Fog along roadways is a dangerous hazard that leads to crashes resulting from limited visibility. Low visibility gives drivers less time to react to potential obstacles that can suddenly appear and require immediate action. To solve this issue, early warning systems involving Dynamic Message Signs or other types of devices are used to alert drivers of the impending visibility condition so that they are prepared. This research focuses on testing the effectiveness of one form of warning systems to investigate how it impacts driver behavior in foggy conditions.

To accomplish this objective, a simulation study is developed to test variables of interest including: Roadway Type, Fog Level, DMS Presence, Beacon Presence, Traffic Volume, and DMS Message Provided. Using a factorial design, 24 scenarios are created by randomizing the variables listed using statistical software to be tested on 72 volunteer participants. Using a NADS MiniSim Driving Simulator, the participants driving behavior is recorded including speed and breaking behavior under an initial clear condition followed by a reduced visibility fog condition.

From demographics, drivers age 35 and over consistently showed a higher likelihood of speed reduction between clear and fog conditions with overall reduction increasing with age. This is seen when looking at the mean change in speed based on driver age where young drivers (18-25 yrs) reduced speeds by 7MPH, older drivers (35-45 yrs) reduced by 12MPH, and elder drivers (65+ yrs) reduced by 17MPH. The more often a person drove and those that were educated at a graduate level also showed a higher chance of speed reductions. This demonstrates the impact of experience and exposure to driving performance under reduced visibility conditions. Those who recently drove under fog conditions or learned to drive in Florida were found to be less likely to reduce their speeds when entering the fog. This is attributed to these drivers being confident or familiar with the environment resulting in risky driving behavior.

For the scenario variables, it is determined that the type of roadway a driver travels plays a major role in how much speed reduction occurs and thus how much a driver decelerates when entering a low visibility environment. On average, drivers traversed the fog zone at 50MPH with the lowest travel speed being 30MPH. Since the speed limit on the freeway is 5MPH higher than the arterial, drivers' traveling along this road are noted to decelerate at higher rates to achieve this target speed. Additionally, DMS presence and message also provided an impact on the drivers' choice to decelerate and reduce travel speed within the fog condition. Under the most severe conditions, the probability of a driver reducing speed increases as the number of DMS present increases. Additionally, when a DMS presents a warning and specifies the action that a driver should take, in this case 'reduce speed,' greater speed reductions and decelerations are observed and are more likely to occur. Interestingly the number of DMS did not have a significant impact on driver behavior under every fog condition like the message presented did except in the most severe fog condition. Taking into account that 33% of drivers did not accurately remember the number of DMS encountered it can be concluded that the warning message itself is the most important aspect of the early warning system. This indicates that drivers accurately remember being directed to reduce speed whether they are given the advisement once or multiple times based on the number of DMS present.

Further research into how the warning message is presented or worded could provide additional insight into the impact it can have on driver behavior. Since it is observed that drivers acknowledge the 'reduce speed' advisement, it is likely that specifying a specific speed limit could also warrant driver obedience. Additional testing and observation of driver reaction to larger traffic volumes and situations within the fog would also allow for further analysis of driver behavior under reduced visibility and the impact the early warning system has on their behavior.

Major: Civil Engineering

Educational Career:
Bachelor's of Civil Engineering, BS, 2014, University of Central Florida

Committee in Charge:
Dr. Mohamed Abdel—Aty, Chair, Civil, Environmental, and Construction Engineering
Jaeyoung Lee, Associate Professor, Department of Civil, Environmental, and Construction Engineering
Naveen Eluru, Civil, Environmental, and Construction Engineering

Approved for distribution by Dr. Mohamed Abdel-Aty, Committee Chair, on January 5, 2016.

The public is welcome to attend.