DRISI
Caltrans Division of Research, Innovation and System Information

Research Notes

Developing Engineering Countermeasures for Wrong Way Driving

Identifying methods to communicate wrong way information to severely intoxicated drivers leading to the development of effective engineering countermeasures.

Transportation Safety and Mobility

JUNE 2022

Project Title:
Wrong Way Driver Mitigation

Task Number: 3705

Start Date: September 1, 2019

Completion Date: August 31, 2022

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WHAT IS THE NEED?

Wrong-way collisions account for only about 3 percent of accidents on high-speed divided highways, but they are much more likely to result in fatalities than other types of highway crashes. Most wrong-way events on controlled-access highways are head-on collisions caused by drivers who are severely intoxicated.

Research has consistently identified the cause of many wrong way driving collisions, as drivers whose blood alcohol content is twice or more than the legal limit of 0.08 percent, often 0.20 and higher. Current countermeasures include installation of larger signs at driver sight level, flashing beacons, and retroreflective pavement markings. Research indicates these countermeasures are effective in producing self-corrective actions of wrong way driver movements when the driver is not intoxicated, but that they have had little to no effect on reducing wrong way collisions caused by severely intoxicated drivers.

Current countermeasures require a certain level of cognitive ability to see the countermeasure, recognize what it means, and take appropriate action. The proposed research seeks to understand the cognitive abilities of severely intoxicated drivers as a first step in developing effective engineering countermeasures to prevent severely intoxicated drivers from entering highways in the wrong direction and causing fatal collisions.

WHAT ARE WE DOING?

Based on the customer's written request, we have developed a scope of work for a research project. We have spoken with

a few researchers and sent the scope of work out to several research institutions via a Call for Submissions (CFS) document. The scope of work outlines how this task should be divided into a series of subtasks and expected deliverables along the lines of the following:

- Based on the task objective, design experiments to gather data on the cognitive ability of severely intoxicated (2 times the legal limit or higher) drivers
  - *Deliverable*: Project plan and experiment design document
- Obtain approval for human subject testing.
  - *Deliverable*: Documented approval from appropriate authority
- Set up experiments
  - *Deliverable*: Functioning experiment apparatus
- Recruit test subjects and conduct experiment
  - *Deliverable*: Recorded data
- Analyze data and prepare final report
  - *Deliverable*: Report characterizing the cognitive abilities of impaired test subjects relative to non-impaired ones, identifying the types of stimulus to which these drivers may respond, and design recommendations for countermeasures tailored to severely intoxicated drivers

WHAT IS OUR GOAL?

The proposed research seeks to understand the cognitive abilities of severely intoxicated drivers as a first step in developing effective engineering countermeasures to prevent severely intoxicated drivers from entering highways in the wrong direction.

WHAT IS THE BENEFIT?

Although this task is in the conceptual stage, focusing on which types of stimuli most affect severely intoxicated drivers, future study could use its findings to develop and deploy engineering countermeasures to prevent wrong way entries onto state highways. This would align with the Caltrans' Strategic Goal of Safety and Health.

WHAT IS THE PROGRESS TO DATE?

The contract between Caltrans and Auburn University was signed by Caltrans' Division of Procurement and Contracts (DPAC), and the project manager held a kick-off meeting with the Auburn researchers and the Caltrans project panel. The research team obtained approval to administer alcohol to human test subjects from Auburn University's Institutional Review Board (IRB).

The researchers updated all the software used by the driving simulator to the latest version. They then programmed the virtual road networks for three testing scenarios and one training scenario into the driving simulator. They also developed simulation models for the proposed new WWD countermeasures, including the "Lane Alert 2X" wrong way pavement arrows and Directional Rumble Strips (DRS), and existing countermeasures, including Do Not Enter/Wrong Way signs, type V arrows and two-way retro-reflective raised pavement markings based on Caltrans MUTCD requirements.

The researchers moved the driving simulator from the Engineering Department to the lab in the Psychological Sciences department and conducted a training session for the research assistants to familiarize them with the ethical and safe treatment of participants and data, operating the driving simulator and the eye-tracking devices, and guiding participants through the entire testing procedure before the actual lab testing session began.

A recruitment plan using the Departmental of Psychological Sciences subject pool, multiple social media platforms, and physical flyers was launched on Jan 10th, 2022. The initial laboratory session was conducted on February 21st, 2022. As of June 7th, 2022, 484 individuals completed the initial eligibility survey, 64 met the criteria for inclusion in the study, and 14 have completed all team will recruit human participants three sessions of lab testing. One participant was unable to complete all three sessions of lab testing.

Work planned for next quarter:

The research team plans to complete all three sessions of lab testing for about 16 more participants by the end of July. They will download and archive data from the driving simulator and eye-tracking devices and begin analyzing it for the final report.

IMAGES

Image 1: Driving simulator

Image 2: Participant's view of driving simulator

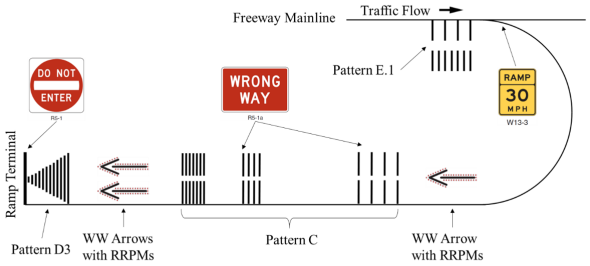

Image 3: Directional rumble strip patterns

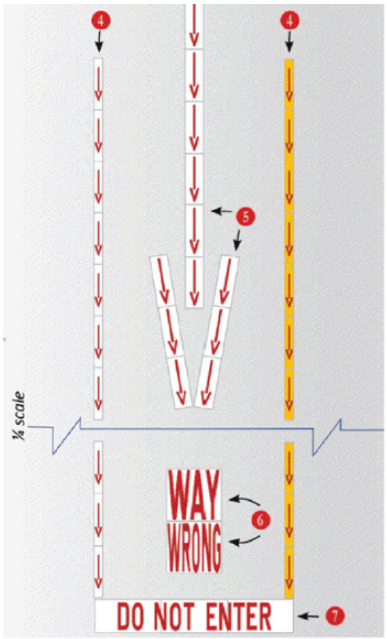

Image 4: Lane Alert 2X bi-directional countermeasure

Image 5: Enlarged DO NOT ENTER and WRONG WAY signs

Image 6: Directional rumble strip pattern D3 installed in the field