



HIGHWAY VISIBILITY RESEARCH NEEDS

Nathaniel H. Pulling

The visibility concerns of highway users can be conveniently grouped into categories that have to do with drivers, vehicles, and roadways. Pedestrian visibility is not readily pigeonholed in this scheme, so let me mention at the outset that the effectiveness of reflective clothing for pedestrians, operators of two-wheeled vehicles, and highway maintenance personnel is a topic that apparently needs research.

During the next decade there will be many more physically handicapped drivers than there were in the 1970s, and it is ironic that many of them will be paraplegics and epileptics, themselves the product of motor vehicle collisions. The proportion of older drivers also will increase sharply in the years to come. More and more drivers of all ages are operating under the influence of drugs of all kinds. The devastating effects of alcohol have been much publicized, but I am informed that more needs to be learned about the synergistic effects of prescription drugs on both vision and cognition. In spite of all the research that has been done on driver vision, there is little agreement yet on the desirability of binocular vision for commercial drivers and on what should be the cutoffs for licensing in relation to various kinds of acuity, field of view, glare resistance, and so forth. We know how serious the degradation of night vision in drivers over 70 years old can be, but most of us have to be evasive when pressed for practical recommendations. It is my private opinion, by the way, that, from the standpoint of causing highway accidents, failing vision in oldsters is not nearly as significant as slippage in their information-handling ability.

As we turn our attention from the vision difficulties of drivers to the visibility problems of their vehicles, there comes immediately to mind the oft-heard question of car designers who ask, What does a driver need to see? It is a



deceptively simple question, but the answer continues to elude us. It seems to me that there is an important need for minimum standards for rearward visibility that are more meaningful and significant than those we now have. In most passenger cars, a lane change to the right requires a glance over the shoulder (something older people crippled with arthritis cannot do), and in many vans and small trucks the situation is nothing short of menacing. Another vehicular visibility problem that has been only partly solved is the spray from fast-moving heavy trucks, which may well be a frequent cause of collisions on crowded highways.

Among the visibility needs brought to my attention recently, the outstanding favorite is higher and color-differentiated brake lights. In view of all the research that has been carried out, the lack of innovative standardization is the subject of widespread complaints. In a general sense, the deficiencies of vehicular conspicuity badly need correction. For instance, side collisions with trucks

N. H. Pulling is project director for automotive safety, Liberty Mutual Research Center, and he is chairman of TRB's Committee on Visibility, and a member of the Committee on Vehicle User Characteristics and the NCHRP Panel on Maintenance Level-of-Service Guidelines.

are frequent, and the most prevalent cause seems to be lack of conspicuity. Improved lighting, and especially reflective marking, should be researched in practical, systematic tests in highway use for both the sides and backs of large trucks. In this connection, truck drivers and motorists in passenger cars cannot understand why slow-moving vehicles are not permitted to use flashing hazard lights in many states; they believe that speed differential matters.

As trucks become larger and more prevalent on our highways, they are known to cause accidents because they block the vision of drivers in passenger cars, and the situation is exacerbated by the proliferation of subcompact cars. At the opposite end of the spectrum of vehicle size, there is well-documented need for visibility aids on motorcycles, mopeds, and bicycles. High-visibility flags and stroboscopic presence lights on two-wheeled vehicles of all kinds might save the lives of thousands of cyclists. And the numbers of such vehicles are going to skyrocket as the energy crisis deepens.

Reduced visibility is one of the oldest and most feared of hazards in all forms of transportation. In spite of all the research that has been done, moreover, it appears that there is still need for highway speed guidelines for the reduced visibility caused by fog, rain, snow, and dust. Fog patches on high-speed highways are extremely dangerous, and reliable warning devices are badly needed. Similarly, in snowstorms, slow-moving plows and sanders (and even stationary work vehicles) present visibility problems related not only to early detection but also to perception of distance, rate of closure, and direction of movement.

Even in good weather, there is need for standardization of conspicuity aids for all kinds of emergency vehicles. Perceptual confusion actually is quite commonplace in highway driving, and it is especially prevalent in the form of visual pollution in and near highway business districts. Traffic signals are often hard to recognize and sometimes not easy to interpret, signing is especially confusing, and the clutter of visual stimuli makes it difficult to perceive stray pedestrians, bicyclists, and other hazards. The claims files of any insurance company contain thousands of cases in which inexperienced drivers, motorists under the influence of intoxicants, and old people became so confused in shopping centers that they became involved in seemingly preventable collisions. There are psychologically related problems with roadway signs. More data are needed on luminance and contrast requirements for highway signs, and every one of us can attest to the desirability of greater comprehensibility.

In this connection, there are a few human-factors specialists who are commencing to have misgivings about the proliferation of pictorial symbols in transportation. The variety of pictorial roadside signs is quite fascinating, and the lexicon of symbols being internationally standardized for use in vehicle controls (and especially for construction and agricultural machinery) is quite mind-boggling. I can imagine that expanding the variety and inventiveness of this new symbol language may have some unforeseen

consequences in the areas of safety and accident prevention.

Long before there were engineers and scientists, vehicle and roadway lighting was of concern to travelers at night. In spite of burgeoning knowledge on this subject, and the spectacular improvements in hardware that have been introduced in recent years, there seems to be a continuing need for further research. Tunnel lighting, for instance, requires further improvement, and more data apparently are needed in order to optimize fixed and vehicular lighting for driving on urban highways and through interchanges in the country. Of utmost priority in my own mind is the acquisition of practical and valid data for establishing priorities for energy-saving curtailment of roadway lighting. As the energy shortfall worsens, and particularly when serious shortages develop, public outcry will cause fixed roadway lighting to be shut off. Sometime during the 1980s or at any rate before the turn of the century, I expect that our highways in the northeastern United States may become as dark as they were during the submarine blackout nights of World War II.

Another consequence of the energy shortage has been the influx of small cars onto U.S. streets and highways. It is quite obvious that drivers in these automobiles have much lower eye heights than drivers did during the years when highway sight distances were established. As a result, short people in some subcompact cars occasionally cannot see over the crest of hills as well as they should, they are blinded by maladjusted headlight beams, they have difficulty with forward visibility around large trucks, improperly reflective signs appear dim, and roadside delineators are too high for good visibility in some locations. The eye height of 3.5 ft that is now being considered by the American Association of State Highway and Transportation Officials for revising standards may turn out not to be low enough for some of the small cars that are bound to form a large percentage of the automobile population at the end of this century.

Curiously enough, the research topic mentioned most frequently by the respondents to my survey of professional opinion had to do with pavement markings. More appropriate eye-leading characteristics were suggested, along with improved visibility for highway striping. Performance in wet and snowy weather is desired, along with greater permanence and improved retention for reflective beads embedded in the paint. It seems to me that greater durability and more hiding power are desirable for the paints that are used to obliterate striping on road surfaces. I drive regularly on highways where the lane markings have been changed, and it is now impossible to determine where one is expected to drive. In like manner, obsolete lane markings in construction zones often remain so conspicuous that they lead unwary motorists into crashes with construction barriers. In short, roadway markings not only need to inform motorists more reliably but also to have better capability for obliteration or removal.

While this catalog of visibility concerns for the 1980s is intended to be a user-oriented one, I think that it would not be amiss to mention the professional needs of