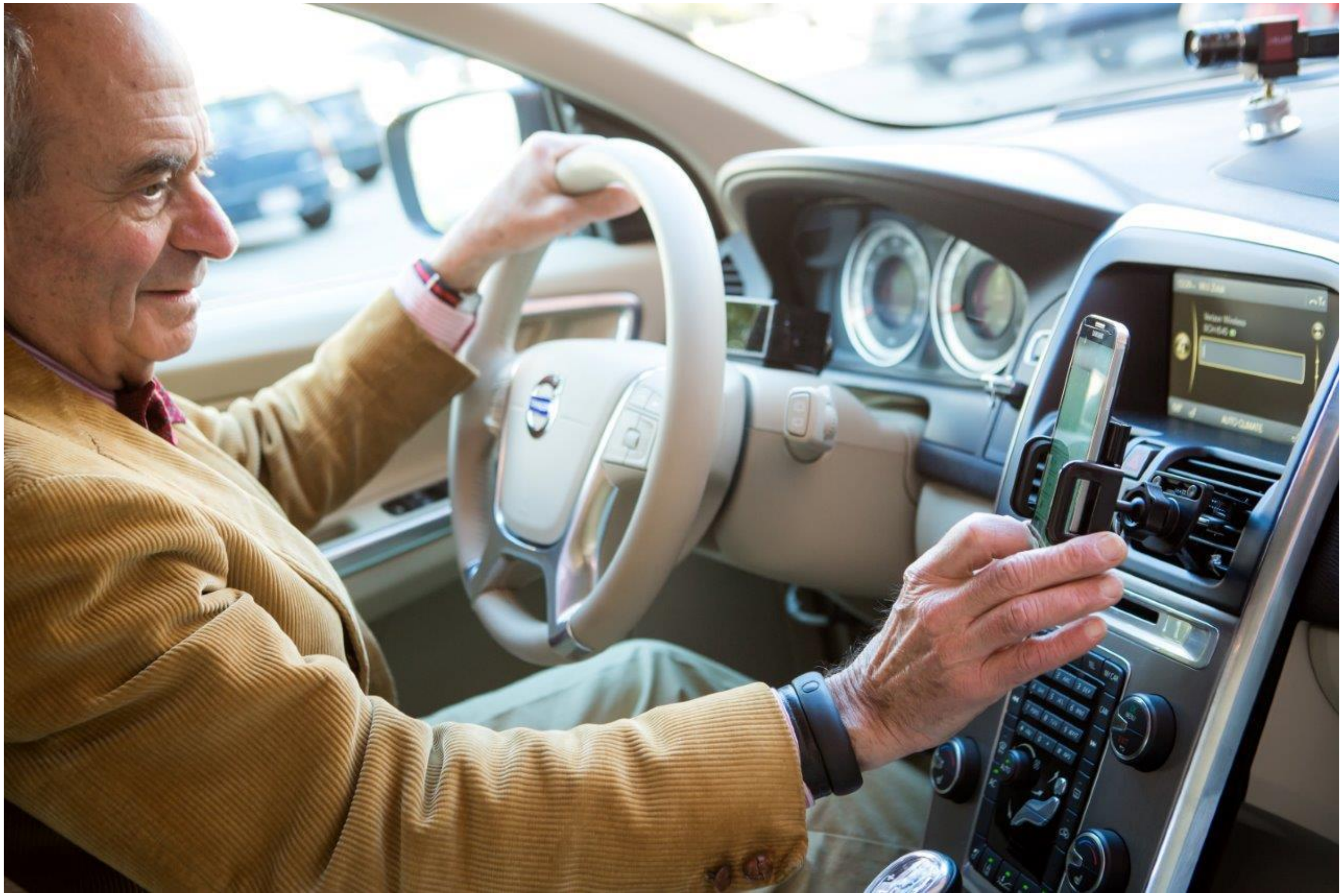
The Future is More Information

The Future has More Older Drivers



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and Expanding Automation

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Automation Technologies are Going to Alter Driver Experience?

Vehicle Miles Traveled (VMT)

Vehicle Miles Driven (VMD)

Today	Tomorrow?
VMT = VMD	VMT ≠ VMD

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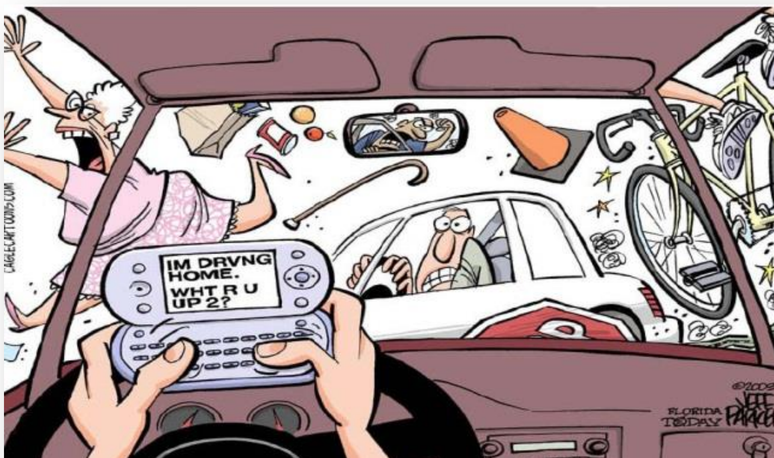
The Challenge

For Safety Professionals, Regulators and Manufacturers



How to develop safe vehicles that provide drivers with enjoyable easy to access information while using automation and other safety technologies to help maximize driver focus on the road?

Achieving this goal will require a better understanding of how different forms of task load impact driver focus under different operating contexts

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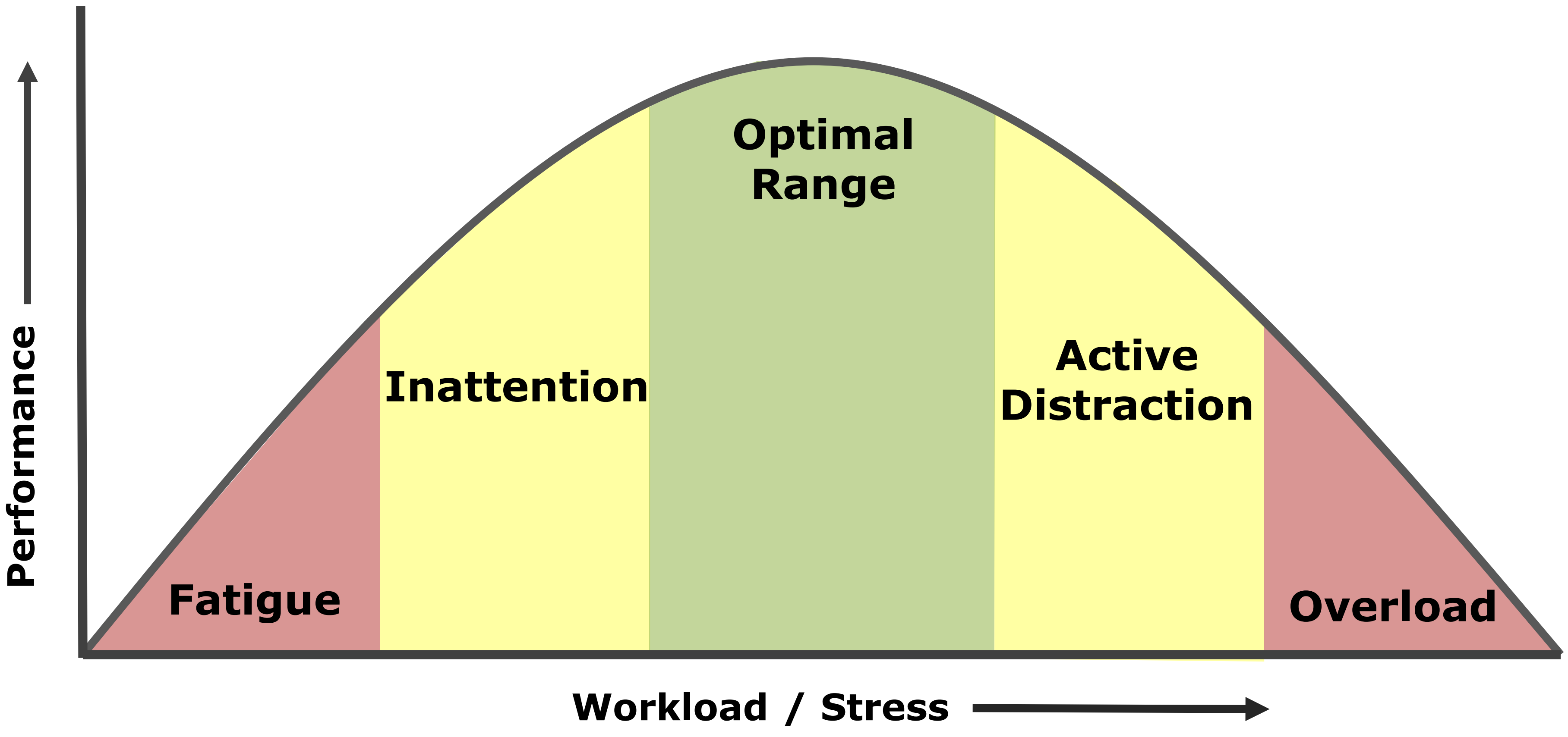
Workload & Performance

Yerkes-Dodson Law

The relationship between performance and physiological or mental arousal



(Source: Coughlin, Reimer & Mehler, 2011)

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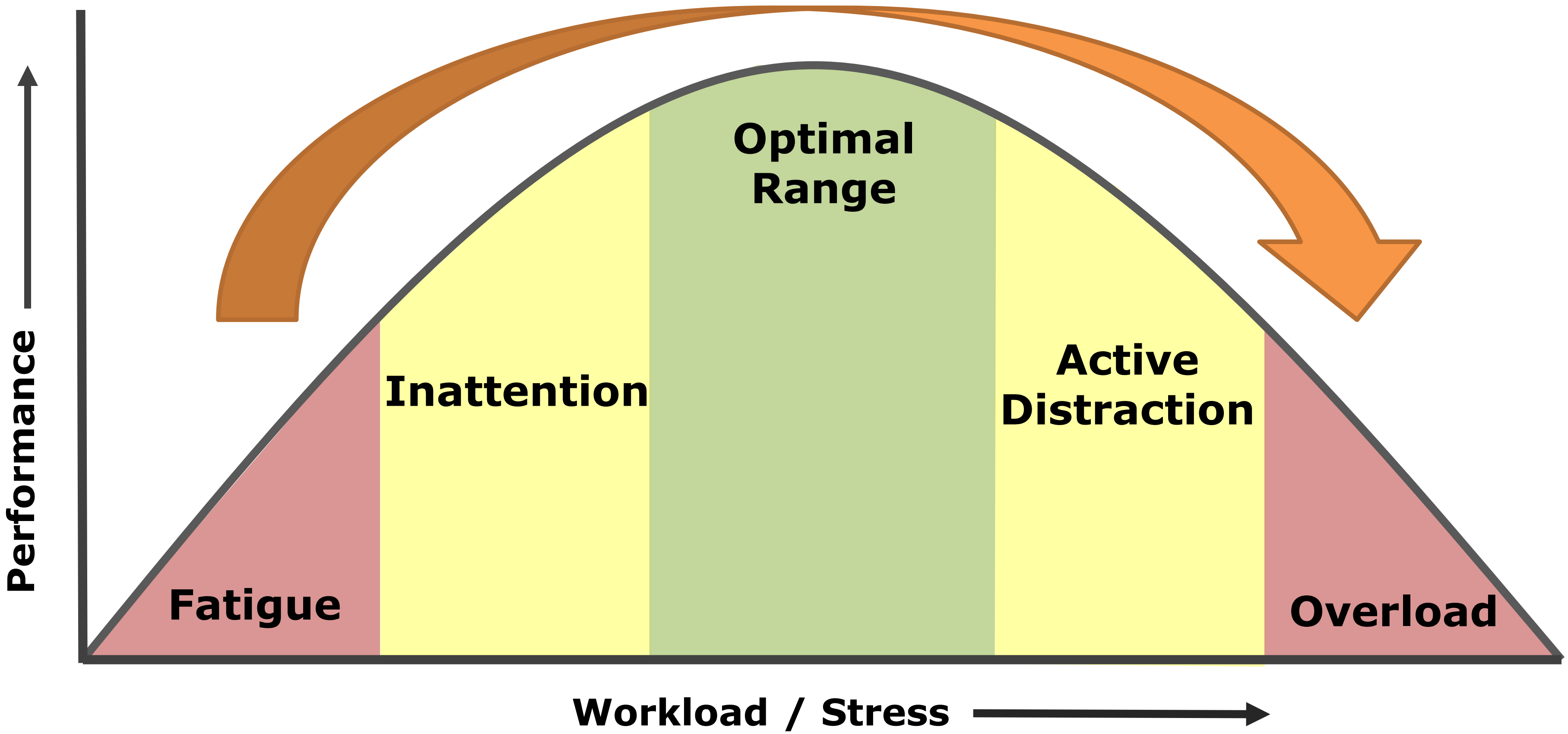
Workload & Performance

More Information in the Vehicle Tends to Increase Workload



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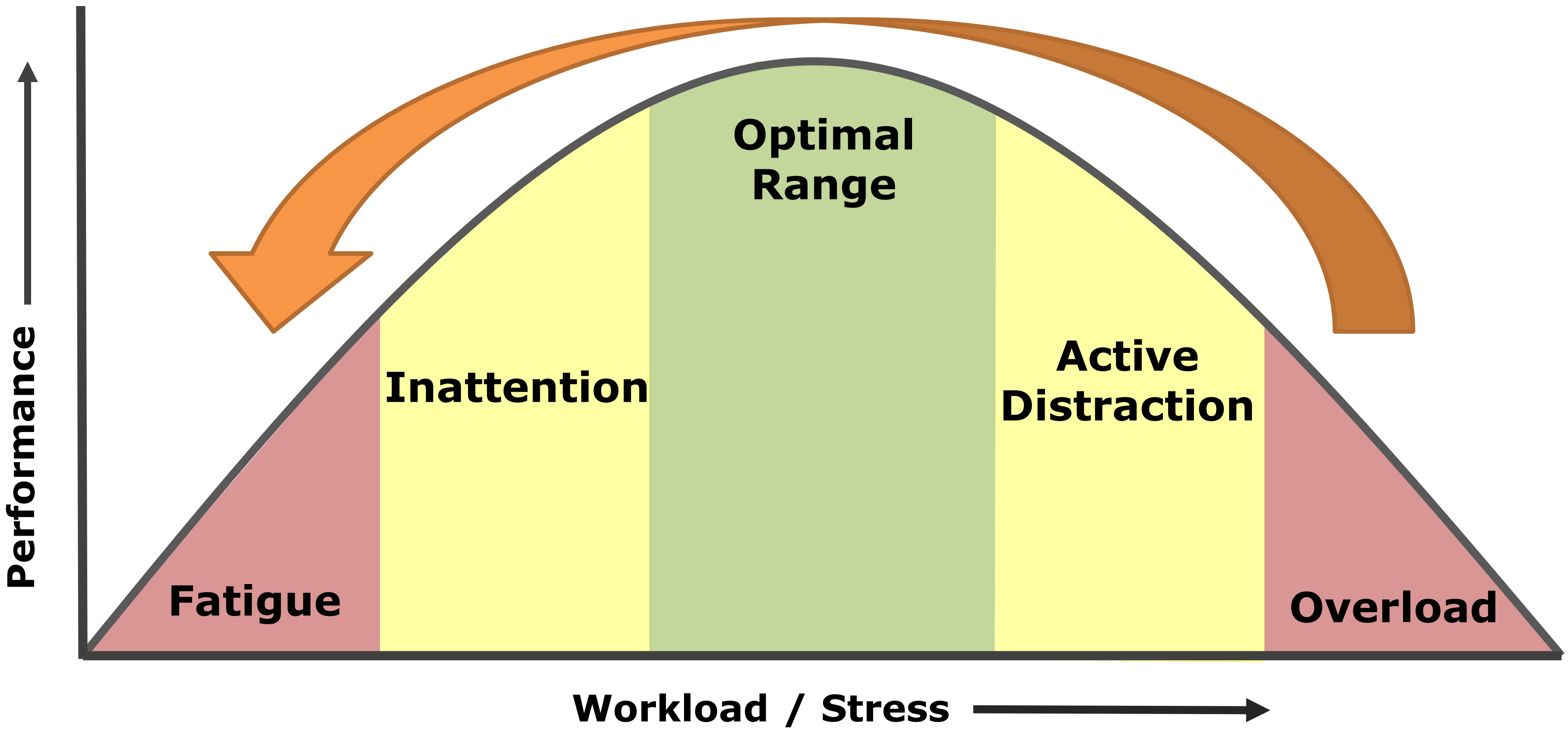
Workload & Performance

Automation Tends to Lower Workload



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The Benefits of ADAS

Autonomous Emergency Braking (AEB) – a key technology for enhancing older adult safety?

Projected benefits

Front crash prevention ratings

2014 large and midsize cars and midsize SUVs

	Autobrake points 12 mph test	Autobrake points 25 mph test	Forward collision warning points	Total points
SUPERIOR				
BMW 5 series (Collision Warning with braking function)	2	3	1	6
BMW X5 (Collision Warning with braking function)	2	3	1	6
Hyundai Genesis (2015; Automatic Emergency Braking)	2	3	1	6
Mercedes-Benz E-Class (Pre-Safe Brake)	2	3	1	6
Buick Regal (Automatic Collision Preparation)	2	2	1	5
Cadillac CTS (Automatic Collision Preparation)	2	2	1	5
Cadillac XTS (Automatic Collision Preparation)	2	2	1	5
Chevrolet Impala (Collision Mitigation Braking)	2	2	1	5
ADVANCED				
BMW 2 series (Collision Warning with City Braking function)	2	1	1	4
Buick LaCrosse (Automatic Collision Preparation)	2	1	1	4
Lexus IS (Pre-Collision System)	2	1	1	4
Audi A3 (2015; Audi Pre Sense Front)	2	0	1	3
Audi A6 (Audi Pre Sense Front)	2	0	1	3
BMW 3 series (Collision Warning with City Braking function)	1	1	1	3
BMW 5 series (Collision Warning with City Braking function)	1	1	1	3
BMW X5 series (Collision Warning with City Braking function)	1	1	1	3
Dodge Durango (Forward Collision Warning with Crash Mitigation)	1	1	1	3
Lexus GS (Pre-Collision System)	1	1	1	3
Mercedes-Benz CLA (Collision Prevention Assist Plus)	2	0	1	3
Infiniti QX50 (Intelligent Brake Assist)	0	1	1	2
Infiniti QX70 (Intelligent Brake Assist)	0	1	1	2
BASIC				
BMW 3 series (Collision Warning with braking function), Infiniti Q70 (Intelligent Brake Assist), Toyota Avalon (Pre-Collision System)	0	0	1	1

SUPERIOR
Models earning a total of 5 to 6 points, based on performance in autobrake tests and credit for forward collision warning.

ADVANCED
Models earning a total of 2 to 4 points, based on performance in autobrake tests and credit for forward collision warning.

BASIC
Models earning 1 point for forward collision warning or in 1 of 2 autobrake tests.

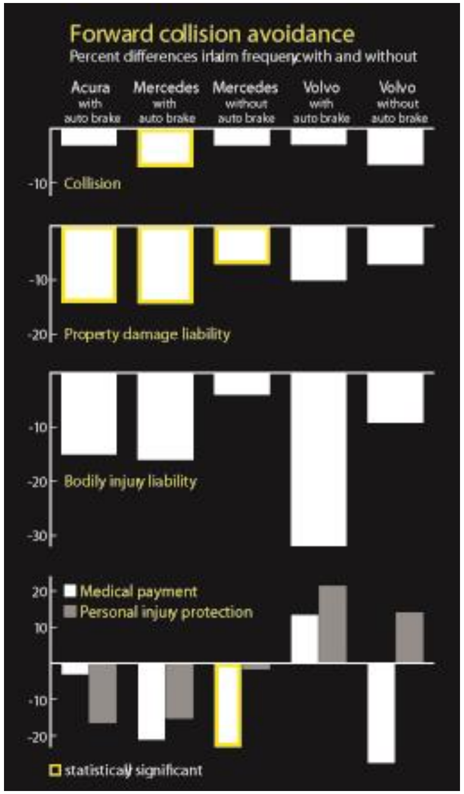
Point system based on autobrake performance

speed reduction (mph)	points
12 mph test	
less than 5	0
5 to 9	1
10 or more	2
25 mph test	
less than 5	0
5 to 9	1
10 to 21	2
22 or more	3

For details on individual vehicles, go to iihs.org

IIHS Crash Avoidance Ratings 2014

Real-world benefits



IIHS, Status Report 2012

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Cognitive Oriented Interfaces…..

… using voice and hands-free technology offer the promise of reducing the time a driver's eyes are drawn away from the roadway and maximizing the time a driver's hands are on the wheel, however

Distraction Related Accident Risk

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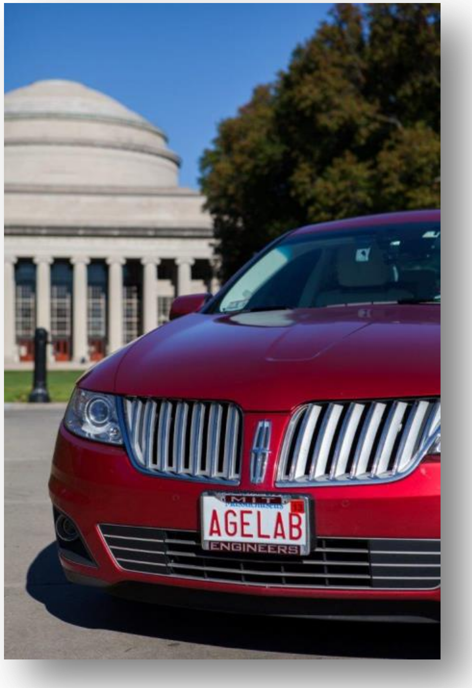
Developing a Comprehensive View of the "Modern" Driver Vehicle Interface

Limited objective research had been available on drivers' interactions with production level voice interfaces under actual driving conditions. In 2011, the AgeLab initiated the first in a series of studies considering a range of DVI interactions in a Lincoln 2010 MKS.

- Studies focused on:
  - Assessing the demands associated with a voice interface
  - Considered the impact of structured vs. self-guided training
  - Evaluated an "experienced" user mode vs. the "default" mode



Reimer, B. & Mehler, B. (2013). The Effects of a Production Level "Voice-Command" Interface on Driver Behavior: Summary Findings on Reported Workload, Physiology, Visual Attention, and Driving Performance. MIT AgeLab White Paper No. 2013-18A. Massachusetts Institute of Technology, Cambridge, MA.

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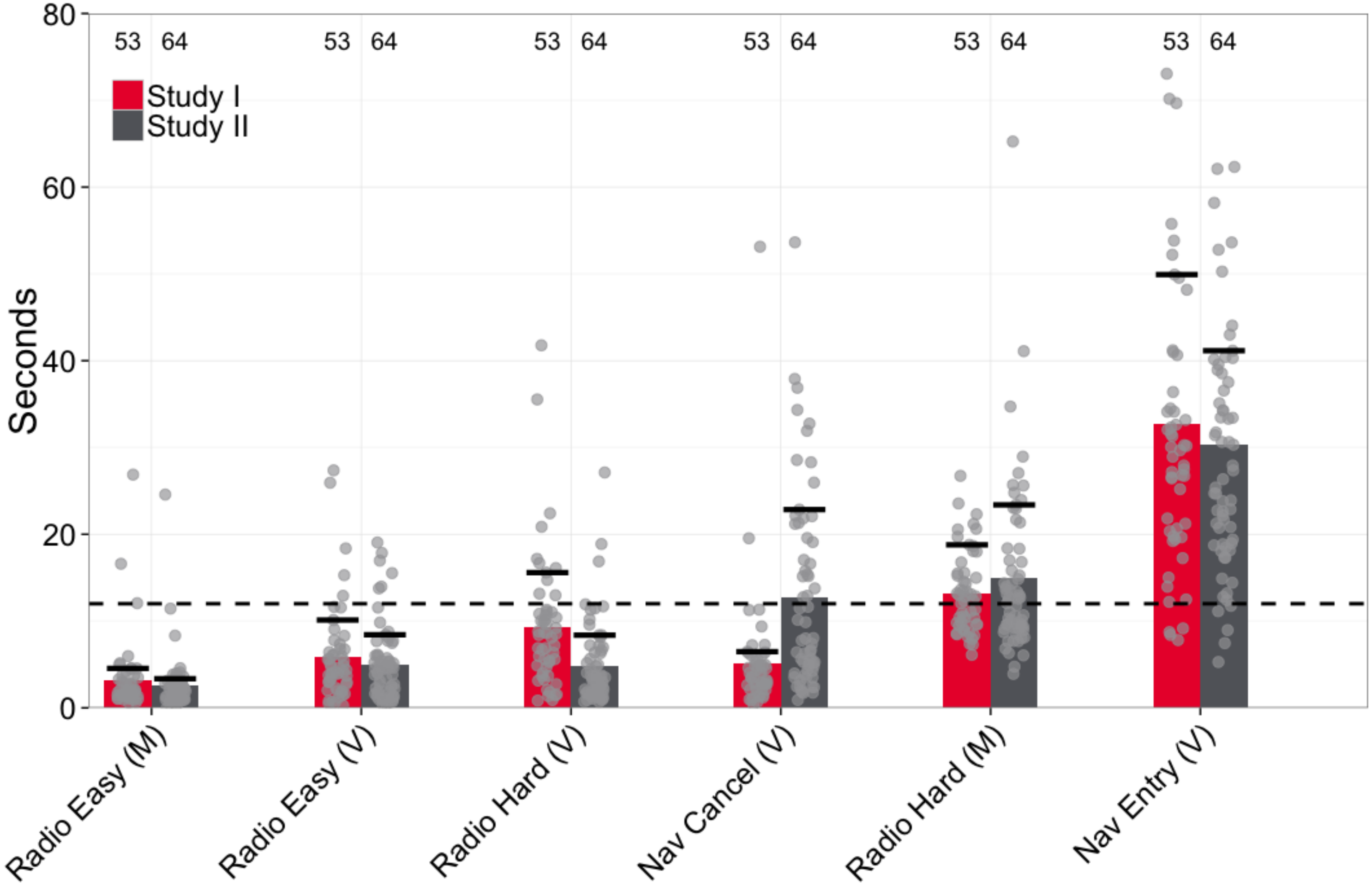
An Unexpected Effect

Total Eyes Off Road Time



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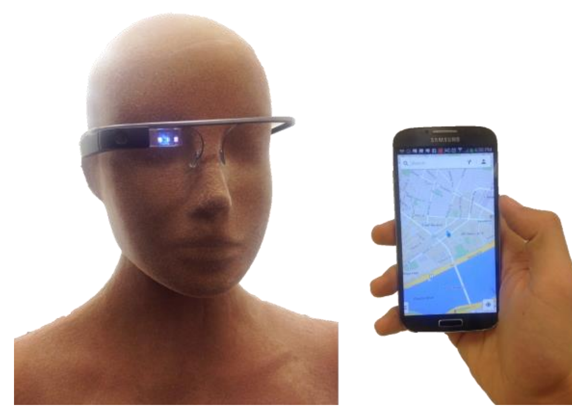
"Expected and Unintended" Findings

- Voice recognition was better than expected with only 6 of 193 subjects being "dropped" for issues
- The voice-command interface showed advantages over visual manual interaction on selected tasks
- Also on the positive side, cognitive load for the voice-command tasks studied was generally lower than expected (based on self-report, physiology, driving performance)
- However, as shown earlier, visual demand for some voice-command tasks was higher than might be expected
- Recent data validates the generalizability of findings across multiple vehicles as well as engagements with portable devices.

Google Glass vs. Samsung Galaxy

Brief description of a simulation study

- Compared performance of a full alphanumeric destination entry task using:
  - Google Glass
  - “Driver mode” voice interface of a Samsung Galaxy smartphone
  - Touch interface of a Samsung Galaxy smartphone
- A total of 24 participants were drawn from a college-age sample (mean age 25.0 years)
  - Native English speakers
  - Technologically experienced (considered as best case example of technology early adopters likely to use the Glass system)



Beckers, N., Schreiner, S., Bertrand, P., Reimer, B., Mehler, B., Munger, D. & Dobres, J.(2014). Comparing the Demands of Destination Entry using Google Glass and the Samsung Galaxy S4. To Appear in the Proceeding of the 58th Annual Meeting of the Human Factors and Ergonomics Society. Chicago, IL.

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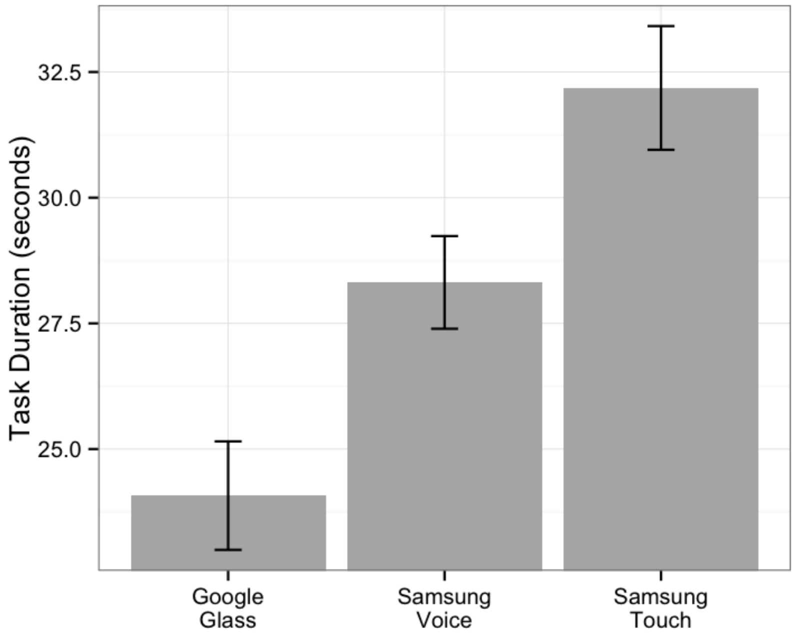
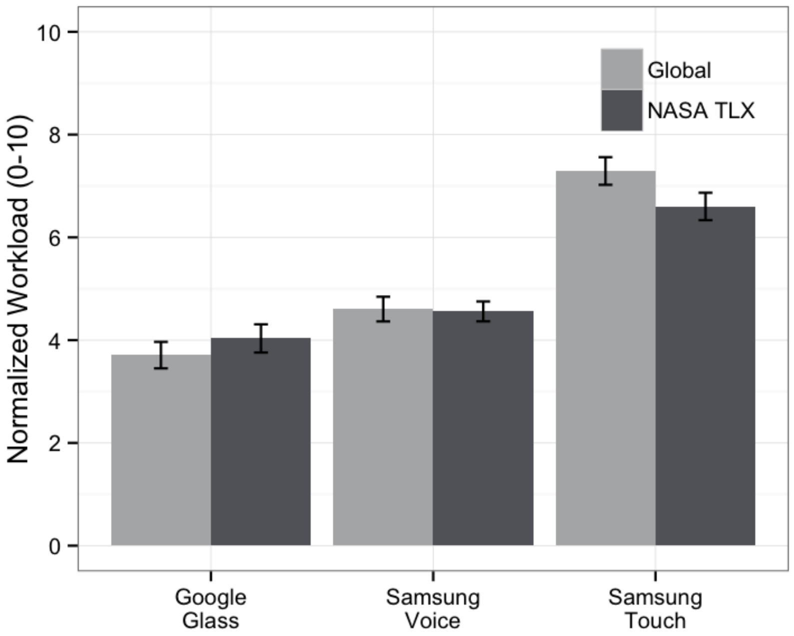
Results

Task Time



Workload



The **Google Glass dialog structure** resulted in a **shorter interaction**. Both **voice-interfaces** have **lower workload** ratings than the smartphone touch interface.

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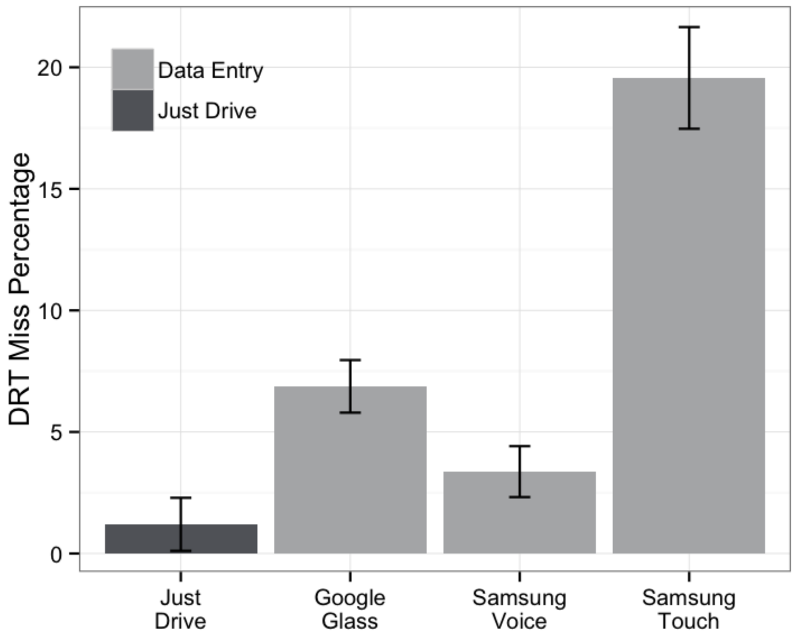
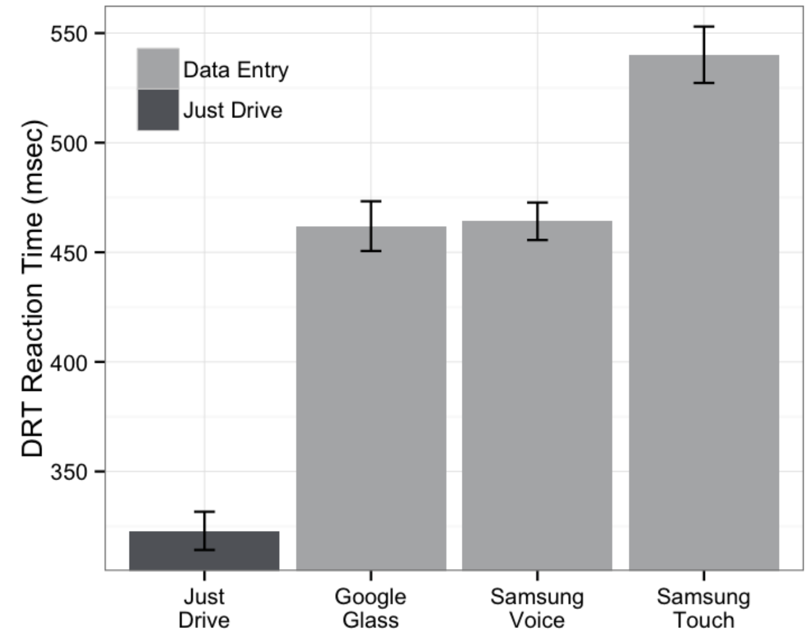
Results Related to Distraction

Remote DRT approximates a brake light reaction task

DRT Misses



DRT Reaction Time



The **DRT** reaction time shows **no statistical discrimination** between the two voice interface modes **but the miss percentages are different,** clear **advantages to voice over touch**.

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Some Summary Observations

- The task structure of Google Glass does have selected advantages that should not be overlooked.
- Modern voice command interfaces are not “eyes free hands free ways of communicating with a vehicle”. While there are advantages of this mode of interaction they must be evaluated as multi-modal interfaces that draw upon visual, manual and cognitive resources.
- This argues that a holistic view of the demands placed upon the driver is needed when developing new technologies.
- New methods are needed to evaluate how the “benefits” and “costs” of ADAS and other automated vehicle technologies play together to ultimately impact driver safety.
- Moving forward we shift attention from distraction towards developing technologies that support driver focus in a context relevant way.

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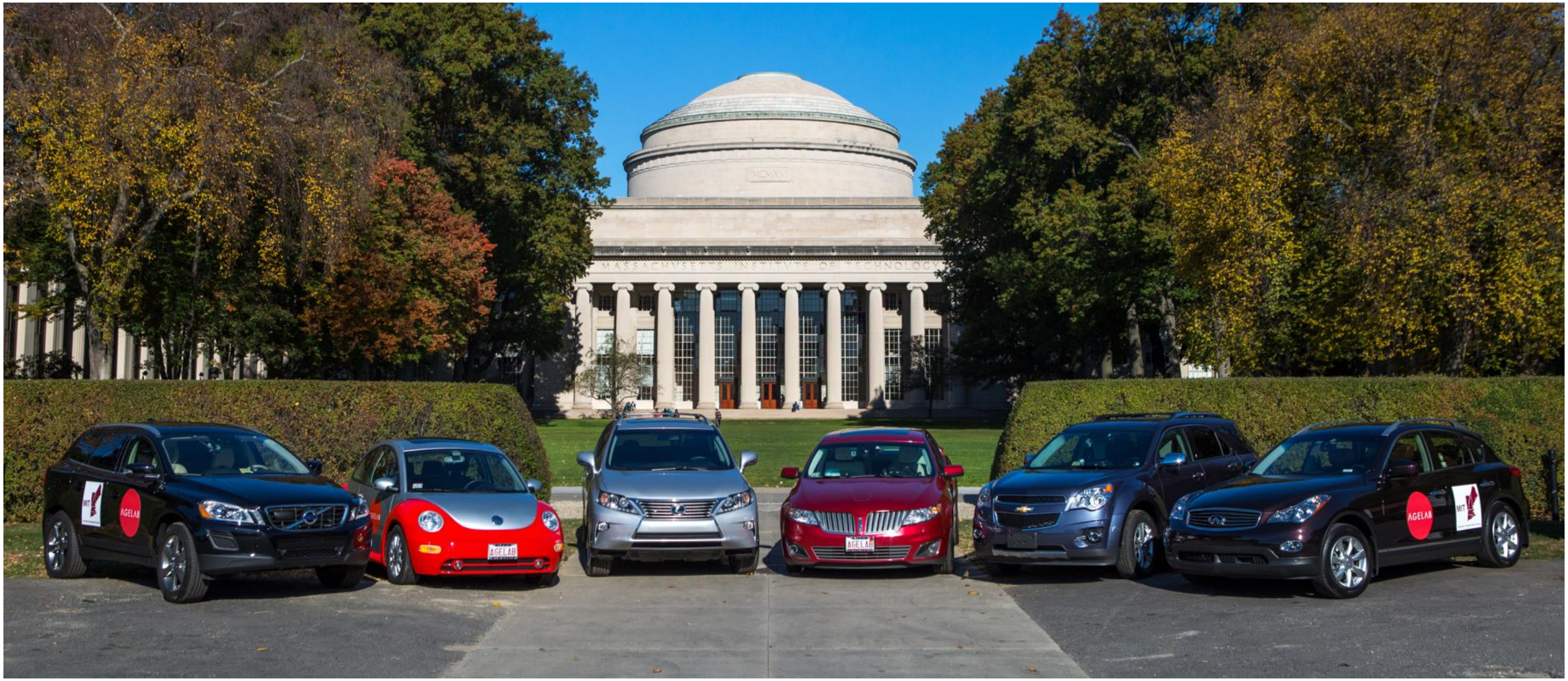
Questions



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