Mixed-Function Automation Naturalistic Driving Study

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Research Sponsor:

Objective

- **Investigate driver interaction with market-ready mixed-function automation (MFA) through a naturalistic driving study (NDS)**
  - Evaluate how drivers operate vehicles equipped with MFA
  - Monitor internal vehicle data relevant to targeted functions
- **Phase 1: Project Planning**
  - Start Date: November 2015
- **Phase 2: Project Execution**
  - End Date: April 2018

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Focus Areas & Vehicles

- Driver performance
- Driver engagement
- System performance
- Driver-System Interaction
- Other topics of interest
  – Driver interface design
  – Unintended use
  – Unintended consequences
  – Safety and security
  – System failures
  – Licensing and training

Audi Q7

Infiniti Q50

Mercedes-Benz E350

Tesla Model S

Volvo XC90

Stakeholders

Recruitment

- Recruit 120 drivers from the Northern Virginia/Washington, DC region
  - Equal number of males and females ages 25-39 years old and 40-54 years old
  - Screening for 1,200 miles per month
    - Incentive to drive at least 1,200 mi (1,932 km) during participation
    - Targeting ~15,000 mi (24,140 km) per year for each vehicle
    - FHWA (2015) national average is 13,476 mi (21,687 km) per year

Participant Compensation

- Driver payment will comprise
  - Up to $500
    - Up to $360 if mileage ≤ 1,200
      - Weekly questionnaires: $20 per questionnaire
      - $0.25 per mile driven
    - $500 total if mileage > 1,200

Data Acquisition

- Vehicles equipped with VTTI's NextGen Data Acquisition System (DAS)
- Accelerometers
  - Peaks indicate SCEs
- Vehicle variables
  - Speed
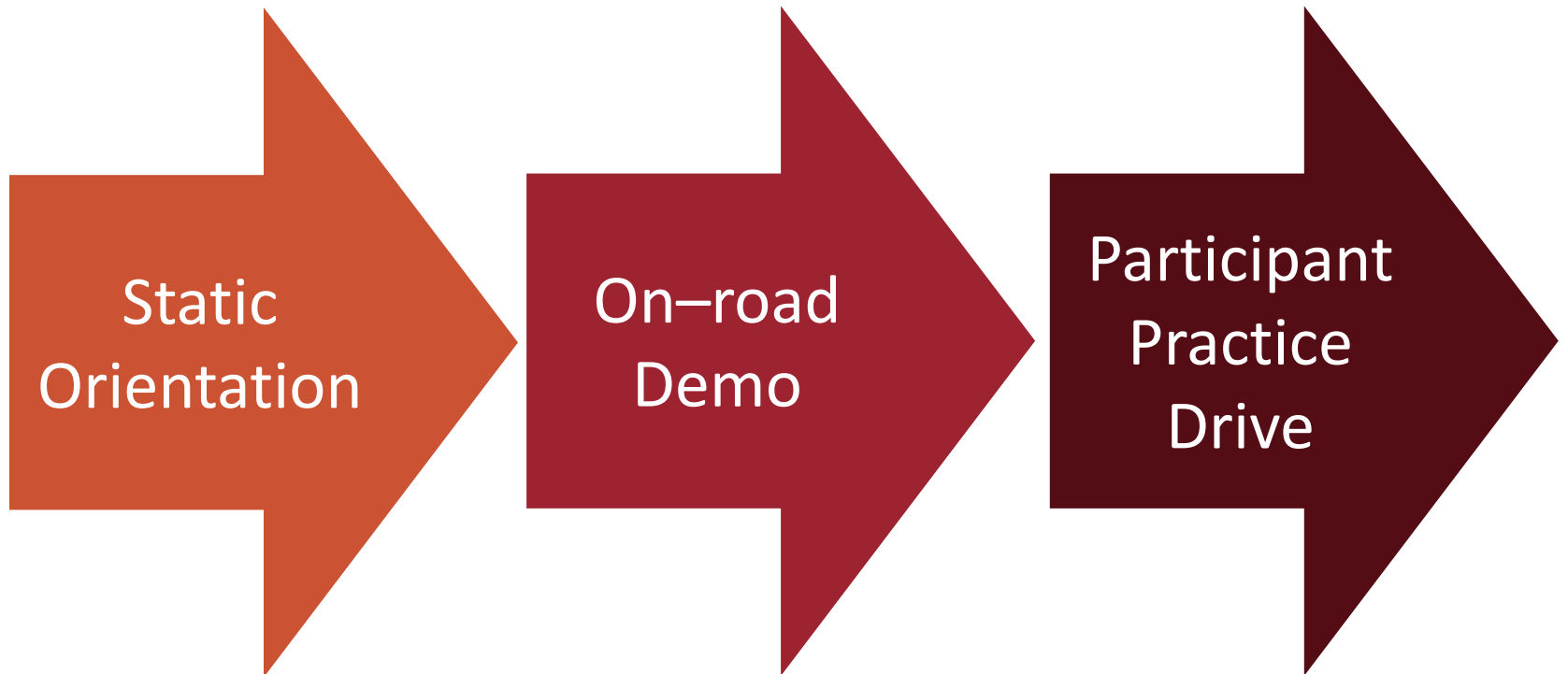 - Lane position
  - Headway
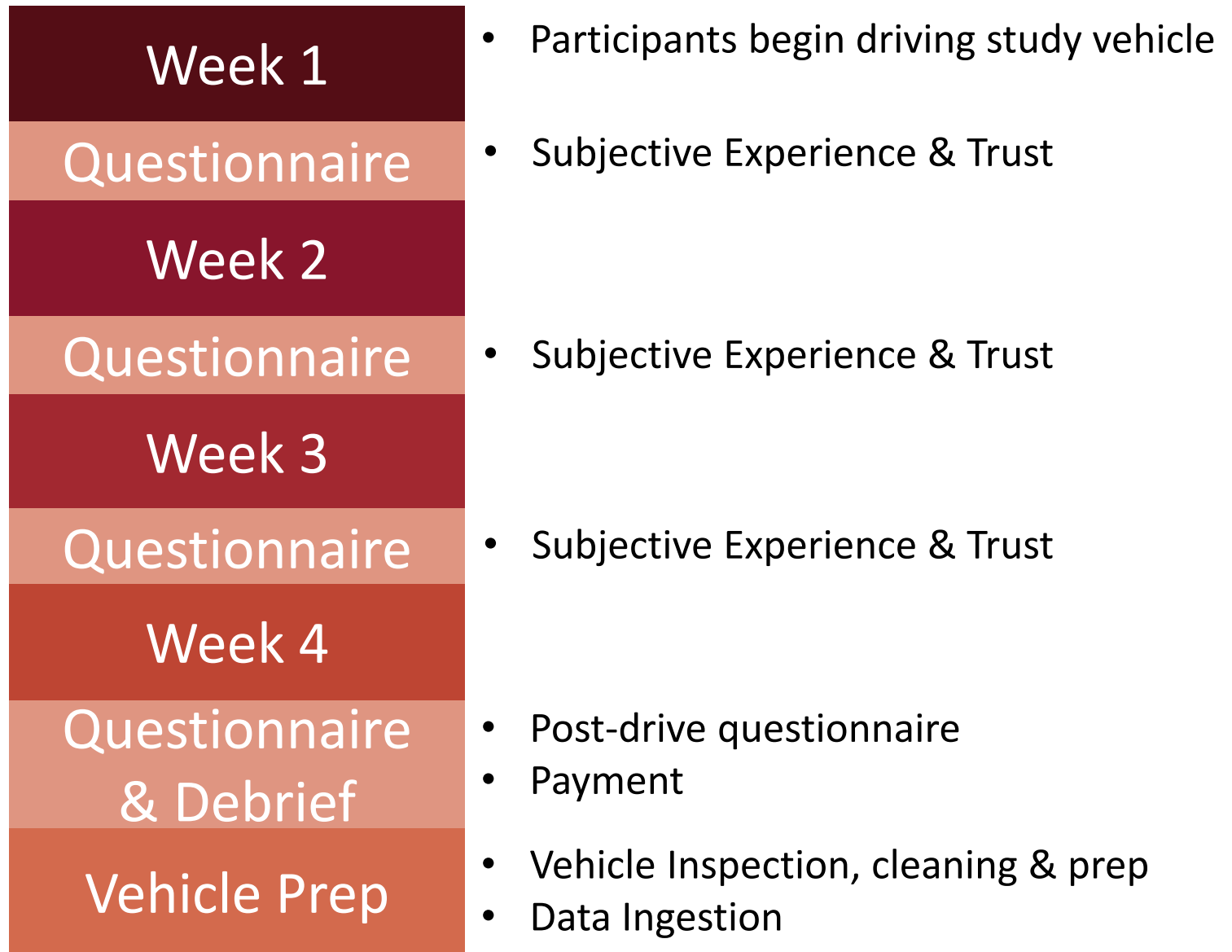 - GPS
- Incident button

DAS Video Views

- Forward view
- Driver face
- Over the shoulder (OTS)
- Foot well (pedals)
- Rear view
- Instrument cluster (HMI)

Training

Static Orientation → On–road Demo → Participant Practice Drive

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Participant Timeline

Week 1	• Participants begin driving study vehicle
Questionnaire	• Subjective Experience & Trust
Week 2	
Questionnaire	• Subjective Experience & Trust
Week 3	
Questionnaire	• Subjective Experience & Trust
Week 4	
Questionnaire & Debrief	• Post-drive questionnaire • Payment
Vehicle Prep	• Vehicle Inspection, cleaning & prep • Data Ingestion

Data Sampling

Epoch Type	Total Number of Epochs	Estimated Total per Driver	Estimated Frequency per Week per Driver
2 Functions Active	1,440	12	3
1 Function Active	1,440	12	3
0 Functions Active	1,440	12	3
MFA Alerts	1,440	12	3
All SCEs	All	All	All

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Data Reduction Variables

- Driver variables
  - Non-driving task engagement, drowsiness/impairment, etc.
  - Visual behavior
- Vehicle variables
  - Speed, lane position, headway, etc.
- Environmental variables
  - Roadway markings, roadway type, traffic density, relation to junction, weather conditions, lighting conditions, etc.

Question Reduction

- Full question reduction will be performed on all epochs

- Similar to SHRP2 data dictionary
  - Captures driver variables, vehicle variables, and environmental variables

Operator Behavior Analysis Timeline

Alert Onset

Time to Regain Control
& Time to React Begin

Time &
Method Used to Regain
Control Assessed

Time to React

Time to Regain Control

Time to React Ends
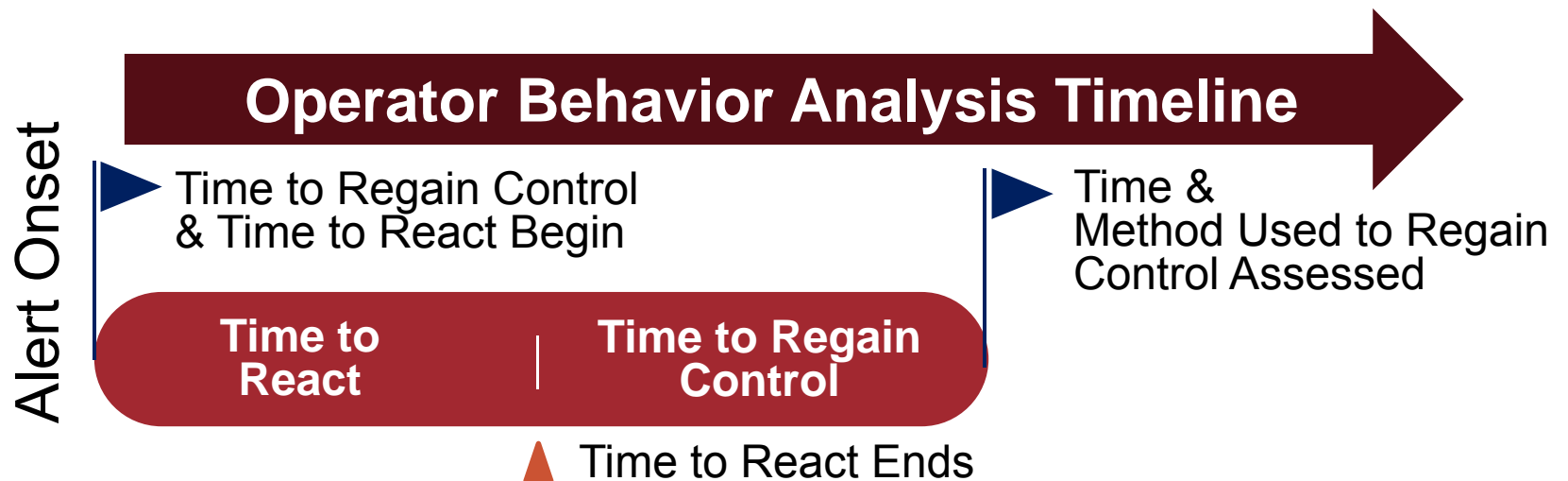
Safety Critical Event

ありがとうございます

Thank You!

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