Drivers predictably encounter the unpredictable. Whether as benign as a newspaper blowing across the road or as serious as a child darting from the curb, drivers must decide what to do when confronted with these situations. In the case of the blowing newspaper, a driver may decide to do nothing, whereas in more serious situations, drivers typically respond. Unfortunately response alone does not guarantee successful avoidance. Failure to avoid the hazard may lead to injury, which may in turn lead to close scrutiny of the driver's response.

In this article, we describe how scientists and engineers evaluate driver responses to help clarify liability questions. Driver responses are generally scrutinized in three ways: 1) response speed, 2) response choice, and 3) response magnitude.

Response Speed
A driver's perception/response time (commonly called PRT) is a measure of how much time a driver takes to respond to a hazardous event. “Perception” is perhaps a misnomer here, since we cannot read the driver's mind to determine the moment a hazard was first “perceived”. Indeed, if drivers were held accountable to when they said they first “perceived” the hazard, they could simply say they never saw it!

Instead, PRT is bracketed by two events. The first event is when a hazardous event begins or becomes apparent. This might be the moment a stopped vehicle begins to accelerate into the path of the approaching driver, or the moment when a pedestrian steps out from behind a parked truck. The second event is when the driver begins to execute a physical response, such as steering or braking.

**Driver response is evaluated on:**
1) Speed
2) Choice
3) Magnitude

During a driver's PRT, it is generally accepted that they must perform four tasks. First, the driver must detect the hazard in front of them. In daytime, this is usually straightforward. At night, reduced lighting may reduce a driver's opportunity to detect the hazard.

Second, the driver must identify the situation as hazardous. This may be clearly apparent when approaching a stationary pedestrian who is looking in the opposite direction but could be more difficult if the collision path between two vehicles must be predicted.
Third, a driver must decide what to do. Their options include doing nothing, swerving left or right, braking or accelerating, or some combination thereof. The complexity of the hazardous situation can complicate this decision. Drivers typically respond faster when the response choice is clear. For example, in response to a decelerating lead vehicle, the decision to brake is clear. In response to an oncoming vehicle crossing the centerline, the decision to swerve left, swerve right, brake, or do nothing is less clear, and it typically takes drivers longer to decide how to respond.

Lastly, a driver must physically act. In the case of braking, the driver moves their foot from the accelerator to the brake pedal. If a driver already had their foot over the brake, their response time can be quicker.

**Perception Response Time, or PRT, is a measure of a driver's response speed to a hazardous event. It begins when the hazardous event begins or becomes apparent and ends when the driver applies a physical response.**

Once the driver begins to initiate a vehicle response, such as steering or braking, the PRT is considered “officially” over.

Human factors and accident reconstruction techniques have evolved far beyond the one-size-fits-all approach to perception/response time, recognizing that driver response will depend on the hazard confronting the driver and its context. Numerous studies have tested drivers under nearly real-world conditions, and these studies often help provide a better context against which to evaluate a driver.

**Response Choice**

Facing a complex hazard, a driver may not know which avoidance response is best. In retrospect, their decision to swerve left instead of right might seem to be clearly wrong. Sometimes drivers are criticized for not making what may appear to have been a better choice.

This sort of after-the-fact avoidance analysis incorporates what is referred to as hindsight bias. That is, with the benefit of hindsight, the analyst can clearly see the avoidance maneuver that should have been taken. Unfortunately, that clarity is not always present in the moment and drivers often rely on instinct. For example, drivers often steer away from a hazard. Although intuitive, this can increase, rather than decrease, the likelihood of collision. Imagine a vehicle accelerating across a driver’s path from a stop sign on the right. The approaching driver is likely to swerve left. Unfortunately, this response steers the car towards where the incurring vehicle will be, rather than steering towards where it won’t be, a moment later.

Steering towards the incurring vehicle is counter-intuitive. It may successfully avoid a collision if that incurring vehicle continues accelerating across the approaching driver’s path, but could cause a collision if the incurring vehicle instead stops. The behavior of the incurring vehicle is something the approaching driver can predict.

For these reasons, some jurisdictions acknowledge that drivers facing the “agony of collision” should not be held to a standard of perfection, but to a standard of what a “reasonable” driver would do in similar circumstances. When judges and juries are shown that an incident driver responded in a manner consistent with other “typical” drivers in a study with similar circumstances, the incident driver will often be considered to have chosen a “reasonable” response, despite the unfortunate outcome.

With hindsight, we may see that steering away from an incurring hazard resulted in tracking its path to impact.
Response Magnitude

Often, collision avoidance analyses assume that once a driver’s PRT is complete, their brakes can be fully applied – perhaps subject to some mechanical lag within the brake system. The problem with this approach is that drivers typically do not take advantage of their vehicle’s full braking capabilities. If drivers don’t typically brake as hard as possible, yet are held to this standard by analysts or courts, drivers may be found to be at fault for a collision when their imperfect behavior actually reflects that of a typical driver.

Think about your own emergency driving experiences. How often did you lock up your tires and skid down the road? Or in the case of modern anti-lock-brake-equipped vehicles, how often did you feel the characteristic pulsation of anti-lock braking through your brake pedal? If you are typical of many drivers, your answer is likely “not very often” or perhaps even “never”. Even if you have achieved these high levels of deceleration, it is likely that they weren’t achieved instantly but rather evolved as you continued to assess the situation you were responding to.

There are numerous experiments that suggest drivers faced with a simulated hazard will not typically respond immediately with full braking. As early as 1968, researchers used a driving simulator to expose subjects to the sudden appearance of a pedestrian entering the road from behind a shed located near the road edge. The results showed there was a significant variation in the degree of braking applied by the subjects. In fact, the subject who had the fastest initial brake response time never actually applied his brakes hard enough to avoid impact.

Conclusions

In litigation, driver response may be assessed in three ways: 1) response speed, 2) response choice, and 3) response magnitude. Response speed, typically quantified as perception-response time (PRT), is assessed based on the particular hazard confronting the driver with reference to experimental data. Response choice, which may be linked to the “agony of collision”, is difficult to critique without the influence of hindsight but may also be compared to typical experimental response. With respect to response magnitude, many studies have demonstrated that drivers are hesitant to fully apply their brakes – even in emergency situations. For those that do, there may be a significant delay in reaching higher levels of deceleration. Consideration of these three issues allows scientists and engineers to evaluate the “typicalness” of a driver’s response in a particular incident.

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Kurt Ising is a Senior Engineer and Principal of MEA Forensic Engineers & Scientists. In 1994, Mr. Ising obtained his Master’s degree in Aerospace Science and Engineering from the University of Toronto. He joined MEA Forensic in 1995. Mr. Ising is responsible for technical investigations of motor vehicle accidents with an emphasis on driver visibility and human factors issues.

Jason Droll is a Senior Human Factors Scientist at MEA Forensic Engineers & Scientists. He completed his PhD in Brain and Cognitive Science at the University of Rochester in 2005. Dr. Droll joined MEA Forensic in 2010, but has been working in the forensic human factors field since 2008. He specializes in analysis of the performance and behavior of people in a variety of tasks, such as when driving or using consumer products.

Pamela D’Addario is a Project Engineer at MEA Forensic Engineers & Scientists having joined the firm in 2008. She completed her Master’s degree in Industrial Engineering (Human Factors) at the University of Toronto in 2014 focusing on driver response to hazardous events. Ms. D’Addario conducts technical investigations of motor vehicle collisions with specialization in cases involving motorcycles, recreational vehicles, pedestrians, nighttime visibility, and human factors.

Collision Reconstruction
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