Feature Articles

TRB Workshop Series:

PROBING THE HUMAN FACTOR IN TRANSPORTATION

In the days preceding World War II, highway research was predominantly concerned with properties of materials, such as asphalt, concrete, stone, and steel, and with design methods for pavements, bridges, and other physical structures. Only comparatively recently has much attention been paid to the users of the highway and other transportation systems.

In 1967 a great step was taken in this direction when the first Workshop on Human Factors was sponsored by the Highway Research Board. This has now become an annual event, taking place just before the Annual Meeting of the board (now the Transportation Research Board). During the ensuing 8 years, experts have assembled to discuss the problems of the vehicle driver and passengers, the pedestrian, the bicyclist, and the users of many other transportation modes.

The workshop has evolved into a full-day meeting with 6 concurrent sessions at which problems such as drugs, alcohol, visibility, reaction to traffic signals, and driver education are thrashed out in detail. In keeping with the true workshop nature of the concurrent sessions, no formal papers are presented or published. An examination of the topics and findings of the 2 most recent workshops reveals a continuity of subject area and an evolutionary trend toward increased emphasis on driver behavior.

One of the sessions at the 1974 workshop was devoted to bicycling, a topic that was to achieve even more significance during the gasoline shortage later that year. The 26 participants discussed the problems and solutions involved in bicycles sharing streets and highways with other vehicles and considered the construction of exclusive bikeway networks. Many such networks are now in the planning, construction, or operational stages across the country.

What are the main problems involved in bicycling? One is the lack of enforcement of traffic laws, according to experts from all over the country. On a 5-mile course in Washington, and another in Baltimore, cyclists could cover the distance 40 seconds quicker than a motorist, provided the cyclist ignored traffic signals and other controls; but the cyclist had no advantage over the motorist if they both obeyed the regulations. This seems to be a universal problem and one that can only be solved if a system of bicycle licensing and registration is put into effect nationwide.

Accidents involving bicycles generally happen within a block of home, and the cyclist is usually carrying a passenger. Cars are generally not involved in these accidents; on the national scale, cars are involved in only 5 percent of bicyclist injuries, but are involved in 95 percent of bicyclist fatalities.

Two other sessions during the 1974 workshop were devoted to solving one of the basic problems inherent in any consideration of human factors. To compare one vehicle to another or one section of highway to another

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1 In the session on adverse environmental effects on driver and traffic performance, led by David Solomon and Burton Stephens, FHWA's Richard Schwab and Oregon DOT's Dwayne Hofstetter (foreground) are prepared to discuss the extensive highway fog research in Oregon.

2 A. James McKnight, fourth from left, leads serious discussion in the session on teaching accident avoidance skills in driver education.

3 Gerson Alexander of FHWA's Office of Traffic Operations makes a point in the session dealing with means to alert drivers to hazardous locations, led by Robert Hostetter.

transportation was a topic of one of the 1974 sessions. The aim of the session, which was attended by 2 dozen people, was to provide an overall look at urban transportation as a focus for human factors research. The group discussed bus services: How can service be improved and costs cut? How can the computer be used in operations? How can we combat vandalism? How can we humanize the interaction between the bus driver and the passenger without impairing efficiency? Other discussions covered other transit operations: personal rapid transit vehicles and the problems involved, such as difficulty of getting in and out of the cars, vibration, jerking, and the needs of the handicapped; demand-responsive systems and the various factors liked or disliked by the user (for example, coffee service on the bus had little appeal); and rail transit, especially the New York subways where the retirement of many experienced controllers has left the control of the system in the hands of relatively inexperienced crews. Participants pointed out that events that might lead to a disaster occur many times each hour in the New York City subway system; the load on the controllers is considerable. Also featured in the session was a discussion on modal choice.

Yet another 1974 session was devoted to traffic safety education—defined as a comprehensive and coordinated educational program that is designed to improve highway use in terms of efficient and safe mobility and that is delivered in a preventive or remedial fashion to all highway users. The participants came to the conclusion that

is relatively easy, but to compare 2 drivers is virtually impossible because of the many physical, physiological, mental, and emotional factors involved. How do you resolve the characteristics of the average, or "design driver," for whom a facility can be designed and built? Forty-four participants, representing government, private industry, and the academic world, spent the day in 2 sessions trying to identify and define the important design driving parameters and variables and their application to real-world highway design and operations problems. This represented the workshop goal: bringing together human factors and highway and traffic engineering personnel to provide an interdisciplinary approach to the problem. Although a definitive solution to the primary task of defining the design driver was not achieved, the discussion proved to be most valuable in developing valuable highway design and operations concepts along the same line.

For the first time in the series of workshops, urban

the program must deal with far more than the youth safety problem because people of school age represent only about one-fourth of the population; that safety problems cannot be solved solely by school-based programs and certainly not by driver training alone; that more data are needed on various modes of road use and more accurate and complete data on the accident experience of the several groups; and that, to be effective, instruction must begin early in life and continue throughout life.

The sixth 1974 session was concerned with sign evaluation techniques. The participants were asked to examine 3 types of problem areas: (a) diagnosis, the identification of locations where problems exist because of inadequate signing; (b) comparison, the evaluation of signing alternatives for a particular location or application; and (c) research, the increased understanding of the information acquisition process and the characteristics that distinguish a good sign from a poor one. Those present contributed a large variety of measures and methods. However, they concluded that understanding is currently insufficient for diagnosis. "We can," they said, "compare 2 signs but we cannot evaluate 1 sign and determine whether it is the optimal one for a particular route-guidance decision point."

Those returning a year later to the Eighth Workshop on Human Factors, held January 12, 1975, found that many of the same subjects were still of compelling interest and that several new ones had been added.

Down to shirt sleeves for action, the participants in the session on drugs respond to leadership from Herbert Moskowitz, seated left of rostrum (checked shirt). Nathaniel Pulling, chairman of TRB's Committee on Simulation and Measurement of Driving, is second from right.

Once again, the reaction of drivers to traffic controls was under discussion. Specifically, the subject was intersection signalization for vehicles and pedestrians. Session participants discussed how a signalized intersection works and what problems occur at the location. What type of driver and pedestrian behavior leads to delay, to conflicts, and to accidents at a signalized intersection? Many of the workshop participants agreed that a gap exists between what the traffic engineer expects a device to do and what the general public expects. For example, a pedestrian signal is meant to inform the pedestrian when it is safe to cross the street. Yet, what does the pedestrian rely on before crossing: the pedestrian signal, the vehicle signal, or the traffic flow?

The participants suggested that, instead of studying how drivers and pedestrians react to existing traffic control devices, we should measure the intuitive behavior of drivers and pedestrians in particular situations and then,

if required, design traffic control devices to reflect that behavior.

Safety education was again in the forefront, this time in the form of a session on accident-avoidance training. Training in last-minute accident-avoidance techniques has become popular in recent years, mainly in programs for drivers of emergency vehicles such as police cars, ambulances, and rescue trucks, but also to a certain extent in high school driver education programs. The workshop participants were asked to identify the appropriate objectives and content of accident-avoidance training, to review the nature and adequacy of present programs, and to identify the research, development, and operational needs of the future.

The participants pointed out that it is not enough to count the number of cones knocked down on a training range to assess a driver's skill; this has little bearing on real life. Taking into account the problems of simulating collision situations safely and the maintenance of skills once they are learned, they concluded that a great deal more must be learned about accident-avoidance training before it can be put forth as an effective accident countermeasure. They pointed out that skills learned in a simulated situation are unlikely to transfer to a real-world situation encountered in different vehicles and under conditions of stress. Moreover, students and even instructors have been known to use their "advanced" skills in driving at excessively high speeds and performing unsafe maneuvers, having acquired a false sense of confidence.

The 16 people attending the session on pedestrians addressed 2 different accident problems: accidents involving pedestrians who are not in school and those who are. They pointed out that educational programs must stress safety in all aspects of life, not just when one is crossing the street. The elderly are a hard-to-reach group because few belong to organized groups, yet their accident record is high enough to warrant a special effort. Midblock crosswalks, where vehicles are prohibited from parking, help to decrease visual obstructions but also decrease pedestrian scanning activity and may also create traffic flow and capacity problems. Pedestrian overpasses and underpasses have drawbacks; they are underused or used for illegal and immoral purposes. It was generally agreed that the problems of nonschool pedestrians are largely educational; few understand the meaning of flashing versus nonflashing walk signs.

Safety information is available to preschool and school pedestrians through television programs, day care centers, nursery schools, and regular school programs. Play streets in densely populated urban areas can serve as a focus for community activities while reducing the number of vehicles that drive through and thus reducing the conflicts between the cars and the young pedestrians. Proper control of cars through use of barriers and prohibitory signing is essential in creating a safe play street, cautioned the participants, pointing out that sometimes off-street play areas are preferable.

The session on adverse environmental effects on driver and traffic performance was marked by a procession of potential hazards to the driver. What happens when you encounter dust storms or sand storms? When you run into fog or into a dark tunnel from bright sunlight? When children cross the street in front of you before dawn? These occurrences may be quite rare, but the effects can be drastic. For instance, though the overall percentage of fog accidents is small, the percentage of multivehicle accidents in fog is disproportionately large. It was concluded that, although in some categories there was the possibility of significant reductions in the number of accidents, more often it was the increase in accident potential due to adverse environmental effects that was of concern to the motorist.

How can the driver of an automobile be alerted that he or she is driving on a hazardous section of highway? The hazardous locations must first be located and identified, and this requires new techniques, according to the participants in the session on means to alert drivers to hazardous locations. The use of accident records to locate hazards has its drawbacks, implying as it does that at least one has already occurred. On-site observation was thought to be the best answer.

Proper signing and guidance information must be provided in such a fashion that the driver does not drive off the road while trying to read the sign. Highways do not have to have steep grades, curves, and blind intersections to be dangerous; long, flat stretches of road are equally dangerous if the driver's attention flags or if he or she falls asleep. Participants felt that rumble treatments on shoulders to alert inattentive or sleeping drivers were not cost-effective.

A new subject was introduced in the session on drugs, driving performance, and highway accidents. Five experts presented summaries of the role in highway accidents of opiates, amphetamines, tranquilizers, barbiturates, and marijuana. Although data regarding each drug family were too scant to establish definite trends for each, the consensus was that marijuana, barbiturates, and tranquilizers have a detrimental effect on driving performance and that opiates and amphetamines have a lesser effect and may in certain cases enhance performance. The first group of drugs are also found under laboratory conditions to augment the deleterious effects of alcohol. The second group did so to a much lesser extent, and in fact amphetamines may sometimes counteract the effects of alcohol on performance. Participants called for further detailed testing, using basic laboratory techniques, driver simulator testing, and testing on the road, both closed and open course.