Human Factors in the Driving Environment. I spent a week in August of this year taking a Human Factors class taught by Jeff Muttart. His name is not well-known outside of the accident reconstruction community, and perhaps there are many accident reconstructionists who have not heard of him. He is an ACTAR accredited accident reconstructionist who decided, some thirteen years ago, to study the pre-impact actions of persons involved in collisions. To evaluate those factors, he reviewed dozens of test sets done by researchers all over the world and based his initial work on a review of over ten thousand (that's right, 10,000) tested subjects in a wide variety of situations, from low-fidelity simulator (brake, screen, and steering wheel) to real-world driving situations. He divided the observations and actions of drivers in reacting to immediate hazards which required an emergency response into: the detection interval, perception-reaction time, movement, vehicle latency, and vehicle response. The detection interval is the period of time between when a hazard might first become visible to the instant that the driver perceives it as a hazard. The perception-reaction time is that interval from the detection of the hazard to the decision regarding the appropriate response. The movement period is, of course, the time it takes a person to physically initiate some action in response to the hazard. Vehicle latency is the time from the end of driver movement until the vehicle is effectively responding to the driver's input. After that comes vehicle response, which is beyond the realm of human factors.

Studies have shown that most drivers react to an immediate hazard by applying brakes, even in those situations where the only way to avoid a collision is by a steering input. Although the steering response has been studied, the response of braking is the one of most interest, since most reactions are braking, which may involve skidding or actuation of the anti-lock braking system, if the vehicle has one. For those situations where braking is the response of choice, he groups the perception-reaction time with the movement time and calls that interval the brake reaction time. Including the additional factor of vehicle latency (for braking, the time between when the brake pedal is first applied until the brakes are fully functioning to slow the vehicle), he defines that interval as perception–response time. Interestingly, he has been able to take the ten-thousand-plus tests and use factors to account for differences in testing to relate them. This is based on studies of human reactions and performance dating back to the nineteenth century and a man named Frans Donders, who developed a methodology to determine the time spent in conducting certain mental processes and the resulting physical response; he called it the subtractive method. In essence, he would time people who were asked to perform a response after a choice, then he would time people for the same test where there was no choice, only a response. The difference between the first test and the second test was the time involved in making the choice, which he could numerically evaluate by subtracting. What we now call a stop-watch was invented to measure small increments of time involved in those tests.

Other psychologists and researchers over the years have built on that original principle to be able to determine, with surprising repeatability, how much time is involved in certain routine tasks for virtually every person. In other words, most people take essentially the same amount of time, plus or minus a very small amount, to move a foot from the gas pedal to the brake pedal. In a low-fidelity simulator, people are told to press the brake pedal when they see a light come on. In the driving environment, there is extra time involved in understanding the hazard and deciding how to respond; that extra time increment is the same, plus or minus a few milliseconds, for virtually every person. So studies of reaction time done on a low-fidelity simulator can be related to studies done on a high-fidelity simulator by adding the extra time involved in understanding the hazard and deciding what to do about it. Jeff Muttart used the ten-thousand-plus tests and stepwise linear regression to develop formulas which can numerically determine a driver's perception-response time for virtually every common situation in driving: path intrusions, lane changes, slowing of lead vehicles, traffic signals, and other situations. His work also address topics such as night conspicuity (or lack thereof), eyewitness reliability, fatigue effects, driver distractions (cell phones, eating while driving, etc.), and others. He created a computer program, called DRIVE3, which can be used to calculate the average perception-response time for virtually every driving situation. This also gives ranges based on percentile groups (standard deviations). This program is available to accident reconstructionists through various methods. But wait! There's more! Since developing DRIVE3, and while working on another computer program which will