We Drive By Night

AND WHEN WE DO WE OFTEN MISJUDGE OUR VISUAL ABILITIES, COURTING DISASTER.

BY HERSCHEL W. LEIBOWITZ AND D. ALFRED OWENS

Picture driving down a familiar road on a pleasant evening. It's dark, but the weather is clear and the traffic is light. Suddenly you hear a thud from underneath the car. You puzzle over the noise for a moment, decide it was either a piece of wood, a pothole or some other obstacle and drive on. Later that night, the police come to your home and tell you that one of two pedestrians walking along the road earlier has been struck by a car and killed. Badly shaken, the other person described your car and remembered your license-plate number. You are arrested and charged with manslaughter.

This story sounds incredible, but it might easily come true. The

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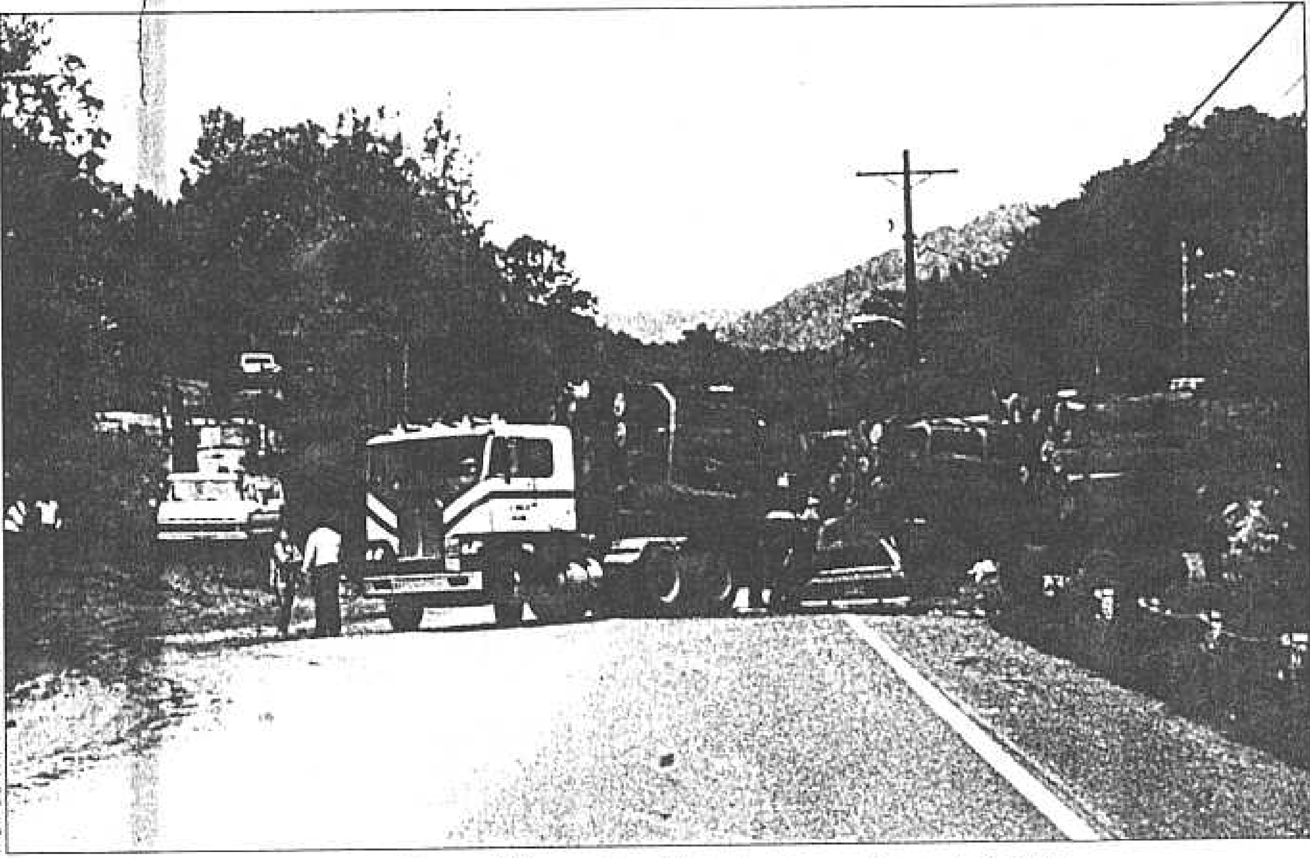

THE PROGRESS, CLEARFIELD, PENNSYLVANIA

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facts are clear and simple. More than half of all traffic deaths occur at night, despite the fact that far fewer miles are driven then. With mileage taken into account, the nighttime fatality rates are three to four times higher than daytime rates.

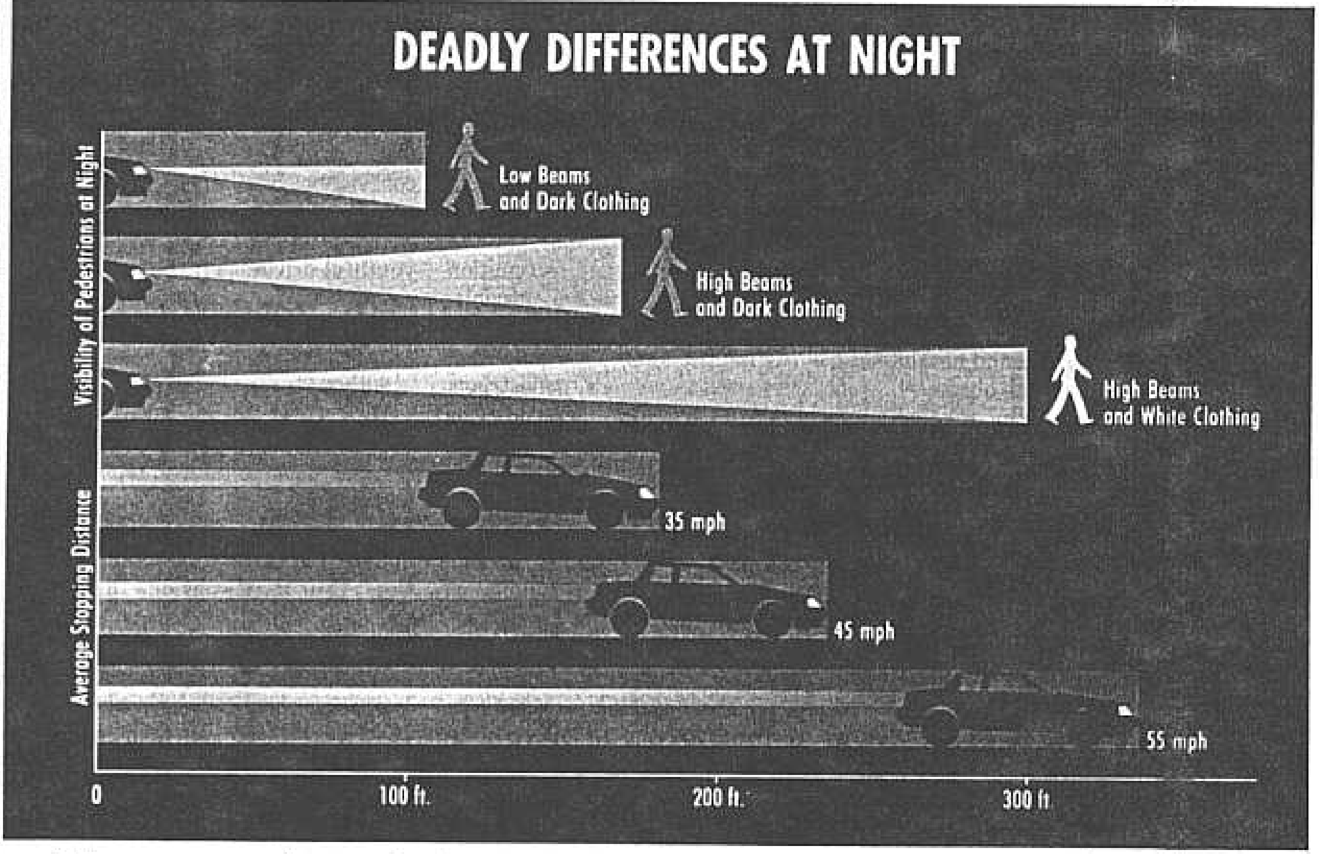
The reasons for this wide difference in fatalities are complex. The usual suspects—fatigue, drinking, reduced visibility—are certainly involved. But a more insidious problem plays a major role in the nighttime death toll. Most of us drive as if we can safely go as fast at night as during the day—a misplaced confidence that can be understood in light of findings in the neurophysiology of vision.

Before we discuss these findings, the risks of nighttime driving may be easier to appreciate if we consider the kinds of accidents that happen then. For example, each year more than 4,000 highway pedestrian deaths occur at night. The drivers usually say that they did not see the pedestrian in time to stop or to take evasive action. One study, on nighttime driving accidents on record at the Indiana Department of Motor Vehicles in 1966, says that nearly one-quarter of the drivers involved claimed they heard the sound of impact before they saw the pedestrian. Some of the comments may simply reflect driver carelessness or self-justification, but studies of pedestrian visibility suggest a basic truth.

Under ideal conditions—high beams turned on, no glare from the headlights of oncoming traffic and a pedestrian clad in white—a driver can see a pedestrian from about 300 feet. This may seem like a safe distance, but researchers at the University of Michigan have found that, considering reaction time and braking distance, it takes the average driver 317 feet to stop a car at 55 miles per hour under optimum driving conditions. Visibility distance drops to less than 100 feet if a pedestrian is wearing dark clothing and the driver is using low-beam headlights.

This problem is compounded by the fact, discovered by researchers at Indiana University, that pedestrians consistently overestimate how well oncoming drivers can see them. From the pedestrian's viewpoint, oncoming headlights look like floodlights; it is hard to imagine being inconspicuous while bathed in such intense illumination. But in fact, pedestrians usually present very little contrast to the night roadway scene and are nearly invisible to oncoming traffic until it is too late.

An "underride collision," in which the hood of a car slides under a larger vehicle and the passenger compartment is crushed, provides a dramatic illustration of how drivers run into obstacles they would never hit in daylight. Consider an accident that occurred a few years ago in rural



Drivers can more easily see pedestrians wearing light-colored clothing, but stopping in time may be impossible.

Pennsylvania. A young couple was driving home one clear, dry winter evening. As they came over a small hill, a truck driver, about 900 feet down the road, was backing a tractor-trailer rig into his driveway on the right side of the road.

The automobile driver was aware of the truck's position in the oncoming lane. The truck's headlights were on, and the car slowed when the truck driver sounded his horn. But the automobile driver evidently could not see the 45-foot-long trailer extended broadside across the entire highway. Instead of stopping, the car accelerated and plowed under the body of the trailer. Skid marks started only 10 feet before impact. The accident tore off the car roof and killed both occupants instantly.

Such underride collisions, which almost always happen at night, claim an estimated 570 lives every year. These tragic accidents demonstrate the need for improved lighting and reflection of such potential obstacles as tractor trailers, railroad trains and other heavy equipment. As is true of pedestrians, the visibility of low-contrast obstacles on the highway is so poor that the average driver cannot see them in time to avoid a crash.

PART OF THE PROBLEM IS THAT REDUCED ILLUMINATION DOES NOT AFFECT ALL VISUAL FUNCTIONS EQUALLY.

But illumination and contrast are only part of the problem. Another important component is our misperception of the risks involved in nighttime driving. Why don't we change driving behavior to adjust for the limitations of nighttime visibility? At one level, the answer is quite simple. Most drivers just do not realize how poor their vision is after dark. At another level, this dangerously irrational behavior has a neurophysiological basis: Reduced illumination does not affect all visual functions equally.

Research with animals (see "The Hamster Connection" box) provided the first evidence for the existence of parallel processes in vision. Many visual tasks can be classified as depending on one of two general modes. The more familiar is the "focal" or recognition mode. We use it to identify what we are looking at, and it dominates our conscious awareness. The other mode is the "ambient" or guidance mode, which helps us decide where objects are and guide our movements. This mode works automatically; we are rarely conscious of it.

Most complex types of behavior depend on both modes of vision, and they usually cooperate so efficiently that we have no idea of how much visual information we are using at any time. A good illustration of these complementary modes is our ability to read a newspaper while we walk along the street. We do a remarkably good job of navigating around a variety of obstacles, some of them moving, while understanding what we are reading. To avoid disaster, we must make a number of complex perceptual and behavioral adjustments simultaneously without awareness.

Driving requires the same simultaneous use of the guidance and recognition modes. The driver's primary job, of course, is steering along the path ahead, which depends mostly on the guidance mode. Although this must be done continuously, it is not the only visual task. The driver must also check dashboard instruments, read road signs and monitor the road and nearby surroundings for potential obstacles. These activities require the recognition mode. In good light, experienced drivers have little trouble using both modes of vision simultaneously.

The trouble comes when night falls. Recognition functions, such as acuity, sensitivity to contrast and the ability to perceive objects, degrade rapidly. In contrast, the guidance mode is not affected until illumination falls to levels well below that provided by the usual nighttime highway environment.

This selective deterioration helps explain why most drivers feel confident and "overdrive" their headlights. Since the guidance mode is not impaired, the driver can steer the vehicle as easily and accurately at night as during the day. And, at the same time, the most frequently used "recognition" information is artificially enhanced to compensate for the loss of daylight. Dashboard instruments and road signs are either illuminated or made from highly reflective materials, and other vehicles usually have lights on them.

These artificial improvements all increase safety in one way, but they also unjustifiably enhance motorists' self-confidence. Since road signs and instruments are easy to see, and the guidance vision system continues to function well, drivers usually fail to realize that other visual recognition tasks have become next to impossible. The most dangerous hazards of nighttime driving, the dimly lit, unexpected obstacles such as animals, pedestrians and disabled or unlit vehicles appearing suddenly from a parking space or side road, will be seen too late.

The prudent driver chooses a speed that is comfortable, based on largely tacit evaluations of variables, including traffic flow, weather conditions, posted speed limits and one's own capabilities. Years of driving experience can lead the motorist to judge accurately all these factors, except the last. A driver who has not had a night accident is not likely to appreciate that the greatest dangers in nighttime driving are effectively invisible.

Conditions other than selective impairment of recognition vision can also produce a dangerous discrepancy between self-confidence and ability. One of the most threatening consequences of alcohol intoxication, a major contributor to the highway death toll, is the fact that alcohol unjustifiably enhances a driver's self-confidence at the same time that it is impairing judgment and slowing reaction times. The combined effects of alcohol and selectively diminished vision are extremely dangerous because they compound the discrepancy between ability and self-confidence. Similarly, the bravado of youth may help explain the disproportionate number of accidents involving youthful drivers. Traffic accidents are responsible for more deaths of people between the ages of 15 and 24 than all other causes combined.

Although our highways have been getting safer for decades, nighttime fatality rates are still too high. This terrible cost to individuals, families and society is not necessary and can be reduced through a better understanding of drivers' tasks and capabilities. The most obvious answer to greater nighttime safety is better roadway illumination. Improvements in automotive headlighting and installation of overhead lighting systems have already proven their value, but further advances may be economically impractical.

Fortunately, several other more feasible measures should be considered. One is to require by law that all possible roadway obstacles, including trailers, trains and pedestrians, display distinctive lights or reflective materials. Another is to legislate different speed limits for daytime and nighttime conditions; this is particularly important on secondary roads, which are likely to have cross traffic, pedestrians, cyclists and other unpredictable obstacles.

But the most important step may be education: teaching drivers and pedestrians about selective impairment of recognition vision at night. Enacting special speed limits, for example, is not likely to work unless motorists appreciate the true hazards of nighttime driving. If they do, they may choose to reduce their speed voluntarily, regardless of posted limits. Increased driver awareness of the special risks associated with nighttime driving should make our highways safer.

THE HAMSTER CONNECTION

Research on the visual systems of the golden hamster has helped us better understand the differing problems of daytime and nighttime driving. Anatomists know that the visual tract of mammals is linked to at least two separate areas in the brain. The major connection, known to be essential for normal pattern perception, is with the visual cortex. But there is a second link, with midbrain structures in and around the superior colliculus, whose function was not clear.

About 20 years ago, physiological psychologist Gerald Schneider discovered that these two links served distinct functions in hamsters; interference with either neural connection produced different changes in behavior. When Schneider surgically destroyed the visual cortex, the animal could no longer discriminate between patterns of lines and dots but could still move accurately toward objects such as sunflower seeds. In contrast, when he destroyed the superior colliculus, the hamsters retained their ability to discriminate between visual patterns but were unable to perceive the location of various objects in the environment and to move toward them.

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