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## Final Report

*Project Title:*

# Evaluating the Effect of Google Glass on Driver Distraction

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## **RESEARCH PROBLEM**

The number of drivers aged 65 or older has been increasing rapidly over the last ten years. There were more than 40 million elderly drivers in United States, which is a 50% increase from 1999. While there is an increase in mobility and independence associated with driving, the high risk of being injured or killed in a motor vehicle accident involving older drivers has become a major concern in society today. Older drivers accounted for about 17% of fatal and 10% of injury-caused traffic crashes in 2013. The overrepresentation of older drivers in at-fault crashes and collision related fatalities may be associated with physical frailty and/or impairments that lead to failure to yield the right of way, unseen objects, and failure to heed stop signs or signal.

Intersections are particularly dangerous for elderly drivers. Because older drivers had significantly fewer glances toward the turning direction and other vehicle traffic for hazards when turning at T-intersections or at four way intersections, they may have a greater likelihood of a critical incident. For elderly drivers, they are more likely to crash at intersections with the presence of signals and signs, probably because that dealing with them requires larger amount of visual and mental resource, which may be a greater challenge for the elderly considering their decreased sensory, perceptual, cognitive and motor performance. Recent studies have identified advances in technology that make it possible to reduce the unsafe behaviors that lead to fatal crashes at intersections by providing customized feedback and training to older drivers in the form of alerts. The purpose of this study is designing some visual and auditory alerts which can effectively help older drivers increase their detection of potential hazards without interfering with other driving tasks.

## **METHODOLOGY**

This study includes drivers ages 60 and over and examines whether visual and auditory alerts before intersections and turning left maneuvers improves or interferes with hazard perception for drivers in this age group. The glance behavior at intersections of drivers aged 60 years and older is recorded and evaluated using a high fidelity driving simulator and eye tracker. Older adults in age 60 and over a high-fidelity driving simulator and record glance behavior at intersections are evaluated. The effectiveness of visual and auditory alerts before intersections and turning left maneuvers for older drivers are investigated in this study.

We developed a total of eight mini scenarios and all participants navigated them. The driving simulator and an eye tracker in the Arbella Insurance Human Performance Laboratory at UMass Amherst were used.

During the experimental drives, half the participants received auditory and visual alerts regarding upcoming intersections and traffic conditions. Auditory alerts include specific instructions to participants to help them safely navigate through intersections. The same information also was provided visually on the center screen towards the bottom right corner of the simulator with the potential hazard highlighted and repeatedly flickering. Each subject navigated all the eight drives once. Participants were assigned to either a control group or group with auditory and visual alerts (collision warning alert conditions). A Latin square method was used across drives to counterbalance the sequence of them for participants (Winer, Brown & Michels, 1971). Participants in collision warning alert group received auditory and visual alerts about the presence of latent hazard in advance of the intersection. Drivers in the control condition received no such alerts.

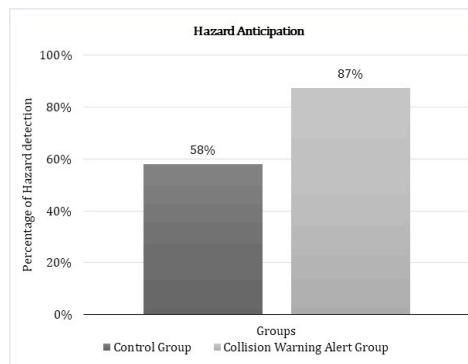
The effectiveness of visual and auditory alerts was examined with assessing the drivers' latent hazard anticipation behavior and the performance of the drivers' secondary task. Two hypotheses were examined in this study. First, the effectiveness of alerts at improving drivers'

secondary task. Second, the effectiveness of alerts at improving drivers' latent hazard anticipation behavior.

## RESULTS

To analyze whether the warning alerts improve the performance of the behavior of elderly people, the drivers' hazard anticipation ability and driver's secondary glances were taken as dependent variables. To analyze the latent hazard anticipation and secondary glances a univariate analysis of variance (ANOVA) was used.

The hazard detection ability was measured by whether the driver glanced at the target zone or not while in the launch zone. Therefore, the number of hazards anticipated was binomially distributed, assigning a 1 if the participant glanced at the target zone while in the launch zone, and assigning a 0 if the participant did not glance at the target zone while in the launch zone (Samuel and Fisher, 2015). The average of their scores over the eight scenarios for each participant were considered as a final score for analysis. The observed percentage of hazards detected across the various scenarios in two groups are represented in figure below. A univariate analysis of variance (ANOVA) was used to compare the percentage of vehicle latent hazards anticipated across two groups. The analysis revealed that participants who received collision warning alerts exhibited statistically higher anticipation rates compared to the control group [F (1, 38) =27.02 p=4.1].



The proportion of correct secondary glances executed by participants were submitted to a univariate analysis of variance (ANOVA) to compare the results across two groups. As a result, the overall difference between the two groups was not statistically significant [F (1, 38) =0.014 p=4.1]. The observed percentage of percentage of secondary glances across the various scenarios in two groups are the same.

## CONCLUSIONS

The effectiveness of visual and auditory alerts before intersections and turning left maneuvers for older drivers in age 60 and over were investigated in this study. In this study the older female subjects were more sensitive to simulator sickness than male subjects. Of the total participants 17% of male and 50% of female participants experienced motion sickness.

The results show that appropriate visual and auditory alerts can improve the performance of drivers in latent hazard detection as hypothesized. The experiment results illustrate that there was no significant effect found for secondary glance behavior for older drivers who received collision warning alerts compared to those who did not. One possible explanation for this is that secondary glances can improve with training instead of using alerts the reason is that it is habit of drivers.