

Using Science to Identify the Driver

Introduction

Questions of liability and criminal responsibility often hang on who was driving. The value of a catastrophic injury claim in a single vehicle accident also turns on whether the injured party was the driver or a passenger. But when two vehicle occupants claim the other was driving, the physical evidence may be the only route to sorting out who was behind the wheel.

Two types of forensic engineers bring different areas of science to bear on identifying the driver.

Mechanical engineers can quantify how occupants move inside a car before, during and after a crash. Combined with damage or contact marks inside the car, their analysis can sometimes identify who was-or who was not-driving.

Biomechanical engineers, on the other hand, analyze an occupant's injury pattern and compare the forces needed to cause these injuries with the forces experienced by occupants in different seats during the crash. Matching injuries with a particular seated position can also sometimes determine who was driving.

The goal of this article is to explain how mechanical and biomechanical engineers use different pieces of the physical evidence to determine who was driving.

Who was driving?

Late one night, a tired driver steers too late to negotiate a bend on a quiet rural road and the car yaws off the right shoulder into a tree. The impact to the car's right rear wheel area is severe and the car spins off the tree, coming to rest several metres away. Emergency responders find a deceased female with long dark hair lying outside the car. The other occupant, a male with short blonde hair, has a forehead abrasion and is walking around the accident scene confused and in shock. The police find short blonde hair in a star-shaped windshield fracture ahead of the passenger's seat. When asked, the male says he was not driving, even though the car belongs to him. Was the male in the passenger's seat as he claims?

A mechanical engineer used the tire marks, vehicle damage and the car's rest position to conclude that the car drifted off the right side of the road and hit the tree at a speed of about 60 km/h. The force of the impact slowed the car's speed by about 50 km/h and spun it clockwise at a rate

of about 1 1/2 revolutions per second. Further analysis showed that the occupants would move forward and to the right relative to the interior. If neither occupant was wearing a seatbelt, the driver's head would strike the passenger's side of the windshield and the front passenger's head would strike the structural A-pillar to the right of the windshield. Since the male occupant's hair was found on the passenger's side of the windshield, he was probably the driver.

A biomechanical engineer analyzed the head injuries sustained by both occupants. The male suffered a concussion and forehead abrasion, whereas the female died from a depressed skull fracture and an underlying brain injury. The force applied to the head and the resulting head acceleration were determined for a driver hitting the windshield and the right front passenger hitting the A-pillar. Windshields are designed to fracture during head contact and thus expose the head to lower peak accelerations than the rigid A-pillar. The driver's head impact with the windshield glass would not have generated enough force to fracture the skull whereas the passenger's contact with the A-pillar could have fractured the skull. As in the mechanical engineer's analysis, the biomechanical analysis placed the surviving male in the driver seat.

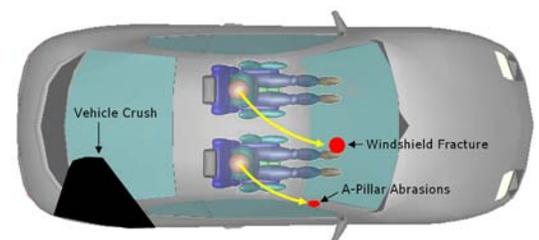


Figure 1 - An analysis of occupant motion concluded that the short blonde hair found on the right side of the windshield was probably from the driver. An analysis of injury concluded that the driver would experience a less severe head injury than the right front passenger. Both analyses identified the same individual as the driver.

Letting the evidence speak...

Physical evidence provides the foundation for a robust forensic engineering opinion. So, what kind of evidence are engineers interested in and why?

Mechanical engineers rely on evidence from the accident scene and the car when analyzing occupant motion. The location and magnitude of external damage to the car and tire marks,



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pavement gouges, damage to roadside objects and the rest positions of cars, debris and occupants at the accident scene are important. If this information cannot be gathered first hand, then the police, witnesses and news media can be canvassed for useful photographs or notes.

The interior of the car may also hold vital information. A trained eye can find cracks, dents and scuffs caused by occupant contact, such as head contact with the windshield or knee contact with the dash or centre console. Clothing material transfer or residual DNA at these contact sites can be related back to specific occupants. When combined with an analysis of occupant motion, this kind of evidence can conclusively identify who was driving.

A detailed vehicle examination can also uncover other clues. Marks on the seat belt components may reveal whether a seat belt was worn. The driver's seat might be too far from the pedals for a short occupant to reach them. The position of the driver's seat may correspond to the memory setting for only one occupant's smart key. In rarer cases, the impression of a shoe sole may be found on the brake pedal.

Nowadays, the airbag systems of many cars capture and store electronic data from a crash. So-called "black box" data can include the original seat adjustment and classify the weight of a seat's occupant. These data can help identify the seated positions of occupants based on stature and weight. These data can also show that there was no one in the passenger seat, information that is useful when someone claims the driver fled the scene

of the crash. The veracity of a driver's statement can also be tested by comparing it to a black box record of steering, braking and throttle use in the seconds leading up to a crash.

Biomechanical engineers rely on the location, severity and pattern of diagnosed injuries described in the medical reports. They compare the mechanisms of these injuries to the forces experienced by an occupant in different seats inside the vehicle. Both the shape and extent of interior damage can be more consistent with one occupant's injuries than another occupant's injuries. Forces applied to the occupant by airbags, seat belts, loose cargo and crush into the occupant compartment vary with seat position or can cause injuries to occupants in some seat positions but not others. The relative rest positions of ejected occupants can also indicate who was ejected first and therefore who was seated closer to the ejection portal.

In some cases, minor injuries such as lacerations, bruises or abrasions provide the best evidence. For example, a driver will experience seat belt bruising over the left clavicle whereas a right side passenger will experience seat belt bruising over the right clavicle. Or a small curved laceration on the right knee may correspond to a window crank on the passenger door rather than the centre console adjacent to the driver's knee. Photographs of the injuries, particularly superficial injuries, can be very useful for matching injuries to the objects an occupant can hit inside the vehicle.

Summary

The physical evidence present in the aftermath of a car crash often contains valuable clues that identify who was driving. Mechanical and biomechanical engineers bring different areas of science to bear in these sometimes difficult cases. When the physical evidence is present, one or both of these forensic specialties can objectively answer the question of who was driving the car when it crashed.

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