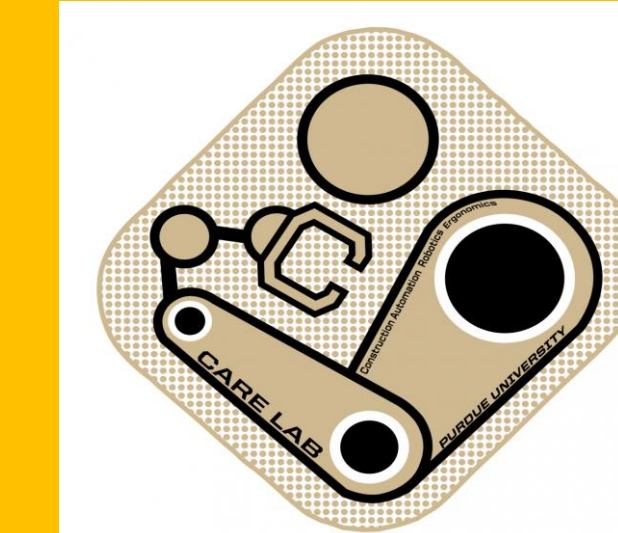# Cognitive Attention and Its Application in Countermeasures on a Curve Section

Hongyue Wu*, Yunfeng Chen*, Junan Shen**, Weinan Gao***, Mohammad Ahad**, and Osahon Iroghama**

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Problem Statement and Objective

- **Cause of premature death:** motor vehicle crashes
- **Causes of 90% traffic crashes:** human errors – visual information processing
- **Attention-related issues:** inattention, distracted attention, and "looked but failed to see"

This study aims to:
- Propose a methodology to evaluate the effectiveness of countermeasures of traffic safety based on drivers' cognitive attention and driving performance.

Methodology

- **Eye tracker:** Tobii eye tracker 4C with upgrade key
- **Driving simulator:** STISIM M100
- **Traffic simulation:** Paramics

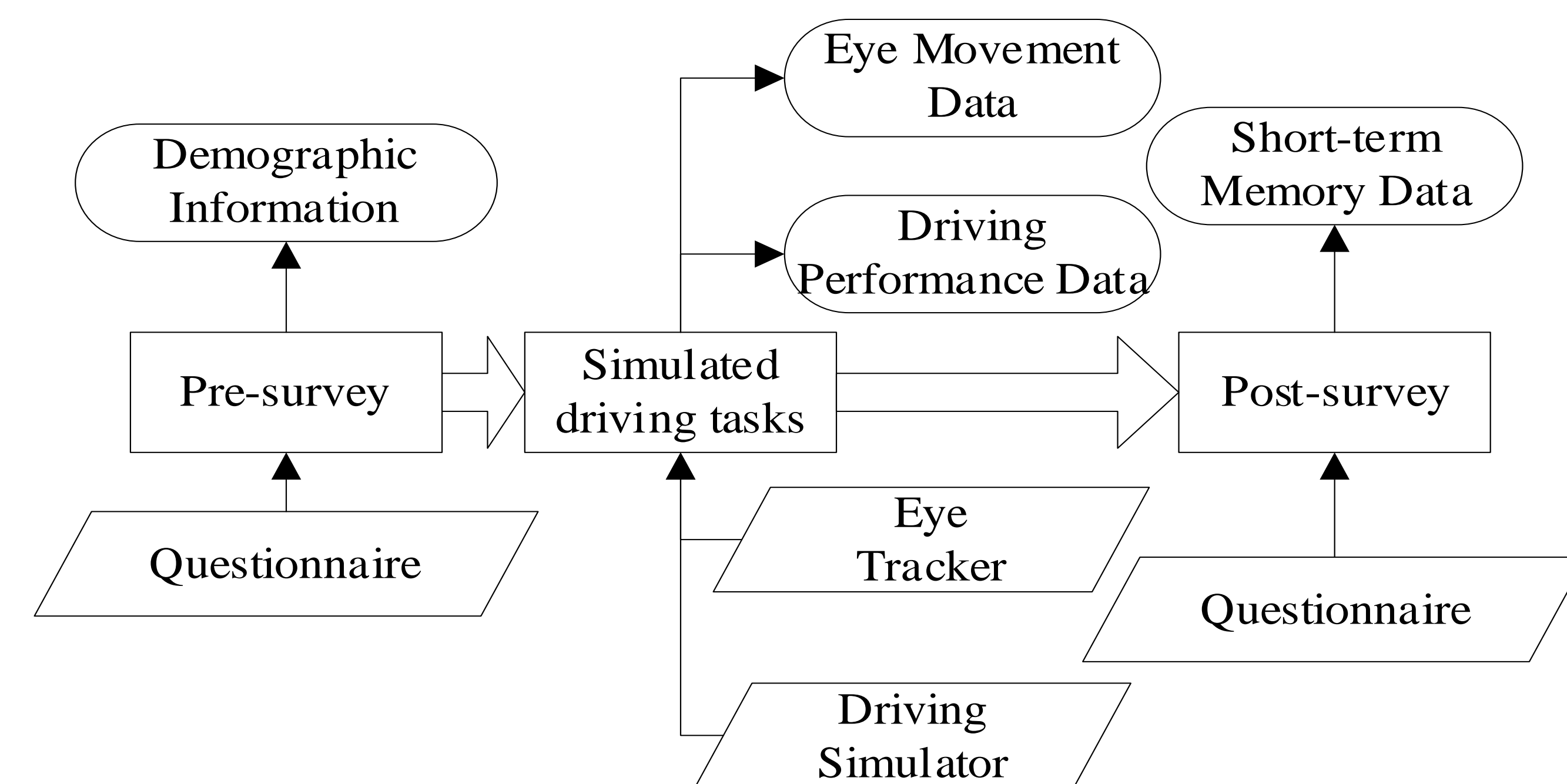**Figure 1.** Driving Simulator and Eye Tracker System

Figure 2. Experiment Procedure

Driving Simulation and Scenario Modeling

- **Case:** two-lane rural curve (Cypress Lake Road, Statesboro, GA)
- **Curve type:** horizontal and vertical curves; right and left curves
- **Length:** 3000ft (0.57 mile)
- **Road Grade:** 30ft difference at first 0.4 mile
- **Traffic flow:** light traffic and heavy traffic
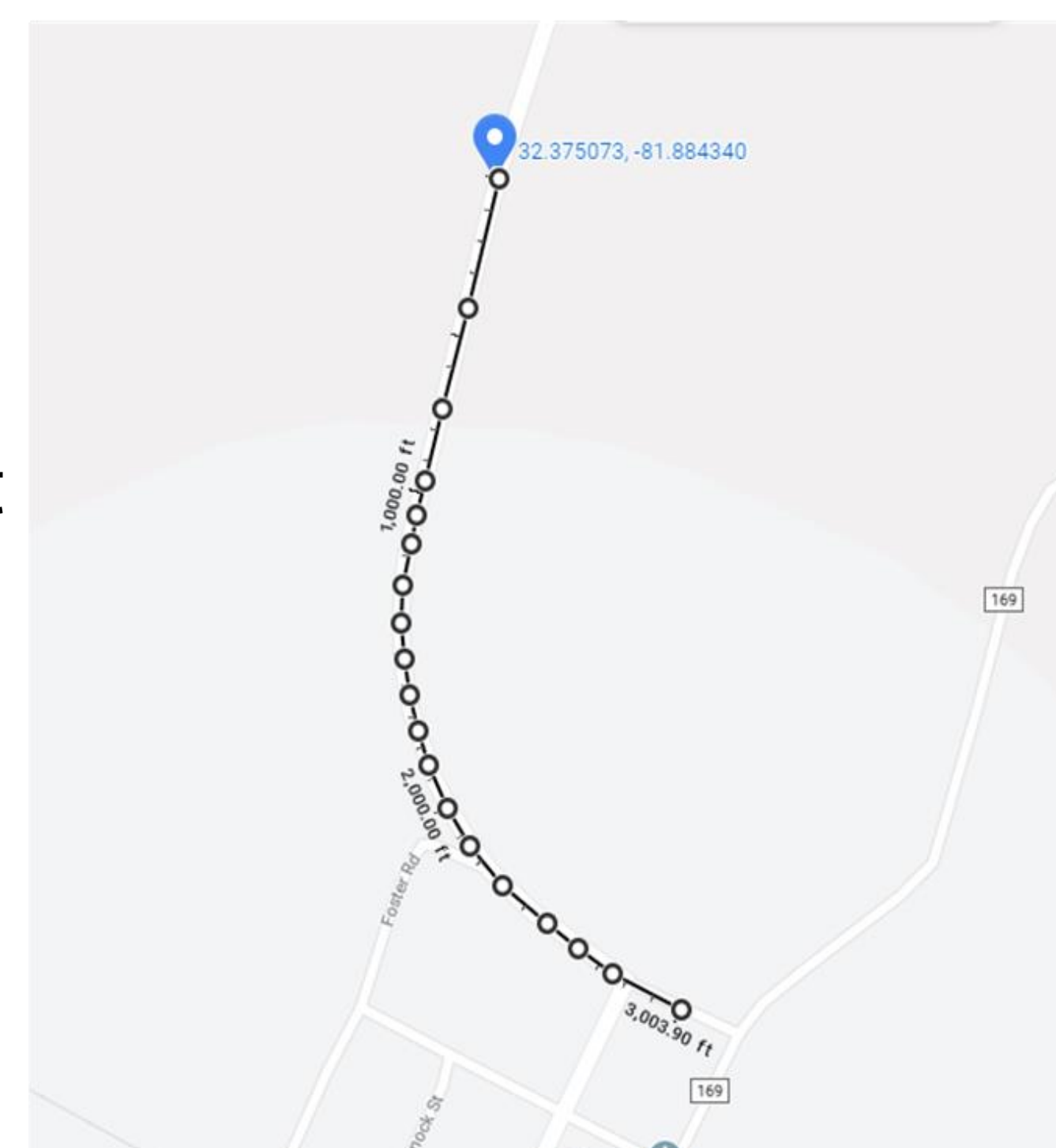- **Weather:** clear and fog

Figure 3. Selected Case

Table 1. Countermeasures and Runs

Runs	Countermeasures in each run	Countermeasures
R1	C1	C1=Centerline Pavement Marking
R2	C1, C2	C2=Edge Line Pavement Marking
R3	C1, C2, C3	C3=Shoulder Rumble Strips
R4	C1, C2, C4	C4=Flexible delineator posts
R5	C1, C2, C5	C5=Posted Speed Sign
R6	C1, C2, C6	C6=Curve Warning Sign
R7	C1, C2, C7	C7=Curve Speed Warning Sign
R8	C1, C2, C8	C8=Increased Shoulder Width
R9	C1, C2, C9	C9=Changed Horizontal Curve Curvature
R10	C1, C2, C10	C10=Decreased Curve Grade on Negative Grade
R11	C1, C2, C11	C11=Increased Curve Grade on Positive Grade

Figure 4. Basic Scenario Model Example

Findings and Conclusion

Comparison using Analysis of Variance
- **Significant differences** among the countermeasures and weather and traffic flow of:
  - Eye movement (cognitive attention)
  - Driving performance
  - Short-term memory

Visualization of Attention
- Most participants focused their attention on the roadway.

Figure 5. Heat Map

Relationship between Countermeasures and Safety
- **Effective countermeasures:**
  - Edge line pavement marking
  - Shoulder rumble strips
  - Flexible delineator posts
  - Curve warning sign
  - Increased shoulder width
- **Weather and traffic flow:**
  - Foggy weather with heavy traffic flow: most dangerous
  - Clear weather and no traffic flow: most safe

Conclusion

- The proposed methodology can evaluate the effectiveness of countermeasures considering cognitive attention and driving performance to improve traffic safety.