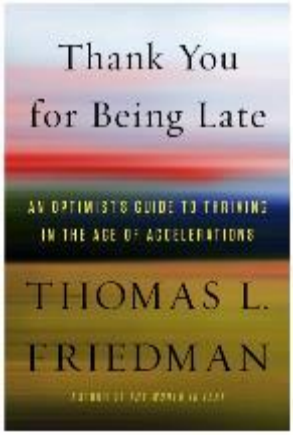
# Modifying the Curve of Future Technology Development with Adoption, Product Development and Gaps in Consumer Education

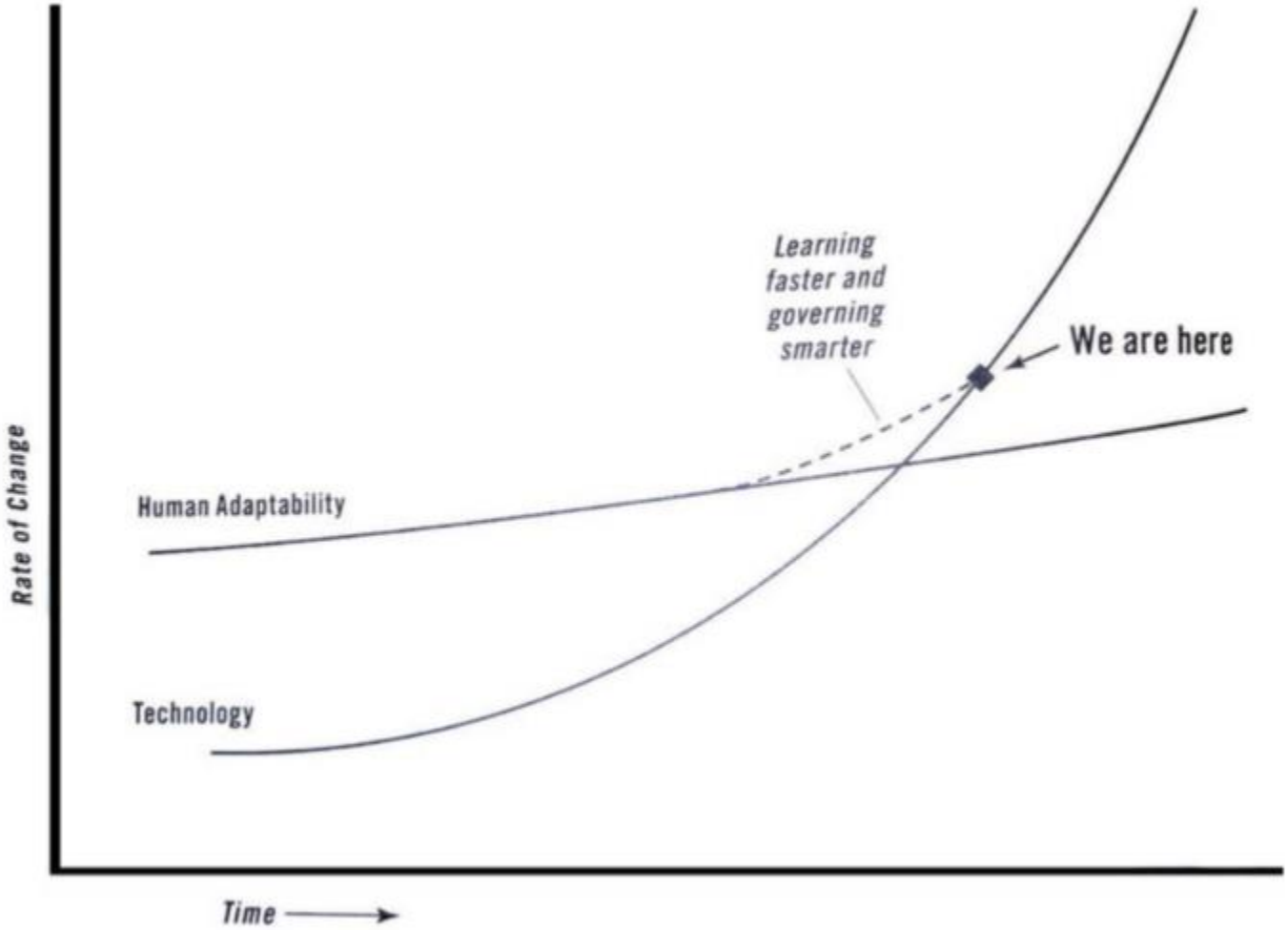

Chuck Gulash

CSRC
Collaborative Safety Research Center
TOYOTA

June 13, 2017

# Future Technology & Human Adaptability



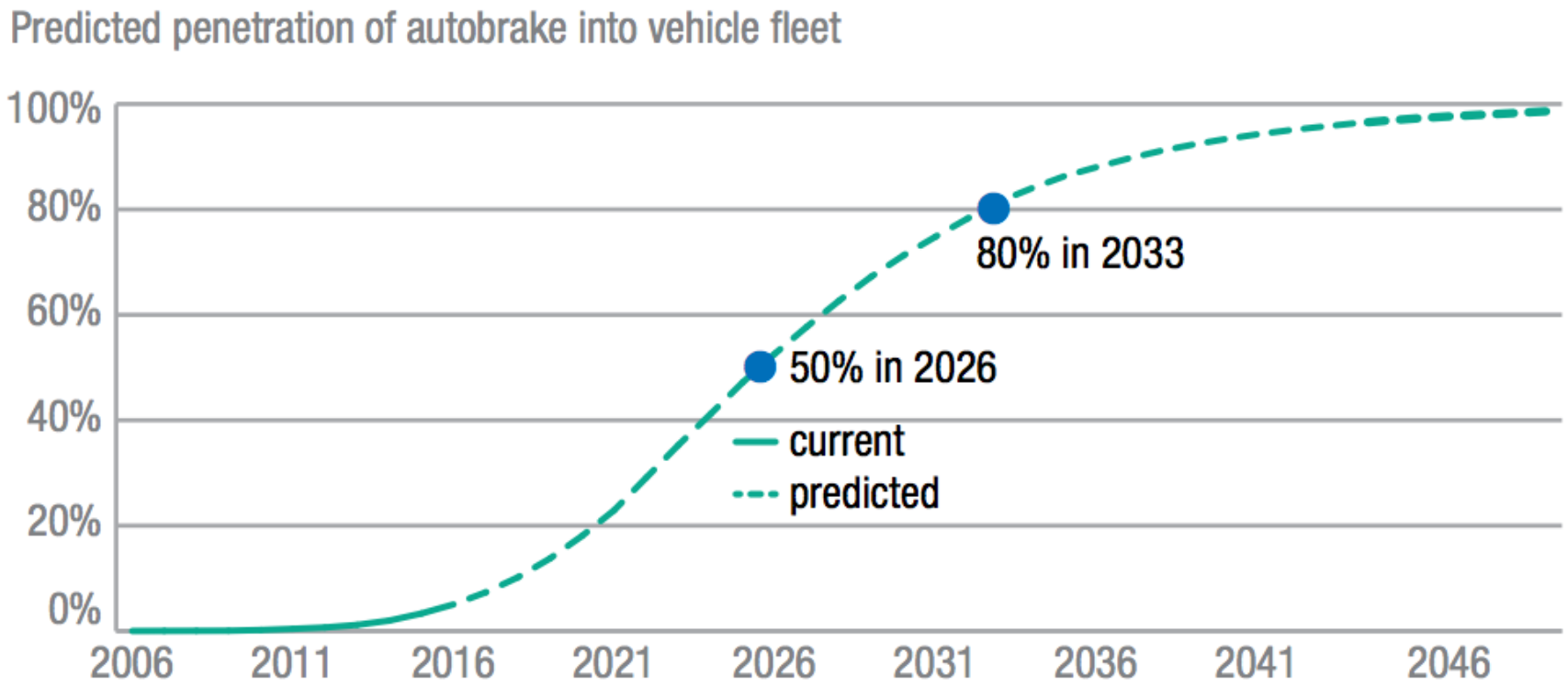




Astro Teller
Google X

# Adoption Rates

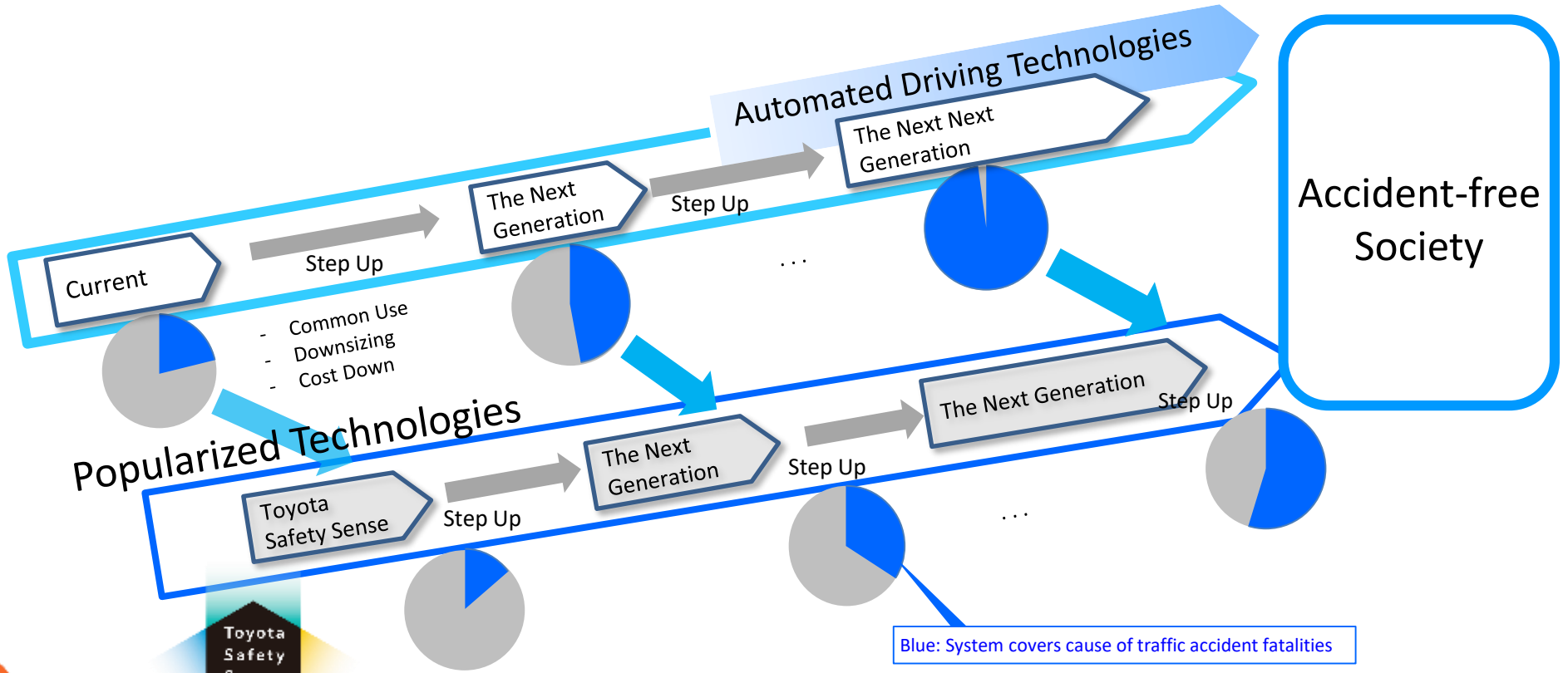
## IIHS Predicted Penetration U.S. Vehicle Fleet

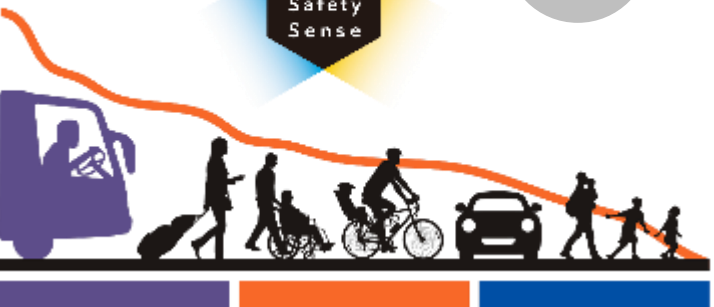
### AEB:  Auto Emergency Brake – assumes standard 2022




Status Report
Insurance Institute for Highway Safety
November 10, 2016

# Toyota Safety Technology Development and Deployment



# Toyota Safety Sense

Standard on almost all Toyota – Lexus cars in the U.S. by end of 2017


PCS(Pre-Collision System)


PCS with Pedestrian detection*


AHB(Automatic High Beam)


LDA(Lane Departure Alert)


DRCC(Dynamic Radar Cruise Control)*

* Available for Toyota Safety Sense P

# Toyota Pre-Collision System with Active Steering Assist

Higher collision avoidance capability by automatic steering with AEB

Automatic Braking

Automatic Steering

**Mixed Fleet** of Conventional, Increased Driver Assist Systems and Automated Vehicles …

**FOR DECADES**

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TOYOTA

# Main Research Areas

## 2011 – 2016

- Distracted Driving
- Vulnerable Road Users
- Active Safety

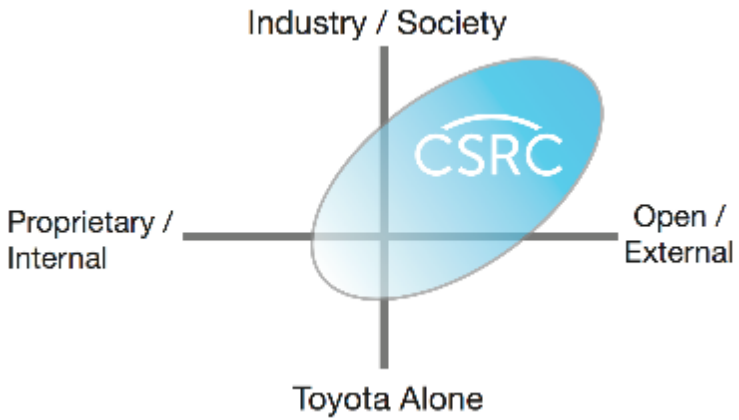
**44** projects

**23** Research Institutes

**200+** researchers

**200+** papers

# Research Style





Search “CSRC 5 Year Chronicle” to download pdf.

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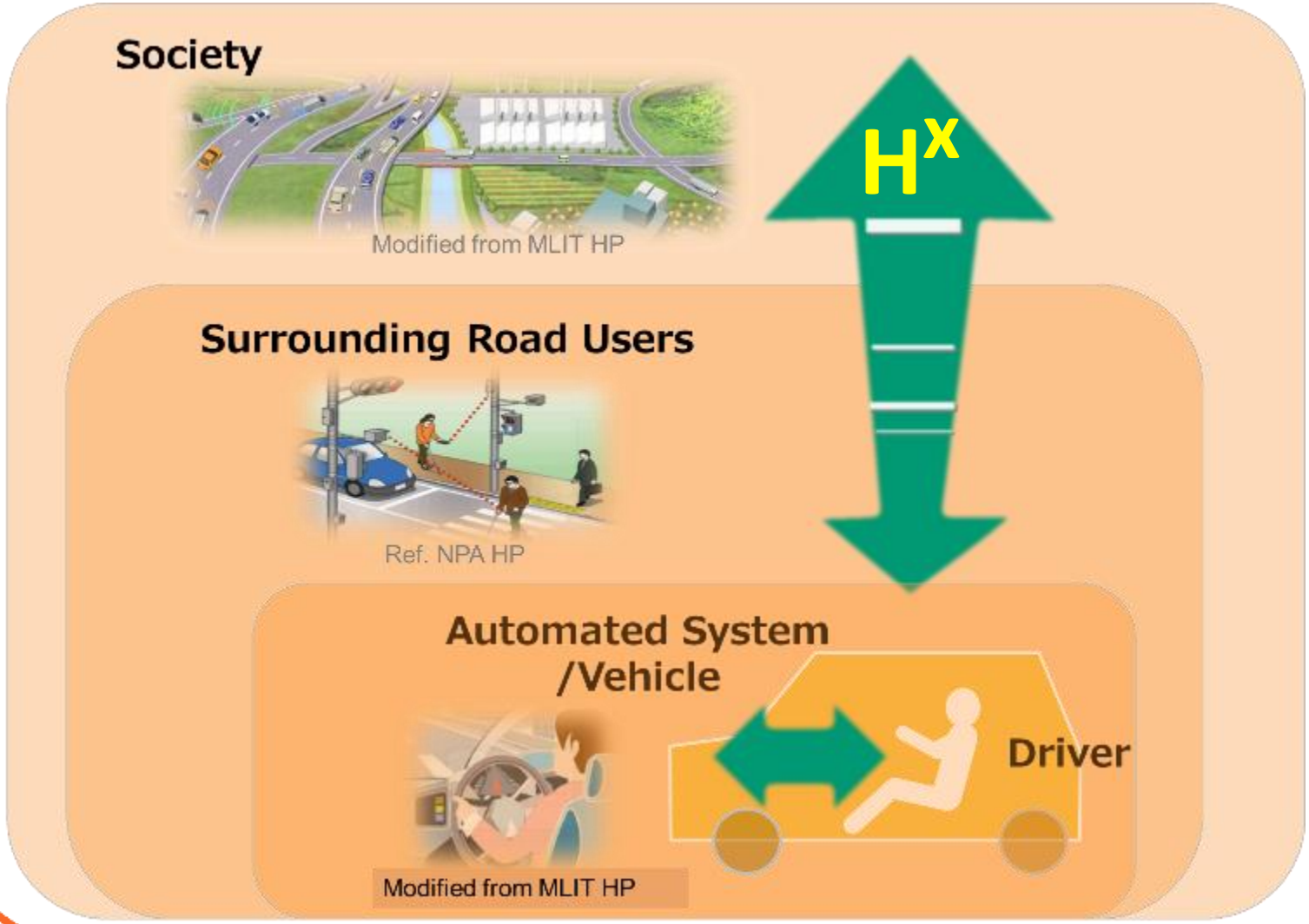
# Main Research Areas

## 2017 - 2021

- Active / Passive Integration
- Human Experience ($H^x$)
- Driver State Detection
- Data Analytics – Naturalistic Data Sets

# Human Experience - $H^x$



# Human Experience Research Categories

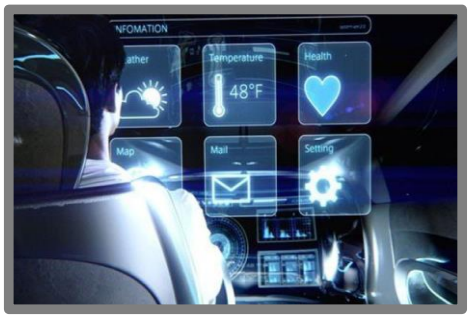
Mixed Automation Levels

Education/Behavior Change

Across Lifespan

Road User Interaction

Human-in-the-Loop




Personalization & Experience

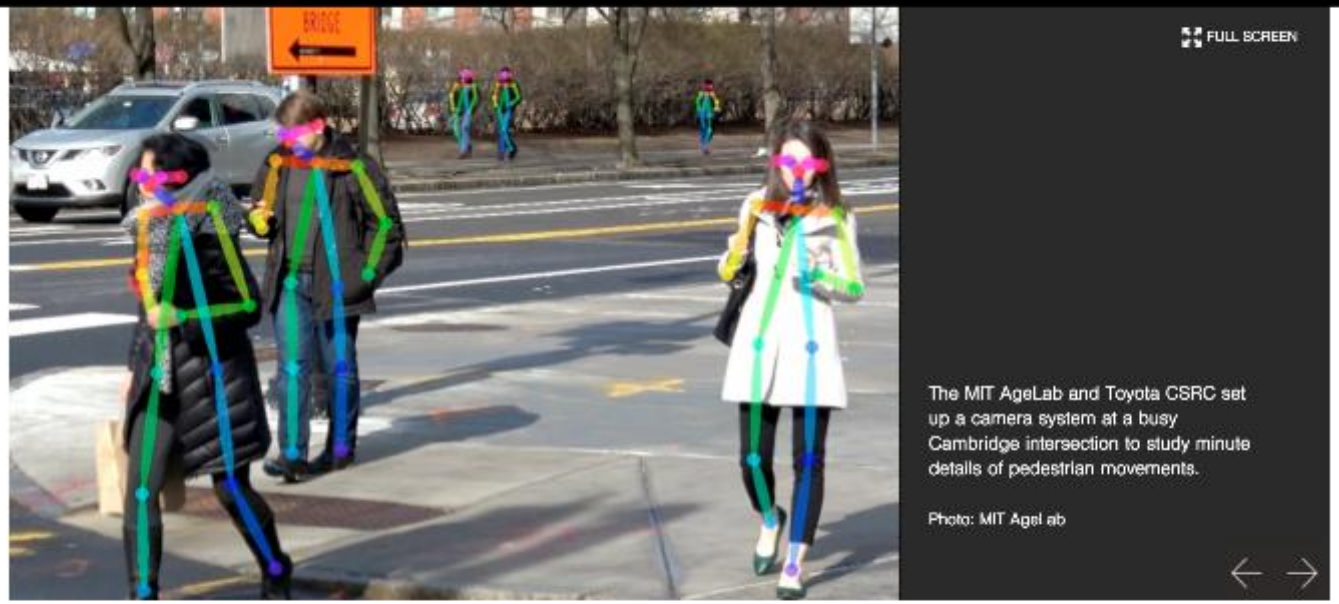
Driver State Estimation

# Human Experience – Social Interactions

MIT News

ON CAMPUS AND AROUND THE WORLD

Browse or Search



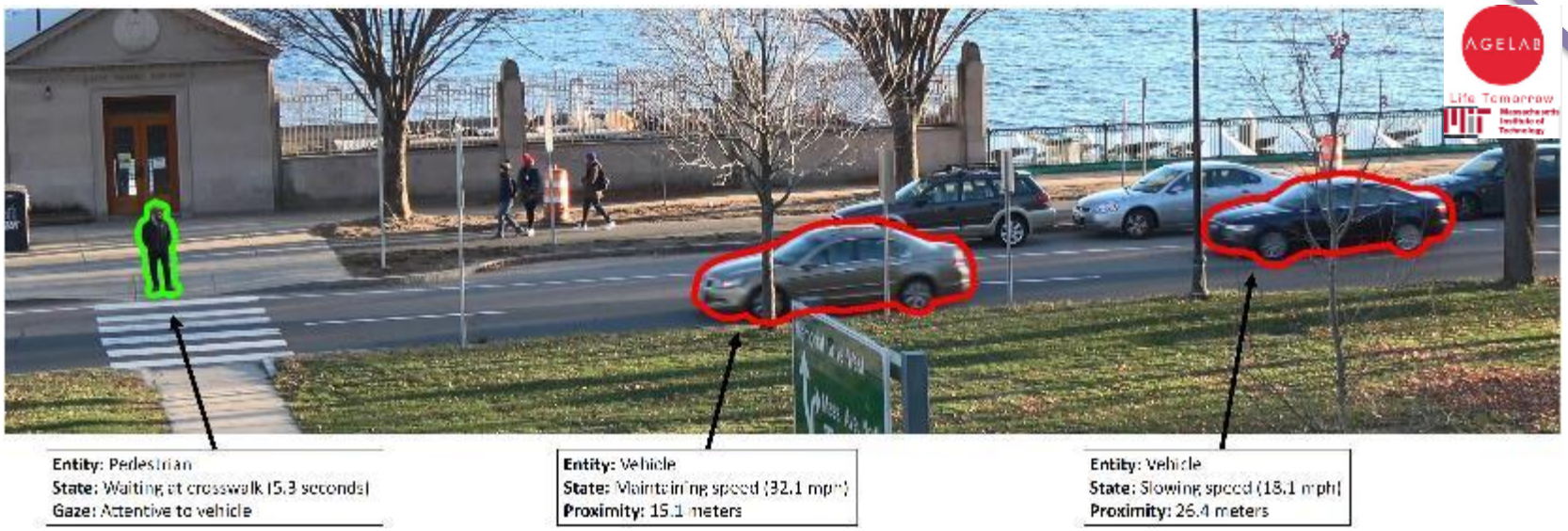

## AgeLab researching autonomous vehicle systems in ongoing collaboration with Toyota

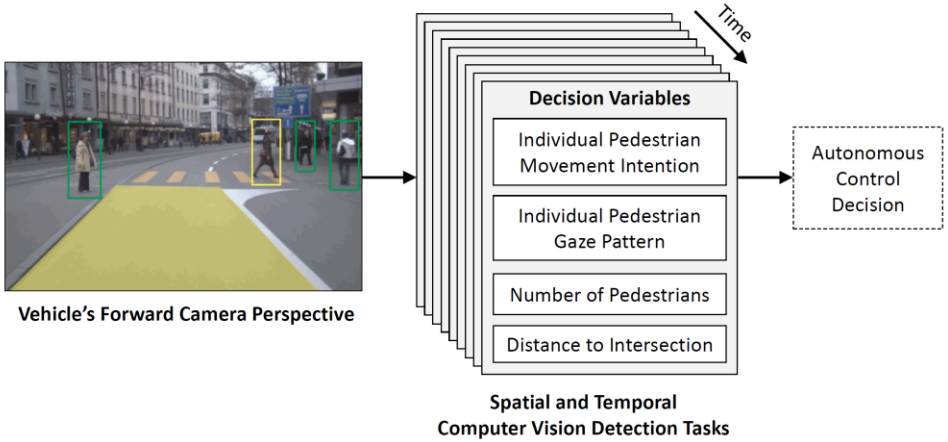
Innovative MIT research focuses on developing systems to perceive and identify objects in their environment and understand social interactions in traffic.

**Christine Adams | Center for Transportation and Logistics**
**June 8, 2017**

In Progress

# Human Experience – Social Interactions




Vehicle's Forward Camera Perspective

Spatial and Temporal Computer Vision Detection Tasks

- Convert 1000's of these interactions in patterns of vehicle/pedestrian behavior.
- Propose how a automated vehicle could mimic this behavior in how intent is communicated by move in a way that decreases safety risk – provide smooth and safe traffic, avoid information overload on pedestrians

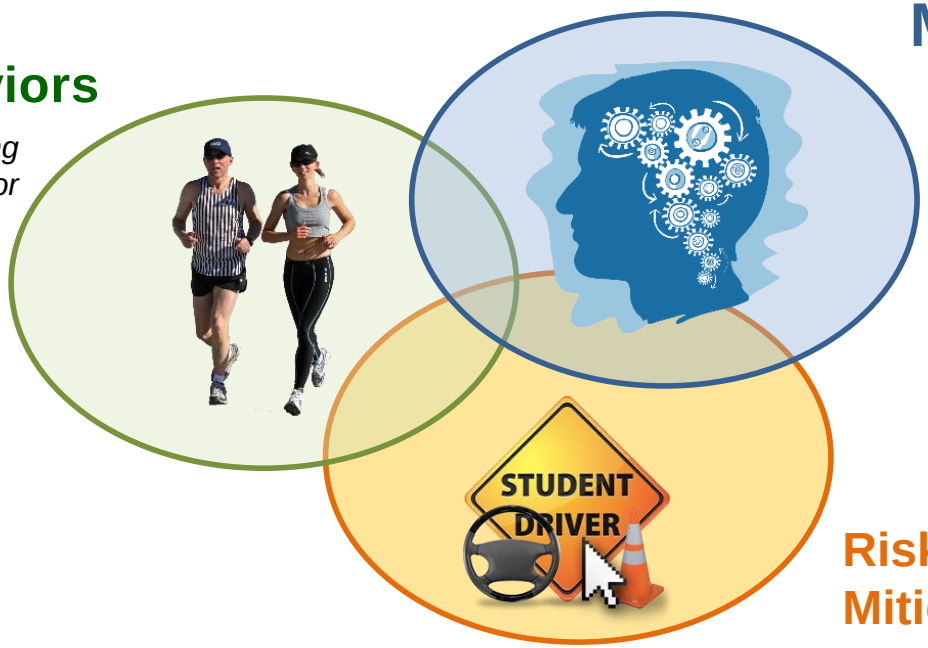
In Progress

# Gaps in Consumer Education

Research for increasing societal acceptance of advanced technologies

**Behaviors**

*Fostering safe driving behavior*




**Mental Models**

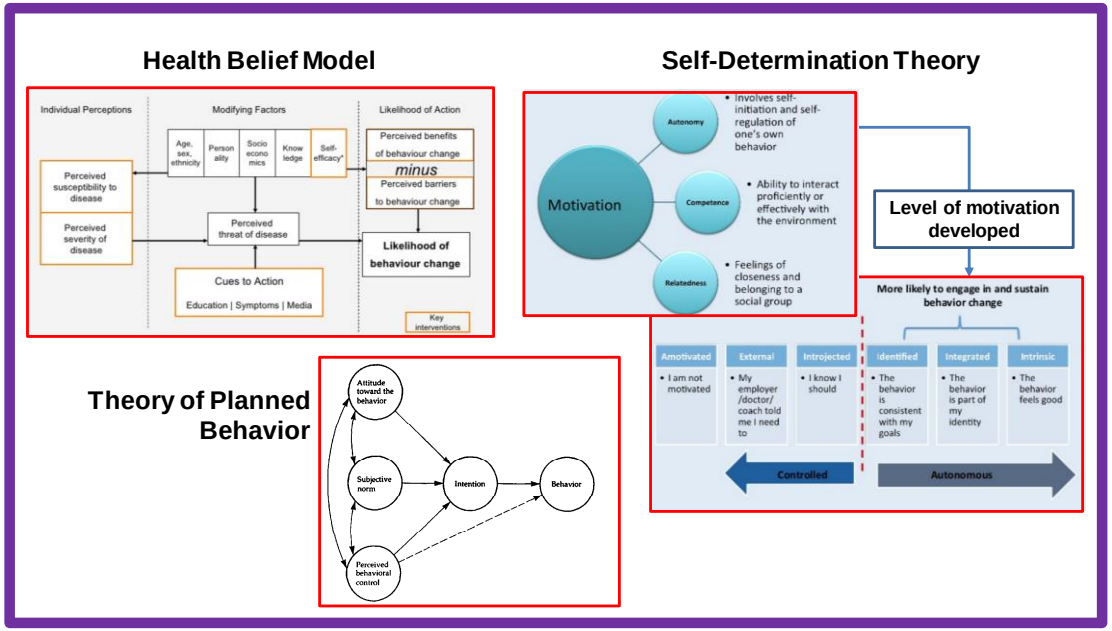
*Learning how to create appropriate mental models*

**Risk Mitigation**

*Education and training methods for the 2020's*

# Human Experience – Societal Acceptance
# Fostering Behavior Change in the 2020's

What evidence-based factors are possible for long-term changes in road user behaviors

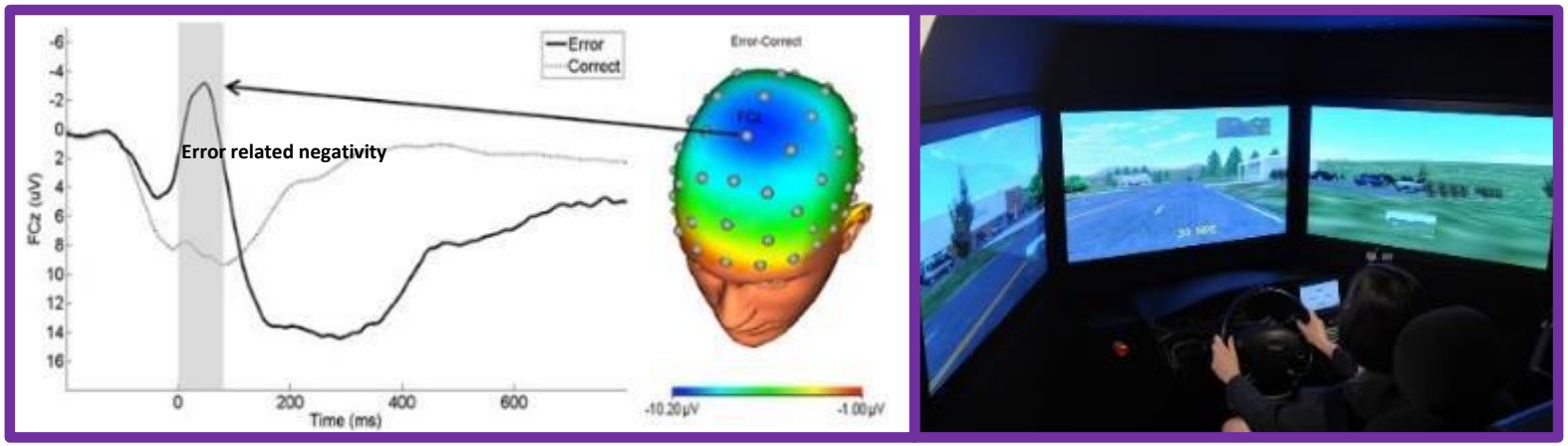



In Development

# Human Experience – Societal Acceptance

## New Safety Technology Mental Models

Understand how users develop and maintain mental models, explore new methods of introducing and educating users on new technologies




Hajcak, G (2012)

In Development

# Human Experience – Societal Acceptance

## Risk Mitigation in the 2020's

Predict the future nature of self-regulating behaviors, evaluate methods of enhancing self-regulation

In Development

# Road to Zero - 30 Year Horizon

- Mix of technology, road user understanding, traffic environments
- CSRC research aimed at filling knowledge gaps, supporting Safe System development
- Encourage your input on identifying the gaps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