Analyzing Autonomous Driving Misuse through Eye-Tracking and Driver Behavior

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Introduction

Autonomous driving technology

- Allows vehicles to navigate autonomously, requiring driver intervention in Level 2 vehicles for safety (SAE).

Problems

- Accidents caused by driver misuse (e.g., drowsy driving or failure to switch to manual driving).
- Lack of understanding of system limitations can lead to inadequate intervention.

Research gap

- Most studies focus on simplistic driver behaviors (e.g., eye closure) or system malfunctions, ignoring the relationship between driver tendencies and misuse.

Objectives

Driver Behavior Analysis

- Develop a simulator to analyze driver behaviors during misuse scenarios.
- Quantitatively assess eye-tracking data for understanding driver reactions.

Misuse Scenario Focus

- Investigate the relationship between misuse of Level 2 autonomous driving and accidents.
- Analyze behavioral characteristics before and after collisions.

Methods

Data Collection

- Vehicle simulator experiments with 77 participants (ages 20-50).
- Data gathered through eye-tracking (20Hz) and vehicle control.
- Misuse scenario simulation

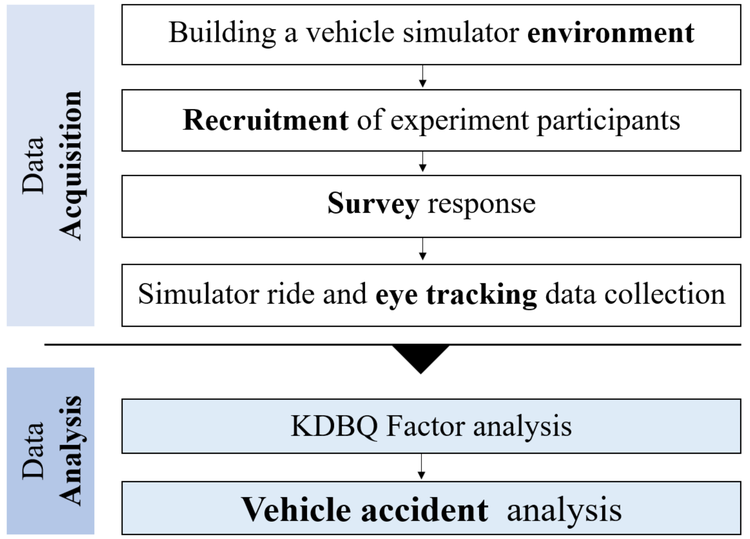
Experiment Stages

- Preliminary survey, calibration, and simulation drive
- Eye-tracking data pre-processed into 10-second intervals before and after collisions.

KDBQ Survey

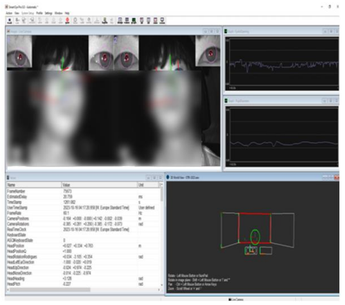
- Factor analysis conducted to extract principal components

Methods



- Overview of the research process

Vehicle simulator



Eye tracking data collection

- Vehicle simulator environment

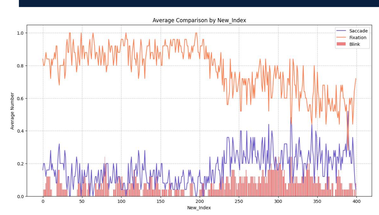
Results

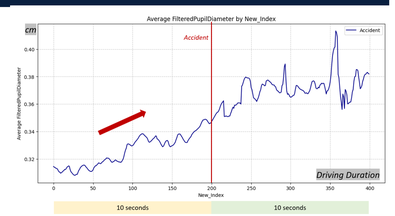
Accident Rate: 32.5% accident rate: 25 out of 77 participants experienced accidents.

KDBQ Factor Analysis

- *Violation*: Emotional and deliberate driving violations
- *Unfocused Error*: Failing to check surroundings (blind spots, road conditions)
- *Mistake*: Misjudgment of vehicle control (gears, speed)
- *Confused Error*: Errors in parking or reversing.

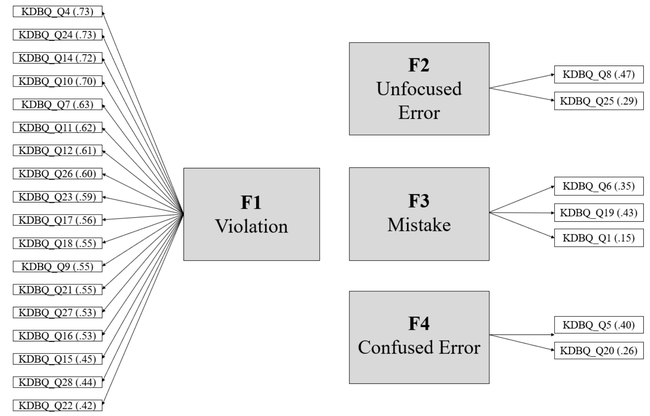
Results





Eye-Tracking Analysis

- Saccades increased post-collision; fixations decreased
- Blink frequency increased after collisions, indicating psychological stress
- Pupil dilation observed 10 seconds before collisions.



- Overall composition of extracted factors of KDBQ

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Conclusions

- Eye-tracking data reveals distinct behavioral patterns
- KDBQ analysis identifies four key driver behavior factors that correlate with misuse of autonomous driving features.

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