The goal of this study was to evaluate driver risk behavior in response to changes in their risk perception inputs, specifically focusing on the effect of augmented visual representation technologies. This experiment was conducted for the purely real-driving scenario, establishing a baseline by which future, augmented visual representation scenarios can be compared. Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) simulation technologies have rapidly improved over the last three decades to where, today, they are widely used and more heavily relied upon than before, particularly in the areas of training, research, and design.

The resulting utilization of these capabilities has proven simulation technologies to be a versatile and powerful tool. Virtual immersion, however, introduces a layer of abstraction and safety between the participant and the designed artifact, which includes an associated risk compensation. Quantifying and modeling the relationship between this risk compensation and levels of virtual immersion is the greater goal of this project. This study focuses on the first step, which is to determine the level of risk perception for a purely real environment for a specific man-machine system - a ground vehicle – operated in a common risk scenario – traversing a curve at high speeds. Specifically, passengers are asked to assess whether the vehicle speed within a constant-radius curve is perceived as comfortable. Due to the potential for learning effects to influence risk perception, the experiment was split into two separate protocols: the latent response protocol and the learned response protocol. The latent response protocol applied to the first exposure of an experimental condition to the subject. It consisted of having the subjects in the passenger seat assess comfort or discomfort within a vehicle that was driven around a curve at a randomlychosen value among a selection of test speeds; subjects were asked to indicate when they felt uncomfortable by pressing a brake pedal that was instrumented to alert the driver. Next, the learned response protocol assessed the subjects for repeated exposures but allowing subjects to use brake and throttle pedals to indicate if they wanted to go faster or slower; the goal was to allow subjects to iterate toward their maximum comfortable speed. These pedals were instrumented to alert the driver who responded accordingly. Both protocols were repeated for a second curve with a different radius. Questionnaires were also administered after each trial that addressed the subjective perception of risk and provided a means to substantiate the measured risk compensation behavior.

The results showed that, as expected, the latent perception of risk for a passenger traversing a curve was higher than the learned perception for successive exposures to the same curve; in other words, as drivers ‘learned’ a curve, they were more comfortable with higher speeds. Both the latent and learned speeds provide a suitable metric by which to compare future replications of this experiment at different levels of virtual immersion. Correlations were found between uncomfortable subject responses and the yaw acceleration of the vehicle. Additional correlation of driver discomfort was found to occur at specific locations on the curves. The yaw acceleration is a reflection of the driver’s ability to maintain a steady steering input, whereas the location on the curve was found to correlate with variations in the lane-markings and environmental cues.