Research Report Summary

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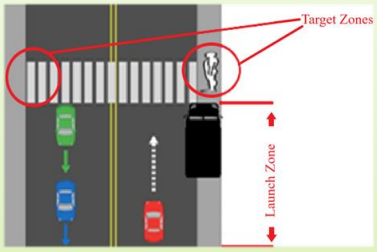
Risk Awareness and Perception Training using VR Headsets: The Validation of VR Headsets to Measure Hazard Anticipation Behavior

The objective of the current study is to evaluate the use of virtual reality (VR) headsets to measure driving performance for driving simulation studies and ultimately redesign the Risk Awareness and Perception Training (RAPT) program exclusively on a VR-headset-based driving simulator. Virtual reality is desirable because headsets are several orders of magnitude less expensive than driving simulators and, if validated, could greatly extend the powers of simulation.

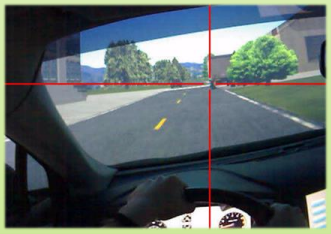
The current study specifically examines drivers' latent hazard anticipation behavior both because it has been linked to crashes and because it has been shown to be significantly poorer in young drivers than in their experienced counterparts in traditional driving simulators and in open-road studies. Latent hazard anticipation is also important in terms of designing a VR version of the RAPT program, since it is the central theme of the training program. The total time middle-aged drivers spend glancing at a latent hazard and the average duration of each glance were also compared to these same times for younger drivers using a VR headset and a fixed-base driving simulator.

In a between-subject design, 48 participants were equally and randomly assigned to one of four experimental conditions: two young driver cohorts (18-21 years old) and two middle-aged driver cohorts (30-55 years old) navigating either a fixed-base driving simulator or a VR-headset-based driving simulator. All participants navigated six unique scenarios while their eye movements were continually tracked.

Example Scenario: Obscured Crosswalk



Pedestrian is obscured by a truck parked before a crosswalk. Oncoming traffic obscures the other side of the crosswalk.



The scenario from the driver's point of view on the fixed-base driving simulator. The red cross is the eye-tracking crosshair.

The scenario from the driver's point of view on the VR-headset-based driving simulator. The red circle is the eye-tracking crosshair.

The proportion of latent hazards anticipated by participants, which constituted the primary dependent measure, was found to be greater for middle-aged drivers than for young drivers across both platforms. Results also indicate that the middle-aged participants glanced longer than their younger counterparts on both platforms at latent hazards, as measured by the total glance duration, but had no difference when measured by the average glance duration. Moreover, the magnitude of the difference between middle-aged and younger drivers was the same across the two platforms. The study also measured user-experience-based attributes and measures from the Driver Behavior Questionnaire in order to weed out anomalies that could have risen in the experiment.

The study provides some justification for the use of VR headsets as a way of understanding drivers' hazard anticipation behavior and using this knowledge to create a RAPT program designed solely for a VR-headset-based driving simulator.

The figures below represent the proportion of latent hazards anticipated by each group (top left); the weighted simulator sickness scores for each driver group (top right); and the mean average glance duration and mean total glance duration for each driver group (bottom middle).