

## The 3 Factors

A traffic accident is a highly involved, complex interaction between two objects. It includes a series of events that led up to the conclusion of the traffic accident. It is not simply a car hitting another object. To fully reconstruct a traffic accident, one must thoroughly understand, and evaluate what has occurred that caused, or contributed, to this event.

The reconstruction of a traffic accident must take into consideration there are various factors associated with all traffic accidents. To properly reconstruct a traffic accident, three essential and distinct factors must be investigated and documented in order to provide a well-founded explanation of the series of events prior to, during, and after a traffic accident.



### Human Factor:

Human Factors are associated with the individuals involved in the traffic accident. They include the driver and passengers but can also include bystanders. Factors include the individual's distractions, use of alcohol or drugs, use of medications, medical events, fatigue, and the individual's perception and reaction time (PRT). Most traffic accident cause classification systems have focused on the errors and actions of the participant that immediately led to the conflict. The actual reasons why human failure occurred are often not considered.

In 2015, the National Highway Traffic Safety Administration, a branch of the U.S. Department of Transportation, published a two-page memo declaring that "the critical reason, which is the last event in the crash causal chain, was assigned to the driver in 94% of the crashes." The memo, which was based on the NHTSA's own analysis of crashes, noted that traffic accidents are the result of many interacting factors.

In the "SUMMARY OF IMPORTANT FINDINGS" of a 1999 study prepared for NHTSA, "*The Relative Frequency of Unsafe Driving Acts in Serious Traffic Crashes*", the study determined the specific driver behaviors and unsafe driving acts that lead to crashes, and the situational, driver and vehicle characteristics associated with these behaviors. A sample of 723 crashes involving 1284 drivers was investigated. The crashes provided a fair sample of serious crashes involving passenger vehicles in the United States and in-depth data was collected and evaluated on the condition of the vehicles, the crash scene, roadway conditions, driver behaviors and situational

factors at the time of the crash. The focus of the study was to determine the primary cause of each crash and uncover contributing factors.

In 717 of the 723 crashes investigated (99%), a driver's behavioral error caused or contributed to the crash. There were six causal factors associated with driver behaviors that occurred at relatively high frequencies for these drivers and accounted for most of the problem behaviors. They were:

- **DRIVER INATTENTION.** The most dominant component of the causal factor pattern was driver inattention. Driver inattention indicated a lack of focus on the required field of view (typically forward). This definition encompassed both the driver inattention and driver distraction categories. Inattention was noted as the sole causal factor for a majority of the drivers who contributed to crash causation.



- **VEHICLE SPEED.** The second largest component of the causal factor pattern was the vehicle speed factor. These typically reflected circumstances in which the driver was exceeding the speed limit and the absolute vehicle velocity contributed to crash causation.

It should be noted, however, that this causal factor was assigned in a small number of crashes where the vehicle's travel speed was at or below the posted speed limit. In these situations, the travel speed was inappropriate for prevailing weather/roadway conditions and contributed to a pre-crash loss of vehicle control (i.e., too fast for conditions). While the road conditions could be considered a separate causation factor, the driver's inability to recognize the hazards associated with hazardous roadway conditions or weather is considered a Human Factor.

- **ALCOHOL IMPAIRMENT.** Alcohol impairment was the third largest component of the causal factor pattern. In addition, the study found that alcohol impairment was a contributory factor in combination with other primary factors for many of the drivers.
- **PERCEPTUAL ERRORS.** The fourth most frequently assigned causal factor involved perceptual errors associated with intersection crashes. Two specific scenarios were noteworthy:

(1) The subject driver checked for approaching traffic, did not see the other crash-involved vehicle (e.g., looked, did not see), and then attempted to cross or turn at the intersection.

(2) The driver checked for approaching traffic, saw the other vehicle, but then either misjudged the distance to that vehicle or misjudged the approach velocity of that vehicle (e.g., accepted inadequate gap to another vehicle).

- **DECISION ERRORS.** The primary scenario in this group involved subject drivers who attempted to turn or cross with an obstructed view. While these situations typically reflected intersection crashes, there were a number of collisions which occurred at non-intersection locations (e.g., driver attempted to cross the roadway from a private/commercial driveway or attempted to turn into/exit a private/commercial driveway). Additional causal factor types in this category included violated a red traffic signal, attempted to beat a phasing signal, or violated a stop sign



- **INCAPACITATION.** Drivers who fell asleep or experienced a seizure/heart attack/blackout or other medical condition contributed to the causal factor pattern.

Past research has indicated the vast majority of traffic accidents are caused by human error. A landmark study by Indiana University (Treat, et al, 1979) found that Human Factors caused or contributed to 93% of the crashes investigated. The three major human factors most frequently reported in that study included improper lookout, excessive speed, and inattention.

Recent events illustrate the importance of human factors analysis in traffic accident reconstruction. One example is the 2018 Uber autonomous vehicle accident in Tempe, Arizona. The accident involved a woman who was walking her bicycle across the street when she was struck and killed by an Uber self-driving car. The National Transportation Safety Board (NTSB) investigation found that the vehicle's system detected the bicycle rider 5.6 seconds before impact. However, the driver was watching a video on her phone and not paying attention to the road. In-car video showed her gaze was re-directed from her phone about one second before impact. Driver steering input was determined to have occurred less than a second before impact, but the driver did not apply the brakes until about one second after the impact. The NTSB also identified several human factors that contributed to the accident, including the vehicle operator's inattention and over reliance on the vehicle's automated system.

The 2019 fatal crash involving a Tesla Model S in Delray Beach, Florida is another traffic accident that highlights the importance of evaluating the Human Factor. The crash occurred when the vehicle, which was on autopilot, collided with a tractor-trailer that had crossed its path. The National Transportation Safety Board (NTSB) investigated the accident and found that the driver was not paying attention to the road and was relying too heavily on the vehicle's automated system. The NTSB also found that the autopilot system contributed to the accident by not detecting the trailer.



Another example is the 2019 crash involving a tour bus in Bryce Canyon, Utah, resulted in the deaths of four passengers and injured several others. The investigation found that driver fatigue contributed to the accident.

Probably the most infamous traffic accident where Human Factors was the primary cause of a traffic accident is the tragic death of Princess Diana at the age of 36 in a car crash on August 31, 1997. Princess Diana, along with her fiancé Dodi Fayed and driver Henri Paul, were killed when their Mercedes-Benz W140 slammed into a pillar in the Pont d'Alma tunnel in Paris France. The accident was attributed to a number of factors, including the behavior of the driver and the presence of paparazzi pursuing the vehicle. However, there were also several Human Factors that contributed to the accident.



- Speeding

The high speed of the vehicle was determined to be a contributing factor. The Mercedes was traveling at a high rate of speed at the time of the crash estimated at 59 to 68 mph (95 to 110 kph). More than twice the speed limit of 31 mph (50 kph). The high speed was likely due to the pressure of being pursued by paparazzi.

- **Lack of Seatbelt Use**

Investigators found that no one in the Mercedes was wearing seat belts at the time of the crash. This greatly increased their risk of injury and death in the accident.

- **Driver Intoxication**

The autopsy of driver Henri Paul found an alcohol level of 0.175 g/mL (1.75 g/L), three times over the legal limit to drive. Prescription drugs also tested positive in the toxicology examination.

- **Failure to Maintain Control**

The driver lost control of the vehicle, likely due to a combination of factors of high speed and driving while intoxicated, and the presence of paparazzi.

The 1999 French investigation determined high speed and driving while under influence of alcohol and prescription drugs was the primary factor in this traffic accident.

The tragic accident that claimed the life of Princess Diana was a stark reminder of the importance of Human Factors in traffic accidents. Speeding, lack of seatbelt use, failure to maintain control, and driving while under the influence can all contribute to the likelihood and severity of a crash.

Human Factors analysis can be challenging, as it requires a deep understanding of the human element of an accident. Accident reconstructionists must consider factors such as the operator's training, experience, and cognitive workload. They must also consider the interaction between the operator and the technology or equipment involved in the accident. Human Factors analysis is a critical component of accident reconstruction. Recent case studies highlight the importance of this analysis in understanding the causes of accidents and understanding how Human Factors are involved in a traffic accident.

### **Mechanical Factor:**

The second factor that must be considered in a comprehensive reconstruction is "The Mechanical Factor." Mechanical factors address issues associated with the involved vehicles and proper documentation of the involved vehicles is necessary. A mechanical vehicle inspection should be completed on all traffic accidents, particularly those involving serious injury or a fatality. This is not to say that a mechanical inspection of the vehicles involved in a minor traffic accident should be ignored. While a serious injury or fatal traffic accident may require a full mechanical inspection, a simple exterior inspection of the major operating features of a motor vehicle can be completed as part of any traffic accident investigation.

Ideally, a full mechanical inspection should be completed by an individual that is experienced in determining mechanical failures as part of the causation or contributing factor of a traffic accident. Most general mechanics are not trained to specifically identify these factors.

All mechanical inspections of vehicles involved in a traffic accident start with a walk around of the vehicle on the scene. Careful notes must be taken of any suspected mechanical failure that may be involved in this traffic accident. Also be aware of damage that may not have been

caused, or appears out of place, by the mechanics of the traffic accident. If something doesn't look right, you may need to walk back to the scene to see what caused the damage and if it could have contributed to a loss of control.

Photographing the vehicle is a crucial step in this process. As a young Trooper we used standard department issue 35 mm cameras with roll film. The film was expensive as well as the processing of the photographs, and it was time consuming. It often took weeks before we received our photographs back from the processing department and only then did we find 8 of the 12 pictures were out of focus or too dark to see any detail. The digital cameras available to the accident investigator allow for a mass quantity of photographs that can be instantly viewed for clarity and detail. And you don't need to use an expensive DSLR or mirrorless digital camera. The cellphones available today have excellent cameras that offer high quality photographs. Many professional photographers are using cellphone cameras as part of their trade.



I teach a course on the use of photography in traffic accident investigations. The first thing I tell my students is, "Know how to use your camera." The time to know how to use any camera is before you need it. Be familiar with what the camera can and cannot do and how to use the features available with your gear. Many times, I arrived at an accident scene and saw officers looking through the owner's manual for their camera while trying to figure out how to use it.



There are a ton of free classes available teaching how to use your camera, including the camera on your cellphone. Along the lines of the camera, it's a good idea to have several in your scene tool kit. A backup or secondary camera is good in case your primary one gets broken, (it happens) or you need a special photograph that your primary camera can't get. An example is a tight spot where you need to get in between compacted damage or underneath the dash or seats. A regular size DSLR may not fit but a slim line digital camera will. These are relatively inexpensive and a lot less than your cellphone. I have a slim line digital camera that I've used for years and it's great for this purpose and costs under \$100.

As part of the inspection, don't forget to check the lights on the vehicle. Headlights, day or night, increase the visibility of the vehicle, as do taillights. Were the turn signals needed and were they operational? Check the cover of the lights for dirt or fading that may affect the ability for them to be seen. Same goes for the windshield where defects and tinting should be noted.

Next is the interior inspection of the vehicle. Granted, the damage caused by the collision may not allow entry but do the best you can to check the position and functionality of switches and pedals. Don't forget the seatbelts and airbags as well as anything inside that may be a factor. I worked a traffic fatality where the damage to the vehicle did not match the extensive injuries the passenger sustained. While doing an interior inspection a large item that was not secured in the vehicle became a projectile that struck the passenger and caused the injury.

A part that is frequently overlooked or under investigated are any recalls to the vehicle. The National Highway Traffic Safety Administration (NHTSA) has a free website where you can enter the VIN of the vehicle and search for recalls (both active and reported). Just because an active recall is not listed for the vehicle you are searching for doesn't mean they are not affected by other recalls listed on the website. The website also indicates any owner complaints, active investigations, and manufacturer communication for the year, make and model of the vehicle or like vehicles. By searching the additional information that is available on the website a potential issue with the vehicle(s) in your investigation may be discovered and should be addressed. At a minimum, to rule out that this was a causal or contributory factor in your investigation.

This posting is just a short, basic description of a traffic accident mechanical inspection. (Or vehicle autopsy, post-crash inspection, etc.) For further reading I suggest finding a copy of "*Vehicle Documentation: The Inside Story*", by Arnold G. Wheat, BS, ACTAR. Mr. Wheat is the Chairman of S.O.A.R. (the Society of Accident Reconstructionists) and has given this presentation at numerous accident reconstruction conferences, most recently at WREX2023, the World Reconstruction Exposition, held in Orlando, Florida. This article explains the value of and how to conduct a vehicle mechanical inspection.

## **Vehicle Documentation: The Inside Story**

By Arnold G. Wheat, BS, ACTAR

Presented at WREX 2023 Conference, Orlando, Florida



## Environmental Factor:

These factors include not only weather conditions but the condition of the roadway as well as anything in the area that may affect the ability of motorists to safely operate their vehicle on the roadway. Environmental factors consist of more than what the weather conditions were at the time of the traffic accident and they can play a significant role in contributing to traffic accidents. These factors can include:

- **Weather Conditions:** Adverse weather such as rain, snow, ice, fog, or high winds can reduce visibility, decrease tire traction, and increase stopping distances. Research how the weather was at the time of the traffic accident and immediately after. Don't forget to determine the air temperature and wind chill factor.



- **Road Conditions:** Poor road conditions like potholes, uneven surfaces, or debris can lead to loss of vehicle control or sudden maneuvers. Document the type of roadway material that was on the scene and what was the condition of the roadway. Is there snowpack or icy conditions / black ice. Was the road wet from a recent rainstorm causing a hydroplaning hazard.



- **Lighting Conditions:** Low light conditions such as darkness or glare from sunsets/sunrises or oncoming vehicles can impair visibility and make it harder for drivers to see hazards or other vehicles. It's a good idea to sit in the driver's seat, if possible, and see if there are any conditions that would affect the driver. Don't forget to check the condition of the windshield. A windshield that is cracked, pitted, or so dirty can cause decreased driver visibility.





- **Traffic Density:** High traffic volumes increase the likelihood of accidents due to congestion, reduced maneuverability, and increased stress levels among drivers. Consider the experience level and age of the driver and how that may affect the ability of the driver to handle the increased stress.



- **Road Design:** Poorly designed roads, intersections, or lack of clear signage can confuse drivers, leading to wrong turns, abrupt stops, or failure to yield situations. Check line of sight visibility and what may have affected the driver's visibility. The condition of the traffic signals, signs, and marking should be evaluated.



- **Construction Zones:** Road construction activities can alter traffic patterns, reduce lane widths, create temporary hazards, and require sudden speed changes. Check that all the required signage is in place and visible. Construction zones on state or federal roadways typically have a site plan that must be filed which will include the traffic control plane. The traffic control plane will show what signs were required and where they must be located. A handy reference for signs and placement on public roadways is the Manual on Uniform Traffic Control Devices (MUTCD) which is a free download on the U.S. Department of Transportation, Federal Highway Administration website.



- **Presence of Pedestrians and Cyclists:** Areas with heavy pedestrian or cyclist traffic require drivers to be more attentive and cautious. Check the surrounding area for signs indicating pedestrian or cyclist traffic. Document any crosswalk and/or crosswalk signs and signals.



- **Animal Crossings:** Rural areas or places near wildlife habitats may experience accidents caused by animals crossing roads unexpectedly. Again, document any signs indicating animal crossings and if the time of the traffic accident was when animals are known to be active.



- **Environmental Hazards:** Natural disasters like earthquakes, floods, or landslides can damage roads or create hazardous driving conditions. If a traffic accident occurs after a hazardous weather event, document any warning signs and the distance to the area of the traffic accident.



- **Pollution Levels:** High levels of air pollution can reduce visibility and affect driver concentration and visibility. Check for any public announcement or warning of high levels of air pollution that could affect driver visibility.



Environmental factors are an important part of the on scene investigation. By completing a detailed review of the three factors associated with traffic accidents, an investigator can accurately determine the cause and any contributory factor to a traffic accident and provide an unbiased and comprehensive conclusion.

By properly exploring “The 3 Factors”, a reconstructionist will be able to provide a comprehensive and unbiased conclusion as to what caused and what contributed to a traffic accident.