Let's Shed Some Light on Pedestrian and Cyclist Safety—An Approach to the Problem

Richard E. Marland
Chief, Injury Control Program
National Center for Urban and Industrial Health
U.S. Department of Health, Education, and Welfare
Public Health Service

PEDESTRIAN FATALITIES INCREASE

In 1966, over 9,000 pedestrians were killed on our nation's streets and highways. Another 500,000 were injured.* This combined total approximates the population of a city the size of Albany, New York. It is only slightly smaller than the population of Arlington, Virginia.

The death trend is upward. Pedestrian fatalities have jumped about 15 percent overall since 1961. As one might expect, four out of five pedestrian deaths in urban areas occur when pedestrians are crossing or entering streets. And more than half of them occur *between* intersections.

In rural areas, about 10 percent of pedestrian accidents result in fatalities, compared to 1.5 percent for accidents that do not involve pedestrians.* The disadvantage of being a rural pedestrian—instead of being in a car—is obvious. You're more than six times as likely to be killed if you are a pedestrian.

Of last year's pedestrian deaths, over 5,000 (or over 55 percent) occurred at night.* This, despite the fact that the number of pedestrians is significantly smaller at night than during daylight hours.

NIGHT VISION

Why are night hours the most dangerous hours? Obviously, because we cannot see as well. The human eye is, indeed, a remarkable instrument. But it has its limitations, especially at night. Unlike some members of the animal kingdom, we have not been gifted with anything like exceptional nighttime vision.

* Data from the Injury Control Program and the National Center for Health Statistics, U.S. Public Health Service.

Add to this the fact that our ability to see at night—bad to begin with—*decreases* with age. After we reach age 20, the amount of light we need to see objects at night doubles every 13 years. Thus, at age 60, we require eight times as much light as at age 20.

Why is our nighttime vision bad? Our eyes have two sets of detector elements. They are called rods and cones. They are different in shape, and they are entirely different in sensitivity characteristics.

The cones, which work for us during the day, are linked to the visual cortex by a single nerve fiber. The visual cortex is that part of the brain that interprets visual information. Color sense is also associated with the cones. Distribution of cones around the eye's retina is such that they are most closely packed at the center of the eye. As a result, we see very fine detail, in full color, at the center of the eye during the day.

On the other hand, our night detector elements—the rods—have no color sense and are few in number. They are distributed, for the most part, away from the center of the eye—on its periphery. Since the rods are responsible for peripheral vision, any constriction of the pupil, as caused by looking into on-coming automobile headlights, will reduce visibility.

Moreover, the link between our nighttime rods and the brain is different from that of our daytime cones. Many of the rods are linked in a complicated manner and many have to share one single nerve path to the brain's visual center.

As a result of all this, our vision by night is not good. Add to this the fact that pedestrians often make it more dangerous for themselves by wearing dark clothing at night. Few of them heed suggestions to wear white clothing or carry flashlights or lanterns. Undoubtedly, most pedestrians do not realize how poorly motorists see at night and how truly invisible they are, particularly in bad weather, or when an on-coming driver's senses have been dulled by alcohol, drugs, or fatigue.

THE PRINCIPLE OF RETRO-REFLECTION

Now there is nothing we can do about the make-up of the eye. But there is something we can do to help our eyes overcome this handicap. We believe that tremendous improvement in pedestrian nighttime visibility exists in the principle of retro-reflection.

To explain this principle more fully, let us consider for a moment the ordinary reflective surface as represented by a table, a chair, a tree, or a human being. These are diffuse reflectors. A diffuse surface reflects some of the light that strikes it. But it reflects it in random

fashion, that is, in all directions. Consequently, it is very hard to see diffuse reflection at night.

At the opposite extreme, we have mirror reflection, which is one of the more efficient types of reflection. But it has a serious drawback for our purpose. A mirror always reflects light at an angle opposite to which light strikes it. Thus, it reflects light away from its source, unless, of course, the source happens to be exactly perpendicular—that is, absolutely straight ahead.

Finally, this brings us to the concept of retro-reflection. Generally speaking, and within limits, retro-reflective material has the capability of focusing light that strikes it into its own optical system—and returning this light directly back to its source.

It may be important here to remind you that we are not talking about materials that glow in the dark, or phosphoresce all by themselves. Retro-reflective materials reflect light. They must have light shining on them. And automobile headlights provide this light very well.

Tragically, the United States has lagged behind as an innovator in this matter of improving nighttime pedestrian visibility. Let us review, for a moment, some developments in Europe.

REFLECTORS FOR PEDESTRIANS

In 1964, Sweden embarked on a program to encourage pedestrians to use small, reflective tags at night. These small tags are designed to hang from coat pockets and reflect headlight beams back to the driver.

The number of nighttime pedestrian deaths and injuries in Sweden has been dramatically reduced. In 1963, the year before the program was undertaken, 336 nighttime pedestrian deaths and 3,190 nighttime pedestrian injuries occurred *(Swedish Injury Statistics, 1963-1966)*. Last year, despite more cars and more people, pedestrian deaths decreased 26.2 percent, and injuries decreased 21 percent.

Denmark and Norway are also leaders in the matter of nighttime pedestrian safety. Police and insurance and government organizations in these two nations—as well as in Sweden—are actively promoting nighttime pedestrian safety through tag programs and programs encouraging reflectorization of clothing, shoes, jackets, and the like.

There is no reason why the concept of pedestrian reflectivity cannot be put forward more strongly. Consider some areas where reflectorization is an accepted concept. Reflective traffic signs have long been accepted in this country. Every state and literally thousands of cities and counties use them. Reflective traffic signs, in fact, have been given much

credit for keeping motor-car deaths and injuries in check on our modern highways.

Reflectorized license plates have been adopted by some 30 states and the District of Columbia. Unlighted parked cars—or cars with defetive tail lights—are hard to see. But they are not nearly as "invisible" as pedestrians at night.

Railroads use reflective materials to make their cars more visible at crossings at night. And every car and every truck in the United States is required to be equipped with some type of exterior reflectors.

Even the edges of our roads and highways are often outlined with reflectors or with reflective material to warn motorists of curves, ramps, or obstacles ahead.

[Editor's Note—After his talk Mr. Marland showed a short and excellent movie on how retro-reflective materials can be effectively used to improve pedestrian visibility. They return headlight beams directly back to the driver. These materials come in many forms adaptable to the protection of the pedestrian and cyclist.]