DOCUMENT RESUME

ED 075 624 VT 019 911

AUTHOR McKnight, A. James; Adams, Bert B.
TITLE Driver Education Task Analysis. Volume II: Task Analysis Methods. Final Report.
INSTITUTION Human Resources Research Organization, Alexandria, Va.
SPONS AGENCY National Highway Traffic Safety Administration (DOT), Washington, D. C.
REPORT NO DOT-HS-800-368; HumRRO-IR-D1-70-1
PUB DATE Nov 70
NOTE 46p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Ability Identification; Achievement Tests; *Behavioral Objectives; *Behavior Standards; Curriculum Development; *Driver Education; Evaluation Techniques; Instrumentation; Performance Criteria; *Skill Analysis; Student Evaluation; *Task Analysis; Task Performance

ABSTRACT

This report is the second in a series of four reports dealing with the development of performance-oriented driver education objectives and a set of measuring devices for evaluating attainment of the objectives. Included are descriptions of the analysis of driver's tasks and the evaluation of behavior criticality. During the analysis process, the total highway transportation system was examined, and over 1,000 behaviorally-relevant system characteristics were identified. These system characteristics were examined to identify the specific behaviors required of the driver, and the resulting behaviors were organized into a task structure, which included the specific driver response and any associated cue. A group of authorities in the area of traffic safety then conducted a criticality evaluation of the behaviors by ranking them according to whether or not they were essential for all new drivers. The results of the task analysis and the criticality evaluation appear in Volume I, which is available as VT 018 252 in this issue. Volume III, which contains the objectives and the evaluation instrument, is available as ED 072 249, while Volume IV, which describes the procedures used to develop the objectives and evaluation instrument, is available as VT 019 910 in this issue. (SB)

Technical Report 72-13
HumRRO-TR-72-13

ED 075624

HumRRO

Driver Education Task Analysis: Task Analysis Methods

A. James McKnight and Bert B. Adams

HUMAN RESOURCES RESEARCH ORGANIZATION
300 North Washington Street • Alexandria, Virginia 22314

April 1972

Prepared for

Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20591

HumRRO
Technical
Report
72-13

Driver Education Task Analysis: Task Analysis Methods

A. James McKnight and Bert B. Adams

HumRRO Division No. 1 (System Operations)
Alexandria, Virginia
HUMAN RESOURCES RESEARCH ORGANIZATION

Prepared for

Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20591

The Human Resources Research Organization (HumRRO) is a nonprofit corporation established in 1969 to conduct research in the field of training and education. It is a continuation of The George Washington University, Human Resources Research Office. HumRRO's general purpose is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation.

Published
April 1972
by
HUMAN RESOURCES RESEARCH ORGANIZATION
300 North Washington Street
Alexandria, Virginia 22314

FOREWORD

This report was originally prepared for the U.S. Department of Transportation by the Human Resources Research Organization as part of the development of a set of instructional objectives for driver education courses. It is being published by HumRRO because numerous requests have indicated that it would have continuing usefulness in research methodology as well as in driver education fields. It is also available from the National Technical Information Service (NTIS) under the same title, identified as DOT HS 800 368, dated November 1970.

It is the second in a series of four reports dealing with the development of driver education objectives and describes the background of the study and the methods that were used in carrying out the analysis. The first report in the series, *Driver Education Task Analysis: Task Descriptions* (DOT HS 800 367, HumRRO Technical Report 70-103), provides an inventory of the driver tasks. The third report, *Driver Education Task Analysis: Instructional Objectives* (DOT HS 800 369, HumRRO Technical Report 71-9), deals with the performance and enabling objectives and the evaluation instrument which resulted from the task analysis. The final report, *Driver Education Task Analysis: The Development of Instructional Objectives* (DOT HS 800 270, HumRRO Technical Report 72-14), describes the procedures used to develop the objectives from the task analysis.

The work described in this report was performed by HumRRO Division No. 1 (System Operations), Alexandria, Virginia, Dr. J. Daniel Lyons, Director, under sponsorship of the National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation (Contract No. FH 11-7336). Dr. A. James McKnight was in charge of the study, and Mr. Bert B. Adams was the project director. The project staff included Mrs. Jane V. Lee, Mr. James F. McQuilkin, Mr. Stephen Kappel, Dr. Richard D. Behringer, and Mrs. Lola M. Craw, all of HumRRO Division No. 1.

Appreciation is expressed to the project advisory panel for its assistance—ranging from general guidance to direct participation—in carrying out activities of the project. Members of the advisory panel were as follows: Dr. Richard W. Bishop, Florida State University; Dr. Alphonse Chapanis, Johns Hopkins University; Dr. Leroy Dunn, NHTSA; Mr. Paul Halula, North American Professional Driver Education Association; Dr. Earl D. Heath, NHTSA; Dr. Francis Kenel, Illinois State University; Dr. P. Robert Knaff, NHTSA; Mr. Robert M. Nicholson, NHTSA; Dr. Robert O. Nolan, Michigan State University; and Dr. Robert Voas, NHTSA. The contract manager at the time the study was initiated was Dr. Voas; Mr. Nicholson was Contract Manager at the time this report was originally prepared.

Meredith P. Crawford
President
Human Resources Research Organization

SUMMARY

In an effort to start young people on the road to safe driving, over 13,000 high schools across the country conduct programs of driver education. Through these programs, nearly two million students receive classroom and behind-the-wheel instruction each year. Under the Highway Safety Act of 1966, the National Highway Safety Bureau (NHSB)[1] is assigned responsibility for issuing guidelines to assist the states in improving the quality of driver education programs. In several NHSB-sponsored studies attempts to evaluate the effectiveness of driver education programs have been hampered by a lack of an explicit description of what constitutes "good" driving. These studies have concluded that a necessary step in both the development and evaluation of sound driver education programs is an analysis of the driver's tasks. The driving behaviors identified through this analysis could serve as performance objectives from which would be derived the knowledges, skills, habits, and attitudes that are required for proficient driving.

OBJECTIVE

In a study undertaken by the Human Resources Research Organization, sponsored by the National Highway Safety Bureau, the objective was to develop a set of performance-oriented driver education objectives and a set of measuring devices by which attainment of the objectives could be evaluated. In the first phase of the research a comprehensive analysis of the driver's task was conducted in order to identify critical driving behaviors from which instructional objectives could be derived. It is the analysis of the driver's task and the evaluation of behavior criticality that is described in this report.

ANALYSIS OF DRIVING TASKS

In order to assure a comprehensive identification of driving behaviors, an analysis was made of the total highway transportation system including the driver, the vehicle he operates, the highway over which both travel, the traffic encountered, and the natural environment in which the activity takes place. The first step in the process was to identify those aspects of the system that were capable of creating situations to which the driver must respond—for example, curves in the road, traffic control devices, cars ahead, snow, rain, and driver fatigue. Over 1,000 specific behaviorally relevant system characteristics were identified.

The next step was to examine the various system characteristics, individually and in combination with one another, to identify the specific behaviors required of the driver. For example, driving on a hill necessitates certain behaviors, as does the presence of snow on the roadway. The two in combination (i.e., snow-covered hill) give rise to additional behaviors. The maximum number of individual characteristics examined in combination was four; beyond this number, the situations created were so specific and so unlikely to arise that considering them was not worthwhile.

[1] Now the National Highway Traffic Safety Administration (NHTSA).

The behaviors arising out of the analysis of system characteristics were then organized into "tasks", meaning in this case, a group of related behaviors. In some instances, the behaviors represented a sequence of activities leading toward some specific goal (e.g., passing or parking). In other cases, the only relationship among behaviors in the task is an involvement in the same general situation (e.g., night driving or driving on off-street areas).

Once the list of specific driving behaviors was organized into a task structure, the analysis was continued to assure that the specific driver responses were identified along with any associated cues, that is, aspects of the situation that serve to initiate, terminate, or otherwise guide the individual's responses.

While the basic approach through the identification of driving behaviors was analytic, an extensive literature review was undertaken to obtain information in support of each step in the analysis. Literature reviewed included textbooks, research reports, technical reports, legislative documents of various sorts, and films. Close to 600 separate items were reviewed.

CRITICALITY EVALUATION

The behaviors identified during the analysis of driving tasks varied considerably in their criticality to the safety and efficiency with which the highway traffic system operates. An efficient program of driver education must account for this variation. An evaluation of behavior criticality therefore became a part of the analysis. The approach to criticality evaluation was of necessity a judgmental one; there is insufficient data to support any empirical determination of criticality. A group of authorities in the area of traffic safety—driver educators, enforcement officers, license officials, and fleet safety personnel—performed the evaluation. The plan called for each evaluator to rank, in terms of criticality, three groups of 25 behaviors from the total list of 1500 behaviors. This would allow each behavior to be ranked five times. However, since seven of the evaluators did not return completed evaluations, the number of rankings in some cases was four instead of five.

The rankings were transformed to standard scores with a mean of zero and a standard deviation of 10. The scores for each behavior were then averaged to obtain a criticality index for each behavior. An analysis of variance showed a high degree of agreement among the evaluators.

TASK DESCRIPTIONS

The results of the task analysis and the criticality evaluation appear in the set of task descriptions that constitute the first in the series of four reports. A sample is provided on pages 29 and 30 of this volume. The descriptions of behavior have been entered to the left and center of the left-hand pages. Their associated criticality values appear to the right of the behaviors in both numerical and graphic form. The right-hand pages contain information relating to each of the described behaviors as gained from the literature review. This information describes (a) characteristic levels as well as limits of driver performance, (b) criticality information, primarily accident data, and (c) related knowledges and skills.

The contents of the task descriptions have been entered on magnetic tape for use in connection with a tape-operated typewriter system. This approach is intended to permit economical and rapid updating of task descriptions in response to acquisition of new information or changes in various elements of the highway transportation system.

CONTENTS

Driver Education Task Analysis: Task Analysis Methods

Section 1

STATEMENT OF THE PROBLEM

In an effort to start young people on the road to safe driving, over 13,000 high schools across the country conduct programs of driver education. Through these programs, nearly two million students receive classroom and behind-the-wheel driving instruction each year. An activity of such a magnitude is bound to draw the critical attention of the public which is called upon to support it. The question is whether formal driver education programs are more successful than ostensibly less costly "home grown" approaches to driving instruction.

Under the Highway Safety Act of 1966, the National Highway Safety Bureau (NHSB)[1] is assigned responsibility for issuing guidelines to assist the states in improving the quality of driver education programs. In several studies sponsored by the NHSB and the National Academy of Sciences, attempts to evaluate the effectiveness of driver education programs have been hampered by lack of an explicit description of what constitutes "good" driving.[2] While the quality of a driver's performance is believed to be reflected in his accident and violation record, such records, when used as a basis for evaluating driver education programs, have the following deficiencies:

(1) Accidents and violations result from many factors other than the quality of driving behavior, including driving conditions, amount of driving, and local enforcement practices.

(2) Even to the extent that accidents and violations reflect the quality of driving behavior, that behavior is itself a function of many factors other than driving skills developed through driver education programs, including fundamental personality characteristics, age, and experience.

(3) Should driver education be shown to have an effect upon accident and violation records, it would not be possible to determine which aspects of a driver education program were the effective ones and which ones had little or no effect.

The first step needed in the evaluation of driver education was a description of good driving stated in terms of what the driver must do, that is, what behavior is required. These behaviors could then form the basis of performance objectives—terminal performance objectives—to be achieved through driver education courses. From these performance objectives could be derived the knowledges, skills, habits, and attitudes that enable a student to obtain specified performance objectives. The terminal performance objectives and enabling objectives, if properly established, would serve as standards to guide both the development and the evaluation of individual driver education programs.

STUDY OBJECTIVE

As a step in the improvement of driver education programs and in the development of a standard against which to evaluate these programs, HumRRO undertook a study, the

[1] Now the National Highway Traffic Safety Administration (NHTSA).

[2] Harry H. Harmon, *et al. Evaluation of Driver Education and Training Programs*, Educational Testing Service, Princeton, N.J., March 1969.

goal of which was to develop a set of performance-oriented driver education objectives and to describe measuring devices by which attainment of the objectives could be evaluated. Both the objectives and the measuring devices were to be derived from a systematic and comprehensive analysis of the driver's tasks, and both were to reflect the minimum acceptable standards for entry into the highway transportation system.

The task analysis phase of the study is described in this report. The first report[1] in the series contains the task descriptions resulting from the analysis: the present volume describes the methods used in preparing the task descriptions. The driver education objectives and measuring devices are described in other reports.[2]

The remainder of this report is divided into sections—Section 2, Analysis of Driving Tasks; Section 3, Evaluation of Behavior Criticality; and Section 4, Preparation of Task Descriptions.

[1] A. James McKnight, and Bert B. Adams, *Driver Education Task Analysis: Task Descriptions*, U.S. Department of Transportation Final Report HS 800 367 (HumRRO Technical Report 70-103, November 1970), Contract No. FH 11-7336, November 1970.

[2] A. James McKnight, and Alan G. Hundt, *Driver Education Task Analysis: Instrutional Objectives*, U.S. Department of Transportation Final Report HS 800 369 (HumRRO Technical Report 71-9, March 1971) Contract No. FH 11-7336, March 1971; and McKnight, A. James, and Hundt, Alan G. *Driver Education Task Analysis: The development of Instructional Objectives*, U.S. Department of Transportation Final Report HS 800 370 (HumRRO Technical Report 72-14, April 1972), Contract No. FH 11-7336, March 1971.

Section 2

ANALYSIS OF DRIVING TASKS

The purpose of the task analysis was to identify as comprehensively as possible driver behaviors having a *potential* impact upon the transportation system. (The "transportation system," as referred to herein, is the driver, vehicle, roadway, other traffic, the natural environment, and the set of situations created by these elements to which a driver responds.) The emphasis was upon breadth rather than selectivity. Behaviors that were not in any way critical to the needs of the transportation system would be so identified during the criticality evaluation. However, there would have been no way to evaluate any behaviors that had been prematurely eliminated from the analysis.

Sponsor requirements explicitly included analysis of (a) all tasks involved in the operation of four-wheel passenger vehicles in nonprofessional use, (b) all roads under all weather conditions, (c) all future requirements due to technological advances in highways and vehicles, and (d) the cognitive and perceptual as well as the motor aspects of driving tasks.

DRIVER BEHAVIORS IN THE TRANSPORTATION SYSTEM

The method by which tasks were analyzed, was primarily formal analysis rather than empirical observation. It involved the detailed study of the system composed of the driver, the vehicle, the highway over which driver and vehicle operate, the traffic which is encountered, and the natural environment in which the activity takes place. While formal analysis constituted the basic approach, empirical information was utilized to the extent that it was available.

Some consideration was, of course, given to the use of direct observation in identifying the behaviors required of a driver. While observation is one of the oldest and most frequently used methods of analyzing tasks, it was inappropriate to the study of driving behavior for the following reasons:

(1) Most of the effort would be devoted to the observation of the highly repetitive behaviors that consume the great majority of the driver's time.

(2) A large number of highly critical but infrequently occurring behaviors might not be observed at all.

(3) Those behaviors that were observed would not necessarily constitute appropriate responses, and therefore might not be a valid representation of the driver's tasks.

(4) Implicit behaviors such as those concerned with the perception of cues and the processing of information would not be accessible to direct observation.

The systems analytic approach that was taken to study driver tasks is one that has been used extensively in recent years. While the approach has risen out of the development of large equipment-oriented systems, it has proved of value wherever purely empirical methods such as observation, questionnaire, or interview cannot be employed. Although individual techniques of systems analysis differ as a function of their specific application, the approach generally involves (a) an analysis of a system into its sequence of major functions or operations, (b) the mponent operations to identify the specific human tasks involved, ar of individual tasks into their specific behavioral elements.

The progressive reduction of activ system functions to elemental human behaviors is not directly applicable to the highway transportation system. This system lacks the clear sequence of functions that characterize many other systems. Except for the initial functions of starting and accelerating the car and the final parking function, driving behavior occurs in response to situations which are encountered in no fixed sequence. Second, driving behavior does not evidence the clear hierarchy of behavior that characterizes many systems. While some driving behaviors are elements of a superordinate category such as those behaviors involved in passing or entering a freeway, other behaviors are highly specific responses to isolated situations. The latter include responding to highway warnings, stopping for a pedestrian, or dimming the headlights for an oncoming vehicle.

Since so much of driving behavior appeared to be related to highly specific driving situations, in the systems analytic process employed an attempt was made to identify these specific situations directly rather than to arrive at them through progressive reduction. Once the specific situations and their associated behaviors were identified, they could be organized into categories on the basis of temporal, functional, or other logical relationships among them. The systems analytic procedure ultimately adopted consisted of the following activities:

(1) Identification of System Characteristics. Identifying those characteristics of the highway transportation system that give rise to situations to which the driver must respond.

(2) Identification of Driving Behaviors. The analysis of system characteristics individually and in combination, to identify the nature of required driving behaviors.

(3) Organization of Driving Behaviors. The ordering of driving behaviors into a logical hierarchy of tasks and subtasks.

(4) Detailed Analysis of Tasks. The analysis of driving behaviors into their constituent elements.

These activities were preceded by a comprehensive review of the literature to obtain information required both in the systems analysis and in remaining project activities.

LITERATURE REVIEW

While the ultimate goal of the driving task literature survey was the identification of driving behaviors, the survey had to be broad enough to encompass information required in support of the various analytic activities by which this goal was to be achieved. The source materials can be categorized as follows:

Textbooks, pamphlets, and other instructional publications.

Research Reports including experiments, surveys, operations analyses, descriptive and quantitative models, correlational studies, and critical incidents.

Technical Reports concerned with characteristics of vehicles, drivers, roadways, traffic, or the general environment.

Accident Statistics and summaries such as those prepared by the National Safety Council and individual states.

Legislative Documents, including individual state policies, practices, codes, and ordnances, as well as summaries such as the Uniform Vehicle Code.

Films, including motion pictures and photographs of driver behavior, as prepared for instructional, research, or legislative purposes.

The literature review was maintained throughout the course of the study, the nature of the review changing to support the activities being carried on. Upon completion of the project's first phase, some 600 separate publications had been reviewed. A bibliography is included in the first report in this series.

Since the literature review was intended to support the entire analytic process, items related to each step of the process were extracted including information of the following types:

(1) System characteristics. Characteristics of the transportation system related to driver behavior.

(2) Driver behavior. Behaviors required of drivers described in terms of situations and their appropriate responses.

(3) Criticality information. Information concerning the criticality of certain behaviors to the transportation system, including (a) characteristic levels of driver performance, (b) variability of driver performance, (c) frequency with which the behaviors are required, and (d) the impact of the behaviors upon system goals, primarily those related to safety.

(4) Knowledges. Information related to behaviors and to their role in enabling or motivating drivers to perform.

(5) Skills. Descriptions of perceptual, motor, or intellectual processes involved in performance.

Items (4) and (5) were intended to support the development of driver education objectives during the second major phase of the study.

To permit faster retrieval of extracted information, each item of information was entered into computer storage. The items were coded in terms of the system characteristics to which they were related. Approximately 1500 individual entries were made, many of which contained information under more than one category. The use of the computer for the storage and retrieval function was a result of an original intention to utilize automatic data processing for organization and printing of the task descriptions which constitute the first report in this series. However, as will be noted later, a more efficient procedure was found and the use of the computer was restricted to the processing of information from the literature review.

IDENTIFICATION OF SYSTEM CHARACTERISTICS

The nature of everyday driving, according to the concepts advanced in this report, is determined by the transportation system in which driving takes place. It is a set of situations created by this system—the driver,[1] vehicle, roadway, traffic, and natural environment—that shape the responses the individual must make as a driver. The first step in the identification of driving behavior therefore was an analysis of the transportation system to identify relevant characteristics of the system. Inasmuch as this activity formed the foundation for later analyses, particular pains were taken to see that the analysis was very broad, since to overlook any relevant system characteristics could result in the omission of potentially critical driving behaviors.

System Goals

The demands placed upon the driver in his activity within the transportation system are those which the system must secure in order to fulfill its own objectives. The first

[1] The concept of the driver, in effect, *creating* situations to which he must respond is not as sophistic as it appears when one looks at such driver states as fatigue and the specific behaviors needed to accommodate it.

step in an analysis of the transportation system therefore was to decide upon the goals of the transportation system for the analytic purposes of the present study. These goals may be summarized as assuring the movement of passengers and materiel from one place to another with safety, efficiency, comfort, and responsibility.

Each of these goals creates its own set of behavioral requirements. *Safety* requires that drivers behave in a way th[illegible]ill minimize the chances of injury or property damage; for example, yielding right-of-wa[illegible] intersection. *Efficiency* requires that drivers avoid interfering with the rapid a[illegible]d ec[illegible]nical flow of traffic; for example, positioning the car in the correct lane to mak[illegible] a turn. *Comfort* requires that drivers operate in ways that will not cause discomfort to passengers, other drivers, or pedestrians; for example, slowing down when approaching a puddle near the curb. *Responsibility* means that drivers should be morally and financially responsible for the consequences of their acts, a consideration that underlies the requirement to register a vehicle or to report an accident.

While the transportation system places demands upon the driver to help fulfill its goals, it also helps the driver fulfill his own individual goals. The reason a driver drives is to satisfy his own needs, and while he may concern himself with operating safely, efficiently, comfortably, and responsibly, the behaviors that these goals give rise to in an individual case differ from those of the larger system. For example, the vehicle, as a characteristic of the transportation system, requires a variety of maintenance behaviors. Repair of a faulty transmission must be viewed by the driver as a task if he is going to satisfy his own objectives. Yet, the task of repairing the transmission itself does not help fulfill the broader goals of the transportation system. In fact, the same could be said of the very fundamental task of starting and accelerating the car, since each of the general goals of the transportation system would be furthered by keeping the individual driver off the highway.

While fulfilling his own driving goals through proper maintenance of the vehicle, use of road maps, shifting gears properly, and so on, are clearly among the driver's tasks and currently appear in most driver education courses, a question arose as to the advisability of investigating, under federal support, tasks that were not related to the overall needs of the transportation system. Yet, excluding such tasks would detract from the value of the program to driver educators, for it would furnish them a set of carefully ordered and evaluated objectives covering but a part of a course.

The scope of the systems analysis therefore became that of identifying those characteristics of the transportation system which impose behavioral requirements upon drivers in fulfilling both *individual and system-level* driving goals. However, the analysis was confined to behaviors directly or indirectly associated with transportation, excluding peripheral behaviors associated with recreational uses, improving the vehicle's appearance, financing and purchasing, and the like.

Information Sources

The major source of information concerning driving behaviors relevant to transportation was the literature review described earlier. Each of the publications was examined to identify specific characteristics of the driver, vehicle, roadway, traffic, or external environment that might impose behavioral requirements upon the driver. Of particular value were publications descriptive of critical driving incidents such as accidents, research studies concerned with causes of accidents or violations, and taxonomic studies concerned with identifying and organizing driving behavior.

The initial list of system characteristics, as generated from the literature survey, was organized into a logical hierarchy. This step led to the identification of additional relevant characteristics. The result of this effort was a list of nearly 1300 characteristics of the transportation system having a potential impact on driving behavior. Since the plan of analysis called for examining both individual and combinations of system characteristics, it was desirable to keep the number of specific characteristics as low as possible. This was achieved by the following means:

(1) Particular characteristics that were functionally equivalent were combined; for example, six- and eight-lane highways.

(2) Characteristics that were themselves combinations of more elemental characteristics were eliminated; for example, a "deer crossing" sign represented a combination of [illegible] and "deer crossing."

[illegible] that could be ordered along a continuum as a single variable were so treated; for example, gentle curves, medium curves, and sharp curves could be represented as "degree of curvature."

The final list of about 1000 behaviorally relevant system characteristics appears as Appendix A to this report.

IDENTIFICATION OF DRIVING BEHAVIORS

After comprehensive lists of behaviorally significant characteristics of the transportation system had been prepared, the identification of specific driving behaviors was begun. The first step was to examine each of the individual characteristics and to identify the specific behavioral requirements they imposed upon drivers. This process was fundamentally one of rational analysis supported by whatever information, either of an analytic or empirical nature, could be obtained from the file generated from the literature review. During this phase of the work, a limited number of characteristics were found to have no direct behavioral implications. These were primarily characteristics concerned with internal components of the vehicle which, while important to safety or efficiency of operation, did not require any specific behavior on the part of the driver.

Once all of the system characteristics had been examined and their behavioral implications identified, those characteristics that were behaviorally significant were examined jointly—that is, in pairs—to determine whether their combination called for additional behaviors. For example, while hills and snow-covered highways each call for certain behaviors, their combination in snow-covered hills demands a unique set of behaviors. For want of a better one, we shall apply the statistical term "interacting" to "emergents," that is, to combinations of characteristics that give rise to behaviors beyond what the "additive" combination would produce.

Since the number of combinations of 1,000 characteristics taken two at a time is almost a half-million, some simplification or screening and reduction was needed. This simplification was accomplished by examining general categories of characteristics in combination with one another before addressing them at the level of individual characteristics. One would not, for example, expect behaviors concerned with internal vehicle components that are largely maintenance oriented to interact with behaviors concerned with traffic control devices. It was, in fact, an *a priori* assumption that but a fraction of the combinations would produce meaningful interactions. While no count was actually made, that expectation was generally confirmed.

All meaningful two-factor interactions were next examined in conjunction with the original list of significant individual system characteristics to identify three-factor interactions. Again, the analysis began at the level of major headings and worked down to the level of individual characteristics. While the same analysis could have been carried to any number of characteristics, it did not appear fruitful to do so. In the few cases where the addition of a fourth factor had an effect upon behavior, the situation was now too specific and had too little generality to fit in an overall analysis of driving behavior.

ORGANIZATION OF DRIVING BEHAVIORS

The analysis of transportation system characteristics yielded something in excess of 1500 specific behaviors required in driving. The next step was to organize these behaviors into a logical structure. The purpose in carrying out this organization was the practical one of permitting reasonably facile identification of desired information items. It was not in any way intended to reflect the inherent structure of driving behavior. The organizing scheme that was adopted was that which classifies the behaviors according to the situations giving rise to them. While the behaviors might have been organized according to the responses involved, (e.g., "longitudinal control") or in terms of mediating processes (e.g., "hazard identification" or "risk taking"), in the present case a situational organization had the advantages of (a) requiring the fewest transformations of data from their original form, (b) offering a rather large number of distinct categories (the number of response categories is, for example, extremely limited), and (c) being composed of concrete observable processes rather than abstract ones.

Behaviors were initially divided into two categories: *On-Road* and *Off-Road*. On-Road behaviors were further subdivided into the following categories:

Basic Control—those behaviors involved in controlling movement of the vehicle, without regard to any specific situation.

General Driving—those behaviors that must be performed continuously or periodically rather than in response to a specific situation.

Situational Behaviors—those behaviors required in response to specific situations as follows:

- Traffic-induced behaviors
- Roadway-induced behaviors
- Environmentally induced behaviors
- Car-induced behaviors

Off-Road behaviors were divided into the following categories:

Pre-driving behaviors—those behaviors undertaken prior to driving to assure safe and efficient operation.

Maintenance—those behaviors directed toward the vehicle to assure its safe and efficient operation.

Legal responsibilities—those legally imposed behaviors required to assure that drivers are responsible for the consequences of their actions.

Behaviors in each of the above categories were next grouped into specific tasks. The term "task" is generally taken to mean a unit of work to be performed, one that consists of a sequence of activities all directed toward some specific outcome. Passing, parking, or negotiating intersections all qualify as tasks by this definition. However, many driving behaviors are not a part of any sequence but represent specific reactions to specific situations. Swerving to avoid a pothole, dimming lights for an oncoming car, or reducing speed to permit a passing car to return to lane are examples. Behaviors of this type were grouped according to the type of situation involved, as, for example, "road surface and obstructions," "night driving," or "reacting to traffic." Driving tasks therefore were behaviors that were grouped together either because they occurred at the same time or because they represented responses to the same situation.

As with most systems of classification, individual entries often warranted inclusion under more than one category. Dimming lights for an oncoming vehicle, for instance, could have been considered a component of night driving or of meeting an oncoming vehicle. To enter the behaviors under more than one task would unnecessarily add to the volume of information. Therefore, the behaviors were placed under that one task that seemed to characterize them best and cross-reference was made when tasks were related.

DETAILED ANALYSIS OF TASKS

Once all of the driving behaviors had been organized into tasks, it was necessary to continue the analytic process in order to (a) identify additional behaviors involved in the performance of tasks, and (b) analyze each task to the required level of detail. Concerning the first of these, it had been anticipated that the assembly of behaviors into some logical organization would in itself suggest certain additional behaviors. This was particularly true of behavioral sequences in which the existence of extensive gaps appeared likely.

The initial analysis of system characteristics was intended to identify behavioral requirements at a very general level. Emphasis was upon comprehensiveness rather than detail. It was important, for example, to identify the need to check traffic from behind when preparing for a lane change. The identification of specific activities involved was left for later analysis.

The level of detail required of a task analysis is determined by the intended use to be made of the results. The primary purpose in conducting the present analysis was to assist in the identification of objectives for driver education courses. A neophyte driver cannot be taught to perform an activity correctly unless he is informed of the specific behaviors involved. Nor can accurate inferences be made as to the knowledges and skills that he must possess.

To provide adequate detail, behaviors were described in terms of the specific human *responses* involved and the specific physical *objects* toward which the responses were directed; for example, "looks in rearview mirror" as opposed to "checks traffic behind."[1] Any *cues* that served to initiate, guide, or terminate responses were also identified as specifically as possible. For example, reference was made to "tail lights," rather than merely to "the car ahead," if the former served as a cue to the driver's response. Indefinite cues such as "hazards," or "traffic pattern," frequently found in traffic literature, were avoided unless the terms had been specifically defined.

Quantitative parameters of performance such as following distance, or maximum rate of acceleration, were specified wherever definitive values could be obtained. Actually, this could be done for only a small fraction of the driver behaviors. One reason for the paucity of values may be that drivers are generally unprepared to utilize such numbers. For example, it would do little good to specify longitudinal accelerations in starting or stopping, or lateral acceleration in turns since the driver has no way to measure acceleration. Even values that could be utilized rarely are. Maximum velocity for turning corners, a value that could be readily determined, apparently has not been specified, presumably because drivers respond to other cues. The inclusion of parameter values in initial behavior descriptions was strongly opposed by the driver educators who reviewed them. Not only did the driver educators feel able to judge acceptable limits of performance without the aid of numerical values, but they expressed the belief that their judgments would be more appropriate to the peculiarities of any particular situation than would be a single arbitrary number. Such parameter values as could be obtained were therefore included within the ancillary information that accompanied each behavior rather than being made a part of the description itself.

[1] Once a task such as "stopping" was analyzed, it could be entered as a component of another task without being described in detail.

Section 3

EVALUATION OF BEHAVIOR CRITICALITY

No course of instruction for beginning drivers can be expected to cover the full range of behaviors involved in vehicle operation. If a course is to be effective in meeting the needs of the transportation system, the behaviors selected for inclusion in the course must be those that are the most critical to the system.

The relationship between an individual behavior and the needs of the transportation system is extremely complex. The impact of an individual behavior upon the system depends upon such factors as (a) how often the behavior is required, (b) how well drivers generally carry out the behavior, (c) what effect the behavior has upon the system's goals, and (d) the relative priority of affected goals. Even were the relationships among the various factors to prove quantifiable, the data that would be required to secure a mathematical expression of criticality simply do not exist. It was necessary therefore to rely upon human judgment in obtaining an assessment of criticality. The method utilized in carrying out the evaluation was directed toward obtaining judgments that were as accurate as possible and involved the following steps:

(1) Obtaining Criticality Data—securing data relative to each of the criticality factors described above to aid evaluators in making valid judgments.

(2) Selecting an Evaluation Method—determining which of several methods of collecting evaluative judgments is most appropriate.

(3) Administering the Evaluation—preparing and disseminating evaluation materials and collecting responses.

(4) Generating Criticality Indices—analyzing judgments and obtaining an index of criticality for each item.

OBTAINING CRITICALITY DATA

The judgment of an individual concerning the criticality of various driving behaviors is to a great extent a function of his own experience. One means of securing valid judgments is to select individuals whose experience has exposed them to driving behavior that is reflective of the criticality relationships described earlier. However, the extent of an individual's experience is somewhat limited. Judgments might be improved if each evaluator could take advantage of whatever additional experience is available from published sources.

Literature Review

In the belief that the provision of empirical data bearing upon the criticality of driving behaviors could improve the validity of evaluators' judgments, an attempt was made to secure such data from published literature. The following types of information were sought:

(1) Results of controlled studies concerned with driver responses to various real or simulated situations, for example, maintenance of following distance, estimation of passing distance.

(2) Observations of uncontrolled (i.e., freely occurring) driver behavior, for example, use of turn signals, gap acceptance.

(3) Summaries of accidents classified in terms of situations and/or driver behaviors.

(4) Laboratory studies of traffic-related human capabilities, for example, studies of acceleration or velocity threshold.

(5) Summaries of critical incidents, where criticality is reckoned in terms of the specified system goals.

(6) Theoretical discussions, formal analyses, models, or other treatments of the rationale for criticality of behaviors.

In many cases, information bearing upon the criticality of driver behavior was only incidental to the purposes of the effort being reported. Relevant information was often found as incidental items in tables or embedded in appendices. In a few cases it was necessary to request and re-examine original data.

Accident Analysis

Most traffic accidents result from one or more unsafe acts on the part of drivers. Behaviors that have led to accidents may be considered highly critical to the transportation system. Regrettably, available accident statistics are not very enlightening with respect to behavioral antecedents. While the physical surroundings of accidents are generally described in specific terms, the behavioral descriptions are often either very superficial, as, "failed to yield right-of-way," or do not deal with *direct* causes, as, "driving too fast." Valid behavioral information is sparse. There are several reasons for this, including inability of participants to recall events leading up to the accident, their unwillingness to discuss them, and the difficulty investigating officers have in reconstructing the antecedents from the consequences of an accident.

To investigate accidents in sufficient numbers to provide reliable information was well beyond the scope of the project. However, three sources of detailed accident information were the National Highway Safety Bureau (NHSB), Cornell Aeronautical Research Laboratories (CARL), and the U.S. Army Military Police:[1]

National Highway Safety Bureau. Under sponsorship of NHSB, teams of medical and engineering specialists—at the time of this research there were 15—are engaged in investigation of accidents throughout the country. Highly detailed reports of these accidents are prepared and submitted to NHSB. For our use, 398 reports of recent accidents were obtained from NHSB files. Except for the fact that they involve only late-model cars, the sample of accidents seems reasonably representative of accidents in general.

Cornell Aeronautical Research Laboratories. Under sponsorship of the U.S. Department of Transportation and the Automobile Manufacturers Association, detailed reports on nearly 600 accidents occurring in the Buffalo, New York, area have been compiled. Some 570 of these CARL reports were examined in the present study.

U.S. Army. Arrangements were made with Provost Marshals of the Fort Ord, California, Fort Bliss, Texas, Fort Rucker, Alabama, Fort Knox, Kentucky, and the Military District of Washington, to obtain behavioral information on accidents occurring in or near their area. Information was collected on 132 accidents. While this sample is clearly unrepresentative of accidents in general, it appears to be weighted in favor of minor "fender-benders" which tend to be neglected by other investigative programs.

[1] Appreciation is expressed to the following individuals and organizations for their assistance in obtaining accident reports: Dr. Eugene E. Flamboe and Mr. James C. Fell, NHSB; Mr. John Garrett, CARL; Mr. Donald S. Buck, Safety Director, U.S. Continental Army Command.

The analysis of accident information was directed toward the identification of behaviors that drivers might have performed in order to *avoid* accidents. These avoidance behaviors were of the following three types:

Preventive Behaviors—behaviors that would have prevented an accident-producing situation from arising, for example, staying in lane at the crest of a hill, signalling a turn, reducing speed on a curve. Each accident was expected to identify one or more preventive behaviors.

Defensive Behaviors—behaviors that a driver might have employed to lessen his vulnerability to an accident situation created by someone else, for example, surveying cross traffic before proceeding through an intersection on a green light. The identification of defensive behaviors was confined to those a driver might reasonably be expected to undertake; in this sense, many accidents cannot truly be defended against.

Evasive Behaviors—behaviors that might have allowed a driver to escape from an impending accident, for example, pulling to the shoulder to escape a head-on collision. Evasive behaviors, like defensive behaviors, are obviously not always possible.

The NHSB and CARL reports, to the extent that they described behavior at all, dealt with those behaviors that presumably led to the accident rather than those through which the accident might have been avoided. However, the latter could generally be assumed from the former. For example, if an accident resulted from failing to signal a lane change, it was assumed that signalling would qualify as a preventive behavior. Even where behaviors were not described, it was frequently possible to make reasonable inferences as to the role of specific avoidance behaviors from the details that were provided in the reports which included, in addition to narrative descriptions, measurements, diagrams, and photographs. While pure speculation was not acceptable, there was no security in being extremely conservative. Since the purpose of the investigation was scientific rather than judicial, a "balance of evidence" criterion was adopted (in preference to a "beyond a reasonable doubt") when evaluating the role of the particular behavior in accident avoidance.

In the case of military personnel, cooperation was secured prior to the accident analysis, so that the attention of the investigating officers could be directed to avoidance behaviors at the time of their original investigation. Investigators were briefed[1] concerning the nature of information desired and each was provided a form upon which to record his observations and inferences. Each incomplete report was discussed immediately with the investigator preparing it.

The results of the accident analysis were registered in terms of the behaviors resulting from the task analysis. The number of times in which a specific behavior was involved in an accident was counted and the frequency recorded if it totaled five or more. Where a behavior was associated with fewer than five accidents, the numbers did not seem sufficiently significant to report directly. However, in most cases it was possible to accumulate across individual behaviors and report frequencies for subtasks, thereby assuring that the information was utilized. No attempt was made to deal with the seriousness of the accident. The questionable amount of help this would be to understanding driver behavior was not deemed worth the complications its introduction would entail. All of the accidents involved extensive damage, many were injury-producing, and some were fatal.

The number of accidents with which a particular behavior was associated in the sample of 1,000 behaviors studied cannot be taken as an indication of its relative frequency in the population of accidents at large. It is intended only to provide a rough indication of the behavior's role in accident causation and prevention. A behavior that

[1] A HumRRO Division is located at each of the participating military installations. Investigators were briefed by research personnel at the sites.

was linked to 40 or 50 accidents is probably more critical with respect to safety than one that accounts for less than five.

SELECTING AN EVALUATION METHOD

In determining the criticality of driving behaviors, attention was focused at the level of the individual behaviors rather than at the level of tasks or subtasks. To deal with criticality in terms of the latter categories would be meaningful only if the constituent behaviors were relatively homogeneous; such did not seem to be the case. For example, among the behaviors involved in entering a freeway by means of an on-ramp, the estimation of gap size in the presence of traffic seems more critical than merely entering the highway in the absence of traffic. Whatever criticality is possessed by a task or subtask as a whole is determined by the average criticality of its component elements.

Two alternative approaches were considered for the collection of criticality judgments—rating and ranking. The ranking approach has the virtue of forcing the active manipulation of the items to be judged, encouraging a more conscientious effort than does a rating process. Moreover, it seemed easier for judges to determine whether one behavior was more or less critical than another than to make some absolute rating of criticality.

The principal objection to the ranking approach was the large number of behaviors involved. It is extremely difficult to rank more than 20 or 30 behaviors at a time. If the total set of behaviors were divided into smaller groups, how would the behaviors in one group be compared with another? One way would be to rate, rank, or otherwise compare the groups as a whole, allowing each behavior's position to be a function of its ranking within the group and the position of the group. However, this again would involve the problem of evaluating groups of behaviors.

One means of dealing with the problem is to mix the groups being ranked. If one assumes that each behavior has a true criticality rank in the population of behaviors, then that behavior's rank in any sample drawn from the population should provide an estimate of its population rank. If a sufficient number of representative samples are drawn, the estimate of population rank should be reasonably accurate. The principal concerns regarding the validity of the approach were (a) whether evaluators could make meaningful comparisons of behaviors that were drawn from different tasks, and (b) whether the sampling errors, when added to errors of human judgment, would be so great as to obscure any true differences among the behaviors.

To test the three approaches—rating and both ranking approaches—a pilot study was undertaken using a small sample of behaviors drawn from three different tasks (passing, lane changing, following). In this pilot study, each behavior was evaluated in terms of its contribution to accident prevention by each of the following methods:

- Rating—each behavior was rated along a five-point scale.
- Task Group Ranking—behaviors were ranked with others of the *same* task group.
- Random Group Ranking—behaviors were ranked in groups drawn at random from the three tasks.

Each behavior was evaluated three times by each method. Comments of the nine judges taking part in the pilot evaluation indicated that the ranking method led to a more valid judgment than the rating method. Inter-judge agreement under the three methods was examined by comparing the ratio of the differences *among* behaviors to those *within* behaviors, that is, different judges ranking the same behavior. The higher the ratio, the greater the agreement. The average ratio for the three tasks were 2.72, 1.73, and 2.10 for the "random group" ranking, "task group" ranking, and "rating" methods respectively.

While no statistical significance may be attributed to these results, fear that the random group ranking would be difficult to apply or that true differences among the behaviors would be obscured by differences among the groups of behaviors being ranked was simply not supported. Since the random group method offered the only straightforward means of comparing behaviors across tasks, it was selected for the evaluation.

Once the mixed rank approach had been selected, the only remaining methodological question was how many judgments of each behavior would be required. This question had to be answered before evaluators could be selected and materials prepared. When population values must be estimated precisely, the number of replications (i.e., judgments) is generally quite large. However in considering the imprecision inherent in the concept of "criticality" and the uses to which indices of criticality would be put, it became apparent that a gross estimate, one that would classify the behavior into general levels of criticality, would suffice. Taking into account this objective, the resources available for this phase of the effort, and the large numbers of behaviors that were involved, the number of replications settled on was *five*. Each behavior would be ranked on five different occasions, using a separate, randomly drawn sample on each occasion. Behaviors that were ranked near the top on five different occasions were likely to be fairly critical, those consistently ranked near the bottom to be rather uncritical, and those ranked in the middle to be of moderate criticality.

ADMINISTERING THE EVALUATION

Once the manner of collecting evaluations had been settled, the actual administration commenced. This process involved selecting evaluators, preparing and disseminating materials, and collecting responses.

Selection of Evaluators

People knowledgeable in the needs of the transportation system and familiar with the relation of individual driver behavior to these needs were required for the evaluation process. Five groups meeting the specification were identified:

Driver Education Specialists. Persons engaged in establishing requirements, curricula, and courses of driver educations; not necessarily driving instructors.

Safety Specialists. Persons engaged in identifying requirements for and programs of traffic safety.

Enforcement Specialists. Persons engaged in law enforcement including patrol activities, accident investigation, and other related activities.

Licensing Specialists. Individuals engaged in establishing and administering programs of driver examination for licensing purposes.

Fleet Safety Specialists. Persons engaged in selecting, training, and examining drivers for truck fleets.

The size of the sample was constrained by administrative considerations. To assure a conscientious effort, it was believed necessary to limit each person's activities to two hours. The pilot study had indicated that three groups of 25 behaviors, 75 behaviors in all, could be ranked during this period. Since the number of behavior statements to be ranked totaled 1500 and each had to be ranked five times, a total of 7500 behaviors had to be ranked. This meant a need for 100 (7500÷75) evaluators.

A list of candidates for the evaluation process was assembled with the aid of the National Highway Safety Bureau, the project advisory panel, and the American Trucking Association. Letters were addressed to 125 prospective evaluators explaining the purposes of the study and the nature of the evaluation, and giving the date the evaluation would commence. A return postcard was provided for an indication of their willingness to participate. To encourage a conscientious and expeditious effort, each candidate was offered a $20 honorarium for participation. By the date scheduled for mailing of materials, 97 positive replies had been received. An additional three participants were obtained through personal or telephone contact.

Preparation of Materials

The ranking method required that each driving behavior to be evaluated be entered on an individual slip of paper that the evaluator could manipulate during the ranking process. While the behavior descriptions were prepared from the task descriptions described earlier, the following modifications were introduced:

Wording—for the sake of brevity, behaviors were described quite tersely in the task analysis. To improve their readability, they were transferred into more common, everyday language.

Combining Behaviors—many of the individual behaviors in the task description represented elements of a single unitary act, that is, one behavior could not occur without the other. An example would be the steps involved in shifting gears. Since all the behaviors presumably shared the same level of criticality, they could be evaluated as a single unit. A behavior that was not an integral part of the activity or one in which performance could vary considerably without affecting the other elements, for example, the accelerator-clutch coordination in shifting gears, was removed from the sequence of behaviors to be described and ranked separately.

Context—behaviors removed from their context in the task descriptions were sometimes incapable of interpretation. In preparing behavior statements for evaluation, therefore, phrases and sometimes sentences were added to restore the essentials of context.

In addition to the slips containing the driving behaviors to be ranked, each evaluator received a draft copy of the task description containing the descriptions of driving behaviors and the criticality information described earlier. The draft task descriptions were the same as the final task descriptions discussed in Section 4 of this report except for the later addition of the criticality indices generated from the evaluation process.

Dissemination of Materials

Evaluation materials, mailed to all participants at the same time, consisted of (a) three envelopes each containing a sample of 25 behaviors, (b) the task descriptions, (c) a set of directions (see Appendix B), and (d) an envelope for returning the ranked behaviors.

In the directions, each evaluator was requested to examine the behavior in the task descriptions at the time he was making his initial judgment of criticality. (The behaviors were initially arranged in the same order in which they appeared in the task description.) If he disagreed with the way a behavior was described, he was asked to rank it for criticality nonetheless and to record his objections on the slip of paper. He was also encouraged to comment generally upon the contents of the task description.

Some consideration had been given to entering items of supporting information directly upon the slips used in the ranking process. This would have been done had equivalent information been available on all items of behavior. However, such was not the case and the possibilities seemed great that rankings would be influenced by the presence or absence of supporting information rather than the legitimate implications of that information. While provision of the information in the task descriptions does not negate the possibility of the same effect taking place, the chances seem much more remote. Moreover, referring the evaluator to the task description allowed him to view the overall task content.

Upon completing a ranking, the evaluator was asked to place a colored card in the stack of ranked behaviors, beneath the last behavior he felt was critical enough to be required of an individual before he might be considered qualified to drive. Any behaviors beneath the card, while perhaps very important, would not be so critical as to be required of a "qualified" driver.

Upon completing the ranking, the evaluator was to clip the slips together, place them in the envelope, and seal it. When the contents of all three envelopes had been ranked, he was to place them in a large return envelope and mail it.

GENERATING CRITICALITY INDICES

Despite the advanced indication of willingness to participate in the study, some of the evaluators found it impossible to complete the evaluation within the time permitted by the schedule. Changes of address associated with the end of the academic year delayed receipt of material by some of the evaluators. However, despite problems, the participation of 94 evaluators was secured before it was necessary to begin analysis of results. (A list of evaluators is provided in Appendix D.) Since 100 evaluators were needed to obtain five rankings of each behavior, some behaviors were ranked by only four evaluators. However, no fewer than four evaluators were involved in each ranking. In analyzing the results of the ranking, individual ranks were converted to their normalized equivalents.[1] The normalized scores ranged from $+2.0\sigma$ for a rank of "1" to -2.0σ for a rank of "25"; the mean of zero corresponded to a rank of 13.

Once the transformation was complete, the means of these normalized values and their associated standard deviations were calculated for each of the 1500 behaviors. In addition, the frequency with which each behavior was judged to represent a minimum requirement for a qualified driver (i.e., it was placed above the colored card in the ranking) was obtained. This frequency was used in selecting behaviors for inclusion among driver education objectives during the second phase of the project.

Additional Evaluations

Approximately 50 additional specific behaviors were identified following completion of the original ranking—some were contributed by the evaluators themselves. A method of ranking these behaviors, and others that might emerge later in the program, was needed. Simply ranking the additional behaviors against one another was not appropriate. Since the behaviors were not a representative sample of the population, their standing relative to one another would not approximate their standing within the population. The procedure that was adopted follows:

First, a group of the previously ranked behaviors was selected in such a way as to provide a behavior whose mean rank corresponded to each of the 25 ranks. The attempt was made to select items having the least spread around the mean rank. (It follows that, in order to have a mean rank of "1" or "25", an item had to be ranked in that position by all of the judges addressing it; fortunately, two such items were found.) Next, an additional group of five evaluators took each of the unranked behaviors and assigned it the rank of the behavior in the list of the ranked 25 behaviors to which it most closely approximated in criticality. The behavior was then given the same rank value as the corresponding ranked behavior. The evaluator was also asked to decide whether the

[1] Normalized equivalents were taken from E.S. Pearson and H.O. Hartley, *Biometrika Tables for Statisticians,* Vol. 1, Cambridge University Press, New York, 1958, p. 125.

behavior was sufficiently critical to be considered a minimum requirement for a qualified driver. The results were then processed in the same manner as described for the previously ranked behaviors.

Inter-Judge Agreement

Before any confidence could be placed in the results of the evaluators' rankings, it was necessary to assess the extent to which one evaluator agreed with another. This assessment was done by means of a simple analysis of variance. Were there no agreement among the separate evaluators, the set of normalized scores for any one behavior and the set of mean normalized scores would be no different from the values and means of a chance sample drawn from the total population of 7,398 rankings. However, the more the evaluators agreed with one another, the smaller would be the differences among rankings for any one behavior and the greater would be the differences among the means for the various behaviors.

The results of the analysis of variance were:

Source of Variance	*df*	Mean Square	*F*
Among Behaviors	1576	2.66	6.7
Within Behaviors	5821	.48	

It is evident from the mean squares that the differences (i.e., variance) among the behaviors are very large in comparison to differences (variance) among rankings within each behavior, and the F ratio establishes that the differences among the behaviors are highly significant ($p<.01$). An expression of the above as a degree of agreement or reliability is obtained by calculating the intra-class correlation, which produces a value of .82; this value indicates that a high level of agreement was achieved by sets of five (or in some instances, four) rankings.[1]

The fact that the evaluators evidenced a high level of agreement does not mean that their judgments necessarily reflect the "true" criticality of the behaviors. The indices of criticality remain subjective and one's confidence in their validity must ultimately rest with his confidence in the evaluators. However, a high level of agreement promotes confidence where non-agreement would destroy it. While some portion of the agreement probably reflects common insight into the effect of driving behavior upon the highway transportation system, some portion is probably due to popular assumptions that are shared without factual bases.

Inter-Task Differences

The criticality evaluation focused upon individual behavioral elements rather than entire tasks in the belief that the criticality of behaviors within any task might vary considerably. The results of the evaluation as shown in Volume I substantiate this belief. However, it is also apparent in Volume I that there is a great deal of similarity in the criticality of behaviors within a particular task. Passing behaviors are, for example, far more critical than most maintenance behaviors. The significance of the differences among

[1] Correlation calculated according to a formula described by B.J. Winer, *Statistical Principles in Experimental Design*, McGraw-Hill Book Company, New York, 1962, p. 124.

mean criticalities for the various tasks was tested through an analysis of variance with these results:

Source of Variance	*df*	Mean Square	*F*
Among Tasks	44	49.0	78.5
Within Tasks	7343	.6	

It is apparent that the major portion of variance in criticality of driving behaviors is associated with differences among tasks rather than among the behaviors within a task. The mean criticality values for each task are provided in Appendix C.

Section 4

PREPARATION OF TASK DESCRIPTIONS

The set of task descriptions, the first in this series of reports, represents the result of the task analysis and criticality evaluation. A sample of the task descriptions appears on the next two pages. The descriptions of driving behavior and their associated criticality indices are shown on the left-hand page while the right-hand page provides items of supporting information gathered from the literature survey and the accident analysis described in Section 3.

BEHAVIOR DESCRIPTIONS

The driving behaviors identified through the task analytic process described earlier appear at the left and center of the left-hand page of the sample. Copy for the task descriptions was prepared by means of a magnetic tape-typewriter system in order that revisions could be made rapidly and economically as material was added, deleted, or changed during the analysis and criticality evaluation. Another step taken to facilitate revision was to start each task description with a new page in order to confine the effects of any additions or deletions to a single task.

Recognizing the diverse character of the audience for which the task descriptions are intended, an attempt has been made to use terminology commonly employed by the driving public rather than a technical vocabulary. While a term such as "lower torso restraining device" may be familiar to automobile designers, it might not be understood readily by a highway designer. The term "headway" has a number of common dictionary meanings, but none includes the meaning given by many automotive researchers, that is, the distance separating two vehicles on the same path. The more popular term, "following distance," appears to communicate to a wider audience.

The only "private" definitions were those of "car" and "vehicle." Some convenient distinction had to be made between the vehicle operated by the driver whose task was being analyzed and other vehicles to which he reacts. It seemed reasonable to use the term "car" in reference to the driver, since the scope of the task analysis was limited to cars, that is, four-wheel passenger vehicles.

CRITICALITY INDICES

The results of the criticality evaluation are displayed along the right margin of the left page in the task descriptions. The number corresponds to the mean normalized rank (multiplied by 10 to remove the need for a decimal). At the right of the numerical value, the mean normalized rank is represented graphically according to the following scheme:

X	=	−20 to −12
XX	=	−11 to − 4
XXX	=	− 3 to + 3
XXXX	=	+ 4 to + 11
XXXXX	=	+ 12 to + 20

Task 32: Passing *

		Criticality	
32-1	DECIDES WHETHER TO PASS (TWO- OR THREE-LANE ROADS)		
32-11	Looks along roadside for passing control signs *	5	X X X X
32-111	Does not pass if "no passing" zone is indicated or has been indicated previously (see 21-2, Surveillance or Traffic Controls)	12	X X X X X
32-112	May pass if sign indicates end of "no passing" zone *		
32-12	Observes lane markings	10	X X X X
32-121	Does not pass if left side of lane is marked by the following:	15	X X X X X
32-1211	One or two solid lines		
32-1212	Solid line to the right of broken line		
32-122	Determines that passing is permissible if left side of lane is marked by the following:		
32-1221	Broken line		
32-1222	Broken line to the right of solid line		
32-1223	No markings		
32-123	Does not anticipate end of "no passing" zone *	5	X X X X
32-13	Observes roadway ahead		
32-131	Identifies passing limitations including the following *	13	X X X X X
32-1311	No passing zone *		
32-1312	Hill		
32-1313	Curve		
32-1314	Intersection *		
32-1315	Bridge or tunnel		
32-1316	Railroad crossing		
32-1317	Pedestrian on edge or shoulder of two-lane roadway *		
32-132	Judges available passing distance *	15	X X X X X
32-133	Judges lead vehicle relative to speed *		
32-1331	In accelerative pass, judges lead vehicle speed from car speed *	12	X X X X X
32-1332	In flying pass, judges lead vehicle-car closing rate *	14	X X X X X
32-134	Judges available passing time *		

*An asterisk indicates the presence of related supporting information on the right-hand page.

Code Number	P I	P L	C R	S K	K N	O	
32			X				In 1968, there were approximately 10,000 fatal passing accidents
32-11					X		Abiding by signs, lane markings, and other passing limitations is a legal requirement in most states
32-112	X						(EX) More passing opportunities are accepted when drivers are forewarned 500 feet from the start of the passing zone and given the length of the passing zone (193, p. 124)
32-123	X						Nearly half of drivers violate the end of a "no passing" zone on a two-lane roadway (131, p. 32)
32-131			X				Drivers disregard of roadway limitations to passing was noted in at least 7 out of 1000 accident reports received (HumRRO)
32-1311	X						Nearly 25 percent of drivers violate the beginning of a "no passing" zone (131, p. 32)
							(EX) Drivers were able to judge variables involved in completing a pass within the passing zone. Few drivers initiated passes that could not be completed in time without additional acceleration; few declined to pass when two seconds or more margin existed (81, p. 16)
32-1314					X		It is dangerous and illegal to pass at an intersection owing to the possibility of encountering unexpected vehicle maneuvers, including the following: (a) lead vehicle suddenly attempts a left turn; (b) lead vehicle is forced to the left by traffic entering from the right; (c) on two-lane roads, traffic may enter the left lane without looking, not expecting to encounter oncoming traffic there
32-1317					X		If the pedestrian is on the right, the vehicle ahead may swerve left and force the car off the left side of the roadway. If the pedestrian is on the left, driver could possibly face the alternative of hitting the pedestrian or sideswiping the vehicle being passed (198, p. 5)
32-132	X						(EX) Drivers consistently underestimated the required overtaking and passing distance. Negative errors increased with speed. At 50 miles per hour, over three-fourths of the estimates were considered dangerous (145, p. 42)
32-133	X						The greater the speed, the less likely the driver of an overtaking car is to accept a given passing distance (047, p. 3)
32-1331					X		By attaining a stable headway between the car and the vehicle ahead, the driver matches the speed of the lead vehicle
							When the lead vehicle's velocity is 50 miles per hour, approximately 750 feet are required to complete the pass (28, p. 168)
32-1332					X		A flying pass is one with the original speed of the passing car greater than the speed of the vehicle being passed. This type of pass requires great sight distance ahead (201, p. 144)
	X						(EX) Drivers adequately respond to speed and distance cues that determine the validity of a flying pass decision - car speed, car-vehicle ahead closing rate, distance of each from the end of the passing zone, and the distance headway between the car and the vehicle ahead (145, p. 51)
32-134					X		Judgment of passing time is based on driver's judgment of passing distance and closing rate
	X						While driver's ability to judge closing rate is quite limited, he responds appropriately to passing distance and the speed of the vehicle ahead (193, p. 34)

P I | P L | C R | S K | K N | O

Briefly stated, the greater the number of X's, the more critical is the behavior. The graphic display is intended to permit the reader to identify, at a glance, both the overall criticality of a particular task and the critical elements within the task. An "X" was selected as a graphic symbol because it could be produced by the typewriter and thus stored on the magnetic tape along with the textual material of the task descriptions. Placing the entire contents of the task descriptions on tape was intended to facilitate any revisions of the task descriptions.

SUPPORTING INFORMATION

The right-hand page contains supporting information collected as part of the literature review and the analysis of accident records. The information falls within the following categories as indicated by the placement of the "X" in the column to the left:

Performance Information (PI). Information relating to the characteristic levels of driver performance (e.g., how often he uses turn signals).

Performance Limits (PL). Information relating to the measured limits of human performance (e.g., constant and variable error in maintaining speed).

Criticality Information (CR). Information relating to the impact of certain behaviors upon highway system criteria of safety and traffic flow (e.g., accidents at intersections).

Skills (SK). Information descriptive of the perceptual, motor or intellectual processes involved in performing a behavior (e.g., factors entering judgment of passing distance).

Knowledges (KN). Information concerning a behavior that might play a role in enabling or motivating an individual to perform it (e.g., meaning of sign shapes or rationale for not passing at intersections).

Performance information may be further coded in terms of its origin—"EX" for information gathered under experimental conditions, "FR" for that collected under free observation, and "AN" for that which was analytically derived. Where the information was gathered from a specific literature source, the reference is given in parentheses.

PERFORMANCE STANDARDS

Consideration has been given to the establishment of performance standards for each behavioral element identified in the task descriptions. These standards are of the following two forms:

Tolerance Limits—a set of values which specified the limits of acceptable behavior (e.g., minimum and maximum following distances).

Reliability Standards—the minimum acceptable likelihood of correct performance (e.g., a driver carrying out a group of behaviors bearing a .95 standard of reliability would be permitted a maximum of five errors in 100 occasions).

The imposition of performance standards for the driving population in general did not appear feasible for two reasons. The first was the virtual impossibility of specifying standards that would take account of the varied circumstances under which a behavior was exhibited. For example, a task element dealing with driving on slippery surfaces required avoidance of abrupt changes in velocity or direction. If one were to establish tolerance limits for degree of abruptness in steering control, one would have to consider such variables as the coefficient of surface friction, condition of tires, weight of the vehicle, and gradient of the roadway. The attempt to specify limits in terms of system outputs (e.g., lateral slippage) rather than inputs still requires a specification of the circumstances. Driver educators with whom this problem was discussed were unanimous in their belief that highly specific quantitative standards would be incapable of implementation and that their own judgments, reached in consideration of specific circumstances, would be superior.

The second problem in establishment of performance standards had to do with the question of population to which the standards would be applied. Clearly, one does not expect as much of the beginner as one does of the highly experienced driver. Standards must be established in terms of some specific population. Of primary concern to the transportation system is the novice driver who is about to enter it. Standards for this population would be based upon the minimum acceptable performances required for safe and effective travel. Such a process would be more meaningful than attempting to set standards for a population as nebulous as the average driver.

Because of the difficulties described, no general set of performance standards was specified. The establishment of minimum acceptable performances for beginning drivers became a part of the establishment of driver education objectives which will be described in the final volume. In framing driver education objectives, as opposed to general task performance standards, it is possible to specify in some detail the drivers to whom the objectives are to be applied as well as the conditions under which the performances are observed. The degree of detail that is feasible for each specification has been dealt with in the subsequent HumRRO reports in this series.

USEFULNESS OF TASK DESCRIPTIONS

The task descriptions represent a form of technical data that may be applied to the development of driver education objectives. They do not constitute any sort of end-product, and are certainly not a "course." Before the descriptions of behavior could be employed for instructional purposes, they would require extensive re-organization and re-wording. Even then they would not provide more than a small portion of course content. There are similar problems in their application to other uses. For example, use of the task descriptions by those concerned with simulation would require further examination of the visual, kinesthetic, and proprioceptive cues connected with certain behaviors, as would their application to problems of automotive design.

It is in breadth rather than in detail that the task descriptions should be of greatest value. They place in the hands of interested persons probably the most complete available inventory of the activities that drivers are called upon to perform. Anyone wishing to identify the behaviors that make up a particular set of tasks may do so readily. If the area of concern is one that cuts across tasks, as for example "visual discriminations," greater effort will be required. Yet, the task descriptions will at least provide a source of information that is surer than an investigator's powers of recall. At a minimum, they furnish a checklist that will assist in detecting oversights and blind spots.

The reader is likely to find the task descriptions not as illuminating as those that result from a task analysis performed on a more highly specialized job. Most people, having driven on an almost daily basis over half of their lives, will be highly familiar with almost all of the behaviors described. Indeed, the reader, if he is an experienced driver, more closely resembles the supplier than the consumer of most task analytic information. Certainly there exist behaviors that are not well-known even to experienced drivers. A number of rather interesting, highly individualized behaviors or techniques were uncovered during the literature review. However, many conflicted with more conventional procedures, and few were accompanied by any real evidence of their value. On the advice of the project advisory panel, such behaviors were deleted from the analysis.

APPENDICES

Appendix A

BEHAVIORALLY RELEVANT SYSTEM CHARACTERISTICS

Driver Characteristics

Vehicle Characteristics

Roadway Characteristics

Traffic Characteristics

Environment

DRIVER CHARACTERISTICS

- Physical Characteristics
  - Age
  - Sex
  - Body Measurements
    - Height
    - Weight
    - Limbs
    - Reach Distance
  - Strength/Endurance
  - General Health
    - Physical Illness
      - Chronic
      - Temporary
- Mental Characteristics
  - Cognitive Factors
    - Knowledges
    - Skills
      - Perceptual
      - Perceptual/Motor
      - Intellectual
        - Reasoning
        - Information Processing
  - Motivational Factors
    - Interests
    - *Objectives*
    - Values
    - Attitudes
  - Personality and Emotions
  - Habits
  - Personality
    - Aggressiveness
    - Confidence
    - Impetuosity
    - Neurotic
- Sensory Characteristics
  - Vision
    - *Visual Acuity*
      - Static
      - Dynamic
    - Visual Field
      - Central
      - Peripheral
      - Glare Threshold and Recovery
        - Veiling Glare
        - Dazzling Glare
        - Blinding or Scotomatic Glare
        - Recovery Time
      - Depth Perception
        - Monocular
        - Binocular
      - Night Vision
        - Distance
        - Form Perception
        - Perception Time
        - Adaptation
      - Color Vision
      - Eye Movements
      - Visual Fatigue
      - Perception-Reaction Time
      - Visual Abnormalities
        - Monocular Vision
        - Color Blindness
      - Corrective Measures
        - Glasses
        - Sunglasses
    - Audition
      - Frequency
      - Intensity
      - Masking Noise
      - Fatigue (Auditory Adaptation)
      - Perception-Reaction Time
      - Auditory Abnormalities
        - Temporary Deafness
        - Permanent Hearing Loss
      - *Corrective Measures*
        - Hearing Aids
    - *Kinesthetic*
      - Location of body members and Movement
    - Static (Equilibrium)
      - Balance
      - Acceleration
      - Deceleration
    - Proprioception
      - Discrimination of Movement
        - Force
        - Extent
        - Duration
      - Feedback
  - Olfactory
  - Tactual
  - Organic Viscera
  - Pain
  - Thermal (Cold and Warmth)
- Motor Factors
  - Coordination
    - Gross Motor
    - Fine Motor
    - *Response Time*
  - Motor Rhythm
  - Steadiness
  - Aptitude
  - *Level of Skill*
  - Reaction Time
- Driver States
  - Fatigued
  - Chemically Induced
    - Alcohol
    - Drugs
  - Emotional
    - Anxious
    - Angry

VEHICLE CHARACTERISTICS

- Vehicle Movement
  - Accelerating
  - Decelerating
  - Forward Velocity
  - Reverse Velocity
  - Stopped (Stationary)
  - *Turning Right*
  - *Turning Left*
  - *U-Turning*
  - Lateral Positioning
  - (Changing Lanes)
- *Skidding*
- *Pitching*
- *Wavering*
- Yaw
- Velocity of Movement
- Primary Vehicle Interface
- Controls and Displays
  - Accelerator Pedal
    - Responsiveness
    - Travel
  - Brake Pedal
    - Responsiveness
    - Slack (Play)
    - Force Required
      - Conventional
      - Power Brakes
  - Steering Wheel
    - Responsiveness
    - Force Required
      - Conventional
      - Power
    - Play
  - Gear Selector
  - (Automatic Transmission)
    - Select Driving Gear
      - Low
      - Drive 1
      - Drive 2
      - Neutral
      - Reverse
      - Park
  - *Gearshift (Manual*
    - *Transmission)*
    - *Position for Driving Gear*
      - *1st*
      - *2nd*
      - *3rd*
      - *4th (if available)*
      - *Neutral*
      - *Reverse*
      - Overdrive (if available)
  - Clutch Pedal (Manual
    - Transmission)
    - Travel
    - Play
  - Dashboard Displays
    - Speedometer
    - Oil Pressure Indicator
    - Electricity Ammeter
    - Fuel Gauge
    - Water Temperature
    - Turn Signal Indicator
    - High Beam Indicator

- Mirrors
  - Overhead
  - Side
- *Auxiliary Equipment*
  - Parking Brake
    - Handle/Pedal
  - Horn
  - Seat Belts/Restraints
    - Lap belt
    - Shoulder Harness
    - Head Supports
    - Adjustment
  - Windshield Wipers
    - Type (Electrical vs.
      - Pneumatic)
    - Variable Speed
    - Wiper Blade Condition
    - Effective Area
  - Windshield Washers
    - Fluid
  - Sunvisors
    - Adjustment
    - Tightness (Play)
  - *Defrosters*
    - *Windshield*
    - *Rear Window*
    - Defroster Shields
    - Fan
  - Emergency Aids
    - First Aid Kit
    - Tools
    - Flares
    - Trouble light
    - Flashlight
    - Spare Parts
    - Jack
    - Lug Wrench
    - Spare Tire
    - Tire Chains
      - Full
      - Partial
      - Shovel
    - Heater/Ventilation System
      - Windows
      - Body Vents
      - Heater
      - Fan
      - Air Conditioning
    - *Identification*
      - *License Plate*
      - *Registration*
      - *Inspection Sticker*
    - *Seating*
      - Seat Design
      - Capacity
  - *Vehicle Lights*
    - *Headlights*
      - *Upper Beams (High)*
      - *Lower Beams*
      - *Illumination Distance*
      - *Area of Coverage*
      - *Adjustment*
      - *Alinement*
      - *Dimmer Switch*

- Major Components
  - Master Cylinder
  - Wheel Cylinder
  - Brake Linings/Disc Pads
  - *Fluid Reservoir*
  - *Fluid Lines*
  - *Power Brakes Servo*
    - *Cylinder*
- Drive Train
  - Clutch
    - *Friction Clutch (Manual*
    - Transmission
      - *Pressure Plate*
      - *Diaphragm Spring*
      - *Flywheel*
    - *Fluid Clutch (Automatic*
      - *Transmission)*
      - *Torque Converter*
      - *Radial Blades*
      - *Housing*
      - *Fluid Level*
  - *Transmission*
    - Manual
      - Meshing Gears
    - Automatic
      - Oil Pressure
      - Fluid Couplings
    - Transmission Fluid Level
  - Driveshaft
    - Mounting
    - Universal Joints
  - Differential
    - Ring and Pinion Gears
  - *Rear Axle*
    - *Grease Level*
- Power Plant
  - Engine
    - Engine Characteristics
      - No. of Cylinders
      - Displacement
      - Compression Ratio
      - Horsepower
    - Major Components
      - Head
      - Block
      - Crankshaft
      - Pistons
      - Cylinders
      - Connecting Rods
      - *Valves*
        - *Intake*
        - *Exhaust*
      - *Tappets*
      - *Push Rods*
      - *Timing Gear*
      - Camshaft
      - Rocker Arms
  - Ignition System
    - Battery
      - Voltage
      - Fluid
      - Cable Clamps
      - Terminals
      - Electrolyte Charge
      - Corrosion

- Ignition/Starter
- *Coil*
- Distributor
  - *Rotary Switch*
  - *Condenser*
  - *Breaker Arms*
  - *Points*
- *Spark Plugs*
- Alternator/Generator
- Voltage Regulator
- Oil Lubrication System
  - Oil Pan
  - Oil Pump
  - Oil Filter
  - Oil Pressure
  - Oil Level/Capacity
    - Dipstick
  - Oil Grade
  - Requirement for Oil
    - Change
  - Oil Filler Cap
  - Oil Drain Plug
- Water Cooling System
  - Coolant Type Antifreeze
  - *Coolant Level*
  - *Water Pump*
  - *Thermostat*
  - *Pressure Relief Valve*
  - *Drain Plug Engine*
    - Drain Cock
  - Radiator
  - Radiator Fan
  - Water Hoses
  - Fan Belt
    - Breaks
    - Tightness (Play)
  - Requirement for
    - coolant change
  - Rust
- Exhaust System
  - Exhaust Manifold
  - Muffler
  - Exhaust Pipe
  - Leakage
  - Tail pipe
- Smog Control Devices
  - Crankcase Ventilation
    - System
  - Exhaust Emission Control
- *Fuel System*
  - *Fuel Tank*
  - *Fuel Pump*
  - *Carburetor*
  - *Air Filter*
  - Choke
    - Automatic
    - Manual
  - Intake Manifold
  - Throttle
- Parking Lights
  - Front/Rear
- Tail Lights
  - Night Running Lights
  - Brake (Stop) Lights
- Directional Signal Lights
  - Right Turn

- Left Turn
- *Four-Way Flash*
- *Automatic Lane Change*
- *Automatic Cancellation*
- *Side Running Lights/Reflector*
- *Back Up Lights*
- *Turn Illumination Lights*
- *Panel Lights*
- Convenience Lights
  - Dome
  - Map Reading
  - Glove Compartment
  - Trunk Light
- License Plate Light
- Vehicle Internal Environment
  - Temperature/Humidity
  - *Moisture*
  - *Noise*
  - *Smoke/Gases*
  - *Dust*
  - *Fire*
- Tires and Wheels
  - Conventional
  - Special Traction
    - Snow
    - *Studded*
  - *Characteristics*
    - *Size*
    - *Load Rating*
    - Recommended Pressure
      - Over inflation
      - Under inflation
    - Condition
      - *Strength*
      - Uneven tread wear
      - Bald
      - Cuts/Abrasions
      - *Flat*
      - *Ruptured (Blowout)*
      - *Blisters*
      - *Material imbedded*
        - *in tread*
  - Wheels
    - Front/Rear
      - *Balancing*
      - *Bearings*
      - Alignment
- *Vehicle Loads*
  - *Occupants*
    - *Type*
    - *Number*
    - *Location*
    - *Activity*
  - Objects
    - Type
    - Number
    - Location
    - Activity
  - Trailers
    - Type
    - Weight
    - Size
- *Body and Suspension*
  - Body Characteristics

- Model
  - *Manufacturer*
  - *Year*
  - *Body Style*
  - *Color*
- *Frame*
- Windshield
- Doors
  - Latches
  - Locking Mechanism
- Vehicle Parameters
  - Vehicle Length
  - Vehicle Width
  - Wheelbase
  - Vehicle Height
  - Vehicle Weight
  - Ground Clearance
  - Center of Gravity
- Body Lubrication
  - Requirements
- Suspension System
  - Independent Suspension
  - Coil Springs
  - Leaf Springs
  - Shock Absorbers
  - Heavy Duty Suspension
  - *Condition*
- Steering System
  - Type
    - Conventional
    - Power Steering
  - Steering Characteristics
    - *Force Required*
    - *Turning Radius*
    - *Variable Steering*
    - Stability
    - Understeering Oversteering
    - Response Time
    - Steering Ratio
    - *Front End Alignment*
    - Shimmy
    - Wandering
    - *Vibration*
  - *Major Components*
    - Steering Column
      - Energy Absorbing
      - Breakaway
    - Pitman Arm
    - Tie Rod
    - King Pin
    - Front Axle
    - Power Steering Servo
      - Cylinder
- Braking System
  - Type of System
    - Conventional
    - Power Brakes
    - Drum Brakes
    - Disc Brakes
  - Braking Characteristics
    - Braking Efficiency
    - Stopping Distance
    - Grabbing
    - Fade

ROADWAY CHARACTERISTICS

- Type
  - No. of Lanes
    - Single
    - Two
    - Three
    - Four
    - Six
    - *Eight*
  - Road/Lane Width
    - *Narrow*
    - Wide
    - Expanding
    - Restricting
  - Undivided
  - Divided
    - Median
      - Width
        - *Wide*
        - *Narrow*
      - Type
        - Traversible, e.g., painted medians
        - Deterring
        - Non-traversible
      - Elevation-Cross
      - *Section*
      - *Barriers*
        - *Type*
          - Curb
          - Bar
          - Rail
          - Wall
          - Chain Fence
          - Vegetation
        - Height
        - Width
      - *Openings*
        - *No. per mile*
  - *Classification*
    - Limited Access (*Freeway/Expressway*)
    - Highway
    - Access Road
    - Service/Frontage Road
    - *Driveway*
    - *Street*
    - *Alley*
  - Direction of Travel
    - Dual Direction
    - One-way
    - Turning Lane (Auxiliary)
    - Slow Traffic (Auxiliary)
- Surface
  - Material
    - Dirt
    - Gravel
    - Concrete
    - *Blacktop*
    - Brick
    - Metal Grating
    - Wood
  - Skid Resistance
    - (*Coefficient of Friction*)
  - *Reflectance*
  - *Drainage*
  - Condition
    - Deterioration
    - Potholes
    - Washboard
    - Road Ruts
    - Smooth
  - Road Cover
    - Dry
    - *Wet*
      - *Depth*
      - *Area of Coverage*
    - Sleet and Slush
    - Snow
      - Amount
      - Compactness
      - Drifts
    - *Ice*
      - *Glare Ice*
      - Patch
    - Dust/Film
      - Sand
    - Grease/Oil Spots
- *Alinement*
  - Road Cross Section
    - Superelevation
    - Crown
  - Horizontal (Curves)
    - Right
    - Left
    - Radius
    - Length
    - *Transition*
    - *Sight Distance*
    - *Frequency*
    - Approach
  - Vertical (Hills)
    - Upgrade
      - Gradient
      - Length
      - Sight Distance
      - *Emergency Provisions* (*Pullout for sand and water*)
        - Frequency
        - Approach
    - Downgrade
      - Gradient
      - Length
      - Sight Distance
      - *Emergency Provisions* (*Runaway Ramps*)
        - Frequency
        - Approach
    - Crests and Dips
      - Sight Distance
      - *Frequency*
      - *Approach*
  - Straight
  - Level
  - Winding
- *Intersections/Interchanges*
  - *Intersections*
    - Three Way
      - Right Angle (T)
      - Forked Angle (Y)
    - Four Way
      - Right Angle (X)
      - Other Configurations
    - Four Way Plus
    - Traffic Circles
  - *Interchanges*
    - Geometry
      - Diamond-half diamond
      - Cloverleaf-partial cloverleaf
      - Overhead Pass
      - *Pass Under*
    - *On Ramps (Feeders)*
      - *Right Side Entrance*
      - *Left Side Entrance*
      - Length of Ramp
      - Ramp Grade
      - Ramp Curvature
      - Angle of Convergence
      - No. of Ramp Lanes
      - Width of Ramp Lanes
      - *Acceleration Lane*
        - *Length*
        - *Shape*
      - Curb Offset at Nose
      - Ramp Superelevation
      - Sight Visibility
    - Off Ramps (Exits)
      - Right Side Exit
      - Left Side Exit
      - Length of Ramp
      - *Ramp Grade*
      - Ramp Curvature
      - Angle of Divergence
      - No. of Ramp Lanes
      - Width of Ramp Lanes
      - Deceleration Lane
        - Length
        - *Shape*
      - *Curb Offset at Nose*
      - *Ramp Superelevation*
      - Sight Visibility
    - Spacing of On/Off Ramps
    - Proximity of On/Off Ramps to Structures
- Roadway Obstacles
  - Road Obstructions
    - Construction
    - Barricades
    - *Accidents and Other Emergencies*
    - *Flash Flood*
    - *Landslide*
  - Objects on Road
    - Large
    - Small
      - Rocks
      - Fallen Objects
      - Debris
- Special Features
  - Railroad Crossings
    - *No. of Tracks*
    - *Separation Between Tracks*
    - *Sight Visibility*
    - Approach
  - Bridges/Overpasses
    - Protective Railings
    - Length of Span
    - Height of Span
    - *Clearance*
    - Weight Capacity
    - *Provision for Emergencies*
    - Emergency Warnings
    - *Draw Bridge*
    - Double-Decked Bridges
    - Approach
  - Tunnels/Underpasses
    - Protective Railings
    - Tunnel Walls
    - Tunnel Length
    - *Depth of Tunnel*
    - *Clearance*
    - *Capacity*
    - *Provision for Emergencies*
    - Approach
  - Toll Plazas/Inspection Stations
  - Streetcar/Trolley Tracks
    - No. of Tracks
    - *Turnabouts*
    - *Load/Unload Platforms*
    - *Refuge Islands*
- *Artificial Illumination*
  - *Artificial Lighting*
    - *Type*
    - *Illumination*
    - *Effective Area of Coverage*
    - Glare
  - Reflectors
- *Roadside Characteristics*
  - Shoulders
    - Width
    - Elevation
    - Vertical Alinement
    - *Drainage*
    - *Material*
      - *Earth*
      - Gravel
      - *All Weather*
    - Softness
    - Cross Section
  - Roadside Fixed Objects
    - Right of Way Clearance
    - Structures
      - Piers
      - *Abutments*
      - *Culverts*
      - *Walls*
      - Buildings
    - Embankments
    - Sign Supports
    - Utility Poles
    - Drainage Canals/Ditches
    - Guardrails
    - *Trees*
    - *Vegetation*
    - *Fire Hydrants*
  - Parking Provisions
    - Curb Parking
      - Angular
      - Parallel
    - *Parking Areas*
      - *Lots/Ramps*
    - *Restricted Zones*
    - *Rest Areas*
    - *Parking Meters*
    - Emergency Parking Areas
  - Curb Markings
    - Red
    - Yellow
    - Green
  - *Pedestrian Walkways*
    - Sidewalks
- Traffic Control
  - *Traffic Lights*
    - *Red*
      - Stop
      - Right Turn on Red
    - Amber
    - Green
      - Advance
      - Delay
    - Flashing Red
    - *Flashing Amber*
    - Green Directional Arrows
      - Straight Ahead Only
      - Right Turn Only
      - Left Turn Only
      - *Combination of Above*
  - *Pedestrian Light Signals*
    - *Walk/Do Not Walk*
    - Scramble System
  - Crosswalks/Crossing Areas
    - Pedestrian Crosswalk
    - School Crossing
    - Animal Crossing
  - Stop Signs (*Octagonal*)
  - *Warning Signs (Diamond)*
  - *Railroad Crossing Signs (Circular)*
  - *Information Signs (Rectangular)*
  - Regulatory Signs (Rectangular)
    - Speed Zones
    - *Restrictions*
  - *Yield Signs (Triangle)*
  - *Railroad Crossing Signals*
    - *Flashing Lights*
    - Wigwag Signals
    - Automatic Gates
    - Manual Gates
    - Flagman
    - Crossbuck
  - Pavement Markings
    - *Center Line*
      - *Broken white line*
      - *Solid white line*
      - Two solid White Lines
      - Separated dual pairs of lines
    - No Passing Zone
      - Solid Yellow Line on Right of Centerline
      - Solid yellow line on left of centerline
    - Lane Lines
      - Broken white lines
      - Solid white lines
    - Arrow symbols
    - Right/Left Turn Only
    - Speed Limit
    - Ribbon Sign
    - *Crosswalks*
    - *Slow Traffic*
    - *Thru Traffic*
    - Lane Restriction Markings
  - Traffic Officer Control

TRAFFIC CHARACTERISTICS

- Traffic Movement
  - Traffic Density Congestion
  - Traffic Flow
    - Rate of Flow
    - Traffic Friction
    - Keeping Pace With Traffic
  - Spacing Between Vehicles
- Moving Vehicles
  - Relative Position of Moving Vehicle
    - Oncoming
    - Car Ahead (Following)
    - Car Ahead (Passing)
    - Car Behind (Following)
    - Vehicle Being Passed
    - Intersecting Vehicles
  - *Velocity*
  - *Distance*
  - *Activity*
    - Normal Course Forward
    - Accelerating
    - Decelerating
    - Preturning
    - Turning
    - Turn Completed
    - Overtaking
    - *Pulling out to Pass*
    - *Passing*
    - Pulling Back into Line (Pass Abort)
    - Cutting in After Pass
  - Merging into Traffic Line
  - Diverging out of Traffic Line
  - Changing Lanes
  - Backing Up
  - Stopped
  - *Preparing to Park*
  - Pulling into Park Position
  - Pulling out of Parked Position
  - Erratic Actions
    - Weaving/Wandering
    - Skidding
    - Swerving
    - *Crossing Lanes*
    - *Leaving Road*
    - Crossing Median
    - Going Wrong Way
- *Parked/Stopped Vehicles*
  - Relative Position of Parked/Stopped Vehicles
    - Parallel to Roadway
    - Angular to Roadway
    - Distance from Roadway
    - Relative Position to other Parked Vehicles
  - *Activity*
    - *Discharge/Loading of occupants*
    - Preparing to Pull Out of Parked Position
    - Repairs/Stalled
- Vehicle Types
  - Passenger Vehicles
  - Cars with Trailers
  - Buses
  - School Buses
  - Motorcycles
  - Bicycles
  - Trucks
  - Tractor/Tractor-Trailers
  - Streetcars
  - Trains
  - Emergency Vehicles
    - Fire
    - Police
    - Ambulance
  - Funeral Vehicles
- *Collisions*
- Communications
  - Lights
  - Horn
  - Brake Lights
  - Directional Signals
  - *Hand Signals*
  - *Four-way Flash*
  - *Flares*
  - Flags
- Pedestrians
  - Types
    - Children
    - Adults
    - Elderly
    - Handicapped
  - Activity
    - *Jaywalking*
    - Crossing
    - *Walking in Roadway*
    - Walking Along Roadway
    - Standing in Roadway
    - Working in Roadway
    - Lying in Roadway
    - Playing in Roadway
    - Playing Along Roadway
    - Pushing or Working on Vehicles
  - *Pedestrian Clothing*
    - *Reflectorized Material*
    - Color
- *Traffic Generated Characteristics*
  - *Headlight Glare*
  - Reflectance
  - Noise
  - Exhaust Fumes/Smoke
- Animals
  - Standing/Lying in Roadway
  - Crossing Roadway

ENVIRONMENT

- Light Conditions
  - Daylight
  - *Nighttime*
  - *Dusk/Dawn*
- Cloud Cover
  - Clear
  - *Cloudy*
  - *Sunny*
    - *Sun Glare*
- *Humidity*
  - Humid
  - Dry
- Temperature
  - Hot
  - *Cold*
  - Changes
- Precipitation
- Rain
  - *Drizzle*
  - *Steady*
  - *Intermittent*
  - *Driving*
  - Cloudburst
- Hail
- Sleet
- Snow
  - *Wet*
  - *Dry*
  - Flurries
  - Driving
  - Drifting
- Sand
  - *Sand/Sandstorm*
  - Dust
- *Fog/Haze*
  - *General Fog*
  - Patch Fog
  - Ground Fog
  - *Hazy*
- Wind
  - Force (MPH)
  - Type
    - *Headwind*
    - *Crosswind*
    - Tailwind
  - Steady
  - Transient
    - Gusts
    - Wind Interruptions
    - Vehicle Generated
- Terrain
  - Mountainous
  - Flat
  - Hilly
  - *Desert*
- *Noise*
  - *Intermittent*
  - *Continuous*
  - *Type*
  - *Intensity*
- Time of Day
- General Surroundings
  - Urban
  - *Suburban*
  - *Rural*
  - Residential
  - Commercial
  - Industrial
- Specific Surroundings
  - *Parks Playground.*
  - Schools
  - Hospitals
  - Animal Refuge/Preserves

Appendix B

DIRECTIONS TO EVALUATORS OF TASK CRITICALITY

You have been given three envelopes, each envelope containing 25 slips of paper upon which are written descriptions of driving behaviors. You may open one of the envelopes if you wish. What you are asked to do is to rank the behaviors in each envelope according to your view of their *criticality*, that is, how important it is to our transportation system that a driver carry out the behavior—or be able to do so when the need or desire arises. In ranking the behaviors, place the most critical behavior on the top and the least critical behavior on the bottom.

After you have ranked all of the behaviors, take the colored card and place it in the stack of slips beneath the last behavior that you feel is critical enough to be required of a driver before he may be considered qualified to drive. All behaviors above the colored card would be those which you felt were required of a qualified driver; all behaviors beneath the card, while perhaps very important, would not be so critical as to be absolutely necessary for a driver to do in order to be considered qualified. Should you feel that all of the behaviors are absolutely essential for a qualified driver, you would, of course, place the colored card at the bottom of the stack.

When you have finished ranking the slips in one envelope, clip or staple them together, return them to the envelope, and seal the envelope. Then take the next envelope and repeat the process, continuing until all envelopes have been completed. In order to avoid mixing up the lists, please do not open more than one envelope at a time.

When you have finished, please place all of the envelopes in the large return envelope and mail it back.

The following pages contain some guidance for the ranking process; please read it before you begin.

GUIDANCE IN EVALUATING BEHAVIORS

Assessing Criticality

Assessing the criticality of a driving behavior for the purpose of this activity means evaluating its impact upon the overall transportation system. This involves determining (1) the effect of the behavior on the various goals of the system, (2) the relative importance of each system goal, and (3) how frequently the behavior will be required.

1. Effect on System Goals. The goals of the transportation system are said to be those of facilitating the flow of personnel and material in a way that is both safe and in keeping with the needs of individual users.

Safety. What effect does a particular behavior have upon the likelihood and severity of an accident? A behavior which, if incorrectly performed, is either highly likely to result in an accident, or could produce an extremely severe accident would be judged more critical than one which is not likely to lead to an accident or could only produce a very minor accident.

Traffic Flow. What effect does the behavior have upon the general flow of traffic? A behavior which, if incorrectly performed, is likely to result in a serious traffic tie-up would be more critical than one which could have no effect upon other traffic.

Individual Goals. What effect does the behavior have upon the ability of the individual driver to realize his goal of getting from one place to another rapidly, economically, and comfortably. A behavior which, if incorrectly performed, could delay completion of a trip, result in extreme waste, or produce severe discomfort, would be more critical than one which did not influence these behaviors.

2. Weighting of Goals. In addition to considering the effect of a behavior upon the goals of the transportation system, the judge must weigh in his own mind the relative importance of each goal. Generally speaking, behaviors that relate to safety and therefore to the preservation of human life are given greater weight than those that merely influence the flow of traffic. On the other hand, behaviors related to traffic flow, since they are concerned with the general good, are given greater weight than those behaviors which relate simply to the satisfaction of individual goals.

3. Frequency. The third major factor influencing the criticality of behavior is the frequency with which situations calling for that behavior will arise. Of two behaviors that have about the same effect upon the same goals, that which is required more often will have the greater impact and therefore be more "critical."

Behaviors to be Evaluated

Most of the behavior descriptions include a statement of a situation, in lower case letters, accompanied by an associated driving behavior in capital letters. In some cases the behavior is not related to any single specific situation. In either case, it is the driving behavior, in capital letters, that is to be evaluated for criticality.

Often the statement of behavior consists of a series of specific activities. It is the overall behavior rather than the component activities that is to be evaluated. For example, it would be the act of shifting gears properly that would be evaluated for criticality, not each step in the process. The component steps are listed merely to define the integrated activity.

Task Descriptions

The booklet of task descriptions has been provided to assist you in making your judgments. As you examine a behavior for the first time, you are asked to look it up in the task description booklet. The number in the upper *right*-hand corner on the slip of paper corresponds to the code number(s) of the behavior in the task description. The stack of slips has been arranged in numerical order so that you can work through the booklet from front to back.

The behavior descriptions are on the left-hand page in the booklet. Please look at each behavior briefly to get a grasp of its context; this may make it somewhat clearer to you. Secondly, if the behavioral description in the booklet is followed by an asterisk (*), look across to the right-hand page to the statement bearing the same code number and read the additional information that is provided. This information will be one of the following types, as indicated by the placement of the "X" in the columns to the left:

Performance Information (PI) - Information bearing upon the driver's characteristic performance.

Performance Limits (PL) - Information bearing upon the limits of driver performance.

Criticality Information (CR) - Information bearing upon the criticality of the behavior to safety, traffic flow, or individual driving needs.

Skills (SK) - Descriptions of the complex perceptual, motor, or intellectual processes underlying the behavior.

Knowledge (KN) - Information which may help to explain how or why the behavior is performed.

Wording

To avoid confusion, the terms "car" and "vehicle" are used in the following manner:

"Car" refers to the vehicle being operated by the driver whose task is described.

"Vehicle" refers to all other vehicles.

All directions, e.g., "right," "left," are given from the viewpoint of the driver whose task is being analyzed.

Comments

Bear in mind that you are evaluating the *criticality* of a behavior, not its validity. If you disagree with the way in which a behavior is described, feel free to enter comments or revisions. (Write directly on the slip of paper.) However, it is the criticality of the overall act, regardless of the way in which it is performed, that is to be evaluated. You are also urged to comment upon the task descriptions. Specific comments may be entered directly on the task descriptions or written separately. To be of any use, however, they should be received by July 6th.

You may retain the task descriptions if you wish. However, all of those returning task descriptions with specific comments will be sent copies of the revised descriptions as soon as they are available (approximately two months).

NOTE: The numbers in parentheses on the right-hand pages of the task descriptions refer to a bibliography that will appear in the final edition.

Appendix C

TASK CRITICALITY MEANS AND STANDARD DEVIATIONS

TASK	NAME	NUMBER OF BEHAVIORS	MEAN	STANDARD DEVIATION
11	Pre-Operative Procedures	158	- 2.9	10.1
12	Starting	96	- 9.8	7.3
13	Accelerating	95	- 2.8	8.1
14	Steering	136	3.0	8.3
15	Speed Control	62	- 1.5	8.6
16	Stopping	174	1.4	8.5
17	Backing Up	80	- 1.9	7.9
18	Skid Control	74	10.3	6.6
21	Surveillance	158	1.6	9.1
22	Compensating for Physical Limitations	168	1.5	9.6
23	Navigation	75	- 7.6	8.8
24	Urban Driving	84	4.6	9.1
25	Highway Driving	62	4.3	6.1
26	Freeway Driving	81	5.8	6.8
31	Following	111	7.3	7.0
32	Passing	214	8.6	7.7
33	Entering and Leaving Traffic	95	3.4	7.4
34	Lane Changing	72	5.9	6.1
35	Parking	250	- 5.0	6.9
36	Reacting to Traffic	563	5.9	8.1
41	Negotiating Intersections	532	5.1	7.7
42	On-Ramps and Off-Ramps	272	4.7	5.9
43	Negotiating Hills	111	- .9	7.1
44	Negotiating Curves	61	4.1	8.1
45	Lane Usage	52	3.8	6.6
46	Road Surface and Obstructions	498	3.9	7.9

TASK	NAME	NUMBER OF BEHAVIORS	MEAN	STANDARD DEVIATION
47	Turnabouts	103	- 1.1	6.4
48	Off-Street Areas	192	1.2	7.2
49	Railroad Crossings, Bridges and Tunnels, Toll Plazas	265	- .6	9.1
51	Weather Conditions	216	- 1.6	8.5
52	Night Driving	174	3.5	8.9
61	Hauling and Towing Loads	260	.7	6.7
62	Responding to Car Emergencies	137	- .1	8.9
63	Parking Disabled Car	97	- .4	7.5
64	Roadside Servicing	134	- 6.6	7.8
65	Pushing and Towing	75	- 8.8	5.4
71	Planning	216	-10.5	6.8
72	Loading	219	- 3.9	6.8
73	Use of Alcohol and Drugs	61	11.1	10.2
74	Maintaining and Accommodating Physical and Emotional Condition	75	4.7	10.1
81	Routine Care and Servicing	391	- 8.0	7.6
82	Periodic Inspection and Servicing	125	- 9.2	6.6
83	Repairs Car Subsystems	49	- 4.3	8.5
91	Driver and Car Certification	75	- 7.2	11.5
92	Post-Accident Responsibilities	200	- 7.9	8.5

Appendix D

LIST OF EVALUATORS

	Name	Affiliation
1.	Abercrombie, Stanley	National Education Association
2.	Anderson, Dr. William G.	Teachers College, Columbia University
3.	Austin, Cpl. Leslie	Michigan State Police
4.	Bailey, Robert	IML Freight, Inc.
5.	Baker, Dr. J. Stannard	Northwestern University
6.	Ball, E. Keith	Division of Driver Licenses, California
7.	Barnhart, B. N.	Clairmont Transfer Company
8.	Beam, Martel	Carolina Freight Carriers Corp.
9.	Blood, W. K.	Lee Way Motor Freight, Inc.
10.	Bloom, Officer E.	Denver Police Department, Colorado
11.	Boostrom, Sgt. Ralph P.	California State Highway Patrol
12.	Breuning, Dr. S. M.	Social Technology Systems, Inc.
13.	Calkins, C. D.	Pacific Motor Trucking Company
14.	Campbell, Dr. B. J.	University of North Carolina
15.	Carmichael, Glenn V.	National Highway Safety Bureau
16.	Chalfant, Dr. Milo W.	Traffic Safety Coordinator, Michigan
17.	Cheatham, Sgt. Roy B.	Tennessee Highway Patrol
18.	Cheney, Tom	North American Professional Driver Education Association
19.	Clark, Cpl. Lawrence F.	Pennsylvania State Police Academy
20.	Christenson, Officer Charles F.	Park Ridge Police Department, Illinois
21.	Cockerill, Cpt. James J.	Baltimore Police Department, Maryland
22.	Darmstadter, Neill	American Trucking Associations, Inc.
23.	DeGuire, Sgt. Wilbert C.	Wisconsin State Patrol
24.	Delaney, Officer Michael H.	Lexington Police Department, Kentucky
25.	Ellingstad, Dr. Vernon S.	University of South Dakota
26.	Ellis, Dr. Richard D.	State University at Albany, New York
27.	Engle, Lt. Ralph G.	Washington State Patrol
28.	Fitzgerald, Sgt. R. J.	Vineland Police Department, New Jersey
29.	Fletcher, Dr. Harry D.	Pennsylvania State University
30.	Frazier, Sgt. W. D.	California State Highway Patrol
31.	Fulton, Deputy Chief J. L.	Los Angeles Police Department
32.	Hacney, Sgt. Maurice	Maine State Police

	Name	Affiliation
33.	Hawkins, Dr. Leslie V.	Texas A & M University
34.	Heimstra, Dr. Norman	University of South Dakota
35.	Holmberg, Officer Carl R.	United States Park Police
36.	Horn, Detective Richard R.	New Jersey State Police
37.	Hunter, Lt. C. Jay	Ohio Highway Patrol
38.	Hulbert, Dr. Slade	University of California
39.	Jackson, N. W.	Drivers License Inspector, Texas
40.	Jacobson, John W.	F. J. Boutell Driveaway Company, Inc.
41.	Johnson, Dr. Duane R.	Northern Illinois University
42.	Jones, Lt. Bobby L.	Dade County Police Department, Florida
43.	Jones, Lt. Jack	Oklahoma State Highway Patrol
44.	Kaiser, Sgt. Major John R.	Maryland State Police
45.	Kaywood, Dr. Richard	California State College at Long Beach
46.	Kelly, Lt. David J.	Evanston Police Department, Illinois
47.	Kirk, Dr. Robert H.	University of Tennessee
48.	Koch, Robert	Department of Motor Vehicles, Washington
49.	Koenig, Tech. Sgt. Richard T.	United States Park Police
50.	Koert, Dr. Adrian H.	Michigan State University
51.	Kornegay, Lt. Robert G.	Phoenix Police Department, Arizona
52.	Lacy, Don D.	Crouch Bros., Inc.
53.	Lanham, Lt. Darrell C.	California State Highway Patrol
54.	Martin, Tech. Sgt. E. J.	New York State Police
55.	McDanell, Sgt. G. W.	West Monroe Police Department, Louisiana
56.	McKinney, Sgt. Robert	Kansas City Police Department, Missouri
57.	McPherson, Dr. Ken	State Department of Public Instruction, Olympia, Washington
58.	Miller, Sgt. Ronald J.	Illinois State Police
59.	Minahan, Tech. Sgt. Edward J.	New York State Police
60.	Musgraves, Bob	Steere Tank Lines, Inc.
61.	Mutchelknaus, Reinhold	South Dakota Highway Patrol
62.	Naumann, Heinz	North American Professional Driver Education Association
63.	Nevin, Sgt. L. S.	Baltimore Police Department, Maryland
64.	Neyhart, Dr. Amos E.	Pennsylvania State University
65.	Nolan, Sgt. James T.	Wilmington Bureau of Police, Delaware
66.	Nolan, Lt. John J.	Chicago Police Department
67.	Opfer, Arthur A.	Highway Users Federation
68.	Quensel, Warren P.	Department of Public Instruction, Illinois
69.	Reid, Sgt. Richard	Arlington Heights Police Dept., Illinois

	Name	Affiliation
70.	Richards, Frederick A.	Humble Oil and Refining Company
71.	Risley, Sgt. Raymond	Chicago Police Department
72.	Rosema, Cpl. H. Cal	Michigan State Police
73.	Samis, Cpt. George I.	South Dakota Highway Patrol
74.	Schram, Lt. David	Illinois State Police
75.	Schwenk, Dr. Lillian C.	Iowa State University
76.	Seals, Dr. Thomas A.	Department of Education, San Diego, California
77.	Shaffer, Warren L.	Pennsylvania State Police
78.	Sheehan, Sgt. David W.	San Francisco Police Department
79.	Spang, Trooper Daniel A.	Pennsylvania State Police
80.	Steele, Cpt. D. F.	Dallas Police Department, Texas
81.	Stoutamyer, G. P.	Sentle Trucking Corporation
82.	Sturtz, Lt. David D.	Ohio State Police
83.	Teal, Gilbert	Auerbach Associate
84.	Thomas, Tech. Sgt. Carl	United States Park Police
85.	Thomas, Neill L.	Leaseway Transportation Corp.
86.	Tossel, Dr. Richard	Central Missouri State College
87.	Trigg, Sgt. Jack	Hattiesburg Police Department, Miss.
88.	Turner, Officer Robert	United States Park Police
89.	Ulrich, Dr. Robert A.	Central Missouri State College
90.	Van Gorden, Dean	State Highway Safety Coordinator, Wis.
91.	Vanosdall, Fred E.	Michigan State University
92.	Walsh, Robert B.	Associated Coca-Cola Bottling Company
93.	Wayne, Officer Robert	United States Park Police
94.	Williams, Frank M.	Pacific Intermountain Express Company

BIBLIOGRAPHIC DATA SHEET	1. Report No. DOT HS 800 368 (Nov 70)	2.	3. Recipient's Accession No.

4. Title and Subtitle

DRIVER EDUCATION TASK ANALYSIS:

Task Analysis Methods

5. Report Date

Apr 72

6.

7. Author(s)
A. James McKnight and Bert B. Adams

8. Performing Organization Rept. No.

HumRRO-TR-72-13

9. Performing Organization Name and Address

Human Resources Research Organization (HumRRO)
300 North Washington Street
Alexandria, Virginia 22314

10. Project/Task/Work Unit No.

11. Contract/Grant No.

FH 11-7336

12. Sponsoring Organization Name and Address

Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20591

13. Type of Report & Period Covered

Technical Report

14.

15. Supplementary Notes Three related HumRRO Technical Reports are: DRIVER EDUCATION TASK ANALYSIS: Task Descriptions, TR 70-103; The Development of Instructional Objectives, TR 72-14; and Instructional Objectives, TR 71-9.

16. Abstracts This report describes a method used to analyze and evaluate the criticality of driver behaviors. To assure comprehensive identification of driving behaviors, an analysis was made of the total highway transportation system including the driver, vehicle, roadway, traffic, and natural environment. Each aspect of the system was examined to identify specific situations that drivers encounter and the appropriate responses. The behaviors arising out of the systems analysis were organized into groups of related behaviors or "tasks." The analysis was continued to assure the identification of specific driving responses and associated cues. A group of 100 trafffic safety experts, selected from among driver educators, enforcement officers, license officials, and fleet safety personnel, were asked to evaluate the criticality of the 1700 identified behaviors to the safety and efficiency of the highway transportation system. The driving behaviors, together with their associated criticality indices and various items of supporting information gained through a survey of the driving literature, were entered into a set of driving task descriptions.

17. Key Words and Document Analysis. 17a. Descriptors

*Performance standards
*Criticality
*Accident analysis

17b. Identifiers/Open-Ended Terms

Driver education
Driver behaviors
Instructional objectives
Task descriptions

17c. COSATI Field/Group 05 09 Behavioral and social sciences/Personnel selection, training, and evaluation

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 45
Distribution of this document is unlimited.	20. Security Class (This Page) UNCLASSIFIED	22. Price

HUMAN RESOURCES RESEARCH ORGANIZATION

300 North Washington Street • Alexandria, Virginia 22314

President	Dr. Meredith P. Crawford
Executive Vice President	Dr. William A. McClelland
Director for Business Affairs and Treasurer	Mr. Charles W. Smith
Director for Operations	Mr. Arnold A. Heyl
Director for Program Development	Dr. Robert G. Smith, Jr.
Director for Research Design and Reporting	Dr. Eugene A. Cogan

RESEARCH DIVISIONS

HumRRO Division No. 1 (System Operations) 300 North Washington Street Alexandria, Virginia 22314	Dr. J. Daniel Lyons Director
HumRRO Division No. 2 Fort Knox, Kentucky 40121	Dr. Donald F. Haggard Director
HumRRO Division No. 3 Post Office Box 5787 Presidio of Monterey, California 93940	Dr. Howard H. McFann Director
HumRRO Division No. 4 Post Office Box 2086 Fort Benning, Georgia 31905	Dr. T.O. Jacobs Director
HumRRO Division No. 5 Post Office Box 6057 Fort Bliss, Texas 79916	Dr. Albert L. Kubala Director
HumRRO Division No. 6 (Aviation) Post Office Box 428 Fort Rucker, Alabama 36360	Dr. Wallace W. Prophet Director
HumRRO Division No. 7 (Social Science) 300 North Washington Street Alexandria, Virginia 22314	Dr. Arthur J. Hoehn Director