266

TRANSPORTATION RESEARCH CIRCULAR

Number 266, September 1983
ISSN 0097-8515

Transportation Research Board, National Academy of Sciences, 2101 Constitution Avenue, N.W., Washington, DC 20418

RESEARCH PROBLEM STATEMENTS: DRIVER PERFORMANCE

mode
1 highway transportation

subject areas
51 transportation safety
52 human factors
53 vehicle characteristics
54 operations and traffic control

OPERATION AND MAINTENANCE OF TRANSPORTATION FACILITIES

Donald E. Orne, Chairman
Group 3 Council
Michigan DOT, Lansing, Michigan

COMMITTEE ON VEHICLE USER CHARACTERISTICS
(As of June 1, 1983)

Helmut T. Zwahlen, Chairman
The Ohio University, Athens, Ohio

R. Wade Allen	Margaret H. Jones	Thomas H. Rockwell
Vivek D. Bhise	Rodger J. Koppa	Kare S. A. Rumar
Albert Burg	Jan Moraal	Michael Sivak
Robert E. Dewar	Herbert Moskowitz	Burton W. Stephens
John W. Eberhard	Richard A. Olson	E. Donald Sussman
Martin G. Helander	Michael Perel	Patricia F. Waller
Peter H. Hehlen	Nathaniel H. Pulling	David H. Weir

James K. Williams, Transportation Research Board Staff

INTRODUCTION

This report summarizes research needs in the area of driver-vehicle control performance. The research problem statements were generated by Committee A3B02 --Vehicle User Characteristics. In total, 54 research suggestions were presented by individual members. Each member then provided a ranking of the 10 most important research ideas. Table 1 presents a listing of the 20 research problem statements that received the highest rankings.

Of the 20 research ideas, six are concerned with perception and information processing (see Table 2). Several of these six research ideas emphasize the problems of identifying information cues both for normal driving and in emergency situations. Four of the research ideas are concerned with the development and validation of research methodologies. Monitoring of driver alertness and performance is adressed in four studies. Driving performance of special populations, such as impaired and elderly drivers, is the subject of three research ideas. The effect of road design parameters on driver behavior is the subject of two other research ideas. Finally, one of the 20 addresses the effect of some vehicle design parameters on driver information processing.

It is of interest to note that the Committee gives the highest priority to basic research issues involving driver perception and information processing, driver physiological responses, and the validation of research techniques. Only three of the 20 research issues deal with the hardware characteristics of the driving task, the design of the vehicle and the road environment. These priorities reinforce and emphasize the need for more basic research in this area of traffic safety. It must be noted that the A3B02 Committee has a balanced representation of academia, government, and private industry. The results of the present assessment, are therefore, interpreted as a strong indication of the need

Table 1

Prioritized Research Needs

1. Design Driver Information Requirements.
2. Problems Encountered in Night Driving by Older Drivers in Private and Commercial Vehicles.
3. Alertness Measurement and Aiding of Drivers.
4. On-board Self-Tests for Measuring Driver Performance Degradation.
5. Factors Determining Perception of Risk While Driving.
6. Roadway and Vehicle Cues that Affect Driver Decision Making and Control Inputs in Accident Avoidance Situations.
7. Evaluation Tool for Conspicuity of Visual Targets in Nighttime Driving.
8. Design and Evaluation of Microprocessors and Electronic Sensor Systems As Driver Aids.
9. Models for Driver Eye Scanning and Information Processing in Selected Traffic Environments.
10. Trade-offs Between Signing and Delineation.
11. Effects of Prescription Drugs on Older-Driver Accidents.
12. Performance Specifications for Train Handling.
13. Compilation of Data on Eye Scanning Behavior for Selected Vehicles and Highway Environments.
14. Relationship Between Closed Course Driving Task Performance and Road Behavior.
15. Simple Measures for Monitoring Drivers' Steering Control.
16. Visibility Characteristics of Accidents.
17. Effects of Adverse Weather on the Driving Performance of Impaired Motorists.
18. Standardized Test Route to Represent U.S. Driving Population.
19. Alertness Measurement Enhancement in Train Crews.
20. State of the Art of Traffic Safety Research.

Table 2

Summary of Research Problem Statements by Category

Research Area	Number of Statements
Driver Perception and Information Processing	6
Monitoring Driver Alertness and Control Responses	4
Development and Validation of Research Techniques	4
Specail Populations: Impaired and Older Drivers	3
Design of the Road Environment	2
Vehicle Design	1
TOTAL	20

to address basic research issues in driver performance, most of which have previously received little attention.

RESEARCH PROBLEM STATEMENTS

PROBLEM NO. 1

1.1 TITLE: Design Driver Information Requirements

1.2 PROBLEM: There are several sources of design driver information, such as the Transportation and Traffic Engineering Handbook, SAE Handbook, Human Factors Design Handbook, and several textbooks on driver behavior. Some of the data are incomplete, some are no longer valid, and some were derived from sources that are not applicable to the general driving population. Examples of the latter are some data extrapolated from studies of military drivers, who are not representative of the general driving population.

1.3 OBJECTIVES: The purposes of this study are to: (1) identify the needs among transportation engineers and researchers for information on driver design parameters, and (2) generate that information. Of particular interest are the implications of changes in vehicle size and handling characteristics on traffic engineering policies for roadway design parameters. The study initially should analyze available information in terms of applicability and validity. This information should then be synthesized to fit the needs of transportation professionals. It is anticipated that several special studies will be needed. However, much of the information is probably already available and can readily be made useable by reformatting existing data.

1.4 KEY WORDS: Highway Design, Driver Behavior, Driver Performance, Visual Information, Driver.

1.5 RELATED WORK: Some of these problems are presently being addressed in studies performed by FHWA and NCHRP.

1.6 URGENCY/PRIORITY: High Priority.

1.7 ESTIMATED COST: $300,000.

1.8 USER COMMUNITY: U.S. DOT, state DOTs, traffic engineers and highway planners.

1.9 IMPLEMENTATION: Findings of this research could be used for upgrading of design manuals.

1.10 EFFECTIVENESS: This research has high societal impact.

PROBLEM NO. 2

2.1 TITLE: Problems Encountered in Night Driving by Older Drivers in Private and Commercial Vehicles

2.2 PROBLEM: Older drivers are physically more fragile than younger people and are, therefore, more likely to die or suffer serious injury from an accident. Such accidents are costly in terms of both human suffering and societal costs. Because visual information is essential for vehicle control and crash avoidance, visual defects would be expected to cause more errors in night driving for people over the age of about 45. However, this hypothesis must be tested against actual performance on the road.

There are generally great individual differences among people in every aspect of driving performance, including visual perception. The variability is greater in the elderly groups than in younger groups; hence, it may be important to screen drivers for license restrictions.

2.3 OBJECTIVE: The purpose of this study is to investigate the effects of age on accident rates for commercial and private drivers. Several visual parameters should be measured, such as: corrected photopic acuity, mesopic acuity, glare tolerance, glare threshold, glare recovery, night myopia, and contrast sensitivity. Accident rates may be obtained through surveys of miles of night driving, state accident records during darkness, and FARS data for night accidents. It is essential to have large and representative samples and to avoid the volunteer bias.

2.4 KEY WORDS: Traffic Accidents, Driver Visual Performance, Aging Driver, Glare, Night Myopia, Contrast Sensitivity.

2.5 RELATED WORK: Not known.

2.6 URGENCY/PRIORITY: This research is of high priority.

2.7 ESTIMATED COST: $300,000.

2.8 USER COMMUNITY: NHTSA, older drivers.

2.9 IMPLEMENTATION: Findings could be integrated into existing driver education curricula. Results could also be used by commercial training organizations, military services, and commercial fleet operators.

2.10 EFFECTIVENESS: This research has high societal impact.

PROBLEM NO. 3

3.1 TITLE: Alertness Measurement and Aiding of Drivers

3.2 PROBLEM: One of the most common indictments in accidents is: "The driver was not paying attention to the driving task." Accident studies suggest that 10 to 15 percent of all accidents are associated with inattention, depending on one's definition of inattention. A number of studies have attempted to identify behavioral or physiological indicators of alertness. However, none of these measures has been shown to indicate reliably and unequivocally when a driver becomes so unalert that safety is jeopardized. If "inattention accidents" are to be prevented, more reliable measures are needed. If a driver can be warned of reduced alertness, corrective actions could be taken before a crash occurs. One approach could use a microprocessor to sense unsafe driving actions that are most likely to occur because of inattention, such as traveling around a curve at excessive speed, wrong-way driving, drifting onto the road shoulder or across the road centerline, and missing a stop sign. If a device could be designed to sense these unsafe actions, it could then immediately warn the driver to take corrective action.

3.3 OBJECTIVES: (1) To review the accident literature to identify the extent and nature of unsafe driving actions likely to be caused by lack of driver alertness; (2) To review the state of the art of electronics to determine the feasibility of sensing and warning drivers when they are committing unsafe acts; and (3) To determine, using a simulator, how effective such warnings would be in prompting drivers to take corrective actions in time to prevent or reduce the severity of the accident.

3.4 KEY WORDS: Driver Behavior, Attention, Alertness Monitoring, Nighttime Driving, Drowsiness, Vigilance.

3.5 RELATED RESEARCH: There is a fair amount of previous research in this area. This renewed interest is partly due to recent advances in microelectronics that might be utilized with high cost effectiveness.

3.6 URGENCY/PRIORITY: The priority of this research is high.

3.7 ESTIMATED COST: $500,000.

3.8 USER COMMUNITY: NHTSA, driver educators.

3.10 EFFECTIVENESS: See No. 6, Urgency.

PROBLEM NO. 4

4.1 TITLE: On-Board Self-Tests for Measuring Driver Performance Degradation

4.2 PROBLEM: The majority of automobile accidents occur to "non-problem" drivers, who might be temporarily affected by fatigue,

emotional stress, and low levels of drug or alcohol use that degrade driver performance. It is assumed that most drivers would want to know if their performance is degraded, so that they may decide whether to discontinue driving. An inexpensive, objective, on-board self-testing device for assessing driver performance could be developed for this purpose.

4.3 OBJECTIVE: The objective of this research is to develop an on-board system, complete with sensors, associated displays, and test procedures that can be used to measure driver performance. This system could then be used to obtain baseline measures for comparing normal driving performance with that under special conditions of fatigue, stress and, perhaps, low levels of drug or alcohol ingestion. Candidate measures might include reaction time, steering-wheel movements, brake force distributions, perception of threshold signals, mirror sampling, and vehicle acceleration patterns.

4.4 KEY WORDS: Driver Altertness, Driver Performance, Driver Control Responses.

4.5 RELATED WORK: There exists previously a fair amount of research in this area.

4.6 URGENCY/PRIORITY: This research has high priority.

4.7 ESTIMATED COST: $600,000.

4.8 USER COMMUNITY: NHTSA, private truck-fleet operators.

PROBLEM NO. 5

5.1 TITLE: Factors Determining Perception of Risk While Driving

5.2 PROBLEM: It has long been the conviction of most traffic researchers that if drivers could appropriately perceive the risk while driving, there would be a drastic reduction in the number of traffic accidents. It is therefore of interest to determine the factors that facilitate the perception of risk. If such information were available, it would be easier to institute effective countermeasures through propaganda, driver training enforcement, vehicle design, and design of the traffic environment. Several issues, however, remain unsolved; for example, the extent to which risk perception is affected by driver experience, attention, physiological activation, visibility factors, intoxication, and so on.

5.3 OBJECTIVE: The purpose of this study is to compare the effects of various driver characteristics and traffic characteristics on driver risk perception. An experimental field study is required, the results of which should be analyzed in terms of their practical implications for design of driver education, propaganda, and road or vehicle design parameters.

5.4 KEY WORDS: Driver Risk Taking, Risk Perception, Driver Education, Highway Design.

5.5 RELATED WORK: There exists previous work in this area, some sponsored by NHTSA.

5.6 URGENCY/PRIORITY: This research has high priority.

5.7 ESTIMATED COST: $500,000.

5.8 USER COMMUNITY: NHTSA, driver education agencies.

5.9 IMPLEMENTATION: Through NHTSA.

5.10 EFFECTIVENESS: The result of the study would provide an assessment of the effectiveness of this research.

PROBLEM NO. 6

6.1 TITLE: Roadway and Vehicle Cues that Affect Driver Decision Making and Control Inputs in Accident Avoidance Situations.

6.2 PROBLEM: A better understanding of how drivers react in emergency situations would help to identify possible accident countermeasures that might aid drivers in avoiding collisions. For example, in order to avoid an obstacle that suddenly appears in view, some drivers may turn the steering wheel so quickly that the vehicle goes out of control. By training drivers to make appropriate vehicle dynamic responses, such accidents might be avoided. In order to identify the most effective countermeasures, a model of likely driver/vehicle response patterns during accident avoidance should be developed. To describe realistically driver accident avoidance behavior, the model must consider roadway and vehicle cues that the driver uses for making control inputs and the response of the vehicle to these inputs.

6.3 OBJECTIVE: The objective of this research is to build upon the work of Maeda and Reid to develop a realistic model of driver/vehicle response patterns for emergency accident avoidance situations.

6.4 KEY WORDS: Driver Emergency, Emergency Avoidance.

6.5 RELATED WORK: Some work toward the development of such a model has been undertaken by Maeda in Japan and Reid in Canada.

6.6 URGENCY/PRIORITY: This research has high priority.

6.7 ESTIMATED COST: $300,000.

6.8 USER COMMUNITY: NHTSA, FHWA.

6.9 IMPLEMENTATION: This research could be incorporated in the NHTSA Driver Vehicle Effectiveness Model (DRIVEM) that could be used to predict the accident reduction probability of alternative crash avoidance measures.

6.10 EFFECTIVENESS: This research has high societal impact.

PROBLEM NO. 7

7.1 TITLE: Evaluation Tool for Conspicuity of Visual Targets in Nighttime Driving.

7.2 PROBLEM: The nighttime driving environment

is a particularly demanding one. The increased size of the eye pupil, glare effects, and decreased luminance levels all contribute to degrade the visibility of visual targets. Traffic engineers need guidelines for specifying the design of various devices and for evaluating conspicuity of signs, delineation treatments, signals, and other visual cues.

7.3 OBJECTIVE: The objective of this research is to develop a technique for predicting the level of conspicuity, or a "conspicuity index," based on the amount of attention drivers pay to different types of targets in the night visual environment. The technique developed can be used to evaluate the relative conspicuity of various types of traffic control devices, vehicle lighting, and reflectorizing systems.

7.4 KEY WORDS: Traffic Sign Legibility, Traffic Engineering, Reflectorizers.

7.5 RELATED WORK: There exists some previous work in this area.

7.6 URGENCY/PRIORITY: This research has high priority.

7.7 ESTIMATED COST: $500,000.

7.8 USER COMMUNITY: FHWA, traffic and highway engineers.

7.9 IMPLEMENTATION: The information resulting from this research could be used in engineering guidelines.

7.10 EFFECTIVENESS: See No. 6, Urgency.

PROBLEM NO. 8

8.1 TITLE: Design and Evaluation of Microprocessors and Electronic Sensor Devices as Driver Aids

8.2 PROBLEM: The decreasing cost of microprocessors and special chips can lead to the development of several inexpensive systems for aiding the driver. Examples are: (1) devices for monitoring instantaneous fuel consumption; (2) synthesized speech for information on velocity and vehicle malfunctions, and for sensing road hazards; (3) voice-recognition systems for control of car radio and in-dash displays for various kinds of information (for example, road maps). Although such devices are of great convenience, there is also a possibility that they impose an additional demand on the driving task, and it is as yet unclear as to what extent they might overload the driver's sensory and information processing capabilities.

8.3 OBJECTIVE: The objective of this research is to evaluate several new driver-aiding systems. The effect on driver task loading and simultaneous-task capacity should be evaluated through field experiments. The research should analyze the effects of loading of the different sensory modalities and should result in design recommendations.

8.4 KEY WORDS: Driver Information, Electronic Aides, Synthesized Speech, Driver Performance, Decision Making, Vehicle Displays.

8.5 RELATED WORK: There has not been much research in this area.

8.6 URGENCY/PRIORITY: This research has high priority.

8.7 ESTIMATED COST: $500,000.

8.8 USER COMMUNITY: NHTSA, automobile manufacturers.

PROBLEM NO. 9

9.1 TITLE: Models for Driver Eye Scanning and Information Prosesses in Selected Traffic Environments

9.2 PROBLEM: It is well known that drivers obtain most of the information necessary to drive through the visual system. It has also been documented that drivers have a limited capacity to process the information necessary to successfully accomplish the driving task. Investigations of drivers' strategies for visual sampling of the environment are therefore of great importance. There is a need to develop and validate quantitative models for driver eye scanning and information processing. These models should be applicable to selected traffic situations (freeway driving, urban intersections, rural intersections, freeway exit ramps, etc.) and should produce accurately the spatial and temporal eye-scanning activities involved. The information processing models could further produce some of the input for driver vehicle control models such as DRIVEM.

9.3 OBJECTIVES: (1) To develop and validate quantitative driver eye-scanning and information-processing models. (2) To conduct a series of laboratory and field experiments in order to provide data necessary for both the model development and the model validation processes.

9.4 KEY WORDS: Driver Eye Movements, Information Processing.

9.5 RELATED WORK: There has been little research in this area.

9.6 URGENCY/PRIORITY: This research has high priority.

9.7 ESTIMATED COST: $600,000.

9.8 USER COMMUNITY: NHTSA, FHWA.

PROBLEM NO. 10

10.1 TITLE: Trade-Offs Between Signing and Delineation

10.2 PROBLEM: There are a number of roadway-traffic control features that provide guidance and navigational cues to drivers. They include signals, signs, and painted delineations on the roadway. Depending upon the traffic environment, it is likely that the effectiveness of signing or delineation systems may vary considerably. Important factors that might influence the choice are: weather characteristics, number of signs and other distracting elements,

width of roadway, etc.

10.3 OBJECTIVE: This study proposes to analyze the trade-offs between signing and delineation in providing effective guidance and navigational cues to the driver. Experiments should be performed using on-the-road measures of driver performance. The study should result in specific design warrants and recommendations to be used by traffic engineers. Several traffic environments should be analyzed.

10.4 KEY WORDS: Driver Information Processing, Decision Making, Traffic Navigation, Way Finding, Highway Design.

10.5 RELATED WORK: There has not been much research in this area.

10.6 URGENCY/PRIORITY: This research has high priority.

10.7 ESTIMATED COST: $600,000.

10.8 USER COMMUNITY: U.S. DOT, state DOTs, traffic engineers.

10.9 IMPLEMENTATION: Results could be used in design guidelines.

PROBLEM NO. 11

11.1 TITLE: Contribution of Prescription Drugs on Older-Driver Accidents

11.2 PROBLEM: Due to deteriorating health and perhaps also changes in motivational factors, older drivers tend to use prescription drugs much more frequently than do younger drivers. Although the use of prescription drugs is sanctioned by medical doctors, older drivers may have a tendency to use drugs more than is warranted. There can be detrimental effects of such usage, particularly with drugs that decrease driver attention and information processing.

11.3 OBJECTIVES: The objectives of this research are to investigate the extent to which older drivers use prescription drugs and to compare such usage with that of other age groups of drivers. The adverse effects of prescription drugs on driver behavior should be systematically evaluated either by compiling information or by conducting studies on driver performance.

11.4 KEY WORDS: Drug Usage, Driver Behavior.

11.5 RELATED WORK: There is not much research in this area.

11.6 URGENCY/PRIORITY: This research has high priority.

11.7 ESTIMATED COST: $400,000.

11.8 USER COMMUNITY: NHTSA

11.9 IMPLEMENTATION: Information on recommended usage of drugs by drivers should be made available to drug companies, medical doctors, and users.

PROBLEM NO. 12

12.1 TITLE: Performance Specification for Train Handling

12.2 PROBLEM: Individual differences in train handling capability may result from several factors such as type of training, experience, psychomotor skills, age, and physical conditions. Unfortunately, there are no performance standards for train handling. This makes it difficult to evaluate the effectiveness of training programs for engineers. Indeed, without performance criteria, it is impossible to assess the degradation of an engineer's performance resulting from factors such as fatigue, environmentally induced stressors, or alcohol.

12.3 OBJECTIVES: The objectives of this study are to investigate what constitutes satisfactory train handling, and to develop candidate performance criteria for measuring train handling capability. The research should be conducted in a train simulator. These performance measures would then be validated in comparison to real-world performance and by subjective evaluations. In deriving performance measures, a standardized train makeup (number and type of locomotives, number of cars, distribution of tonnage) and a standard terrain defined in terms of horizontal and vertical geometry would be required. Candidate measures for handling include coupling forces between cars, wheel lifting forces, acceleration profiles, and management of throttle and brake systems.

12.4 KEY WORDS: Train Simulator, Training Programs, Fatigue, Stress, Alcohol.

12.5 RELATED WORK: There has not been much research in this area.

12.6 URGENCY/PRIORITY: This research has high priority.

12.7 ESTIMATED COST: $500,000.

12.8 USER COMMUNITY: U.S. DOT, FRA.

PROBLEM NO. 13

13.1 TITLE: Compilation of Data on Eye Scanning Behavior for Selected Vehicles and Highway Environments

13.2 PROBLEM: Knowledge with regard to driver eye scanning behavior is useful when designing and modifying highways, traffic-control devices, and vehicles. During the 20 years, a considerable amount of driver eye scanning data have been collected in the United States and abroad. The results of these studies need to be compiled and classified in a single document. Driver scanning behavior for specific vehicles and traffic environments, expressed in terms of spatial and temporal probability distributions, represents one of the most important inputs when using sophisticated driver-vehicle models such as DRIVEM.

13.3 OBJECTIVES: (1) To develop a classification scheme for drivers visual scanning data ac-

cording to vehicle type (cars, trucks, etc.) and traffic environment (freeway, day-night, rural intersection, rain, etc.); (2) To classify and present driver visual scanning data from previous studies in a useful manner (in terms of spatial and temporal probability distributions, object codes, etc.); and (3) To collect driver visual scanning data for vehicle and traffic environment combinations where important needs eixst and where little or no scanning data are available.

13.4 KEY WORDS: Driver Eye Movements, Information Processing, Eye Scanning, Visual Scanning, Data Bank.

13.5 RELATED WORK: There has not been any previous research in this area.

13.6 URGENCY/PRIORITY: This research has high priority.

13.7 ESTIMATED COST: $600,000.

13.8 USER COMMUNITY: NHTSA, FHWA.

PROBLEM NO. 14

14.1 TITLE: Relationship Between Closed Course Driving Task Performance and Road Behavior

14.2 PROBLEM: A great deal of road research is performed through on-road experiments using special test facilities or preselected road circuits that facilitate investigation of specific driving tasks. Research using such closed course techniques yields interesting information about driver performance. However, one major problem limits the generalizability of results to normal driving. Driver performance is usually monitored and recorded using instrumented vehicles. Monitoring instrumentation and procedures introduce a dimension of artificiality in the driving tasks that challenges the validity of the findings.

It is therefore important to examine the relationships between closed-course performance and regular road behavior because this will be helpful in generalization of the experimental results.

14.3 OBJECTIVE: To undertake a series of studies to investigate the relationship between performance on closed-course driving tasks and road behavior (monitored unobtrusively), and to investigate the sensitivity of closed course performance measures to such factors as: geometry of the road, characteristics of the road surface, roadside buildings and structures, vegetation, signs, etc., interaction with other vehicular and pedestrian traffic, weather conditions, and the characteristics of the vehicle driven.

14.4 KEY WORDS: Driver Behavior, Instrumented Vehicles, Normal Driving, Highway Design.

14.5 RELATED WORK: There has been little previous work in this area.

14.6 URGENCY/PRIORITY: This research has high priority.

14.7 ESTIMATED COST: $800,000.

14.8 USER COMMUNITY: NHTSA, FHWA.

PROBLEM NO. 15

15.1 TITLE: Simple Measures for Monitoring Drivers' Steering Control

15.2 PROBLEM: Derivatives of driver steering control behavior are among the most frequently used measures in driver performance research. Since the beginning of the 1960s, there has been a multitude of studies that have analyzed different measures of driver steering control derived from frequency and amplitude characteristics. Most of the measures have proven to be of little practical use, since there are no clear indications of how they are affected by such parameters as driver fatigue, experience, intoxication, vehicle steering characteristics, and roadway design. Finding reliable and valid measures of driver steering control is not an easy task and it should be addressed in a special research study.

15.3 OBJECTIVE: The objective of the present study is to compare the validity and the reliability of several measures of driver steering control. Measures should be taken under several conditions, such as simulated and real driving, experienced versus less experienced drivers, for different vehicle steering characteristics and for different road environments. The study should critically evaluate different measures for application to training programs, commercial vehicle operation, etc.

15.4 KEY WORDS: Driver Monitoring, Driver Fatigue, Steering Behavior, Driver Behavior, Task Demands, Roadway Design.

15.5 RELATED WORK: There have been few conclusive studies in this field of research.

15.6 URGENCY/PRIORITY: This research has high priority.

15.7 ESTIMATED COST: $500,000.

15.8 USER COMMUNITY: NHTSA, FHWA.

PROBLEM NO. 16

16.1 TITLE: Visibility Characteristics of Accidents.

16.2 PROBLEM: Many accidents are caused because drivers do not see an obstacle in time to stop their vehicle or take appropriate evasive action. For example, accidents occur when drivers fail to see stop signs, road curvatures, pedestrians, and obstacles on the road, and approaching vehicles at intersections. In order to better understand how to prevent visibility-related accidents, a knowledge of the visual characteristics of the car, sign, obstacle, or pedestrian is required. Among the visual characteristics of interest are luminance, size, location, contrast, color, and background color. If this type of information could be obtained for a representative sample of accidents, it could be used to help develop effective countermeasures. For example, headlamp aiming could be improved based on a better

understanding of what intensity levels are needed in various directions; road signs could be located to make them more visible; and treatments to enhance the visibility of vehicles and pedestrians could also be developed.

16.3 OBJECTIVES: (1) To develop an accident investigation methodology to assess the visibility characteristics of accidents. (2) To apply the methodology to a representative sample of accidents. (3) To analyze the data and develop recommendations for countermeasures.

16.4 KEY WORDS: Driver Performance, Traffic Accidents, Roadway Visibility, Risk Taking, Attention, Luminance Contrast.

16.5 RELATED WORK: There has not been much research in this area.

16.6 URGENCY/PRIORITY: This research has high priority

16.7 ESTIMATED COST: $300,000.

16.8 USER COMMUNITY: NHTSA, FHWA.

PROBLEM NO. 17

17.1 TITLE: Effects of Adverse Weather on the Driving Performance of Impaired Motorists

17.2 PROBLEM: There is evidenct that the joint effects of several environmental stressors can lead to severe control performance decrements and increased risk of highway accidents. For example, the risk of having an accident due to darkness alone is approximately 1.5 times that of having an accident on a dry pavement during daylight conditions. At night when the pavement is wet, this risk is elevated to about 3.4 times that of a day, dry-pavement accident. Other evidence suggests that the freeway accident risk between 2 and 3 a.m. with wet pavement conditions is about 14 times that of dry pavement and daytime conditions. This is a period when a large proportion of road users have blood alcohol concentrations at or near .10% (the legal definition in most states for intoxication). Other evidence suggests that although drinking drivers may cope reasonably well during normal driving, additional stressors make the driver unable to cope adequately.

17.3 OBJECTIVE: The objective of this research effort is to systematically evaluate the literature to determine whether it is possible to predict the joint effects of alcohol and environmental stressors such as fog, rain, snow, wind, and darkness. From this effort, recommendations should be made for further research to fill in critical gaps in knowledge with respect to reducing the effects of adverse weather on driver peformance.

17.4 KEY WORDS: Traffic Accidents, Driver Behavior, Wet Pavement, Environmental Stessors, Drinking Drivers.

17.5 RELATED WORK: There has not been much research in this area.

17.6 URGENCY/PRIORITY: This research has high priority.

17.7 ESTIMATED COST: $200,000.

17.8 USER COMMUNITY: NHTSA.

PROBLEM NO. 18

18.1 TITLE: Standardized Test Route to Represent U.S. Driving Population

18.2 PROBLEM: There is no standardized information available for assessing the types of driving conditions that are experienced by different types of drivers.

18.3 OBJECTIVE: The objective of this research is to develop a description of U.S. driving exposure -- most likely a computer simulation -- that may be used to study the potential effectiveness of various safety countermeasures on driver performance issues. The standardized test route should be based on actual field sampling of relevant characteristics related to driver-vehicle performance, e.g., roadway topography, lane configuration, type of traffic control, pavement surface characteristics (friction, roughness, reflectance), roadside and background characteristics, and traffic characteristics (e.g., vehicles of all classes, pedestrians, weather, and other ambient characteristics). Such a standardized test route, when used by several researchers, would also help to tie together results of different studies. This information should be developed for several types of drivers, including the average driver, the urban driver, the rural driver, the elderly driver, and other design driver models.

18.4 KEY WORDS: Driver Performance, Field Research, Normal Driving, Highway Design.

18.5 RELATED WORK: There has not been any research in this area.

18.6 URGENCY/PRIORITY: This research has high priority.

18.7 ESTIMATED COST: $600,000.

18.8 USER COMMUNITY: NHTSA.

PROBLEM NO. 19

19.1 TITLE: Alertness Measurement and Enhancement in Train Crews

19.2 PROBLEM: According to FRA data, one of the major causes of train accidents is "human factors problems." Within this category, lack of crew alertness is often identified as a primary cause for missed signals, speeding, late application of brakes, missed safety communication from dispatchers, and late detection of changes in vertical and horizontal track curvature. Lack of alertness has also been suggested as a cause of some of the more serious train accidents including several rear-end collisions.

19.3 OBJECTIVES: (1) To reexamine past research on alertness in train crews. (2) To develop objective methods of on-board measurement of

crew member alertness. (3) To develop alerting devices or alerting tasks.

Alerting devices should be natural parts of the crews' regular tasks rather than additional tasks. Realistic experimenter-free operational tests involving 12-hour runs should be used to evaluate proposed alertness enhancement devices.

19.4 KEY WORDS: Train Accidents, Vigilance, Alertness Measurements, Alerting Tasks.

19.5 RELATED WORK: There has not been much research in this area.

19.6 URGENCY/PRIORITY: This research has high priority.

19.7 ESTIMATED COST: $400,000.

19.8 USER COMMUNITY: FRA.

PROBLEM NO. 20

20.1 TITLE: State of the Art of Traffic Safety Research

20.2 PROBLEM: The preceding research statements indicate that there are several basic issues that should be addressed in research. Until these research issues have been addressed, it is difficult to address practical design considerations that may improve traffic safety. However, basic and applied research should also be evaluated in terms of what issues remain to be addressed in traffic safety research, as was done so well in the A.D. Little report of 1968. A state-of-the-art investigation is of importance both for compiling and synthesizing the present knowledge, and for reassessing the need for further research, both basic and applied.

20.3 OBJECTIVE: The objective of the present study is to systematically assess the state of the art of traffic safety research. The review should critically evaluate and summarize existing research in driver performance and traffic safety, and assess the need for additional information and further research.

20.4 KEY WORDS: Traffic Accidents, Highway Design, Driver Performance.

20.5 RELATED WORK: This is an update of the A.D. Little Report published in 1968.

20.6 URGENCY/PRIORITY: This research has high priority.

20.7 ESTIMATED COST: $500,000.

20.8 USER COMMUNITY: FHWA, NHTSA, insurance companies, traffic engineers, driving schools.