Automated Vehicles: A Safety Enhancement or Threat?

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NEMPA Autonomous Vehicle Conference
Cambridge, MA

May 10th, 2012

The Ever Changing Vehicle

Over the past 100 or so years, while the outward appearance of vehicles has changed, we have seen very little change in how drivers interface with vehicle.

What do trends in automation tell us about expectations for the next 25 or more years?

The Changing Automotive Interface

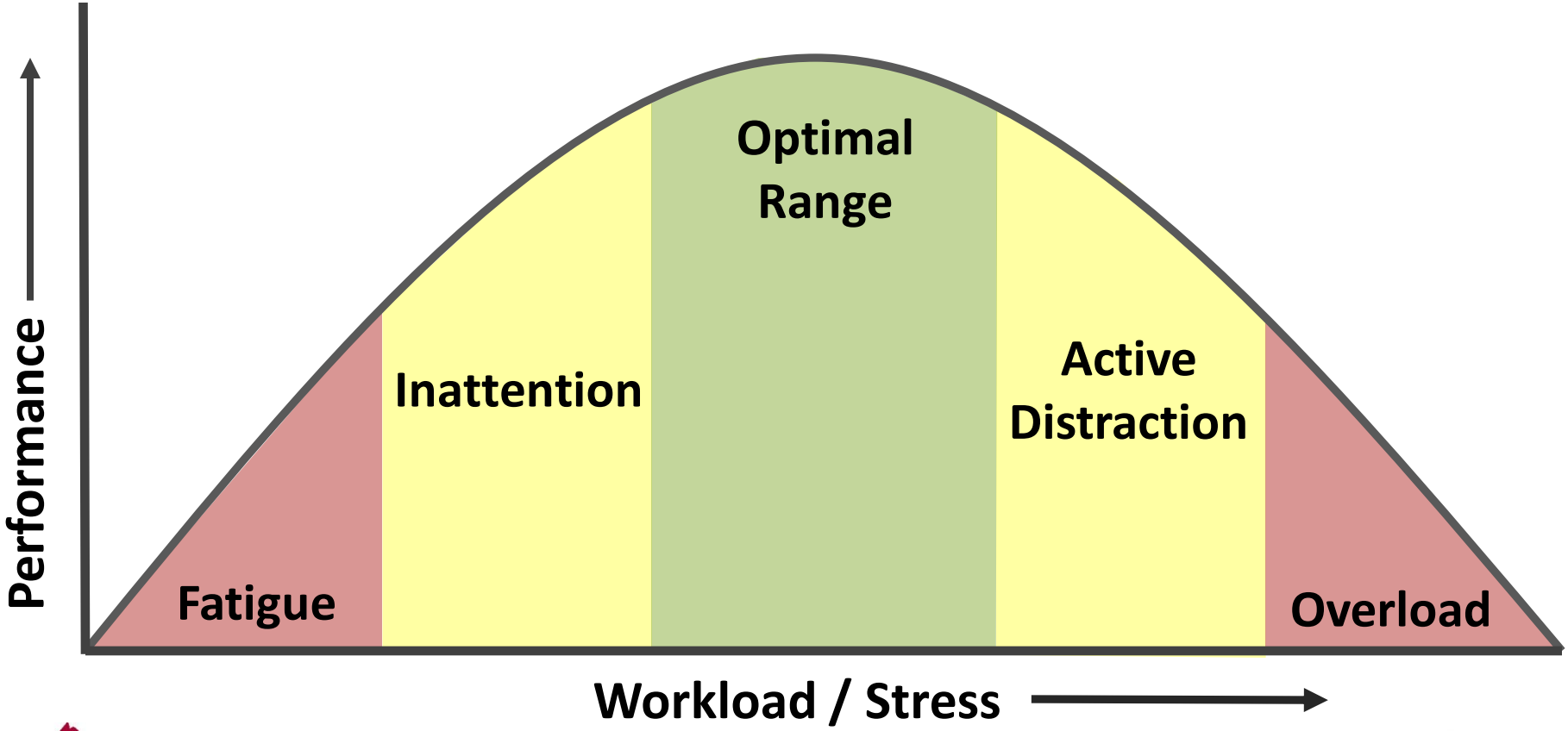
Advanced Driver Assistance Systems (ADAS)

- High speed travel
  - Adaptive cruise control
  - Forward collision warning
  - Blind spot detection
  - Lane departure warning
  - Vehicle stability control
  - Anti-Lock braking systems
- Low speed maneuvering
  - Backup cameras
  - Forward and reverse sensing
  - Cross traffic warning
  - Parallel parking assistance

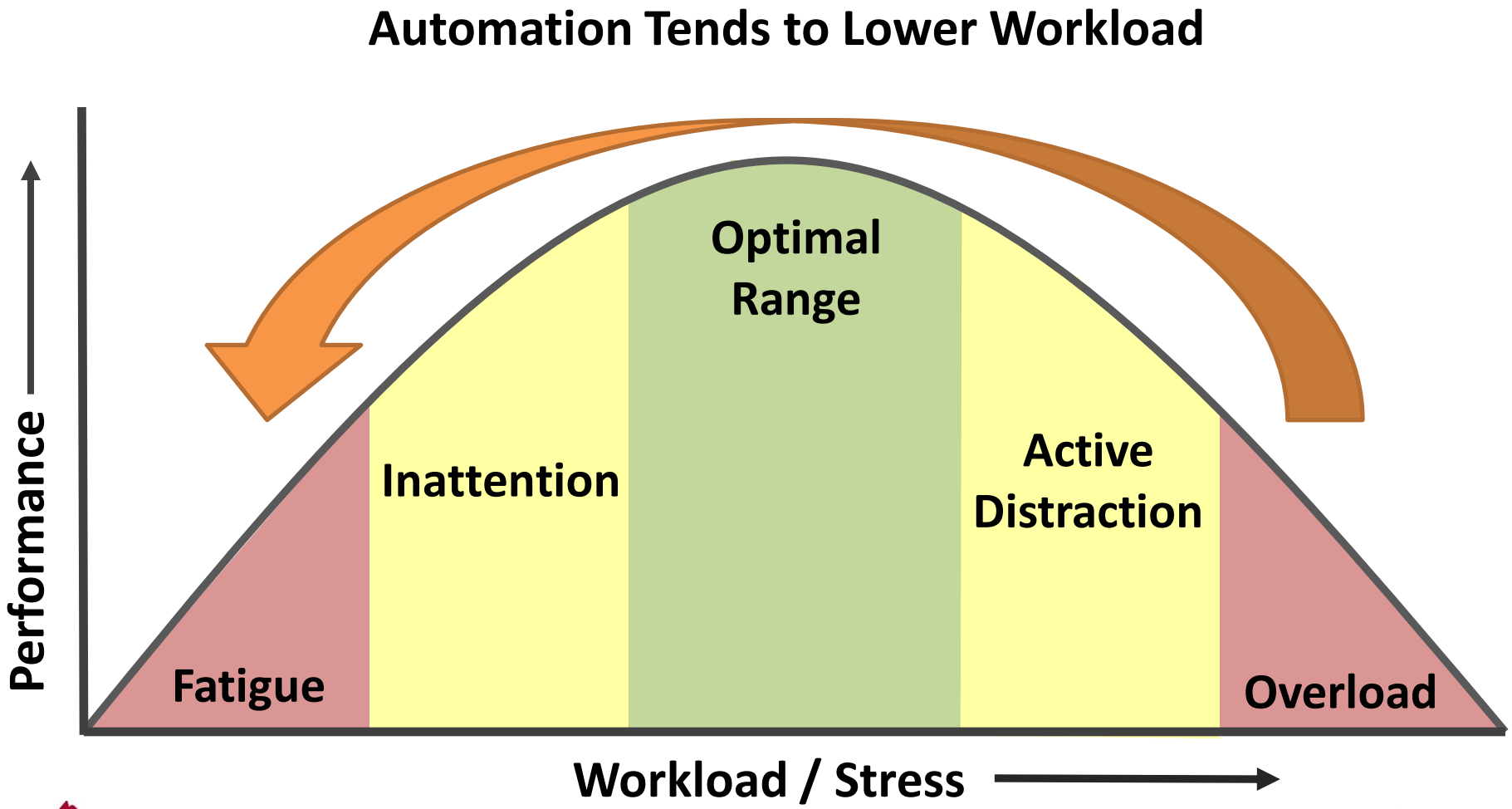
Fundamental Relationship between Workload & Performance

Yerkes-Dodson Law

The relationship between performance and physiological or mental arousal



Fundamental Relationship between Workload & Performance

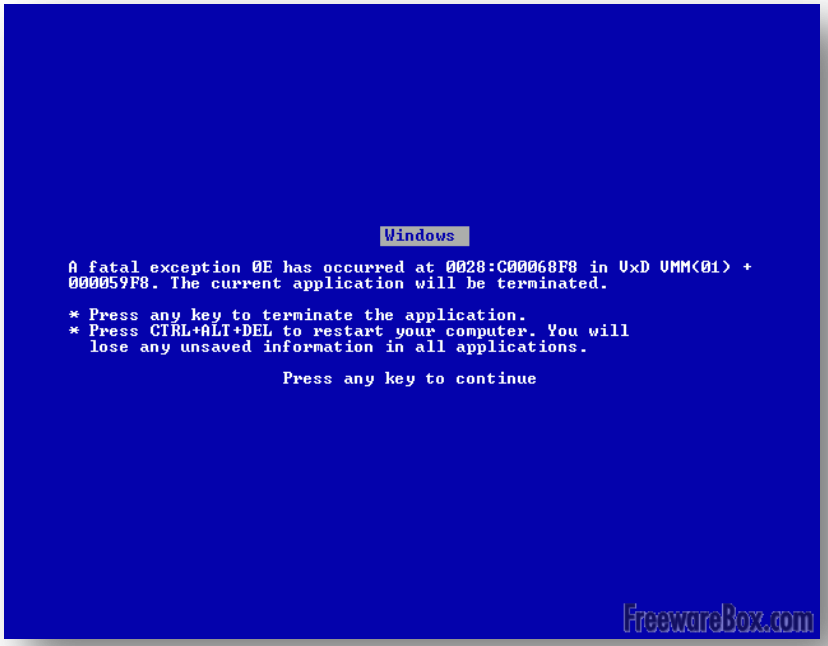


Concepts To Consider

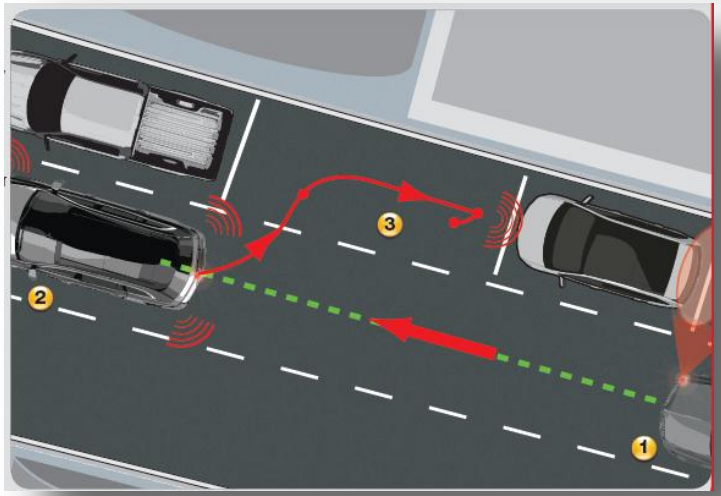
In no particular order of significance

- Trust in technology
- The theory of experience
- Lessons from other domains
- Keeping the driver connected

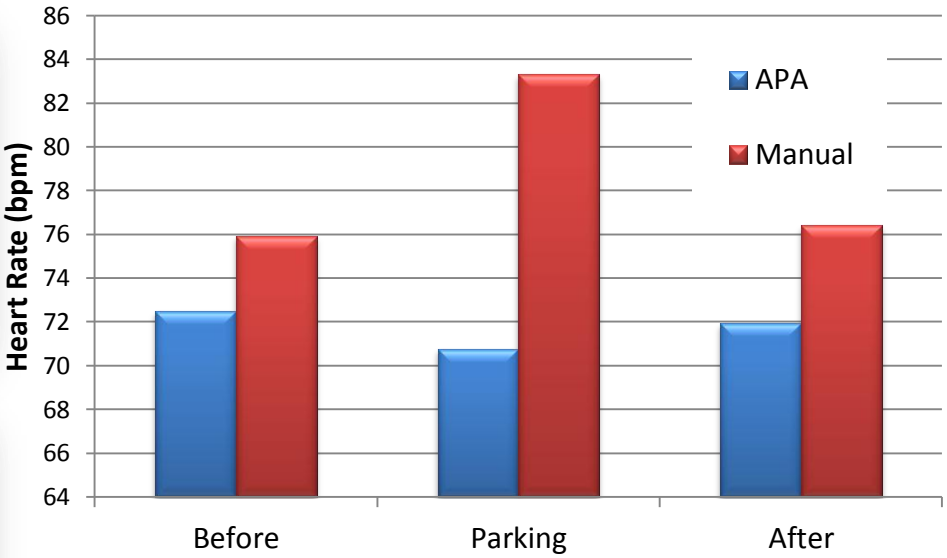
Trust in Technology: Two Case Studies



Ford Active Park Assist



(Reimer, Mehler & Coughlin, 2010)



- Heart rate (HR) when using APA was more than 12 BPM lower than during manual parking
- HR 3.4 BPM lower using APA in anticipation of parking
- HR more sensitive statistically than self-reported stress levels

Automation and the Big Red Button: To Trust or Not?

- In many situations automation will outperform human operation, but will the driver trust it?
- How will one choose when to or when not to provide / accept autopilot control?
- Experiential learning does not yet exist.

Experience

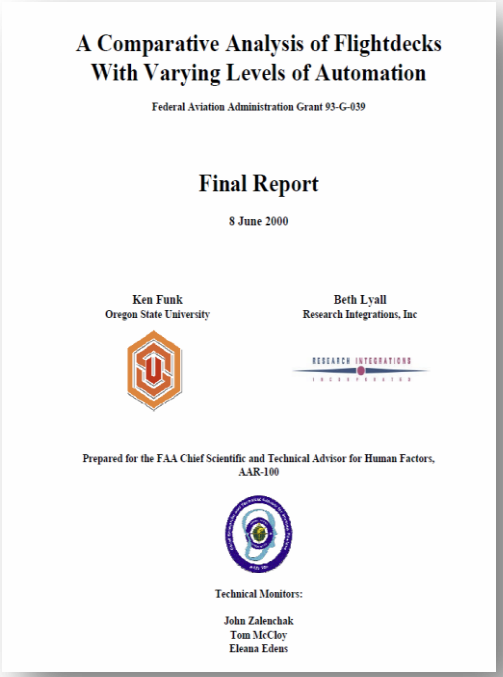
The universal law of learning states that the ability to detect and control traffic hazards increases uniformly as the amount of travel increases. This law implies that accident rate per unit of exposure will decline as the amount of exposure increases. (Elvik, 2006)

- Automation will decreased vehicle miles actively “driven”.
- Lower exposure to hazards alters the “autonomic” encoding of the basic perceptual motor skills associated with reacting to changing demands.
- This suggests we may no longer have the skills necessary for assuming control in situations where automation can’t support us or otherwise fails.

A Case Study: The FAA

Top 3 flight deck automation issues

- "Pilots may not understand the structure and function of automation or the interaction of automation devices well enough to safely perform their duties."
- "The behavior of automation devices -- what they are doing now and what they will do in the future based upon pilot input or other factors -- may not be apparent to pilots, possibly resulting in reduced pilot awareness of automation behavior and goals."
- "Pilots may become complacent because they are overconfident in and uncritical of automation, and fail to exercise appropriate vigilance, sometimes to the extent of abdicating responsibility to it. This can lead to unsafe conditions."
- Many more issues raised including reduced skill



A Comparative Analysis of Flightdecks With Varying Levels of Automation

Federal Aviation Administration Grant 93-G-039

Final Report

8 June 2000

Ken Funk
Oregon State University

Beth Lyall
Research Integrations, Inc

Prepared for the FAA Chief Scientific and Technical Advisor for Human Factors, AAR-100

Technical Monitors:

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Tom McCloy
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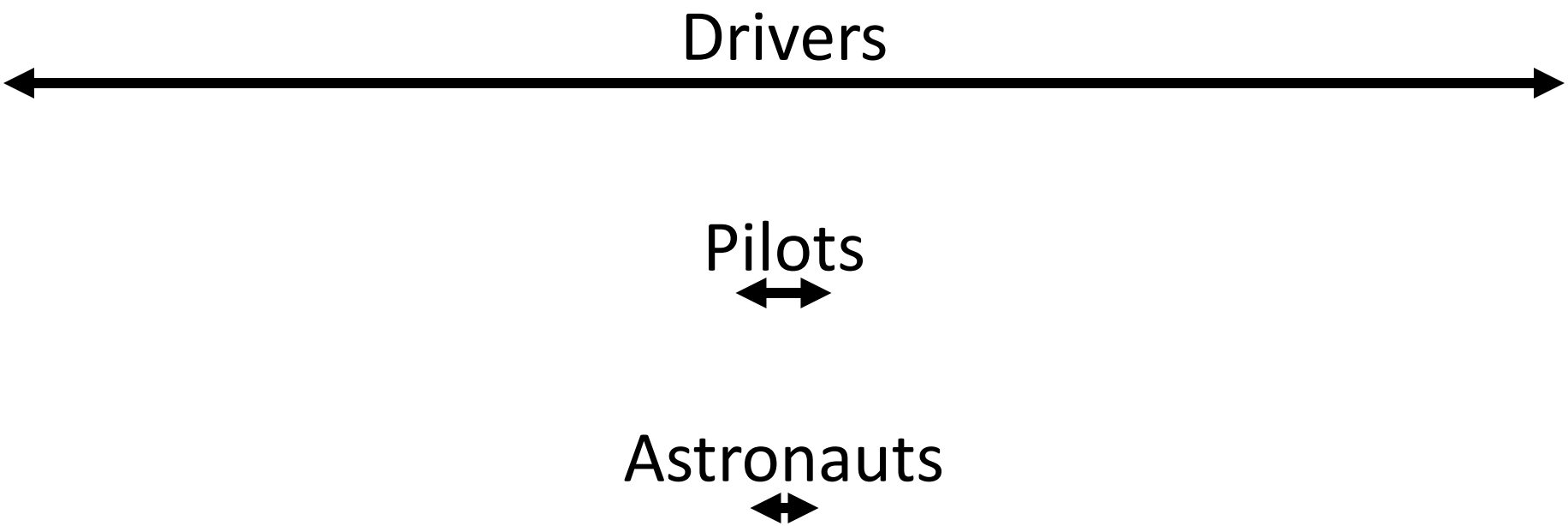
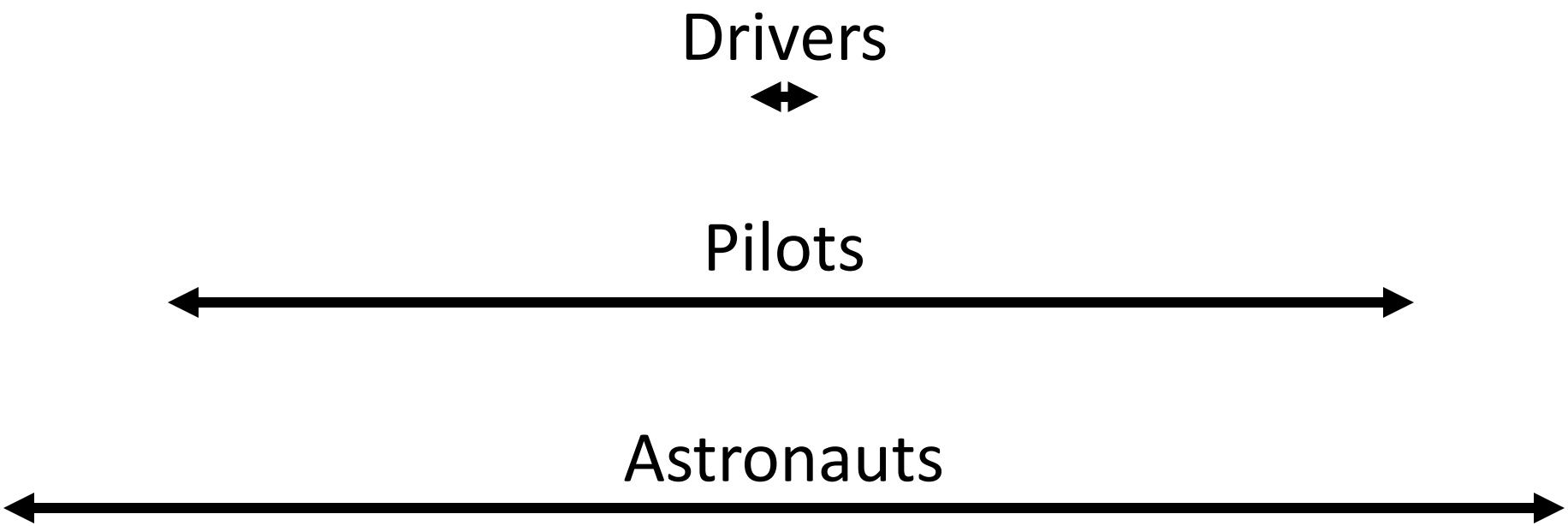
A Simple Way to Think of Operator Behavior Variability



Motivation to Learn and Maintain Focus



Will Increased Automation / ADAS Fix our Distracted Driving Problem?

NO – Until driving is totally autonomous (i.e. there is no expectation of human oversight), it has the potential to make the problem worse.

- "The human is seen as an essential element in the system for monitoring the automation, to act as a supervisory controller over the [automation], and to be able to step in when the automation fails."
- "But it has been become evident that the human, when put in the role of monitor, supervisor, and automation backup in the case of failure, may not perform well."

Sheraton (1995), Human centered automation: oxymoron or common sense?

Education

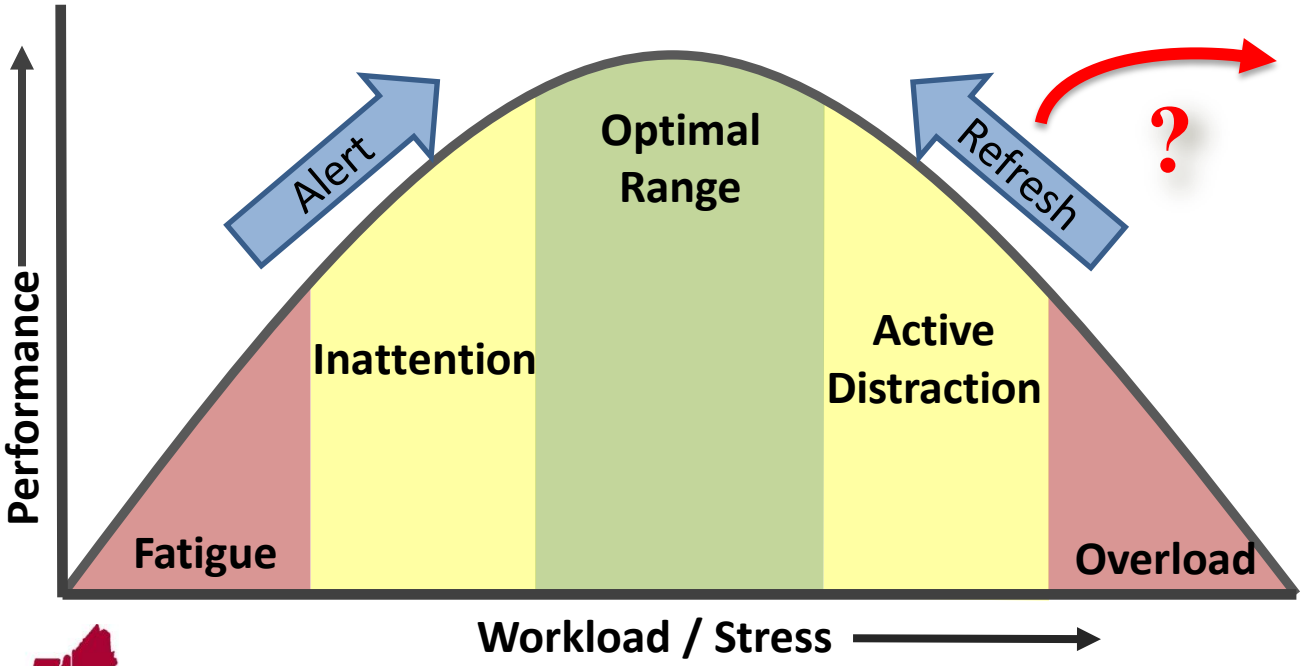
"One of the myths about the impact of automation on human performance is as investment in automation increases, less investment is needed in human expertise"

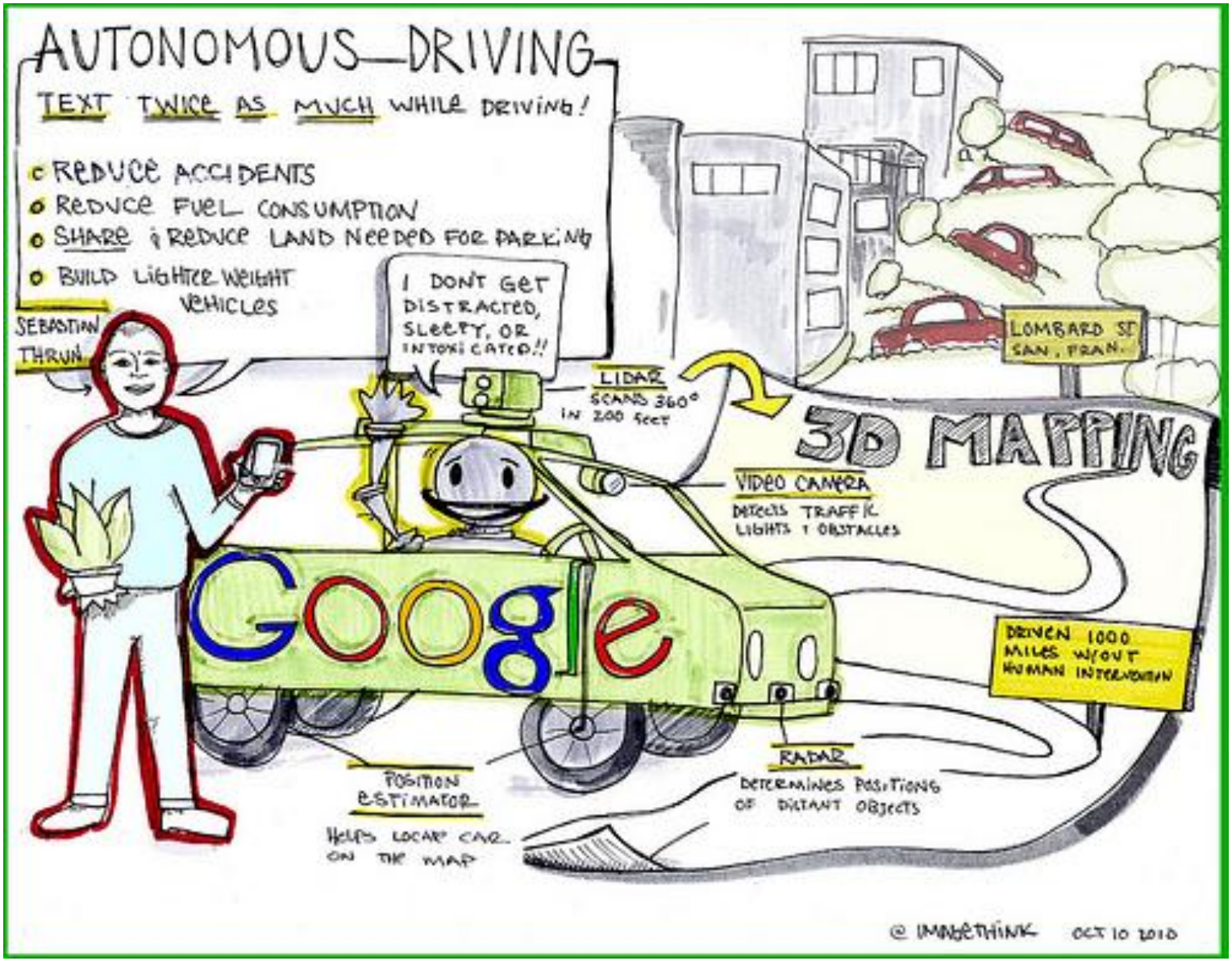
(David Woods as quoted by Robert Sumwalt, 2012)

Aware Vehicles

Individualized Real-time Feedback for the Driver

- Improve self control
- Increase trust (person as an active vs. passive partner)
- Tailor to individual reactivity profiles and capacity




AUTONOMOUS—DRIVING
TEXT TWICE AS MUCH WHILE DRIVING!
REDUCE ACCIDENTS
REDUCE FUEL CONSUMPTION
SHARE & REDUCE LAND NEEDED FOR PARKING
BUILD LIGHTER WEIGHT VEHICLES
SEBASTIAN THRUN
I DON'T GET DISTRACTED, SLEEPY, OR INTOXICATED!!
LIDAR
SCANS 360° IN 200 feet
3D MAPPING
LOMBARD ST SAN. FRAN.
VIDEO CAMERA
DETECTS TRAFFIC LIGHTS & OBSTACLES
Google
DRIVEN 1000 MILES W/OUT HUMAN INTERVENTION
RADAR
DETERMINES POSITIONS OF DISTANT OBJECTS
POSITION ESTIMATOR
HELPS LOCATE CAR ON THE MAP
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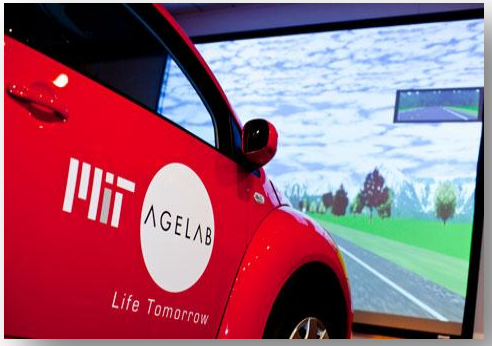
In Summary, I Believe We Need To:

- Continue exploring technologies for autonomous vehicles
- Make parallel investments in developing our understanding of how to optimize the human's connection with autonomous systems
- Clarify the benefits and consequences of system use and misuse
- Learn from complementary domains
- Stop assuming that autonomy alone will solve our nation's transportation problems

MIT Experimental Platforms
On-Road, Simulation & Laboratory



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