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The Role of Human Factors Research in Vehicle Accident Investigation

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Recent technological advances have shaped how investigators analyze vehicle accidents. Whereas accident investigators historically depended solely on research and literature to estimate a driver's response to a potential hazard, in many current cases, video analyses from in-vehicle and other fixed infrastructure cameras can now provide concrete details regarding the exact length of time and nature of a driver's response. Similarly, laser scans of vehicles and roadways enable today's investigators to create animations that reconstruct accidents with varied vehicle speeds and driver focal points. Finally, roadway drone footage can reveal potential site obstructions that investigators might not otherwise have perceived or considered in their assessments. These technological advances have enabled twenty-first century accident investigators to more confidently answer critical questions: How much time did the driver need to avoid the hazard in question? How much time did the driver actually have? Was it sufficient? Whether a driver had as much time as was needed has been referred to as the "critical window" (Krauss et al. 2012) and is the fundamental human factors question in the majority of vehicle-accident investigations.

It is important for accident investigators to analyze both environmental and human variables when drawing conclusions about whether involved parties could have avoided an accident. Did the driver encounter a curve in the road or other sightline obstruction? Did the accident occur during dense fog, a dust storm, or at night? Humans have known perceptual limitations that, when combined with environmental variables, can adversely impact their driving performance. For example, drivers who encounter fog often underestimate speed and perceive objects as farther away than they actually are. This can result in a driver coming upon hazards more rapidly than planned. Fatigue and intoxication are common inhibitors of a driver's ability to detect and effectively respond to a hazard. Expectancy, or the degree to which an event is anticipated by a driver, can significantly impact driver response time. For example, a driver is much more likely to anticipate encountering a pedestrian in a parking lot than in the middle of a highway. A subsequent collision in the former example may be more likely to have been caused by driver error, as the presence of pedestrians in a parking lot is relatively common and expected. In contrast, if a pedestrian darts into a highway at night, the driver likely has a low expectancy for that type of hazard, and, in turn, the ability for that driver to avoid an accident is reduced.

Human factors research can help investigators better evaluate the fundamental difference between what was objectively visible to each party in an accident versus what was likely to have been seen. Whether or not something is actually perceived by a driver is often a function of what the driver was doing and where he or she was looking in the moments preceding the accident. For example, imagine a pedestrian is struck in the road at night. Investigators and jurors might look at a recreated

photo of a pedestrian who is three hundred feet away and wearing similar clothing to the pedestrian in question. While investigators and jurors may easily spot the pedestrian, the recreation may not account for differences in the amount of viewing time allowed and the viewers' own attentional sets. In other words, while the jury had unlimited time to perceive this low-contrast pedestrian for whom they were actively searching, the driver likely had no prior knowledge the pedestrian would be there and had limited time to perceive him or her. Through these types of comprehensive analyses, human factors research provides investigators with the necessary tools to understand how the eyes and brain work together to build driver perception and response. This in turn helps answer the critical question of what a driver is likely to have perceived at the time an accident occurred.

Human factors insights from accident investigations can also help inform decisions about future vehicle design. For example, many automated vehicles possess an emergency response feature that prompts the vehicle to brake if a hazard is detected in close proximity. This feature can unintentionally startle drivers who are not expecting the vehicle to automatically apply its brakes. Eye tracking research tells us that drivers preparing to turn left tend to focus more heavily on the left side of their viewing area. A pedestrian who comes from the right is therefore likely to be overlooked. Human factors research can help manufacturers consider alternative designs that warn drivers of hazards that are several feet ahead—or in parts of a driver's environment that may receive less attention given the driver's task.

Vehicle manufacturers often turn to third parties to assist with both vehicle accident investigation and automated vehicle design. Exponent's multidisciplinary team of engineers, scientists, and human factors consultants leverage expertise in cognitive psychology, visual perception, and human memory to address the critical questions of why a vehicle accident has occurred, to what extent it could have been avoided, and what, if any, automated features could help mitigate future risk.

David A. Krauss, Ph.D.
Human Factors
Principal Scientist
Los Angeles
(310) 754-2749 | dkrauss@exponent.com