# THE ROBOT YOU RODE IN ON

## *TRUST IN SEMI-AUTONOMOUS VEHICLES*

Stanford University Center for Design Research
Wendy Ju, Executive Director of Interaction Design

# RESEARCH TEAM

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Executive Director, Center for Design Research

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  Research Staff
- Catherine Smith
  Master's in Mechanical Engineering
- Hamish Tennent
  Design MFA
- Peter Wang
  Master's student in Chemical Engineering

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# WIZARD OF OZ STUDY SETUP


Behind the scenes, real-time monitoring and control over course, voice interface and dash elements enable improvised interaction

# UNDERSTANDING EXPERIENCE

Mok, B., et al. Understanding Driver-Automated Vehicle Interactions through Wizard of Oz Design Improvisation. Driving Assessment, June 22-25, 2015. Salt Lake City, UT.


TRUST IN AUTOMATION
Metaphors for Shared Control
H Metaphor as a Guideline for Vehicle Automation and Interaction (Flemisch 2003)
The Other H Metaphor (Ju 2015)

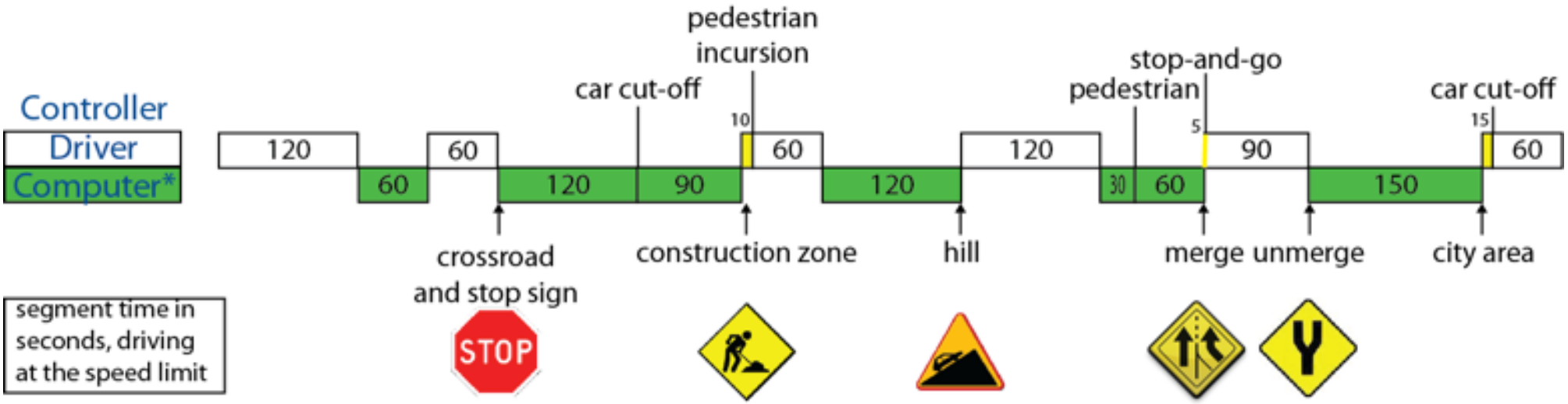
# TRUST IN AUTOMATION

**Organizational Trust (Mayer Davis & Schoorman 1995)**

- Ability: Is the party capable of what they are doing?
- Integrity: Does the party adhere to a set of acceptable moral principles?
- Benevolence: Does the party act with good intention without ulterior motives?


INTERACTION
IN SIMULATION

# TRANSITION FROM AUTOMATION STUDIES



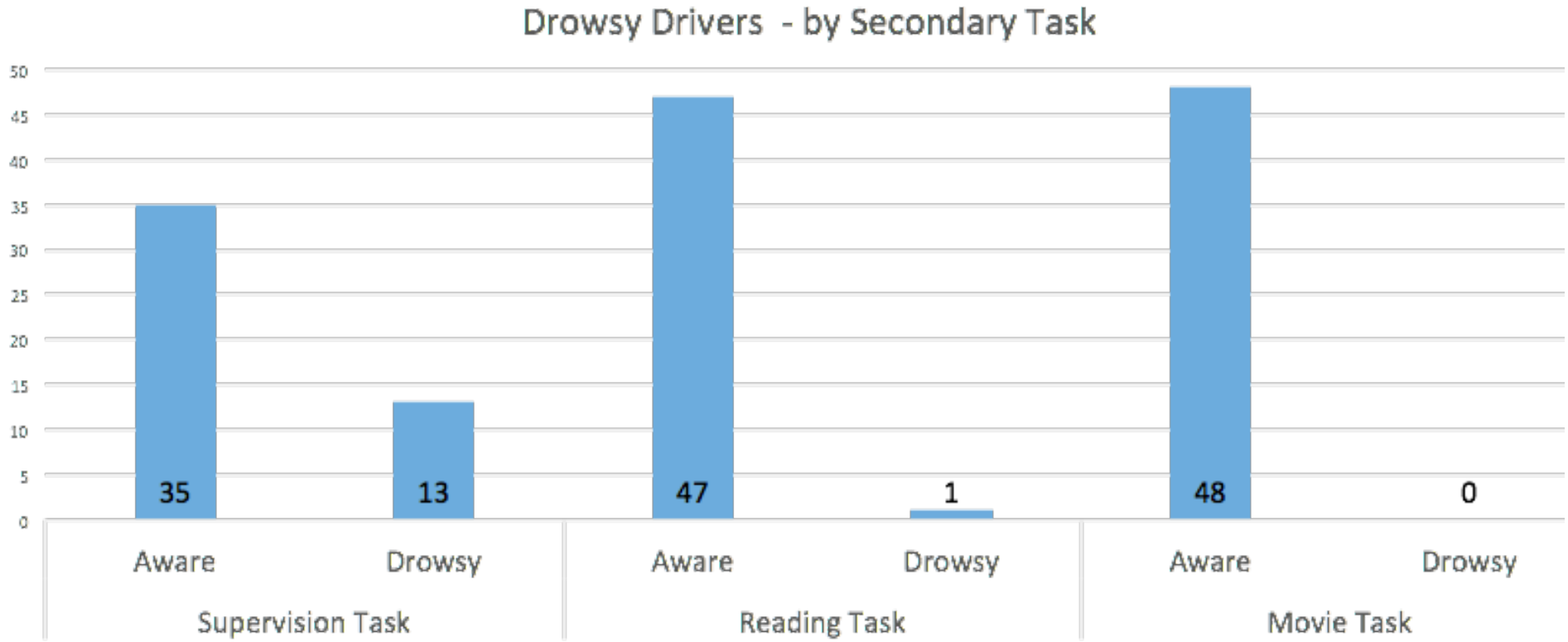


Johns, M., et al. The Driver has Control: Exploring Driving Performance with Varying Automation Capabilities. Driver Assessment 2015, June, Salt Lake City UT.

Miller, D. et al. Exploring Transitional Autonomous Driving with New and Old Drivers. SAE World Congress 2016, April 2016, Ann Arbor MI.

Miller, D.B., et al. Distraction Becomes Engagement in Autonomous Vehicles. Best Student Paper in Surface Transportation Track at 2015 Annual Meeting of the Human Factors & Ergonomics Society, October 2015.

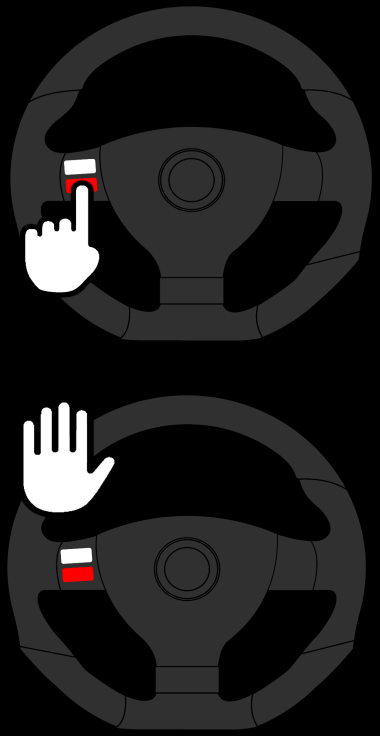
# Supervising Autonomous Vehicles Makes People Drowsy
# Reading and Watching Movies Keeps People Awake




Miller, D.B., et al. Distraction Becomes Engagement in Autonomous Vehicles. Best Student Paper in Surface Transportation Track at 2015 Annual Meeting of the Human Factors & Ergonomics Society, October 2015.

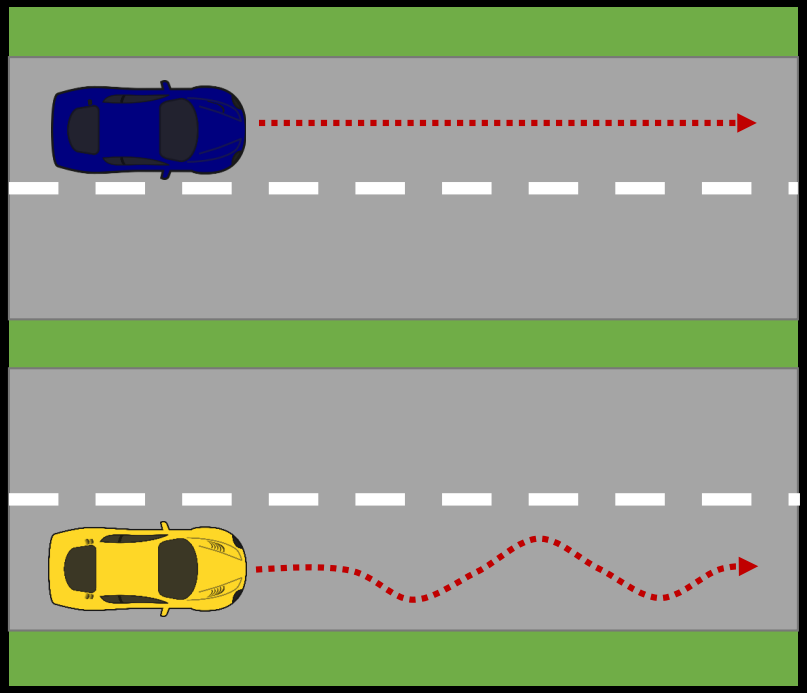
# DRIVER INTERVENTION STUDIES

TAKEOVER



TAKE OVER +INFLUENCE

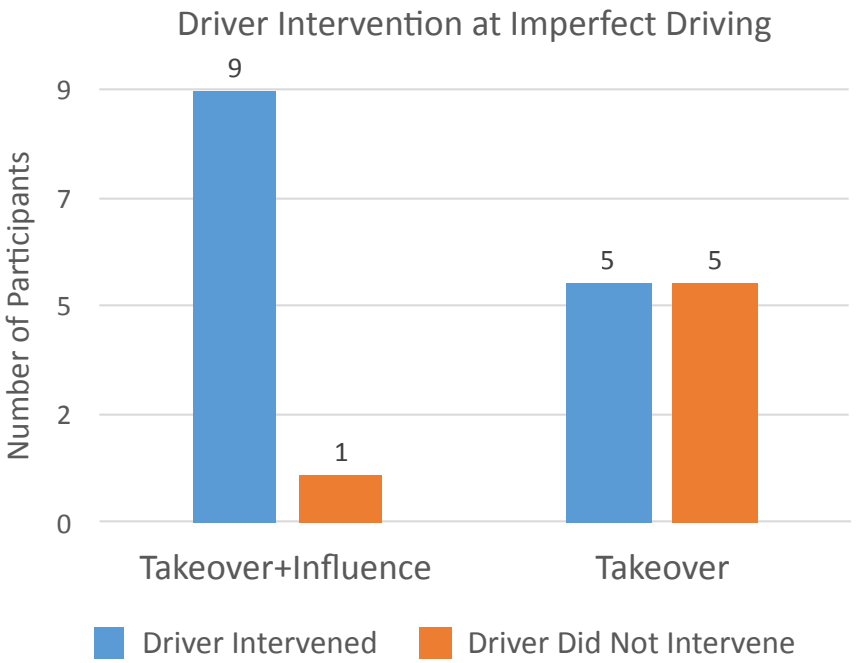
PERFECT DRIVING



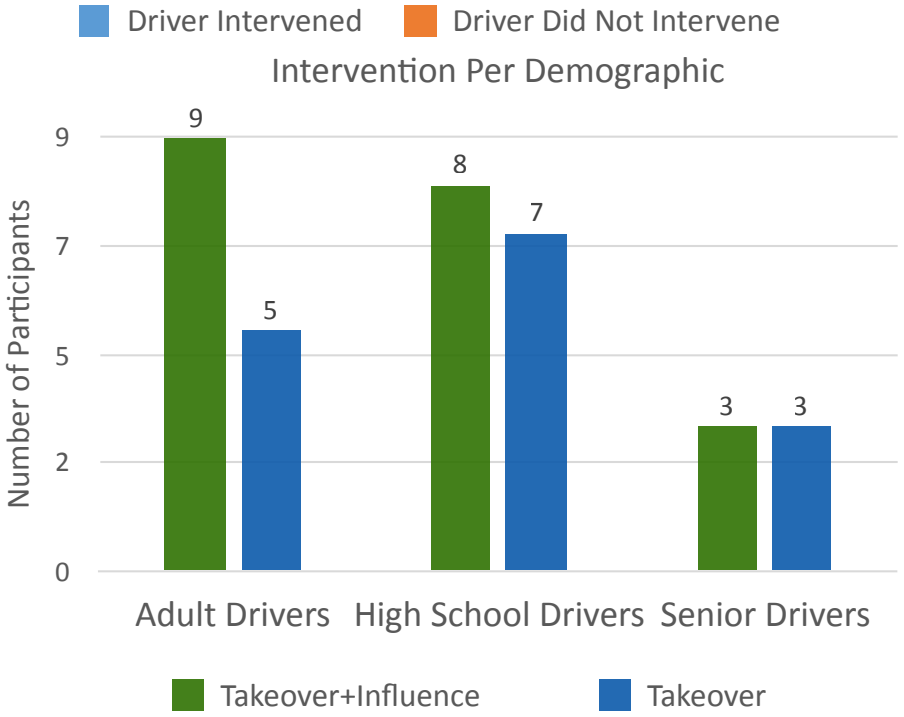
IMPERFECT DRIVING

Mok, B., et al. Take the Wheel: Effects of Available Modalities on Driver Intervention. Intelligent Vehicles 2016.

# DRIVER INTERVENTION STUDIES



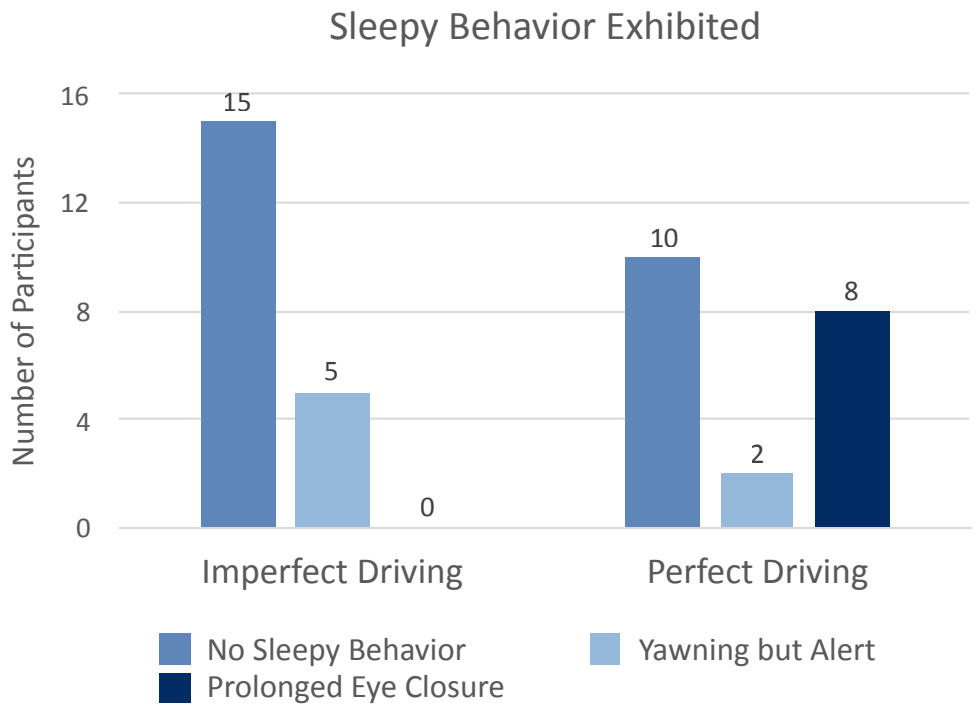

- When given both intervention modalities, drivers intervened significantly more.
- When given the ability to only takeover, drivers were more tolerant of imperfect driving.




- Senior drivers intervened far less due to their trust in the automated driving system. They also had lower confidence in their own driving ability and performance.
- Both high school and senior drivers behaved differently from adult drivers (who instinctively used the influence mode first).
- Many high school and senior drivers used *takeover* initially.

Mok, B., et al. Take the Wheel: Effects of Available Modalities on Driver Intervention. Intelligent Vehicles 2016.

# Imperfect Driving Keeps People Awake




- Drivers in the imperfect driving condition tended to be more alert and displayed less sleepy behavior.
- Prolonged eye closure (more than 1 sec) was common for drivers in the perfect driving condition.

Mok, B., et al. Take the Wheel: Effects of Available Modalities on Driver Intervention. Intelligent Vehicles 2016.

# ON THE ROAD INTERACTION

# ON-THE-ROAD DRIVING SIMULATOR


# ONROAD SIMULATION

RRADS

Real
Road
Autonomous
Driving
Simulation

Baltodano, S., et al. The RRADS Platform: A Real Road Autonomous Driving Simulator. AutoUI, September 1-3, 2015, Nottingham UK.

# PEDESTRIAN INTERACTION

Rothenbücher, D., et al. Ghost Driver: A field study investigating the interaction between pedestrians and driverless vehicles. AutoUI, September 1-3, 2015, Nottingham UK.

# THANKS

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My book, The Design of Implicit Interactions, is now available from Morgan & Claypool online and on Amazon.com.