

Research Report Summary



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1/24/2018

The Impact of Vehicle Automation on the Safety of Vulnerable Road Users (Pedestrians and Bicyclists)

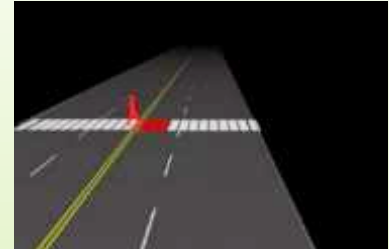
Forward roadway collision warning systems can reduce rear-end collisions, among other unsafe behaviors. Previous studies have shown that young drivers fail to scan adequately for latent hazards (Insurance Institute for Highway Safety, 2017; Hatfield and Fernandes, 2009).

The current study investigated how presenting head-up display (HUD) alerts at different onset latencies influenced the hazard anticipation, hazard mitigation, and attention maintenance behaviors of young drivers across two latent hazard types (pedestrians and vehicles).

This experiment examined the latent hazard anticipation behavior of 48 young drivers aged 18-25 across eight unique scenarios both in the presence and the absence of visual collision warning alerts.

The participants' hazard anticipation, hazard mitigation, and attention maintenance behaviors were evaluated on a driving simulator. An eye tracker was used throughout to gather eye behaviors; vehicle behaviors were automatically recorded by the driving simulator. The control group received no warning information about the potential latent threat. The three experimental groups received the warning information about the potential latent threat either 2 s, 3 s, or 4 s before the latent hazard.

The results indicate that appropriately timed HUD alerts can improve the latent hazard anticipation ability of young drivers in the presence of potential threats such as vehicles and pedestrians.



A sample of the HUD warning alert.



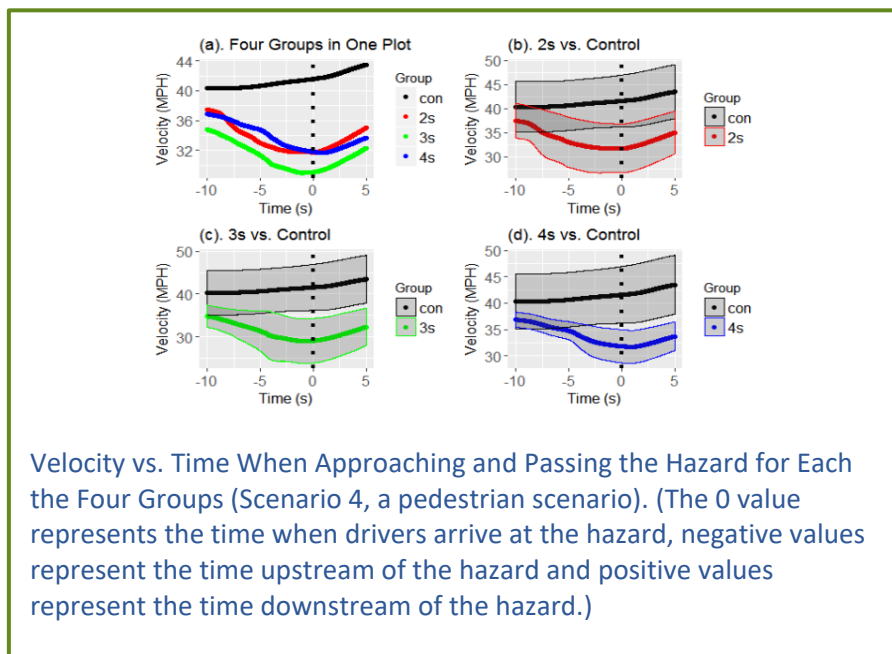
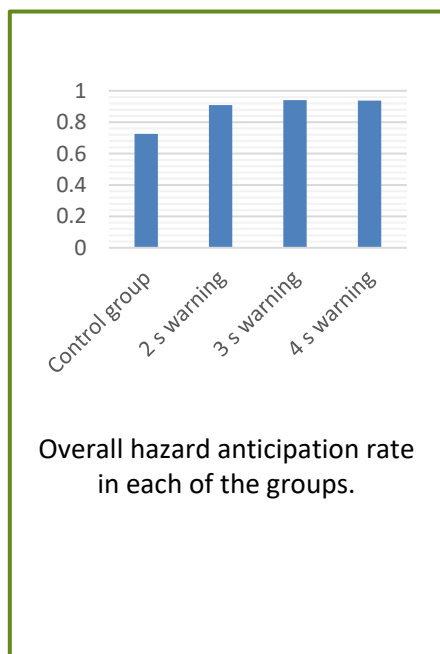
The placement of the alert on the windshield as the driver navigates a scenario with a latent threat.

Drivers who received HUD alerts anticipated a greater proportion of latent pedestrian and vehicle hazards compared to drivers who navigated the same scenarios without any warning message presented to them. Drivers who received the warnings were significantly more likely to glance at the potential hazard compared to the control group. There were no significant differences between the 2 s, 3 s, and 4 s warnings with respect to hazard anticipation.

In terms of hazard mitigation behavior, the velocity profile analysis shows that for pedestrian hazards, the 3 s and 4 s warning groups adopted a significantly slower speed after the warning was presented to them than did the control group. The velocity profile for the 2 s warning group was not significantly different from the control group. However, when the potential hazards are vehicles, the 2 s, 3 s, and 4 s warnings are all ineffective in

terms of improving hazard mitigation behavior.

In summary, the results of this study illustrate the effectiveness of HUD alerts on drivers' hazard anticipation and hazard mitigation behaviors as well as the fact that the alerts do not seem to distract the driver. This information is critical for designing Advanced Driver Assistance Systems (ADAS) systems.



References

Insurance Institute for Highway Safety. (2017). Teenagers: fatality facts based on the US Department of Transportation Fatality Analysis Reporting System (FARS). Accessed May 6, 2017, from <http://www.iihs.org/iihs/topics/t/teenagers/fatalityfacts/teenagers>.

Hatfield, J., & Fernandes, R. (2009). The role of risk-propensity in the risky driving of younger drivers. *Accident Analysis & Prevention* 41 (1), 25-35.