Transitions of Control in Level 3 Automation

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IOWA

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

- Christian Jerome
- Thomas Fincannon

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

THE NATIONAL ADVANCED DRIVING SIMULATOR
THE UNIVERSITY OF IOWA

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

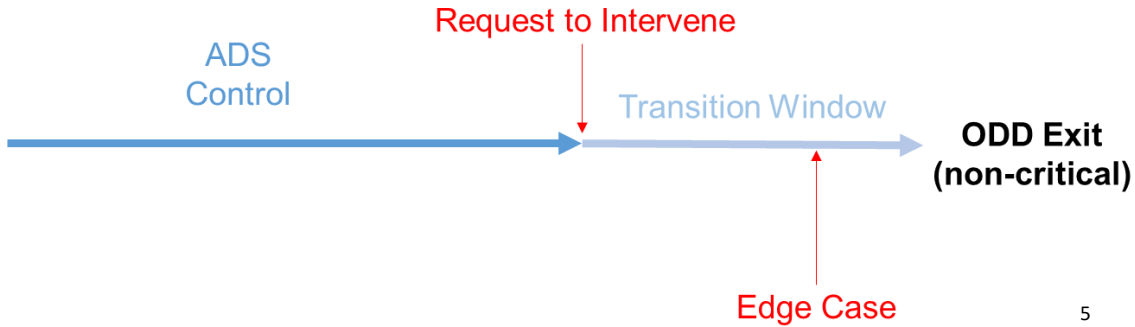
Level 3 Automated Driving Systems (ADS)

- 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

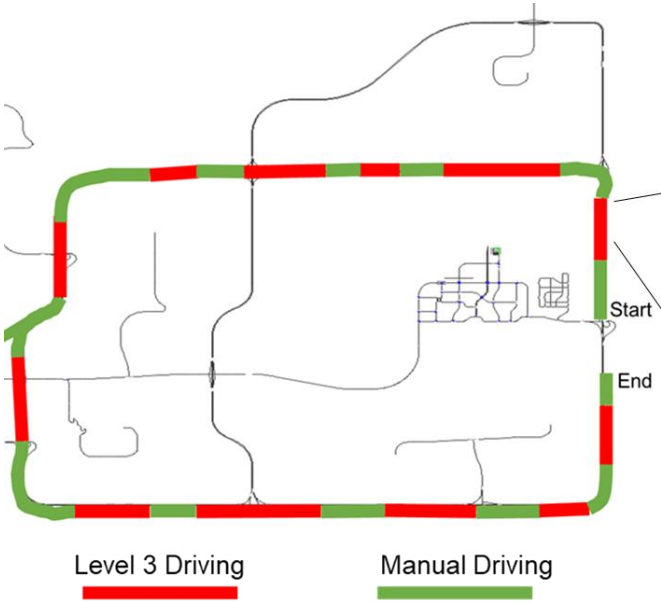
Traffic Jam Auto Drive

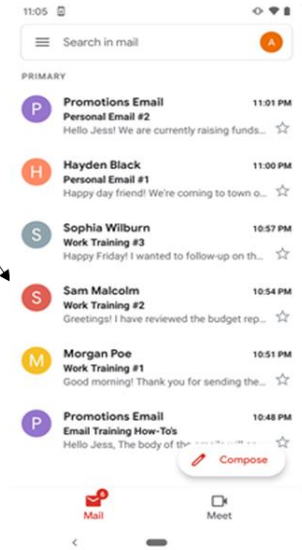
The National Advanced Driving Simulator

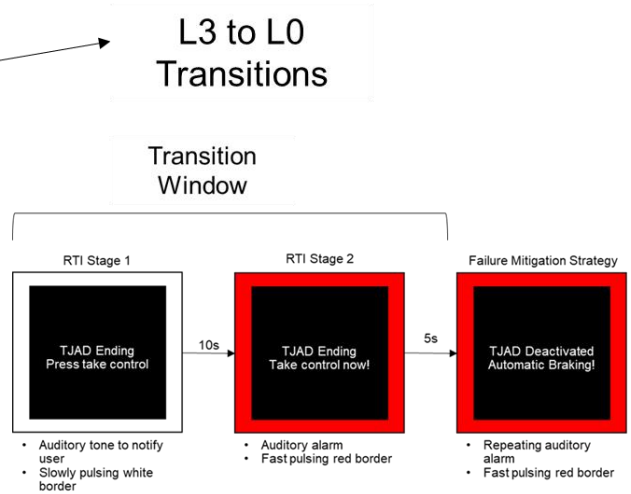
The University of Iowa

TJAD Operating

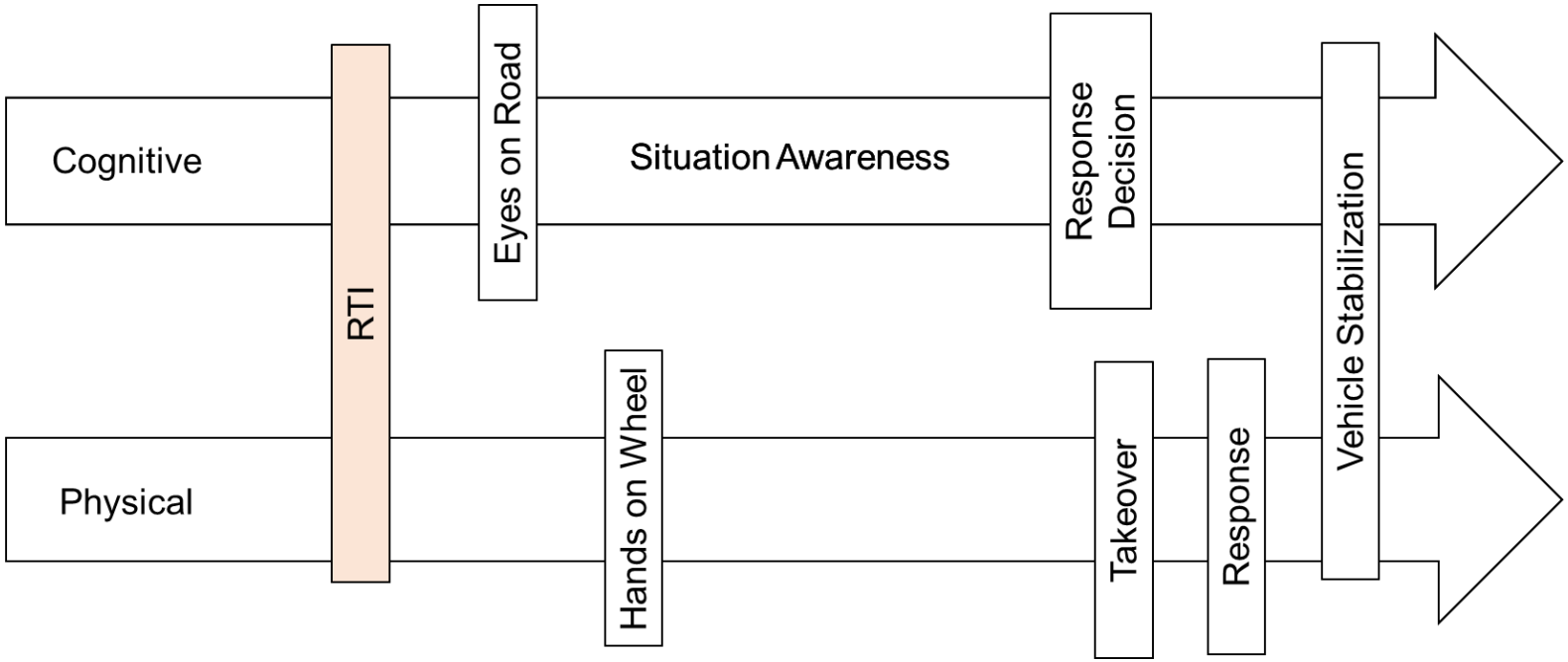
Level 3 Simulator Test Platform





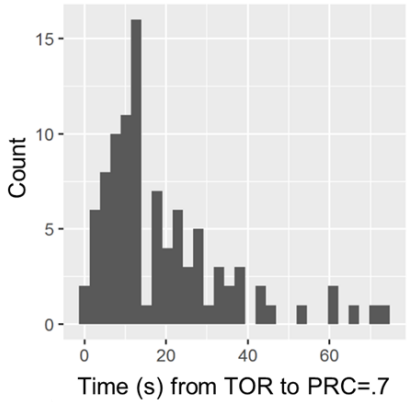


Measuring the Entire Transition



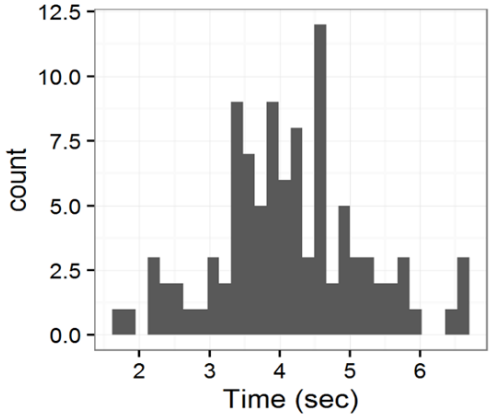
Measuring Transition Timing and Quality

Attention returns to road



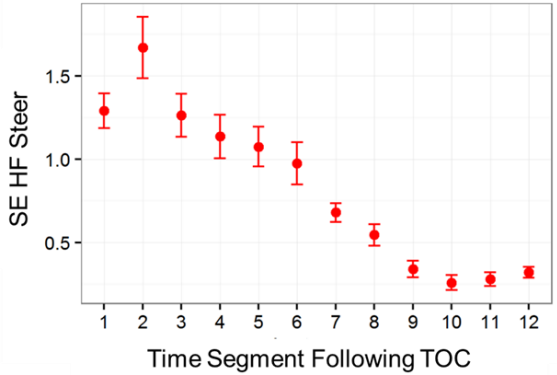
Eye Tracking

Automation Deactivated



Simulator Data

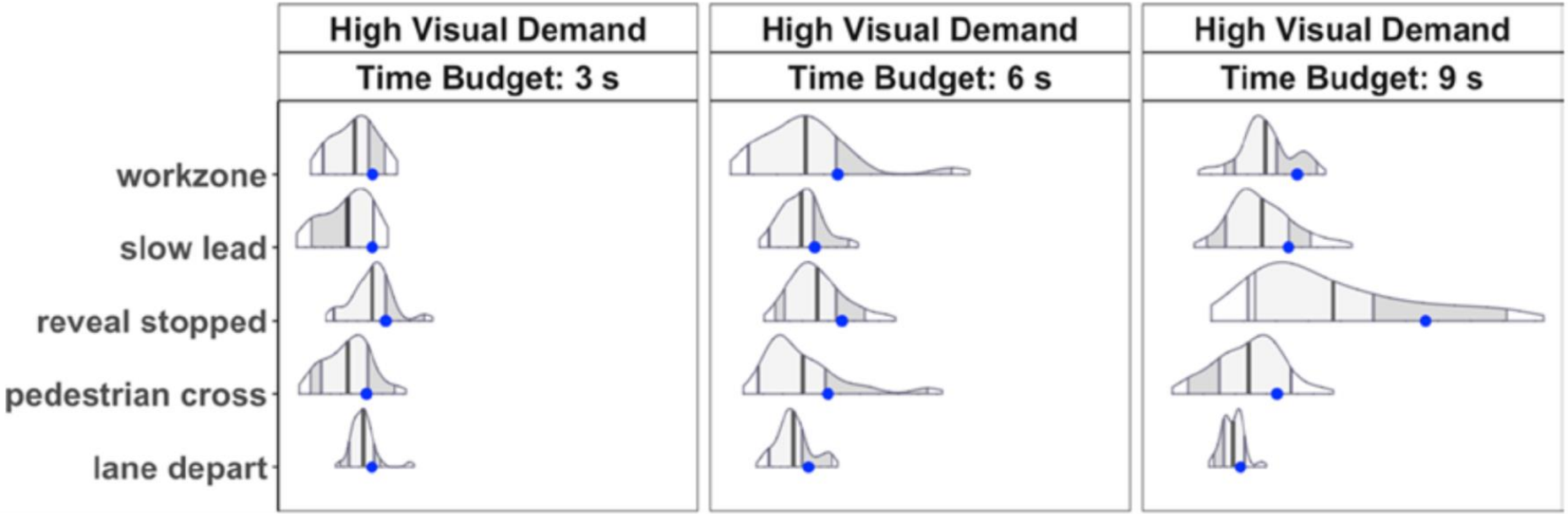
Control Stabilized



Simulator Data

Schwarz et al. (2016)

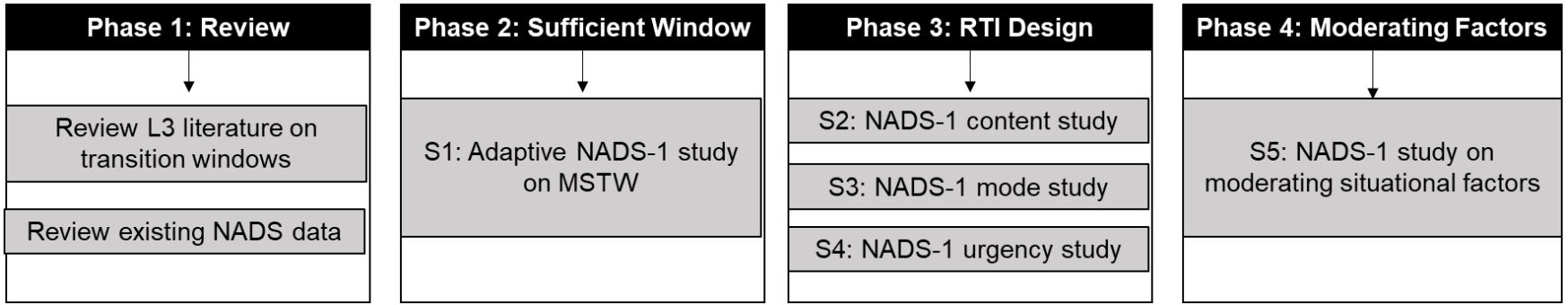
Focus on Response Distributions



DinparastDjadid et al., 2019

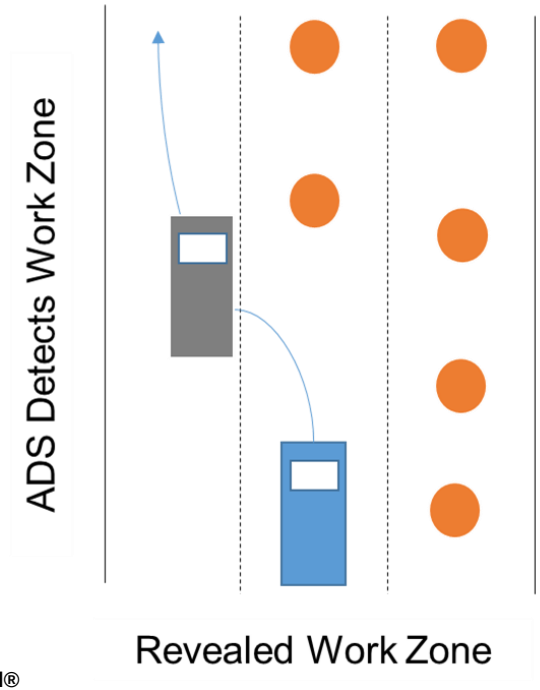
Temporal Components of Warnings and Notifications

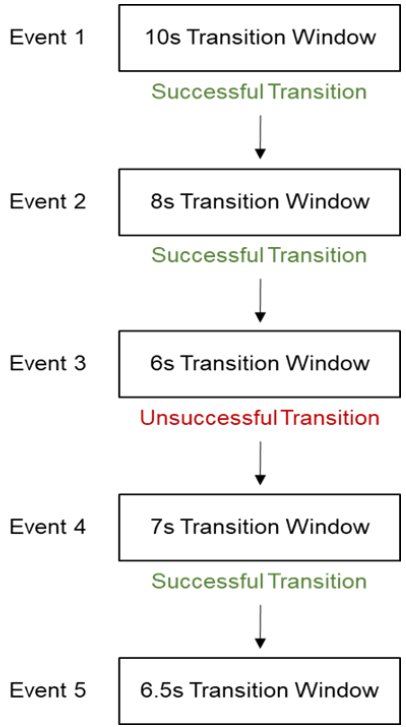
Define the minimum sufficient transition window



Temporal Components of Warnings and Notifications

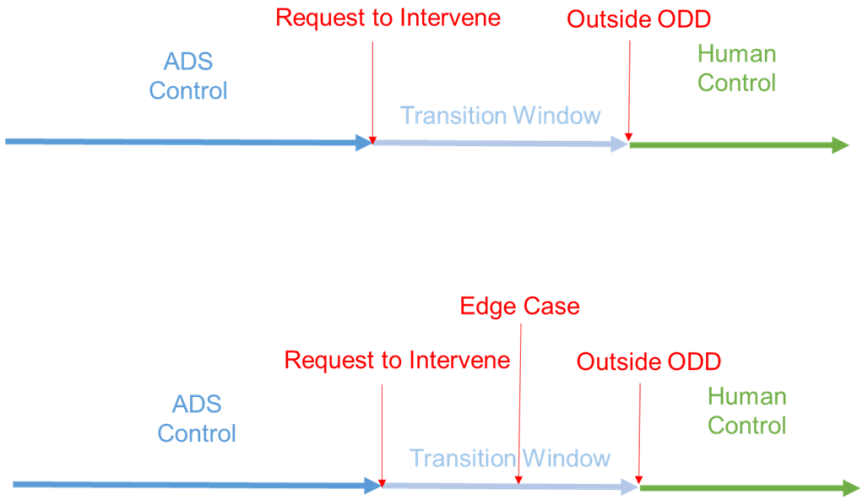
Simulator experiments with adaptive transition window

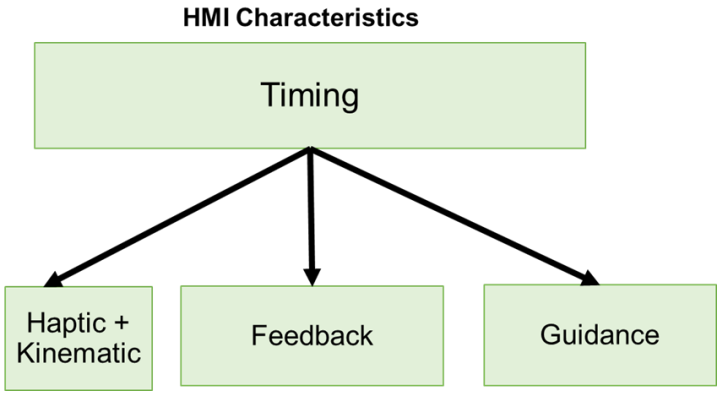




Transition of Control and Post-Transition Driver Performance

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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