



GOVERNMENT/ INDUSTRY

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Executive Leadership Provided By



Transitions of Control in Level 3 Automation

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IOWA

Acknowledgements

IOWA

- Omar Ahmad
- Michelle Reyes
- Cher Carney
- Chris Schwarz
- Tim Brown



- Christian Jerome
- Thomas Fincannon

DISCLAIMER

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Our Mission: enhance safety through understanding the human-vehicle relationship



Technology

Understand and advance vehicle technology and simulation science

- Distributed cross-modal simulation
- Instrumented on-road vehicles
- Digital twins



Understanding

Explore methods for improving driver performance and understanding of technology

- Driver training and exposure
- Mental models
- Naturalistic data collection



Performance

Identify and shift the limits of the human-machine relationship

- Edge case evaluation
- User interface evaluation
- Data reduction and analysis



Mobility

Enhance road user mobility through research and outreach

- ADS for Rural America
- Connected vehicles
- Technology demonstrations



Level 3 Automated Driving Systems (ADS)

- Perform entire dynamic driving task in operational design domain (ODD)
 - Lateral and longitudinal control
 - Object and event detection and response
- User can disengage but remains receptive to request to intervene (RTI)
- ADS issues RTI when approaching ODD exit

Transition Window Parameters

- **Sufficient** transition window for user to reengage

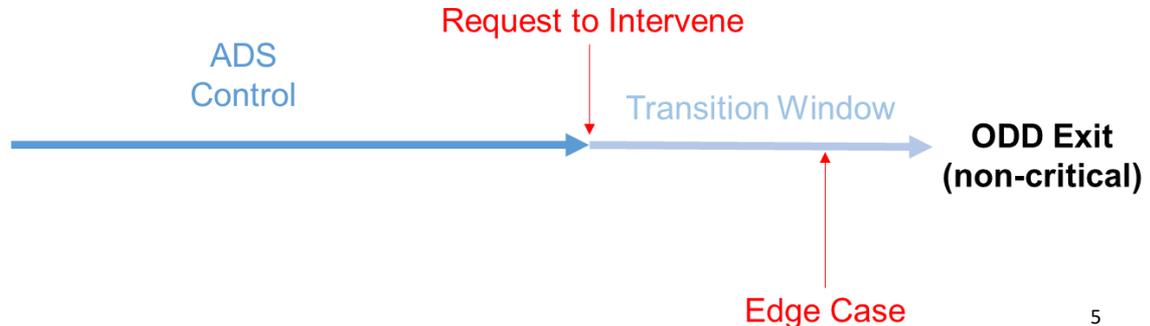
- What is sufficient?



- User is never put in time-critical response situation

- What happens when expectation is violated?

- **Edge cases**



NHTSA Projects on L3-L0 Transition of Control

- Temporal Components of Warnings and Notifications for Safe Manual Re-engagement with the Driving Task in Automated Driving
 - Thomas Fincannon
 - Define the minimum sufficient transition window (MSTW)
- Transition of Control and Post-Transition Driver Performance in Level 3 Automation
 - Christian Jerome
 - Examine the effectiveness of HMI design characteristics for transition of control in normal and edge case situations

National Advanced Driving Simulator, University of Iowa



National Advanced Driving Simulator at the University of Iowa



Traffic Jam Auto Drive

Clear weather



Moderate to heavy traffic

Divided Traffic

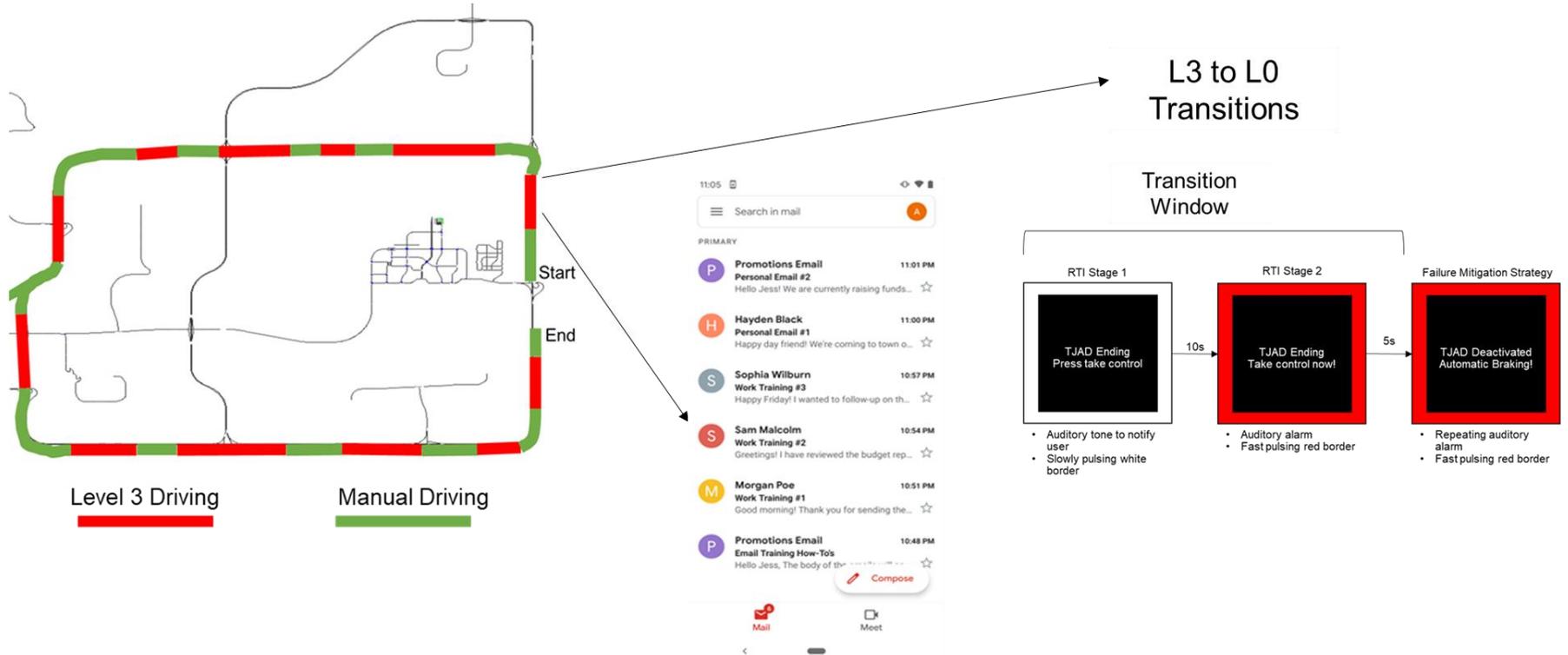
Low Speed (<35mph)

Clear lane markings

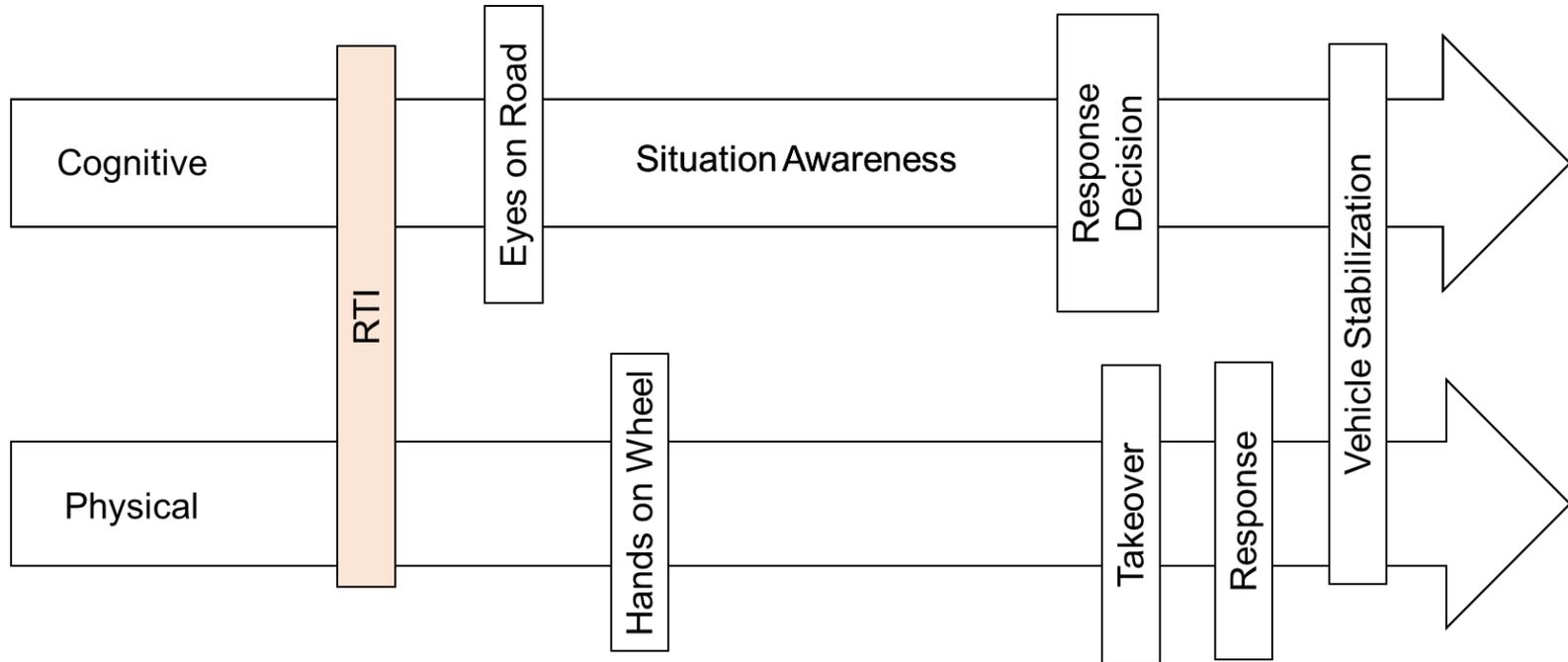
TJAD Operating



Level 3 Simulator Test Platform

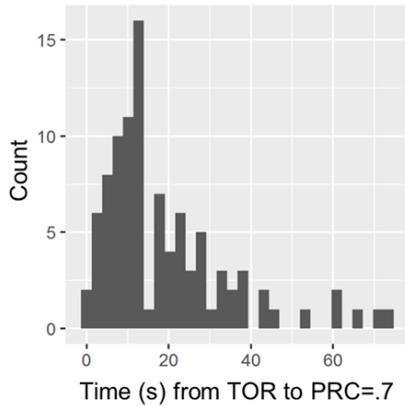


Measuring the Entire Transition



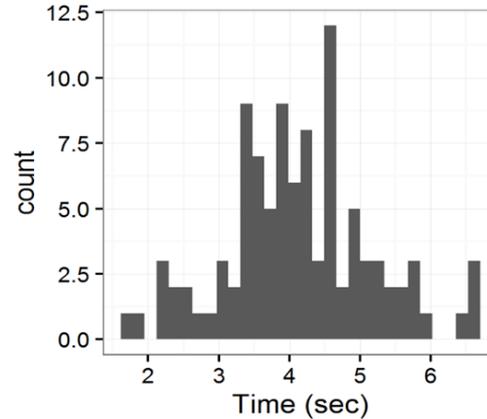
Measuring Transition Timing and Quality

Attention returns to road



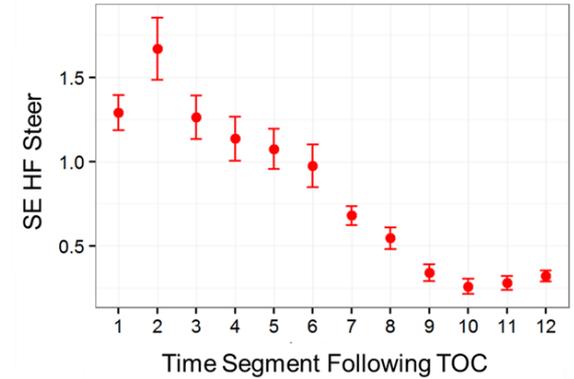
↓
Eye Tracking

Automation Deactivated



↓
Simulator Data

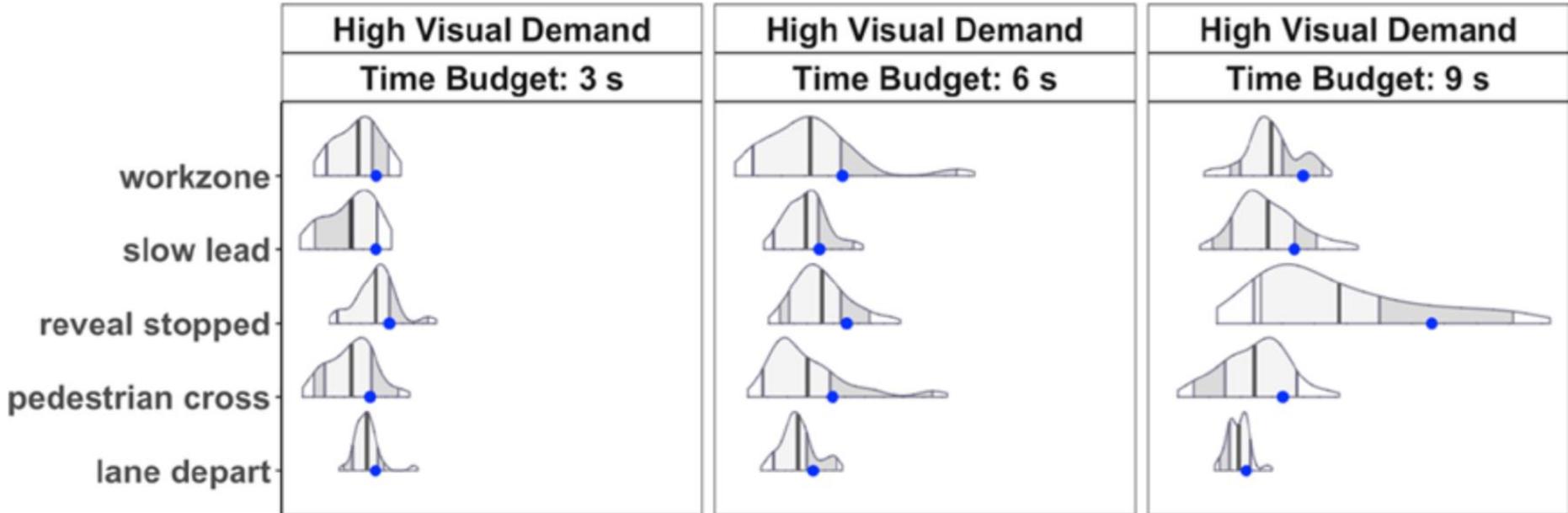
Control Stabilized



↓
Simulator Data

Schwarz et al. (2016)

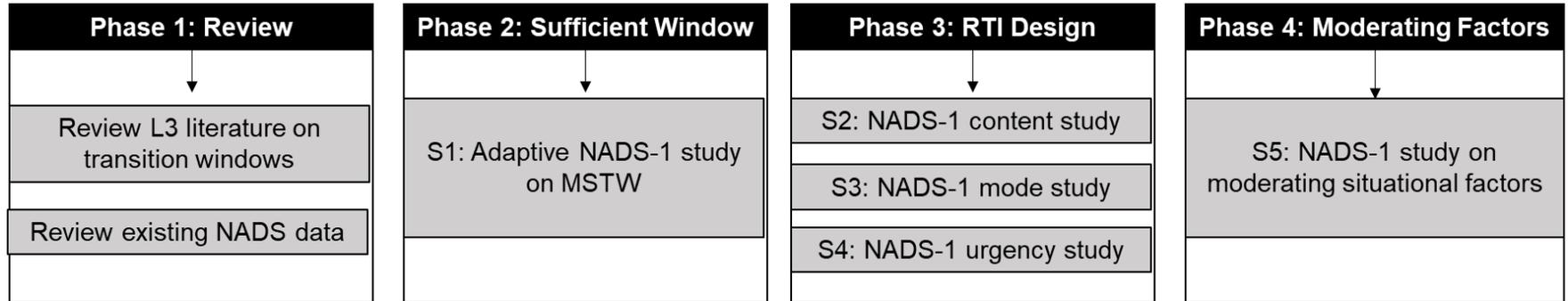
Focus on Response Distributions



DinparastDjadid et al., 2019

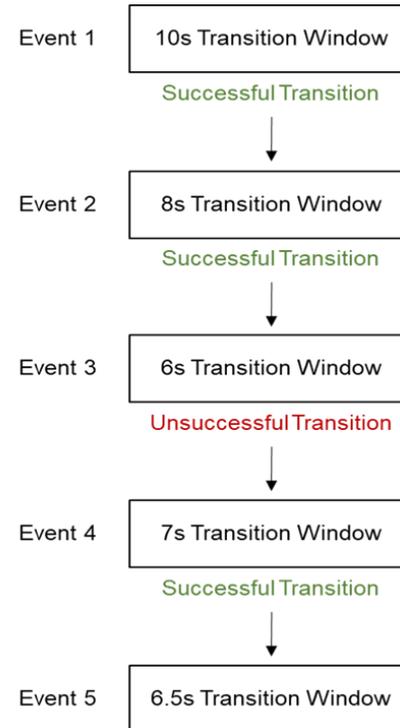
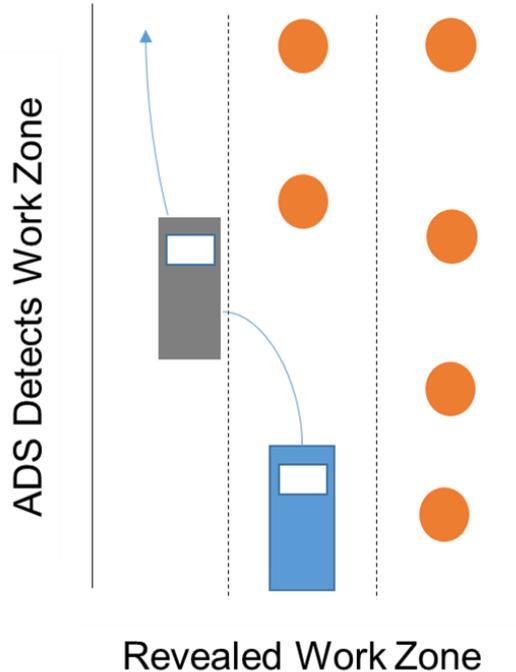
Temporal Components of Warnings and Notifications

Define the minimum sufficient transition window



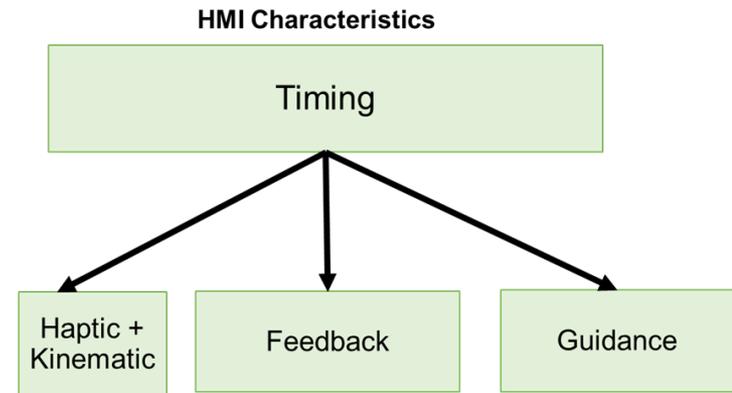
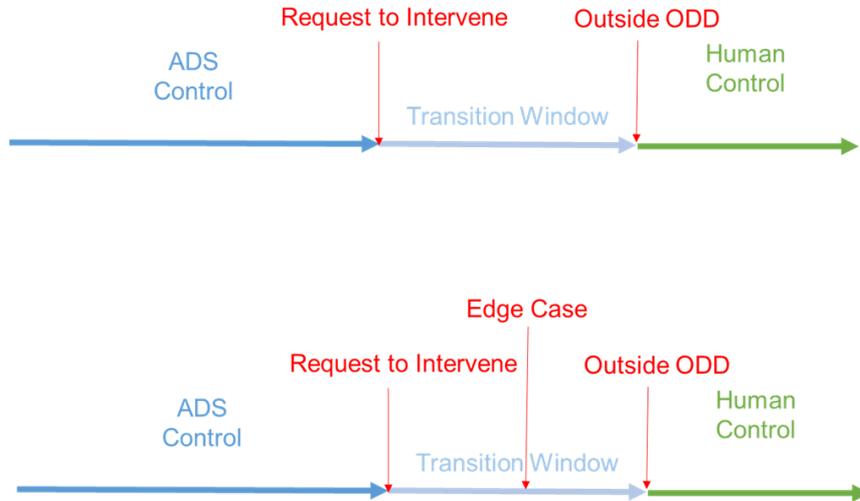
Temporal Components of Warnings and Notifications

Simulator experiments with adaptive transition window



Transition of Control and Post-Transition Driver Performance

Understand impact of RTI design characteristics on transition of control in normal and edge case transitions



Edge Case



Project Outcomes

- Temporal Components of Warnings and Notifications
 - Estimate of the minimum sufficient transition window (MSTW), both in traffic jam pilot and more expansive ODD
 - Understanding of how RTI design characteristics could minimize MSTW
- Transition of Control and Post-Transition Driver Performance in Level 3 Automation
 - Understand how HMI design characteristics impact transition of control timing and quality
 - Both in normal and edge case situations

Thank You

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