The Motor-Vehicle Driver: His Nature and Improvement

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COMPILER'S PREFACE

The nature and scope of this publication necessarily entailed the efforts of technicians from a number of specialized areas of traffic-accident prevention. It was considered appropriate, therefore, that it should be prepared by various contributors and a coordinating compiler rather than by one author.

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J. Williams, Assistant to the President, National Safety Council; Dr. Alvhh Lauer of Iowa State College; J. Stannard Baker of the Traffic Institute of Northwestern University, and to members of the staff of the Center for Safety Education.

This book presents only a brief treatment of certain important considerations regarding the problem of driver improvement. It is not intended to provide an exhaustive treatment, nor to be used as a technical handbook. It is hoped that its publication and distribution will prove to be a forward step in relieving the shortage of organized materials dealing with driver-behavior as related to safety on streets and highways.

MILTON D. KRAMER
Assistant Director,
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New York City, 1949

INTRODUCTION

This publication is an outgrowth of the monograph *Personal Characteristics of Traffic Accident Repeaters* published in 1948 by the Eno Foundation for Highway Traffic Control at Saugatuck, Connecticut. The 64-page monograph presented a summary of the investigation conducted by the Center for Safety Education in cooperation with the Commissioners of the Connecticut Department of Motor Vehicles and the Michigan State Police. It served to provide pertinent facts regarding the testing of the traffic-accident repeater, the personal characteristics of such a driver, and recommendations for his detection and treatment through the use of driver clinics. "The Motor-Vehicle Driver: His Nature and Improvement" supplements that monograph.

Present findings dealing with the driver, made available through research, accident records, and clinical studies, are quite limited. Activities in driver-selection and testing in the last twenty years have yielded only a meager amount of practical information. In order to solve the problem of inefficient driver-performance and traffic accidents, a great deal more will have to be known regarding the nature of the man behind the wheel and the factors that determine his involvement in accidents.

The Center firmly believes that a fruitful approach to the highway safety problem lies in a better understanding of the driver. In years past, this belief has served to sharpen its interest in research and in those of its publications dealing with driver-aptitudes and limitations. In the light of that belief and interest, this volume has been prepared. It brings together pertinent information on the driver, and presents a summary and some evaluation of many of the research studies conducted in this and in foreign countries. It includes the considered opinions of various experts.

The contributors—technicians in psychology, safety education, traffic engineering, enforcement and drivers' licensing—have developed their chapters in terms of important facts in their fields as they relate to driver-behavior. In this way, an attempt has been

made in this volume to treat the driver-behavior problem in its relation to many of the psycho-physical factors and forces in the traffic environment that impinge upon the man behind the wheel. It is hoped that this approach will serve to provide the reader with a broad picture of the problem and to point out certain facts and relationships that have been made evident by experience, research, present practice or statistics.

Complete agreement on every point in this publication is not expected. It will take years of research and experience to provide definitive answers to problems that deal directly or indirectly with driver-behavior. This book, therefore, should be regarded as material designed to stimulate further study. We hope and believe it will contribute to traffic-accident prevention.

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Director,
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New York City, 1949

USE OF THE BIBLIOGRAPHY

In compiling this text, the authors have drawn freely upon studies, published literature pertaining to the driver, and to many other source materials. References to these materials are made throughout the text, particularly when it appeared desirable that the reader be directed to a primary source in cases where only brief mention of it is appropriate in this book.

Because many of the reference materials are related to more than one chapter, and because most of them have been used several times by different authors, the editors have prepared a numbered bibliographical listing that appears at the end of the book. To increase readability, the practice of using footnote references has been dispensed with.

Readers' attention is directed to the bracketed numbers in the text. These refer to the corresponding references cited in the bibliography. The source materials have been arranged in alphabetical order, each numbered appropriately. The one specific number for one specific reference source is retained throughout the book, regardless of chapter. For example, the Eno study, "Personal Characteristics of Traffic Accident Repeaters," is referred to twenty-four times in the text, in four different chapters; namely, Chapters II, III, IV and VII. This study is always referred to by the bracketed number twenty-seven.

CHAPTER I

THE NATURE OF THE DRIVER IMPROVEMENT PROBLEM

In 1895, four pioneer-model motor cars sputtered and chugged on American streets. Five years later, we boasted ownership of 8000 automobiles. In 1948, on some 2,000,000 miles of streets and highways, over 40,000,000 vehicles sped on business missions or pleasure jaunts. The motor car—a rich man's toy at the turn of the century—many think of now as the poor man's necessity. We have become a nation where automobiles are an almost indispensable factor in day-to-day life.

In 1941, persons in the United States traveled by motor vehicle more than 500 billion passenger miles. Mobility is the essence of American living—and the motor vehicle is the nation's prime source of mobility. Our economic, social, cultural and recreational activities are dependent to a great extent on gasoline. We may complain more or less stridently about housing shortages, foreign relations and high prices.

At the wheel, many an American tends to transform himself into a god. After all, can't he make the power of a hundred horses pull himself and his passengers speedily forward? Yet at times he seems unaware of these simple facts—that two things cannot occupy the same space at the same time, and that the automobile is propelled by the principles and forces that propel a projectile.

A review of highway traffic accident statistics reveals that every day over 25,000 drivers are involved in traffic accidents; nearly one hundred persons die as the result. In 1941, the last pre-war year, 40,000 persons were killed in motor vehicle accidents; in 1948, 32,000. [60]*

In addition to the men, women and children who died needlessly in traffic accidents in 1948, nearly one million others were injured and tens of thousands permanently crippled. A yearly

* Please see explanatory note on the use of bibliography numbers which precedes Chapter I.

dollar-loss in the hundreds of millions also results from collisions and smash-ups. Certainly, these conditions call for improvement.

To what factors and forces can this scourge of accidents be attributed? "Speed, Gin and Recklessness?" Do many individual drivers cling to the notion that "accidents happen just to the other fellow"? Can the high toll on our highways be regarded simply as the end-product of "carelessness"? Expert opinion holds that answers far better than these must be found.

The rapid development of the traffic accident problem and the limited success attained, particularly in the thirties, in solving it, has provoked varied explanations for the high-accident rate. Among these are premature conclusions and false concepts, none of which can serve to provide a sound basis upon which to develop productive programs of safety. For example, such fallacious concepts as the following are frequently regarded as true remedies for inefficient motor transportation and street-and-highway accidents:

Only blowout-proof tires should be manufactured

Women drivers should be removed from the highways

Traffic crusades should be run every week

More persons should be arrested

Speed governors should be installed on all cars to limit their travel to forty miles an hour

Color-blind persons should be prohibited from driving

Cars should be made smaller (or larger)

Cars should be built as sturdily as army tanks

Drivers should be forced to visit the city morgue

Roads should be built twice as wide

Fine for violations should be quadrupled

Trucks and buses should be forced to operate on separate roads built for them.

These are some of the "cures" prescribed by sincere but uninformed and technically unqualified persons.

Solution of the accident problem must be sought in *basic* factors that necessarily involve complex inter-relationships. Among these are street and highway design and use, vehicle construction

and operation, enforcement policies and their application, vehicle-use legislation and driver licensing, public education and safety attitudes of the masses, driver-selection and education, and, most certainly, the nature and limitations of the driver in terms of his physical, mental and emotional traits and qualifications.

While each of the above-mentioned factors is important in the accident-reduction problem, *it is upon the driver that paramount attention must be focused.* Many analyses of the causes of traffic accidents clearly indicate that *human* factors such as bad habits, ignorance, lack of skill, psychophysical disabilities, wrong driving attitudes and other personal limitations account for the majority of accidents. In effect, accidents can be viewed as being manifestations of underlying maladjustments in the driver himself or in his lack of orientation to the varying traffic situations he must face on the streets and highways. Traffic engineering, accident analysis, driver education, traffic law enforcement, driver licensing and other such important tools in accident prevention may be viewed in terms of their positive or negative influence on the behavior of drivers.

A sound understanding of the *true* causes of accidents must be based upon an appreciation of the physical, mental and emotional structure of the driver, the elements that influence this structure, the varying degree of their influence, and the concerned forces in society that impinge upon him. The relationship between these factors is difficult to establish. As Ghiselli and Brown [36] have pointed out, psychologists have continued to stress the fact that *human behavior must be considered as an integrated whole and that the individual cannot be regarded as a simple reflex machine that responds now to one stimulus and now to another.*

In calling attention to this, they serve to stress the fact that an improved understanding of the causes of accidents will come from sound analyses of the *interaction* of human responses. To make the problem even more challenging, it should be noted that the performance of a driver varies from time to time and under a variety of conditions. A high degree of consistency is not characteristic of the "typical man" when he is behind the wheel. Rec-

ognition must be given to fluctuations in behavior and to the implications of variability in patterns of response to stimuli.

We must do more than blame the driver for "recklessness," convict him of "carelessness," or punish him for his misdeeds. Rather, we must regard him as a product of circumstance—as a living organism with far less-than-perfect senses—whose aptitudes, intelligence, emotional prejudices and motives combine with other elements to result in certain responses to given social situations. The *quality* of the response, in terms of the traffic situation, may be said to determine whether or not involvement in an accident will result. Accidents, rather than having only one cause, are the result of a combination of a number of underlying causes.

What is it that affects adversely the behavior of drivers? Why is it that so many accidents occur when, presumably, no one in his right mind likes to become involved in a smash up? Why is it that today, more than ever before, special concern is being shown for the "accident prone" driver or traffic accident repeater? To what may we attribute the disproportionately high accident rate of this small percentage of the driving population? What influences may we expect law enforcement, traffic engineering, drivers' licensing and other activities to have upon driver behavior? How important for safety are psychophysical testing devices?

Do we obtain adequate data for accident prevention programming from our present systems of accident recording? What tests, testing devices and techniques should be included in drivers' clinics? How valuable are such clinics? To what uses may they be put? What pertinency has Crum's [20] statement that those who are out to *minimize* accident rates cannot hope to do it merely by working on a large group of operators who, during a *brief* period, have had an unusually large number of accidents? How effective has driver education in schools proved to be? What school safety programs and public educational media should be utilized? What relationships exist between general social attitudes and driving attitudes? What practical recommendations for driver improvement can be made?

The questions raised above are only a few of those that concern persons faced with the problem of improving the driver in terms of his complex nature, his behavior and the environment in which he lives and drives. His many attitudes and emotional responses behind the wheel constitute only one important aspect of his total personality; he must be studied as a *total* individual and as a member of society as well as analyzed as a driver who is susceptible to involvement in accidents.

In only a few cases do the following chapters provide final answers to some of the questions raised in the preceding pages. The reason for this is obvious to those familiar with the ramifications of accident-prevention activities and with the field of research in psychology and safety—*there exists today only a limited amount of proved facts and reliable data.* Based upon a relatively small amount of research and certain proved experiences in the safety field, these data, accordingly, provide only limited answers. When feasible and justifiable, the contributors have included their own opinions or the expert opinion of other technicians and specialists. It should be noted that in so doing, it was the intent of the contributors merely to supplement proved findings as a means of furnishing to the reader additional information of pertinency, even though such information may have only limited value.

Chapters clearly reveal, among other things, that highway accident-prevention and driver-improvement are a challenging and complex problem. The solution requires not only concerted effort but systematic thinking, exhaustive research and a much larger expenditure of funds than has been allotted to it in the past. As Lauer [49] aptly states:

"Let us not deceive ourselves. The problem of highway and traffic safety is going to require many arduous hours of 'hammer and saw' effort to assure fruitful results. Those averse to work and discouragement should retire early. And yet there must be a solution. In the meantime, we must be on the sharp lookout for blind alleys. If perchance we follow one to its termination, there are plenty of avenues remaining to be explored. One or more of them may lead us where we wish to go. The philosophical implications here need not be considered very profound. The fundamental objective is conservation of human life. It is a problem which cannot be considered lightly."

CHAPTER II

ACCIDENT RECORDS AND DRIVER PERFORMANCE

The President's Highway Safety Conference [70] indicates that reports from states and cities for 1947 show definite progress in the collection and use of traffic-accident records. Improvement for some years has occurred in the volume of reporting, in the reliability of facts, in the preparation of summaries, and in the use of accident data by traffic engineers, enforcement officials, motor vehicle administrators and educators. *We now have a stock-pile of data that tells us much about the driver.*

Reports by drivers involved in accidents form the first of two primary sources of information about the actions of drivers and the character of the violations they commit. Nearly all states require accident-reports from drivers involved in fatal and personal-injury accidents and in property-damage accidents in which the apparent amount exceeds a specified figure; usually $25 to $100.

The standard accident report form provides the following information: (1) An identification of the driver; (2) the condition of the driver; (3) what the driver was doing; (4) an indication of law violated by the driver; (5) where and when the driver was involved in the accident; and (6) the kind of accident in which he was involved.

The second of the primary sources of information consists of accident-investigation reports by law enforcement officers. Many jurisdictions record facts disclosed by investigation on this standard accident report form. Frequently, where police investigation of a particular accident has not been made, a police check of the driver's report is made to assure completeness and accuracy.

Knowledge by authorities that an accident *has* occurred is the first in a series of major steps in providing adequate accident

data. An unreported accident yields no data; its facts cannot be investigated or studied, nor can any conclusions about its causes be reached. No opportunity is afforded to observe driver-actions or conditions that might have contributed to the accident. Hence the importance of knowing the facts about as many accidents as possible.

Most fatal and personal injury accidents of a serious nature become known to proper authorities. But there are countless thousands of other personal injury and property damage accidents that remain unreported and uninvestigated. For this reason, much of our knowledge about accidents is derived solely from reports of *fatal* accidents. These however constitute only a small portion of the total number. For example, the National Safety Council [60] estimates the total number of traffic accidents during 1947 at 8,400,000. Of this number, 28,600 were fatal and about 775,500 were non-fatal *injury* accidents. *Many of the conclusions drawn from accident reports are based upon facts representing less than five per cent of all accident occurrences.* Such a sampling cannot disclose a truly accurate or total picture of driver actions and driver failings.

The second major factor that determines the competency of basic sources is to be found in the character of the check-up of driver reports in terms of their accuracy and completeness. The unchecked or unverified report is by itself of doubtful value. Few drivers have the skill, training, authority and time to report correctly on accident causes. Moreover, a driver tends to soft-pedal his own omissions and commissions and to lay blame elsewhere. For these reasons the reliability of driver-reports is determined to a considerable extent by the character of the check-up by the police or other authorities.

Sound accident-investigation by police is the third factor that determines the reliability of data on driver-action. Without it we cannot hope to obtain adequate facts about the driver. Limited police manpower, inadequacy of training and equipment and other factors make the investigation of most accidents difficult and often impossible. Usually police effort concentrates upon the fatal or more serious personal injury and property

damage accidents. We do not know exactly what percentage of all accidents is followed by competent police investigation, but traffic authorities agree that the percentage is low. For the most part we must confine the evaluation of driver action to facts disclosed by the reports of fatal accidents.

Finally, the competency of information obtained from accident records depends upon the investigator and the statistical procedure used. Study and evaluation of the mass of information from reports of many accidents require skills of high order. Erroneous conclusions from reliable facts can be as detrimental to the cause of accident-prevention activities as the unreliable facts themselves.

Facts about accidents are at present reliable in many jurisdictions. But many cities and states still use incomplete reporting, insufficient personnel, poor forms and produce inadequately summarized data. Such limitations should be kept in mind in any evaluation of driver-action based upon data now available.

IDENTIFYING DRIVERS WHO HAVE ACCIDENTS

A notable contribution of accident records is the identification of drivers repeatedly involved in accidents and in repeated violation of law. Such information supplies us with the means by which the accident-repeater driver may be spotted. Identification records disclose that much of our traffic problems can be traced to a dangerous minority of drivers. Estimates from various states show that from 15 to 20 per cent of the motorists are responsible for about 80 per cent of the traffic accidents. In the driver-research clinic recently held in Michigan, records revealed that the 100 drivers studied had had 528 accidents and had been arrested 769 times for traffic violations of traffic regulations! [27]

In order to identify better the accident repeater group and the violators, statewide recording centers should be established in every state. Police departments and courts should supply the record-center with all of the pertinent facts about arrests, accident occurrences and adjudication. Individual driver-record files must be maintained. Exchange of data among centers should be

developed. When all this is done, we shall have effective means of identifying the accident prone driver. While significant recording progress has been made in these directions, present records do not tell us the whole story about the driver-situation.

Residence and Age of Drivers

Other facts disclosed by accident records concern the residence of drivers. Reports from nineteen states in 1947 showed that about 80 per cent of the drivers involved in accidents lived in urban areas. [60, p. 47] In many instances, summaries of records identify particular sectors in which significant proportions of the accident-involved drivers live. The purpose is to direct education, enforcement and other accident prevention activities to areas where they are most needed.

Accident records nearly always provide interesting facts about the ages of drivers. Reports from state traffic authorities in 29 states showed that in 1947 about 11 per cent of the drivers involved in fatal accidents were under 21; 16 per cent ranged from 21 to 25; 51 per cent from 25 to 45; and 22 per cent were 45 or older. [60] In North Carolina, for example, 61 per cent of the accident-involved drivers during 1947 were in the 25–44 age group. [66] From facts such as these, we know that drivers of *all* ages are involved in fatal accidents and that *more than half of these so involved are in the middle years of life from 25 to 45 years of age.*

Accident studies made by the Safety Division of the Missouri State Highway Patrol [55] supply evidence of the teen-aged driver problem.

There is some controversy as to relative responsibility for accidents of drivers of various ages, particularly teen-aged drivers. For many years, the teen-aged group has been believed, generally, to have a disproportionately high accident-involvement rate. Recently, many states have increased the premium rates for liability insurance on automobiles driven by drivers under 25.

In order to determine if the unfavorable assertions made regarding younger drivers, particularly teen-aged drivers, are valid

ones, the Center for Safety Education at New York University has recently undertaken a study of traffic-accident involvement (including *all* traffic accidents) by driver age. From the data collected in Connecticut and Massachusetts, and from parallel data reported from New York and Wisconsin, the observations were made by the Center that drivers between the ages of 20 and 24 had a generally *poorer* accident record than the teen-aged group; and the record of 25–29 age drivers was only slightly better than the teen aged (15–19) group. This research covered a registration of over 5 million drivers in the four states listed.

Driving Experience

Accident reporting has long pooled information about the amount of driving experience of drivers involved in accidents and the relation of the experience to the accident problem. No nationwide studies have been made, and available facts give us only a general answer. Most states have limited information. The driving experience of 19,058 drivers involved in accidents in North Carolina in 1947 is shown in Table I. [66]

Table I

Driving experience	*Number of accidents*	*Per cent*
Learners under instruction	35	1
Less than three months	46	
Three to six months	127	
Six to twelve months	15	
One year	513	3
Two–five years	3,940	21
Six–ten years	5,048	27
Eleven or more years	9,324	48

It should be noted that three-quarters of the drivers were operators with more than five years of driving experience. According to these records, the driver with some years of driving experience is the chief troublemaker on the highways. Of course our knowledge of the relation of driving experience to accidents will be fortified when data are available to correlate facts in terms of mileage driven, driving conditions and other important factors.

Occupation and Personal Characteristics of Drivers

Most accident summaries contain information about driver-occupation. Extant records indicate that *drivers in all walks of life are involved in accidents.* No particular calling has a monopoly. Usually, a fairly well-balanced distribution of accidents is found among professional and business people, farmers, clerical workers, housewives, domestic servants, industrial workers, students and so forth.

Considerable reporting attention is directed to the accident rate of commercial vehicle drivers. The National Safety Council points out that during 1947 the accident rate for some 127,000 vehicles was about 2.7, [60, p. 72] or approximately three accidents for every 100,000 miles of travel. In many states, available information gives the proportion of commercial drivers involved in accidents. In North Carolina, for example, about 15 per cent of the accident-involved drivers during 1947 were operators of commercial trucks, buses and taxicabs. [66]

In the standard accident-report form, provision is made for information about the following "condition" factors of the driver : Physical defect (eyesight, etc.), illness, apparently asleep, other handicaps, apparently normal, wearing glasses, had not been drinking, had been drinking, ability impaired, ability not impaired, or not known whether ability was impaired, and whether or not a chemical test to determine alcholic intoxication was taken following the accident. These are all important condition-factors and are items about which we must learn a great deal more if we are to understand fully the nature of drivers and their role in accidents.

While nationwide facts seem to indicate that illness is seldom a pronounced cause of accidents, we cannot be completely sure that this is so. We know comparatively little, for example, about the extent to which sub-par physical conditions influence susceptibility to accident. We know in a general way that fatigued drivers are involved in many accidents. Studies of night-driving accidents point out that fatigue is usually one of the significant causes. But we know little about the *real* part that fatigue plays in accident cause. Even slight fatigue has a high influence rate on reaction

time, particularly so in these days of swift travel. Loss of a split second in observing an obstruction may spell the difference between a near-miss and a tragic accident. Much research needs to be done before we will have fundamental data on the problem of fatigue in relation to driving. As to the driver who dozes at the wheel or goes to sleep, accident records again treat the situation only in general terms.

Seldom do accident records turn attention to worry, anxiety and other emotional disturbances as causes contributing to accidents. Yet there is little doubt that these conditions definitely affect driving. If the facts concerning them could be obtained, emotional disturbances would perhaps rank high as cause of driver failure. At present, however, records tell us little.

Bodily defects comprise another driver condition that is highlighted in accident reports. Attention is directed chiefly to such limitations as defective eyesight, defective hearing, limb incapacities and so forth. Seldom, however, do records tell us whether or not the defect actually contributed to the accident.

As regards the mental condition of the driver, most records go no further than to class the driver either as "apparently normal" or not normal. We have, therefore, little reliable information that identifies the "sub-normal" driver, or is of value in establishing certain mental qualifications for driving.

Alcohol and Other Narcotics

Certain facts about alcoholic intoxication are nearly always to be found in accident reporting. When the recording of such data began, records were designed to disclose one of the following four facts: (1) the driver was obviously drunk, (2) his ability was impaired, (3) his ability was not impaired, or (4) he had not been drinking. Until chemical testing, the classification of a driver's condition was based almost entirely upon testimony of witnesses regarding driver-appearance and conduct, admissions of the driver and the finding of liquor on or about his person.

Such traditional methods of determining a state of intoxication are obviously subject to question. Evidence about appearance and conduct is generally reliable in the case of a driver in

advanced stages of intoxication. It has doubtful value, however, in identifying a driver who has had enough to drink to impair his driving ability, but not enough to cause him to exhibit actions and appearances commonly associated with drunkenness. Even the medical practitioner has great difficulty in identifying such drivers. For these reasons, countless thousands of drivers suspected of being intoxicated are classified either as "not under the influence" or are included under the nebulous category entitled "information not stated." At present, records do not give us a true or complete picture of the important role which alcoholic intoxication plays as an accident cause.

Even the limited facts available tell an unpleasant story. Reports from twenty-three states showed that during 1947 about 20 per cent of the drivers involved in fatal accidents had been drinking. [60, p. 54] State Highway Department as well as municipal reports reveal that the driver who had been drinking is involved in an important percentage of all accidents. During 1947, for example, the Minnesota Department of Highways reported that 4,575 (11 per cent) of some 41,000 drivers had been drinking. [54] In Evanston, Illinois, chemical tests of some 250 injured drivers disclosed that almost 50 per cent had been drinking and that 20 per cent had been drinking enough to impair their driving ability. [43] On the basis of known facts, authorities estimate that a drinking driver is three or four times more likely to have an accident than the sober driver.

Another factor that is causing increasing concern—one concerning which records provide little data—has to do with the driver under the influence of drugs. The use of such drugs as veronal, luminal, barbital and amytal is increasing rapidly and is an added complication in the problem of identifying accident causes. Much greater attention than is now accorded must be directed to the identification of the driver under the influence of drugs.

DESCRIPTIONS OF ACCIDENT-INVOLVEMENTS

Accident reports devote a great deal of attention to describing the following driving actions: going straight ahead; making a left turn, right turn, or U-turn; starting from traffic; starting

from a parked position; stopping in a traffic lane; slowing down; attempting to avoid a hazard; skidding; leaving the scene of an accident; and so on. In particular, when describing an accident, *records seek to show the movement and actions of the driver in relation to other drivers or objects involved.* Usually, traffic summaries evaluate driving action along such lines as the following:

I. *Two motor vehicles, intersection accidents*
   1. Entering at angle:
      a. both going straight
      b. one going straight, one right
      c. one going straight, one left
   2. Entering from the same direction:
      a. both going straight
      b. one going straight, one right
      c. one going straight, one left
      d. one stopped
   3. Entering from opposite directions:
      a. both going straight
      b. one going straight, one left

II. *Two motor vehicles, non-intersection accidents*
   1. Vehicles traveling in opposite directions:
      a. head-on collision
      b. side-swipe
   2. Vehicles traveling in same direction:
      a. rear-end collision
      b. side-swipe
   3. Collision of moving vehicle with parked car
   4. Car leaving parked position
   5. Car entering driveway or alley
   6. Car leaving driveway or alley

III. *Vehicle colliding with pedestrian or fixed object*
   1. At intersections:
      a. car going straight, entering intersection
      b. car going straight, leaving intersection
      c. car turning right entering intersection
      d. car turning right within intersection
      e. car turning left entering intersection
      f. car turning left within intersection
      g. car turning left leaving intersection

2. Between intersections:
   a. car backing
   b. car going straight
   c. car hit pedestrian on main traveled portion of road
   d. car hit pedestrian or object on turn
   e. car collided with fixed object
   f. car collided with bicycle

IV. *Non-collision accidents:*

1. Leaving road on curve
2. Defective mechanical condition
3. Other

The variety of facts that may be disclosed by the use of such a system is of definite value in accident prevention work. But, because of the kaleidoscopic nature of the actions involved, an exact summary of the movements of a driver and his vehicle is difficult.

Types of Collisions

In terms of the number of lives lost, collision of motor vehicles with pedestrians ranks first. During 1947 such accidents cost 10,300 lives, or 32 per cent. Collision of two or more motor vehicles ranked second—about 9,800 lives, or 30 per cent. Collision of motor vehicle and railroad train or street-car ranked third—1,800 lives, or 6 per cent. Collision of motor vehicle and a fixed object ranked fourth—1,000 lives, or 3 per cent. Last were collisions of motor vehicles and bicycles or animal-drawn vehicles—about 800 lives, or 2 per cent. In all, collision accidents accounted for almost three-quarters of all motor vehicle deaths. In non-collision accidents 8,700 lives were lost, or about 27 per cent. [60, p. 42]

Movement of Vehicles at and between Intersections

Reports from 100 municipal police departments show that where two motor vehicles are involved, the most hazardous situation exists when the vehicles enter at angles—as, for example, one from the north and the other from the east. An estimated 60 per cent of intersection collisions involving two motor vehicles are angu-

lar collisions. About 30 per cent occur when both vehicles enter an intersection from opposite directions. Usually one of the vehicles is attempting to make a left turn.

The same reports provide facts about the movement of vehicles between intersections. Collision between a parked vehicle and a moving vehicle accounts for about 25 per cent of the accidents. Rear-end and sideswipe collision of two motor vehicles proceeding in the same direction accounts for 24 per cent. Twelve per cent occur when vehicles dart into the traffic stream from parked positions. Collision between vehicles proceeding in opposite directions accounts for 11 per cent.

Non-collision Accidents

About one out of every four deaths occurs in non-collision accidents. We know that they happen at and between intersections. In urban areas, about as many non-collision accidents occur *between* intersections as at intersections. On rural highways, as may be anticipated, a high percentage occurs *between* intersections. We know that most non-collision accidents occur when a motor vehicle leaves the road. We might assume that most cars leave the road at curves. That is not so. Extant data show that almost twice as many accidents occur when motor vehicles leave the road on straightaway stretches, as at curves. What we do not know is *why*. Is the roadway at fault? Was the vehicle defective? Was the action due to driver negligence or to driver violation of law? Unfortunately, records do not provide us with a clear and comprehensive picture.

DRIVER VIOLATIONS OF RULES AND REGULATIONS

In accident reporting, increased attention is being devoted to an examination of driver violations. This shift in attention is all for the good, for *violations of law are without question the outstanding cause of traffic accidents.* Reports from 23 states disclose that *a driver violation occurs in 86 per cent of all accidents.* [60] Thus, about nine out of ten accidents involve a violation. This extraor-

dinarily high violation rate is substantiated by reports from cities and rural areas. Reports from 130 cities show a violation committed in 80 per cent of the accidents. Twelve states reported the occurrence of violations in 84 per cent of the rural accidents. Estimates are that driver violations contribute to at least twice as many accidents as do roadway defects and vehicle failures combined.

Since *most accidents result from a combination of factors,* it is difficult to determine one specific cause of an accident. In many instances violation on the part of one or several drivers constitutes the only cause. But in many other instances the accident may be traceable to a combination of driver failings and roadway defects or of driver failings and vehicle defects, and so on. In such cases *the problem of determining a cause or "the" cause of an accident is exceedingly difficult.* We shall know much more about the real influence that driver violation exerts on accident occurrence when accident reports deal more extensively than they do at present with analyses of *primary causes* of accidents. [15]

One of the outstanding facts about driver violations disclosed by records is the multiplicity of the kinds of violations committed. More than 200 different violations have been identified. Violations most frequently committed are: (1) exceeding a stated speed limit; (2) exceeding a safe speed; (3) overtaking and passing on the crest of a grade where such action is prohibited; (4) unlawful overtaking and passing on a curve; (5) unlawful overtaking and passing at an intersection or railroad crossing; (6) passing too close to the vehicle overtaken; (7) cutting in too soon after passing; (8) driver being overtaken does not yield right-of-way or speeds up while passing is being attempted; (9) following too close; (10) being on the wrong side of the road not in passing; (11) failure to yield right-of-way at intersections; (12) failure to give proper signal when stopping or making a right or left turn; (13) using the wrong turning path; (14) improper backing; (15) unsafe starting from a parked position; (16) improper parking; (17) disregard of stop and go light; (18) disregard of stop signs or failure to stop before entering a through roadway; (19) driving through a safety zone; (20) failure to set out flags or flares

when required; (21) driving without proper lights; (22) failure to dim or deflect on approach of another motor vehicle; (23) failure to yield the right-of-way to pedestrians; (24) driving recklessly; (25) careless driving; (26) driving while under the influence of intoxicating liquor or narcotics.

Accident records try to reveal also—and it is important—the proportionate seriousness of the various violations in terms of the frequency with which they are committed. This is important from the point of view that when the leading kinds of violations are isolated and their frequency is rated, then preventive measures can be directed toward the areas where they are needed most urgently. So varied and baffling is the problem of law violation that it is difficult to portray the pro rata seriousness of the various violations. Table II shows the incidence of various violations associated with fatal accidents.

Table II

REPORTED VIOLATIONS IN FATAL ACCIDENTS (1947) 60

Violation	*Urban (Per Cent)*	*Rural (Per Cent)*
Excessive Speed	16	29
Right-of-Way	13	6
Drinking Driving	5	8
Wrong Side of Road	3	12
Improper Passing	2	5
Disregard of Signs and Signals	4	4
Other Violations	20	12
No Reported Violation	40	43

Speeding is one of the leading violations. Twenty-five out of 100 drivers involved in fatal accidents in 1947 were violating speed regulations. Reports from 130 cities indicated that sixteen drivers out of 100 were operating at excessive speeds. Reports from twelve states showed that on rural roads twenty-nine out of 100 drivers involved in fatal accidents had been driving at excessive rates of speed. Our most reliable information in the reports is about the driver who has exceeded a *stated* speed limit. We know less about the driver who was operating below a stated speed limit but was traveling *too fast for conditions.*

What speeds were being driven by drivers at the time of accidents? Because much of our information about speed is based upon the estimates of drivers, we cannot depend too much upon our knowledge of speeds being driven at the time of accidents. Three-quarters of the drivers involved in accidents, according to estimates, were traveling at the time under 40 miles an hour. When we turn to the relation of speed to *fatal* accidents we find that in about three-quarters of these the driver was *exceeding* 40 miles an hour. Higher speeds definitely increase the severity of accidents.

Appropriating the Right-of-Way

Violation of right-of-way traffic regulations is the second outstanding driver failure contributing to accidents. Most right-of-way violations take place at intersections. A driver about to make a left-turn cuts in front of a driver proceeding through the intersection; a driver entering an intersection does not yield to another driver entering the intersection from an angle; a motorist runs down a pedestrian in a cross-walk; another motorist enters a roadway from a private drive and in doing so crashes into a vehicle on the highway. Because right-of-way violations are leading causes of accidents, we must know much more than we do about *why* a driver violates the rule.

Driving on the Wrong Side of the Road

Third among the leading driver violations is driving on the wrong side of the road. Such violators are not the ones who are attempting to overtake and pass. They monopolize the center of the road or "wander" over to the left side. Because of this type of violation, many head-on and sideswipe-collisions occur. In certain areas, as many accidents are caused by driving on the wrong side of the road as by driving at unlawful speed.

Improper Passing and Signaling

Improper passing is another frequently committed violation. A driver attempts to overtake and pass another vehicle at an inter-

section, a railroad crossing, on a curve or at the crest of a hill. Why? Perhaps because of his inability to gauge the speed of vehicles; because of disregard for the safety of others, or because of impatience. Improper signaling, or failure to signal before stopping or making a turn, is another violation that results in accidents. Most rear-end collisions are due to these two difficulties —or to following too closely upon the vehicle in front. Records disclose a variety of improper signaling practices; failure to give any signal at all, giving the wrong kind of signal, not giving the signal in time. Why these actions? Data, though giving no clear answer, show the frequency of stop-sign violations in accident cases. We cannot, however, be absolutely certain of the extent to which the driver is responsible for these violations. Improper position of the sign, variations in the kinds of signs used and other factors often contribute to stop-sign violations.

Headlight Glare

One serious violation that records do not show is drivers' failure to dim or deflect their headlights when approaching another vehicle. "Failure to dim headlights" is seldom given an important place in accident-causes. Yet if the facts were known, this act would probably rank high.

SUMMARY

Accident records show drivers of all ages involved in accidents and give statistical evidence of the disproportionately high accident-rate of younger drivers. Neither sex has a monopoly on safe driving, and we do not know, actually, whether the male or the female driver is the safer. While the facts show that drivers with some years of motoring experience are involved in most accidents, there is little evidence upon which to base reliable conclusions as to the relationship between the amount and kind of driving-experience and the degree of accident-involvement. Drivers in all walks of life are involved in accidents.

Driver-condition plays an important role in accidents. Impair-

ment of driving ability resulting from intoxication is a leading cause of accidents; factors such as illness, fatigue, worry and emotional instability are others. *Records, however, do not disclose the degree of importance of these factors in the accident picture.* While facts tell us it is the apparently "normal" individual who is involved in the great majority of accidents, we do not have a clear and adequate picture of the "normal" psychophysical inadequacies of these individuals as drivers and the degree to which these inadequacies make for unsafe driving.

One of the chief contributions of records is in relation to driver violations. Principal among these are exceeding the safe speed, driving on the wrong side of the road, unlawful overtaking and passing, failure to comply with stop-sign and signal requirements, failure to make a proper signal on stopping or turning, not yielding the right-of-way and following too closely.

We do have a clear picture of the kinds of violations that contribute most to accidents; and, while further study of the problem is needed, we do know something about *why* drivers violate certain traffic rules and regulations. Apparently, it is for one or all of the following reasons: (1) the driver does not possess the skills and abilities required for safe and efficient driving; (2) he does not have the required knowledge or understanding about rules of the road or the meaning of signs and signals; (3) he has neither good attitudes nor the desire to observe the rules of the road.

Accident records will not serve their finest purpose in accident prevention until we know much more about drivers than we do at the present time. We must learn more about the levels of mental and physical competency required for safe driving and more about how the personal characteristics of drivers contribute to accidents. The task is significant and challenging. To probe into the complexity of human capacity and driver-behavior is difficult and involved.

CHAPTER III

PSYCHOPHYSICAL APTITUDES, LIMITATIONS, AND ACCIDENTS

Association of the term "psychophysical" with automobile driving is of relatively recent origin. The use stems from observations by experimental psychologists that certain behavior patterns determine to some extent the effectiveness of a driver behind the wheel. If we subscribe to the contention advanced by Johnson [46] and others that certain persons have more accidents than would be normal on the basis of chance, we must search for the basic reasons.

"*Psychophysical*" means, in effect, the relation between the psychological act and the physical act. Automobile driving involves physical control in the way of manipulative skill; and to maneuver a motor vehicle safely, physical control must be coupled with psychological control through the exercise of accurate judgment and the intellectual guidance of the basic driving skills.

The term psychophysical, as originally used, indicates the relationship between the body and the mind. It is quantified by the general formula S—K log R, where S is the sensation obtained from a given stimulus or experience, and R is the physical stimulus or environmental condition affecting the person. The constant K is merely a proportion or multiplier, just as pi is 3.1416 by which the diameter of a circle is multiplied to secure the circumference.

Psychophysical testing includes the measurement of those physical and mental qualifications needed for efficient driving. A blind man cannot drive; one seriously paralyzed cannot drive; nor can one who is mentally abnormal drive with safety.

For clarification of the problem, consider the qualifications essential to good driving. Take into account all the things a driver may see, hear, touch, smell, or otherwise experience. Next,

consider what he must do to keep out of trouble when he does see, hear, touch and smell efficiently. Speed, surety, and strength of movement are essential in maneuvering a car safely through traffic. Finally, consider the activity of the higher brain centers in providing for quick decisions, accurate judgment, careful planning and the evaluation of danger, as well as for the dexterity of movement that may often brand one driver as safe and another as unsafe.

Proper analysis and understanding of the psychophysical causes of accidents have long been known to aid in their reduction. *Many unknown factors, however, are involved in this relationship between psychophysical factors and accident experience.* It is even difficult to obtain a sizable correlation, statistically, between groups of factors and accidents, although an r of +.45* was obtained by Lauer and Allgaier [51] using gross accident rate** as a criterion. Unfortunately accident rate frequently is an unreliable or inconsistent index, because of sketchy, incomplete and inaccurate records.

It must be remembered also that tests of the driver are not usually made at the time of the accident. Lacking such evidence, it is not possible to ascertain what effect his physical condition with respect to sleepiness, possible intoxication or other factors might have had in the way of invalidating his skill, judgment and other ordinarily sound qualifications.

Difference Between Aptitude and Ability

It may be well to establish the meaning of these terms. An aptitude is the capacity to do a certain thing. Ability, on the other hand, is what one can do at a given time. A typist may have the aptitude to type 100 words a minute, but may not type over thirty

* Correlation (r) is a statistical measure of the degree of *relationship* between two different traits or factors, or groups of traits or factors. In this instance, the relationship being measured is between accidents and a group of psychophysical traits. Statistical correlation is expressed along a scale from −1.0 (a perfect negative relationship), through 0 (no relationship) to + 1.0 (a perfect positive relationship).

** $\text{accident rate} = \dfrac{\text{number of accidents} \times 100{,}000}{\text{mileage driven}}$

words a minute when tested. *Ability is the stage of development to which one has advanced with reference to his aptitudes; it is the product of inheritance and experience, indicating the degree to which one has advanced as a result of training or education.*

Psychophysical Qualifications for Safe Driving

While a great deal has been done in the study of this problem by Lahy [48] in France, Slocombe and Bingham [81], Forbes [34], Weiss and Lauer [94], DeSilva [21], Fletcher [29], Brody [14] and others, the surface has only been scratched. It would take too long to enumerate all the possibilities that might be probed; hence we shall discuss only three general classifications of psychophysical functions that are axiomatically important in driving: the sensory, the central or mental processes, and the response system proper. Without the use of receptors or sense organs, we would never be able to drive. The question of *degree* of sensory aptitudes and abilities needed in driving is a matter for further experimental verification.

It might appear that if the classifications previously given are of fundamental importance in driving, it would be easy to develop a set of tests that would accurately classify drivers. This is feasible clinically and practical in every sense. When statistically treated, however, such factors will not be found to correlate highly with any composite accident index taken from record files accumulated over a long period.

Some of the reasons why a high correlation cannot be obtained between various measurements of driving and accident-proneness are as follows:

1. There are several factors operating at the instant an accident occurs. Driving too fast would not cause trouble if there were no curves, slippery pavements, pedestrians on the right of way, defects in mechanism, or other handicaps and hazards introduced.

2. The true state of affairs at the moment of the accident, or just before it occurs, is rarely known. Accident records at best give only sketchy facts.

3. Too long an interval elapses between the time of the accident and any subsequent test made of the driver.

4. Factors are interrelated: If one is fatigued his attention lapses periodi-

cally and progressively. Under such circumstances the visual fields constrict and certain other body functions deteriorate.

5. Accident records are particularly short on detailed statements about the condition of the driver at the time of the accident.

6. The driver may compensate for his weaknesses. Many drivers with poor vision refuse to drive at night under hazardous conditions. When forced to do so, they drive with extreme caution.

7. Exposure rates are not constant and it is practically impossible to equate them. One driver may need to take five times as many chances as another, due to the nature of driving conditions under which he must operate. Investigators have not been able to establish weightings to balance such effects.

8. Experience and physical capacity are correlated inversely. At the age that one has the highest psychophysical capacity, he is lowest in experience.

9. The matter of blame or personal responsibility for the accident is not given careful consideration. Many accidents are caused by persons who were not actually involved in them so far as contact with the vehicle was concerned.

10. There is no way to account for the part which mechanical failure plays in individual accidents. Defects at times may be a result of, rather than a cause of, an accident.

11. Inequality of training and experience between drivers should be considered. Viteles and Gardner [89] found that women had three times as many accidents as men, but our studies show that men have nearly 50 per cent more experience. Actually, as shown by Viteles, women's accidents under comparable conditions were less serious than those of men.

12. Prejudice and the lack of uniformity in enforcement is evident. A study in Hartford showed that in an area where one nationality primarily was in charge of municipal enforcement, it seemed from casual observation of records that other nationalities were being taken into court more frequently than chance would allow.

13. Failure to take drivers' attitudes into consideration is also important. This is due partly to the lack of valid measuring devices for this factor.

14. Certain chance factors such as a lightning flash, tire blow-out or temporary unconsciousness on the part of the driver cannot be evaluated.

These are some of the reasons why correlations made between a gross accident index and psychophysical-test scores do not yield a high index of relationship. A critical analysis of the facts stated above should be sufficient to indicate why this is the case. It is surprising that correlations of any magnitude at all have been obtained.

A PSYCHOLOGICAL APPROACH TO ACCIDENT PREVENTION

Different psychological factors must be considered in a critical study of the relationship between psychophysical aptitudes and

accidents. Each has a definite contribution to make. We shall base this discussion of the common-sense psychological approach to accident-prevention on the premise that accidents are *caused*—they do not merely *happen*—and that *if all the conditions were known in advance, there are few accidents that could not be prevented.* Though human behavior is more or less variable, it follows certain general patterns of response. Through heredity or environmental influences, certain cultural habits prevail—tending to mold behavior.

It will be necessary to refer also to the previous listing of three elements of behavior: the sensory, the central elements, and the response system proper, including the muscles and glands. (The internal organs, discounted in this discussion, may well hold a prominent place in determining behavior. For instance, we know that the adrenal glands and most other visceral organs are very active during emotional upsets.)

Measuring Behavior

Atomistic psychology deals with the importance of details in behavior as the ultimate determinants of events. The proponents tend to evaluate a man's character by the way he treats his dog. Sometimes they are right. They evaluate a driver by the speed with which he reacts to a single auditory or visual stimulus. An athlete's 100-yard dash, for example, is judged by measuring his reaction time, or speed of movement of the index finger in the laboratory. Are they wrong? Perhaps not entirely. There is something of value in these single measures, *if they are properly interpreted. As total indicators they are inadequate,* and will yield low correlations with any generalized pattern of behavior having a speed or an activity factor, particularly against a general index such as accident record that may be due to any of numerous factors not related to speed of movement.

A Gestalt psychologist looks at patterns. He neglects details but looks for whole *segments of behavior.* He is not interested in the separate colors in designs of a kaleidoscope, but looks for patterns of color. His approach is good, but it also is inadequate

unless supplemented by a more thorough interpretation. He often neglects the time element involved. A pattern today may be reversed or entirely changed tomorrow. An example of this might be shown by the effect of a STOP light placed in a bright setting. It will not be reacted to as a single unit, but as an element in a pattern that might greatly reduce its effectiveness. In other words, according to the Gestalt psychologist, the elements of a driving situation are less important than the patterns of which they become a part.

A new kind of psychology adds a third dimension to the Gestalt approach. It is known as topological psychology. It asserts that the effect of patterns is a temporal influence acting on the person, either pulling him one way (positive valence) or pushing him in another (negative valence). Accident-causation analysis might utilize certain basic principles of this point of view in an effective way. A driver's pattern of reaction to a number of different stimuli changes with time as well as with the patterns in which they are found. A driver is different every moment, and various influences affect him one way today and perhaps another way tomorrow.

Clinical Psychology in Accident Prevention

The clinical psychologist has evolved certain methods of approach that may be good or otherwise, depending upon the integrity and skill of the clinician. He gives certain pencil-and-paper tests. Then by exploratory conversation with the examinee, he derives certain data. By letting the examinee talk spontaneously, as well as by answering questions, he arrives at his own solution to the problem. The clinical method is a supplement to any specific system of testing, and should be used in conjunction with other testing procedures. It is by no means adequate without the supplementary use of laboratory measurements.

If one is not too strongly biased toward any one of these systems, he may arrive at a good diagnosis of a case. *In fact, the use of psychophysical measurements is only a part of the total procedure of accident-cause analysis.* It must be treated as basic evidence

and further considered in the light of two-dimensional as well as three-dimensional patterns of behavior that involve both Gestalt and topological psychology.

Subsequently, one must sit down with the examinee and try to discover how the findings apply to the *particular case* in hand. For example, if an individual has narrow side-vision and yet takes ample precaution by looking to the side at every intersection, it is logical to assume that this compensation may offset his weakness as a driver in this respect. Fletcher [30] has used this technique successfully and has improved the driving records of bad-accident cases as much as 86 per cent. Earlier studies [94] showed subsequent improvement of 52 per cent over a two-year period, according to company records, by similar treatment of drivers.

DeSilva's [23] results, in which he reduced accidents of a high-accident group, were criticized by Johnson* on the ground that the drivers could not become better if they were extremely bad actors at the start. This, however, is not entirely consistent with Johnson's own article in Collier's Magazine, entitled "Born to Crash" [45]. Fletcher [30] found that he could improve the records of both high-accident and low-accident drivers by the proper application of psychophysical tests.

Published data seem to indicate that *psychophysical tests must be used as instruments to supplement the judgment, rather than as primary indicators. Accident-liability or proneness is not a single factor, and must be dealt with accordingly.*

Before any reliable data can be obtained on the value of tests, the accident-recording system itself must be improved. In one study [51], a higher correlation was obtained between supervisors' ratings and accident records than between tests and accident records. One conclusion that might be drawn is that the accident records were unreliable. It is understood, of course, that by validity we mean that a test measures what it is supposed to measure, and by reliability we mean that a test gives approximately the same results each time it is administered.

* In an address before the National Safety Congress at Chicago, 1947.

Weaknesses in Accident Records

Company reports rarely show the records of drivers while operating their personal vehicles when not on duty. Conversely, public records usually do not include all the commercial driving-accident records, since some are not reportable to the state. These are gross weaknesses in accident-record data. In addition, *the degree of severity of an accident is usually fortuitous.* Police records for the most part contain data on the physical conditions of the streets, the vehicle, and certain surroundings; little data on the driver are obtained from them. This is excusable on several bases, but it still renders accident-records practically useless for evaluating driving performance as a criterion against which to establish the validity of psychophysical tests designed to prognosticate driving performance.

TYPES OF PSYCHOPHYSICAL TESTS

In spite of the weakness of accident records and the limitations of measuring devices, some fairly satisfactory results have been obtained by experimenters. In 1912 Munsterberg (see Weiss and Lauer [94]) devised ways of measuring streetcar operators. He found that the lowest one-fourth in a type of intelligence test had the most accidents. His experiments were based on the "action theory," which assumes that correct thinking will guarantee safety in action. He employed a device consisting of a black wooden box covered with plate glass, over which moved a black velvet belt eight inches wide. The examinee fixated a distant car, and at the same time noted a pedestrian crossing his path. Symbols on the belt were understood to represent pedestrians and certain objects and conditions. If the examinee could discriminate correctly as to what should be done in certain specific situations simulating actual traffic conditions, his score was high. If not, it would indicate lower "intelligence" of the type measured. No account was taken of the examinee's ability to act through his neuromuscular system.

Somewhat later, Stern (see Weiss and Lauer [94]) improved

on Munsterberg's technique by using letters on a tape. When certain letters appeared, a key was pressed. Correct discriminations were supposed to indicate the ability to react properly in traffic. This technique was modified somewhat by Sachs and Bobertag (see Weiss and Lauer [94]) by cutting single holes to represent pedestrians and double holes to represent vehicles. During the testing period, intermittent distracting stimuli were introduced from the side. Longer tests were given to induce a fatigue factor.

Accidents Associated with Variable Behavior

Lahy [48] (see also Weiss and Lauer [94]) in Paris found by similar devices and by so-called atomistic tests that uniformity or consistency of response was more important than speed of action or the number of reactions per second. That is to say, a driver might be slow to react, but consistent, and be a safe driver. On the other hand, he might be quick to respond and accurate, and also be equally safe. The person with inconsistent reactions, slow at one time and fast at another, was the poorest risk. This seems to be understandable in the light of everyday experience and observation of driving performance.

Speed judgment—partly a function of pure intelligence—was higher among those with superior records. Since this is partly perception but largely judgment, it is easy to see why the accident-drivers do not do so well. Mira (see Weiss and Lauer [94]) found that thirty-five drivers who made poor records on a similar type of test had three times as many accidents as forty who made good records.

The term "reaction time" is sometimes carelessly used. There are basically three types of reaction time, as follows: (1) Simple reaction time—the period required to press a key by an alerted examinee upon a given type of sensory stimulus; (2) choice reaction time; that is, the examinee *should* react if one stimulus appears and should *not* react if another appears. This requires close attention and involves the use of higher brain centers than simple reaction time. (3) Discriminative reaction time—the capacity to

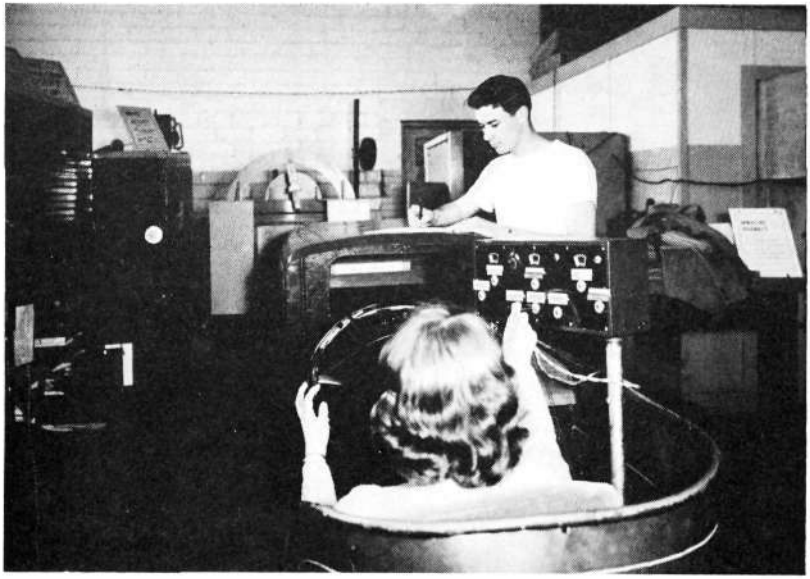
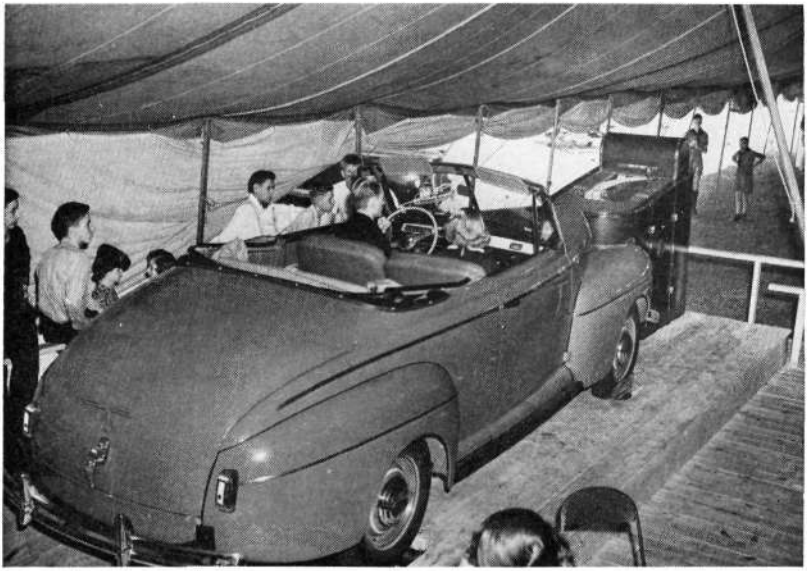


FIGURE 1. One model of the drivometer. Examinee maneuvers pedals, gear shift, wheel, follows changing signs constructed in realistic way. Counters record the accuracy of response.



Courtesy of Ford Motor Company

FIGURE 2. Improved drivometer. Movement of the steering wheel guides the small car over the traveling roadway. Car motor is source of power.

react instantaneously under certain conditions but not to react under others, which involves still higher centers of cortical brain activity. A simple example is that of reacting to a buzzer if a green light signal accompanies it, but refraining from reacting if a red signal accompanies it or if no light appears. These three types of reaction time are often confused. Each may have relation to only *one* type of accident.

Another point with regard to reaction time needs clarification. If one has his foot on the accelerator and then places it on the brake, two separate functions or phases of the reaction must be identified. There is first of all the time necessary for psychophysical inertia to be overcome; secondly, there is the actual time consumed in transferring the foot from the accelerator to the brake pedal. The former usually is primarily a mental function, while the latter, assuming high motivation, is primarily physical or physiological.

How Emotions Affect a Driver's Reactions

Under emotional stress there is also a possibility of a time lag, due to blocking or inhibiting responses. Reaction time, however, is closely related to emotionality and cannot be considered entirely apart from it. This was shown by Gradenowitz (see Weiss and Lauer [94]) who tested presence of mind by introducing distractions while the examinee was manipulating manual controls. For the most part, however, this phase in the study of accident-prone drivers has been neglected. Tests of this type were included in the Eno Foundation [27] study and are described in the next chapter.

Another variable interrelated with reactions and emotionality is intelligence. Given a certain state of emotionality and capacity to react in a certain period of time, the more intelligent person can usually adapt more quickly than the person of low intelligence, and hence is better able to cope with accident situations. In other words, he compensates more easily for his deficiencies. Studies made by Viteles [88] on streetcar motormen indicated six general categories of psychophysical responses as used in the sense

herein described. Good operators were found to be superior in six different ways:

1. By proper reaction to objects through visual perception. They size up situations quickly and make decisions that avoid accidents
2. They exercise good judgment in estimating distances and speed in order to allow for vehicle and pedestrian movements. One with limitations of this nature is a poor risk
3. They are prompt and adept at meeting an emergency. One who is not alert gets into many tight situations and is likely to have an accident
4. They possess the mechanical aptitude and ability necessary to control a vehicle
5. Good attitudes and social qualities of courtesy and consideration help materially to keep a driver out of trouble
6. Personal reliability, such as punctuality, willingness to assume responsibility, and consideration for the rights of others prognosticate better driving records.

To obtain measurements of these basic essentials, Viteles used a "dummy" controller from an old streetcar and had the examinees react to symbolic stimuli appearing on a board in the distance. One aspect of the score was errors made under conditions of distraction. A flashing light appearing at the side of the stimulus board was used to distract the subject. While Viteles' hypothesis appears reasonable, it is difficult to see how he could obtain such clean-cut categories from the experimental data. No conclusive validation data are given.

Our studies of drivers indicate that the following characteristics must be considered in determining natural aptitude and ability in driving. The driver should have:

1. Physical and mental alertness. Most accidents occur when least expected, and the driver who can orient himself to meet a new situation quickly has many points in his favor so far as accident prevention is concerned. Other things being equal, a person with mechanical ability has an advantage in driving.

2. Accuracy and certainty of judgment. It will do no good if one reacts quickly but does the wrong thing. This is a combined function of intelligence and experience. It may be split into:

   a. Judgment of speed
   b. Judgment of distance
   c. Judgment in maneuvering through traffic
   d. Judgment in use of a car
   e. Judgment in considering the possible reactions of other drivers

3. Emotional control and balance. One who is quick to lose his emotional equilibrium will frequently have trouble. One who never becomes ruffled may be inclined to take chances. Either extreme seems to be detrimental to safe driving practices. Again there are elements of both aptitude and acquired traits in emotions which may be differentiated reasonably, as follows:

a. Excitability or temporary behavior which may interfere with reactions in a crucial situation met in traffic

b. Habits of excessive lethargy and moodiness which may dull the perception of danger

c. Crystallized emotional patterns, habits or attitudes which affect the judgment of a driver adversely. These habits or emotional reactions are frequently referred to as attitudes. Courtesy and social understanding are included

d. Permanent moods and conditions of an abnormal nature such as are exemplified by phobias, obsessions, etc.

4. Good sensory equipment is necessary for all-around safety on the highways; hearing, smell, touch, equilibrium, and taste are much less important than vision. The fact that when a correction for mileage is made, night-time accidents are nearly seven times as frequent as accidents occurring during the day is sufficient testimony to the advantage of a good visual mechanism

5. Proper training and indoctrination in safe driving practices are very important. Excessive speed and other improper driving habits figure in a large percentage of accident situations.

Further Study of Psychophysical Traits

A mechancial device was used early by O'Rourke (see Weiss and Lauer [94]) for studying potential reactions of automobile drivers and flyers. Mrs. Shellow [79] greatly extended Viteles' methods and obtained some excellent results with the Milwaukee streetcar operators. She used tests for judgment, emotional stability, general social efficiency, and reliability.

Slocombe and Bingham [81] were among the first to evaluate driving by correlation techniques. They found that the amount of coasting (a prohibited practice) done on a streetcar correlated .51 with accidents, which is indicative of the fact that delinquencies of various types may be a strong component of accident-proneness. High blood pressure was associated with high accident rates, as was also poor attitude toward work. They found also that drivers with longer service records had fewer accidents, but no controls were mentioned. It is conceivable that the company

may have dismissed or discouraged those involved in accidents, to create a selected group of operators.

Weiss and Lauer [94] using groups selected on the basis of visual acuity and accident-frequency records, measured simple and complex psychophysical responses. They found a significant difference between those in the upper and lower halves of the vision-group on three variables, as follows: (1) scores on a control test of a complicated eye-hand coordination using automobile controls, (2) the number of brake reactions, and (3) sitting pulse-rate. The first was highly significant, the second barely significant, the third quite significant. Other variables were studies and the conclusion drawn by the authors was that those with better vision do appreciably better when operating such eye-hand coordination devices as used. The presence of an emotional factor was also in evidence in the experiments.

Likewise, using the same apparatus they found that persons without accident records did almost twice as well on the driving apparatus, showing a definite relation between skill in performance and freedom from accidents. Pulse-rate increase with exercise was greater for accident cases, indicating a lack of physiological stability, which may be related to emotionality or general health. There was no essential difference in visual acuity between those with accident records and those having no accidents. This fact should be commented upon. Persons between 18 and 22 have good vision on the average but poor accident records. Those between 32 and 37 have somewhat impaired vision, but better accident records. It is a case of one factor neutralizing or making another to give spurious results. Studies made to determine the relation between accidents and psychophysical characteristics should always take account of such masking effects, as well as the need for considering syndromes or combination effects.

NEED FOR FURTHER INVESTIGATION

The psychologist or other person studying accident causation should be constantly alert to newer methods of approach to the problem. This is important for two reasons: (1) we are in need

of much more data to explain adequately the causes of accidents; (2) further insight into the problem can reveal new clues as to methods of prevention.

We do not know specifically today why certain drivers have accidents. We do not know that a given driver is going to react the same way every time a certain situation arises. We do not know precisely why certain drivers, with every apparent reason for getting into accidents, singularly are able to stay out of them. Conversely, it is difficult to know why some drivers with every quality for safe driving get into trouble quite frequently.

It is difficult to particularize concerning the role and identity of the compensations made by drivers for their various deficiencies. The writer and others [52] made a study of specific types of compensation, but were unable to apply directly to driving any of the techniques used. From every angle that we have studied the problem of safe driving, however, there is evidence of a powerful neutralizing factor that appears in the form of compensation. At times it would seem to be intelligence; at other times it appears to be emotional in nature; still again it would seem to point to experience and judgment. At present, the implications of this factor of compensation are not generally understood, but like a mysterious distant planet that affects the movement of other known planets, we know that the presence of this unknown can affect the results of measurable variables in a most pronounced way. *More is known, however, about factors that keep a man from being a good driver or that mitigate against safe driving than is known concerning the factors that guarantee one's being a safe driver.*

Records from various sources show that drivers between 18–22 are bad risks, but exact reasons can only be conjectured. So far as the writer is aware, no differential study has been made of the characteristics of drivers within the most dangerous age limits, nor of those within the limits of the safest age. This would mean comparing psychophysical traits of drivers of the same age groups but with different accident records.

It is not known why putting drivers with bad records through screening and other selective techniques will in itself reduce

their accidents, but there is considerable evidence that such is the case. Likewise, procedures of the type Snow [84] used to select drivers, which were merely psychological hurdles, produced results. The exact reasons can only be surmised. Much larger areas concerned with driving are not known than the areas investigated. The surface has only been scratched, largely because funds have not been available for making thorough investigations.

Research

Many of the published studies on safe driving have been incidental to the main projects of the investigators and the results obtained by no means conclusive. Too many have stayed in the field long enough only to make a limited contribution, and often then while carrying a fuller load in teaching, administration, safety promotion, or some other project. In addition to those already described, other studies to be cited later have added some facts but have not led to a solution. Science rarely reveals the secrets of nature in great profusion at any one time. It is likely we will continue to have small isolated contributions until a large cooperative effort is made to solve these problems.

Many Causes of Accidents Shown

DeSilva and Forbes [23] point out that accident-repeaters show a multiplicity of human causes of accidents. The same driver may have accidents due to visual defects, poor motor coordination, or other limitations. Only through a careful interview by one trained in this particular field can the primary causes of accidents be ascertained. The interview should, of course, be supplemented by objective tests and should, itself, be subject to quantification.

In comparing 470 accident-repeaters with a large number of volunteers who were picked by chance, these investigators showed significant differences in nine out of ten tests of the order of 98 or more chances in 100.* The greatest difference was found

* "Chances in 100" is a statistical measure used in connection with the significance of a difference in scores made by two or more groups; it is expressed, for example as "98 chances

in vigilance tests, while the least was found in speed estimation. Reaction-time differences were high also, indicating lax attention as a factor in accidents.

In the earlier study by Weiss and Lauer [94], a similar result was obtained between accident and non-accident cases. In this study it was noted that the first five-minute period of testing was more diagnostic than the second, and the second five-minute period better than the third. A complication of stop lights to be observed during the third five-minute period may have affected the results in some way. The problem involved control of a steering wheel, accurate perception of a situation and split second foot reactions.

Greatest differences were noted in the following points as registered on eye-hand coordination apparatus simulating the controls of an automobile:

1. The non-accident group made a superior showing in overall control of the apparatus.
2. The non-accident group was more active.
3. The non-accident group made more swerves in steering, possibly indicating greater activity.
4. The accident group was erratic in attention to lights used to warn the examinee of hazards.

The general conclusions drawn by these authors indicate that non-accident drivers (1) are more active, (2) can concentrate their attention better, (3) grasp opportunities for advantage more quickly and are more aggressive, as measured by laboratory tests of composite performance.

Aggressiveness as a trait must always be tempered with good judgment born of experience. For example, the "hot rod" driver may be aggressive, but in a very destructive way.

Fletcher [32, 33] has pointed out that of 173 fatal accidents studied, 103 were of the intersectional type. Sixty-one happened on the defective-vision side of the driver, 10 happened to defective-vision drivers on the normal side, and 32 to normal-vision

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in 100 of a real difference." This means that if a difference of the order obtained in one trial were obtained successively in 100 trials, 98 of the test results could be attributed to a significant and basic difference between the groups, and in only 2 trials would the difference be due to chance. Thus, a great deal of significance can be attached to the difference obtained.

drivers. However, where no relation between the accident and side vision was apparent, 80 per cent of the cases showed responsibility for the accident to the other driver. This is a factor which has been grossly overlooked in sheer statistical evaluation of psychophysical tests. It is one reason why high correlations cannot be obtained between accident records taken from "cold storage" and test results. The same investigator also reports that road tests show greater tendency to compensation on the part of persons with defective vision, especially when they know about their handicap. In another study, Fletcher [29] compared groups of drivers paired for age, using "good" and "poor" drivers on several tests. The good drivers were superior in every test.

VALUE OF SELECTION TECHNIQUES

There are two points of view regarding selection techniques. One is that the effect is mostly psychological, therefore the tests need not be highly scientific in their application. The other view is that only the most reliable and valid tests should be used. Even if the effect is largely psychological, *it is important that there be no apparent weaknesses that will tend to reduce confidence in the procedures.* The writer is a strong proponent of the latter view, although he recognizes the value of tests as a psychological hurdle. It is our contention that other things being equal, the more reasonable and scientifically sound the procedure becomes, the greater will be the effect. In addition, the results may be evaluated and improvements in technique made when consistent measurements and currently made records are available.

The benefits of testing programs will depend largely upon how well they are administered. They should reinforce logical arguments that may be advanced and thus give clues on how and when to introduce training or retraining procedures.

As a Psychological Hurdle

As a psychological hurdle, testing programs are effective in keeping away the highly incompetent from commercial concerns.

Snow's studies [84] with Yellow Cab drivers are early examples in this respect. The company gradually developed a very superior complement of drivers, probably because the timid, the incompetent, and the inexperienced for the most part did not apply. Likewise, those already employed began to take inventory of their shortcomings, since jobs were scarce. They realized the company was beginning to suspect the driver as a source of trouble, and many redoubled their efforts to maintain a good record.

Lay drivers preparing for a state driver's license examination known to be "stiff" will take pains to read the code carefully and practice parking, hand signals, proper turns and other maneuvers that should make them better drivers. They may even take special lessons to make them more skillful, thus increasing their chances of passing the examination.

Psychophysical tests may be used in a similar way to improve drivers. In general, the tests should be reliable or give consistent results, so that when a driver fails he will not come back the next day and pass with highly creditable scores. With reliable tests, the unqualified can be isolated and given special training, restricted licenses, or other treatment which will assist them to become safer drivers.

Prognosticating Driving

As tools for absolute prognostication of driving, present tests have limited potentialities because of the many causes of accidents. However, on an actuarial basis it might prove profitable for the insurance companies to make use of the best-known devices for classifying drivers. Undoubtedly, economic losses could be lowered considerably if classification procedures were utilized by well trained men with a good background of experience in this area. Such work is highly specialized. There are perhaps not more than two dozen persons in the United States well enough trained to do a first-class job of driver-testing and classification.

As diagnostic instruments, tests have enormous possibilities with respect to both commercial and lay drivers. In many cities, accidents are reduced successfully through testing programs.

There can be no criticism of these applications, and even labor unions are glad to cooperate when the objective is to increase safety and security.

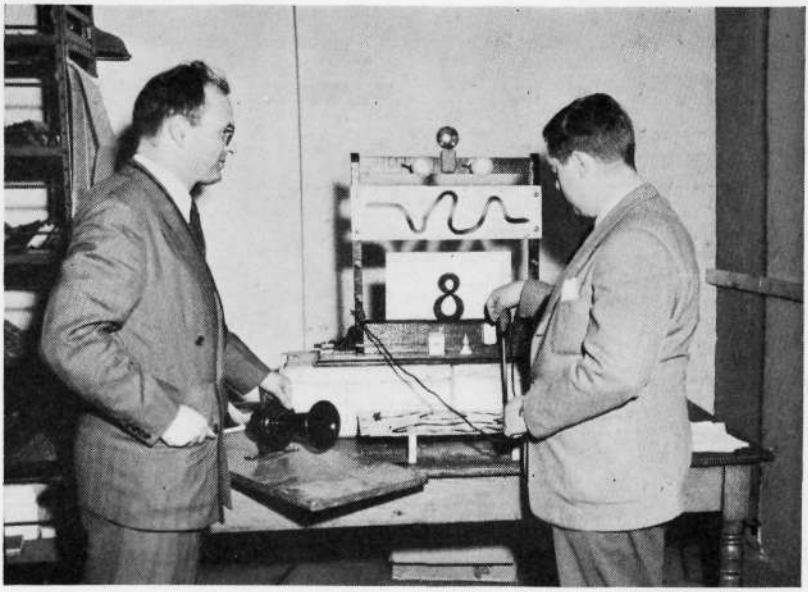
Only a beginning has been made in the therapeutic effects of tests. Additional tests for measuring attitudes, such as those developed by Siebrecht [80] and Conover [19] will materially reinforce the techniques used to measure psychophysical characteristics.

FACTORS AFFECTING PSYCHOPHYSICAL TESTING

Any psychological test is subject to influences of various types, so that even when conditions are carefully standardized, irregular results sometimes may be obtained. It is important first of all to have well-trained examiners administer the tests. These examiners must understand the general conditions necessary for obtaining consistent results and must give precise directions, carefully control the time in certain tests, observe the order of procedure, and properly tabulate results. All these factors enter into the reliability of scores made in psychophysical measurements.

The success of most psychophysical tests depends upon the active motivation of the examinee. For example, unless the examinee is motivated to do his best in a test, the results obtained with regard to such items as reaction time, speed of movement, grip, and certain mechanical aptitudes will be of little significance. It is further important that no emotion-arousing conditions be introduced into the test situation that might affect the examinee's performance adversely and result in an entirely false or distorted picture of his capabilities. It is desirable, of course, to use tests in which disturbing elements are deliberately introduced. Unless the cooperation of the examinee is obtained, test results will have little value. Hence, establishing good rapport in the test situation is an essential procedure and should be accomplished even at the expense of time.

Cooperation is particularly important in tests of such simple basic capacities as strength, speed of movement, reaction time, and vision. Obviously, unless a driver's actual capacities are



Courtesy of the Center for Safety Education,
New York University

FIGURE 3. Measuring Motor Performance

Courtesy of the Northwestern Traffic Institute

FIGURE 4. Preparing Officers for Traffic Supervision

known, it is difficult to rehabilitate him so as to provide for the compensation necessary for the improvement of his driving record.

A proper approach to examinees is difficult to outline or describe in words. It cannot be the same for everyone. Some may be coaxed, others urged, and still others "kidded" into doing their best. Motivation is partly a function of the personality of the examiner and partly a matter of his experience and training.

Standard Directions and Procedure

Unless directions, standard and precise, are presented to every examinee in the same order and manner, scientifically exact results cannot be expected from a test. Many so-called driving clinics have been sub-standard in this respect; any results based on such findings are open to question.

Not only is it advisable that test directions be written out in the simplest form and possibly summarized point by point before the test is administered, but for best results the same procedure should be followed always. In experimental psychology, the order in which a battery of tests is given is sometimes reversed, in an effort to neutralize fatigue effects, but with test procedures this is not permissible unless each subject has several trials and the order of trials is reversed or rotated for each subject alike.

In order that the directions may be properly understood, each person tested should be given a standard number of preliminary trials. Results of these are not included in the final score. The number of preliminary trials should not exceed the minimum necessary for an understanding of the test. In certain cases fatigue may affect the regular test result if too many trial tests are made.

Every test should be made as objective as possible. There should be no chance for guess work on the part of the examiner. The results should be capable of being recorded by the same person taking the test or by anyone else who may be present at the examination. Their exact interpretation, however, may not be

so clearly defined, and thus a great deal of discretion must be exercised in this respect. In all cases the interpretations given the examinee should be positive and aimed at making him a better driver. Fletcher [30] has confirmed our early findings that merely being exposed to a test will do a great deal toward reducing accidents in an accident repeater group.

Unless susceptibility to distraction is being measured, the absence of distracting influences is an important factor in securing reliable and consistent test scores. No interference or coaching from bystanders should be allowed, and in most instances it is best to have the examinee segregated in a booth while being tested. While this latter provision means that distractions can be kept to a minimum, such a deviation from regular driving conditions may not always be desirable. The absence of normal highway noises in a soundproof room may constitute as much of a distraction as extraneous noises in an ordinary room. Since certain traits or weaknesses will show up only under regular driving conditions, the trained and studied judgment of the examiner should always be based on a thorough knowledge of experimental results published in the psychological literature relating to testing conditions.

A test should be long enough to secure a reliable index of the trait being measured, but short enough to be practical and free from the fatigue-inducing element. Testing times vary according to type of test and trait being measured. For example, in testing the speed of movement, reliability coefficients of .90 and above may be obtained from four 10-second periods of tapping with the preferential hand, while it may require from 50 to 100 trials to obtain a reliable index of reaction time. In testing strength of grip, four trials, two with the right hand and two with the left, in alternate order, will give a fair reliability. Additional trials may only invalidate results by inducing fatigue.

Because the optimum time of testing varies so widely, each test should be studied carefully and a statistical evaluation made before anyone can establish the length a particular test should be. Until this is done, no claim to scientific merit relative to their application can be made. In addition, reliability coefficients* ob-

* The reliability of a test refers to its consistency of measurement.

tained experimentally should be published in scientific journals before the test is passed on for general usage by others.

The most important factor in minimizing the effect of outside influences on the value of psychophysical testing is the training of the examiner, for a well trained and experienced examiner will usually be prepared to handle other exigencies which may arise. The examiner's preparation usually takes the form of an academic degree in some phase of psychology as a preliminary requirement. In addition, special training in the techniques of psychophysical tests and measurements, and practical experience in clinical practices relative to their application are requisite to proficiency in this type of work.

Many persons try to justify a poor performance on a test with the excuse, "I lost sleep last night or I could have done better"; "My eyes are poor because I read two hours this morning"; "I would have done much better had I not caught this cold." Experimentally these are known to be largely excuses and actually affect results negligibly. If there is any question about matters which may be considered disturbing factors, the experimental findings in the literature on the test in question should be reviewed to ascertain the facts.

SUMMARY

When all facts are carefully weighed and evaluated, it is clear that certain anomalies of the sensory, central, or motor components of behavior, or certain combinations of them will predispose a driver to accidents. Whether or not he will allow predispositions to lead him into trouble is problematical. An intelligent, well-trained driver may avoid a great deal of trouble by compensating for weaknesses. While failure to utilize or direct superior characteristics properly may lead to an accident, we have never in twenty years of study, encountered a case where *superior* characteristics have in themselves been found to contribute to accident-occurrence. For example, an accident that follows an improperly directed superior vision is due to deficient attention rather than to superior vision. And when a driver with good physical capabilities smashes into a slowing vehicle ahead, the acci-

dent is not due to his superior, sensory-motor system but to poor judgment.

It is not possible to predict individual accident involvement from isolated measures or even from certain combined measures of human capacity. Likewise, desirable characteristics properly coordinated with and under the control of other desirable characteristics higher in the hierarchy of behavior will lead to more miles of safe driving than the reverse of such a situation, partly or in its entirety. Any argument to the contrary based upon a limited set of measurements is little more than speculation.

Any faulty link in the behavior chain, in all probability will result in a later faulty reaction, even though many faulty reactions will occur when no danger is imminent. One time, for example, the writer overtook a car with a weak tail light. Sudden braking skidded the car to the wrong side of semi-icy pavement. Had another car been approaching, a dangerous crash might have resulted. As it was, I maneuvered out of the skid with no serious damage. This sort of experience could occur several times with no serious consequences. Yet one more time of nearly identical circumstances may bring disastrous results. The inevitability of this is shown by the fact that there are nine times as many railway accidents at night as in the daytime—when the automobile collides with a train in rear of the engine.

In contests of speed, strength, or endurance, every provision is made to eliminate factors that would in any way contribute to inefficiency and poor performance. Likewise it is necessary that every known factor contributing to driving be carefully evaluated to determine its relation to accidents and their prevention, and every provision made to eliminate or improve driving inadequacies. Any aptitude or ability related to driving has an optimum level of functioning. If deficient, the general level of driving performance is lowered. That this deficiency may lead to an accident is purely a matter of conjecture; but the odds in favor of accident-avoidance can certainly be increased either by restoring the condition of the driver to normal, or by introducing compensatory measures within him to obtain the same results. In this respect, measuring devices are of great value.

CHAPTER IV

PHYSICAL, MENTAL AND EMOTIONAL FACTORS

Driving is a full-time job. Basic factors for safe manipulation are adequate skill, split-second coordination, directed attention, emotional stability, good judgment, and good attitudes. While driving a modern passenger car requires little strength, driving *with safety* requires good physical and mental health. Limitations resulting from a defective heart, digestive disorders, migraine headache, or arthritis or similar impediments can contribute to an accident. The more common, less serious deficiencies such as a head cold, indigestion, or fatigue may not appear to affect a driver's overall performance. There can be no doubt, however, that they do affect his physical and mental tone and impair the quality of his coordination, attentiveness, and judgment. Both major and minor physical ailments, therefore, may be contributing causes of accidents.

Drivers beset by worry or under mild emotional tension can hardly be expected to be at their best behind the wheel. How much less skillful, then, are drivers who suffer from severe anxiety, obsessions, compulsions and other symptoms of mental disorders.

PHYSICAL AND MENTAL DISABILITIES

To whom should a driver's license not be issued? Article II of the Uniform Vehicle Code [73] recommends certain general restrictions, while allowing freedom to the state and to its motor vehicle administrator to act upon these recommendations. Although these restrictions are general in nature, they allow for certain steps that can be taken by drivers' license departments to insure compliance. According to the Code, the Department shall not issue a license to:

1. Any person, as an operator or chauffeur, who is a habitual drunkard or who is addicted to the use of narcotic drugs.

2. Any person, as an operator or chauffeur, who has previously been adjudged to be afflicted with or suffering from any mental disability or disease, and who has not at the time of application been restored to competency by the methods provided by law.

3. Any person when the Commissioner has good cause to believe that such person by reason of physical or mental disability would not be able to operate a motor vehicle with safety upon the highways.

4. Alternate 8.—Any person when the Commissioner has good cause to believe that the operation of a motor vehicle on the highways by such person would be inimical to public safety or welfare.

These provisions—carried out in many states to a limited degree only—raise certain problems. Who, for instance, is an habitual drunkard? Who shall judge as to whether a person is suffering from a mental disease that makes him incompetent? In such cases, the motor vehicle administrator must secure expert medical advice. The examining agency cannot diagnose or treat disease; this must be done by a physician. Several state departments call upon doctors in other branches of the state government for expert advice.

Following are some of the conditions that may seriously limit efficient driver-performance: [13, 8]

1. *Epilepsy.*—This is a condition marked by periods of abrupt semi-consciousness or loss of consciousness, and frequently accompanied by convulsive movements. Most epileptic convulsions are over in two to five minutes, and the individual may then fall asleep for an hour or more. Of the several types of epilepsy, the largest percentage of cases are known as *grand mal* and *petit mal. Grand mal* involves a loss of consciousness and, usually, convulsive movements. In about one-half the cases, the loss of consciousness is preceded by warning symptoms. In *petit mal,* the victim loses consciousness for a few seconds but does not have convulsions. Persons with epilepsy should not be allowed to drive, since loss of consciousness for even a second may be hazardous when driving. The licensing of an epileptic should be contingent upon a statement from a competent physician, preferably a specialist in neurology. At present there are several state motor vehicle

departments that obtain important data regarding epileptics through arrangements with hospitals. In some states doctors are required to report epileptic cases. In recent years the treatment of epilepsy has effected remarkable results. The use of *dilantin sulphate* and other drugs has been so successful with some persons as to greatly reduce the attacks or seizures.

2. *Poliomyelitis.*—The effects of this disease, commonly known as infantile paralysis, are well known. The installation of special controls on vehicles has afforded an opportunity to many handicapped persons to obtain a license and become good drivers. The licenses of such persons should state clearly their limitations.

3. *Locomotor Ataxia and Paresis.*—Persons afflicted with either of these two diseases should not be allowed to drive. The former is a condition involving a lack of neuromuscular control, especially of the extremities. The latter is a general deterioration of the brain that is almost certain to be associated with impaired judgment and varying degrees of dementia.

4. *High and Low Blood Pressure.*—Brody [14] in his 1940 investigation of a limited number of accident-repeater cases observed that they had a significantly lower blood pressure than the accident free drivers. Tests of systolic and diastolic pressure were included in the Connecticut Clinic of the Eno Foundation study [27]. Dr. Eugene E. Lamoureaux of the Connecticut State Department of Health issued the following statement on the results of these tests: ". . . . . there is no significant difference in the blood-pressure readings of the two groups, and the results of this survey do not prove to be of value in attempting to predict the accident histories of a group of drivers." Dr. William Goldring of the New York University College of Medicine points out that "single observations cannot be used to answer this question . . . . blood pressure is extremely variable and subject to many influences, most of which cannot be evaluated nor indeed are clearly understood." With regard to the effects of high and low pressure, it is necessary to depend upon the doctor in each individual case.

5. *Serious Heart Diseases.*—Persons suffering from serious angina pectoris or coronary thrombosis should not drive. In the case of rheumatic heart disease there is generally little danger of

sudden cardiac failure, and under ordinary conditions a person so afflicted could continue to do a limited amount of driving.

6. *Diabetes.*—Some states have taken action against the more serious diabetic cases. While the disease is well under control through insulin treatment, it is essential that medication be regular and controlled and that the illness be not complicated by heart disease, serious eye defects, or arteriosclerosis. In some states such as Pennsylvania, a diabetic operator is required to furnish a medical certificate periodically.

7. *Spastic Paralysis.*—The more serious case of spastic paralysis, known also as cerebral palsy, should not be allowed to drive. The condition is characterized by uncertain and involuntary contractions of groups of muscles and is likely to result in faulty control of any mechanical device being operated.

8. *Amputees and Paraplegics.*—More than 17,000 veterans have been given cars equipped with special controls to take care of specific orthopedic disabilities. The driving record of these disabled veterans appears to be as good as, if not better than the record of the nondisabled. The veteran has had the advantage of adequate training and has learned to compensate for his deficiencies. These factors have helped achieve this good safety record.

A number of states require an operator suspected of mental illness or special physical defects to procure a statement of mental and physical capacity from a private physician or from a state medical agency or institution.

Differing Effects of Alcohol

Statistics emphasize the significance of alcholism as a personal factor contributing to motor vehicle accidents [60, 43].

The physiological effects of alcohol on the body are well known. Alcohol is not a stimulant to cerebral functioning: it is a narcotic drug that attacks and depresses the central nervous system, interfering with normal neuro-muscular activity [25]. It has been established that intoxication due to alcohol is dependent not upon the total amount of alcohol consumed, but upon

the amount of residual alcohol in the blood. Alcohol in the blood is highly correlated with alcohol in the brain.

While individuals may differ in their rate of absorption and oxidation, *years of clinical investigation have shown that most individuals are intoxicated to the same extent when their blood alcohol concentrations are the same.* Thus, one individual with a high absorption rate and a slow burning rate will reach a certain stage of intoxication on fewer drinks than one who absorbs alcohol slowly and burns it quickly. Yet, both individuals are equally intoxicated once the same amounts of unburned alcohol have collected in the body organs and tissues of each, regardless of the amounts consumed. [25, 35] Studies* of traffic accidents involving the use of alcohol resulted in official recommendation that a .15 per cent alcohol content in the blood be established as the concentration point at which an average man can be considered to be "under the influence"; that is, at the .15 per cent level, serious impairment of driving ability has resulted. Even in earlier stages of intoxication, however, the senses lose their normal acuity: mental functions are slowed down; perception, comprehension, and critical judgment are retarded; coordination of motor functions is reduced.

In addition, alcohol produces psychological changes in the personality, characterized by the removal of inhibitions by feelings of over-confidence and elation, by depression, or by a disregard for authority and responsibility. [26] Therefore, even in early stages of intoxication, psychophysical proficiency or the ability to compensate for shortcomings and the total driving skill of the normally safe driver may be seriously impaired.

Chemical Tests for Intoxication

Advocates of chemical tests to measure intoxication objectively point out weaknesses in traditional subjective methods. Many pathological conditions show what seem to be symptoms of intoxication. Through observation alone, therefore, an innocent

* Studies by both the American Medical Association [6] and the National Safety Council [62].

person may be accused. On the other hand, an impairment of driving ability may be suffered before any external signs of intoxication appear. A man may appear sober when actually his driving ability has been seriously diminished. He may retain coordination as measured by certain tests (such as walking a chalk line) after his judgment is greatly impaired. A chemical test can identify this individual. Furthermore, a subjective diagnosis of intoxication may often rely upon knowledge of the kind and quantity of intoxicant consumed. Such an inaccuracy is eliminated by the use of a chemical test.

Opponents of chemical testing argue that too many legal difficulties are encountered in cases where the constitutionality of submitting such evidence in the courts has not been clarified, and that where penalties are imposed for conviction on a charge of intoxication, they are so severe as to hinder execution of the law. In addition they claim that in many respects chemical testing is a questionable tool, principally because of the many incompletely understood ramifications of the question of individual tolerance to alcohol and the need for specially trained technicians for the effective administration of the test.

As a matter of record, it should be noted that chemical testing has been endorsed by the American Medical Association, the National Safety Council, the American Bar Association, and the American Association of Motor Vehicle Administrators. Such endorsements indicate its increasing acceptance as a reliable measure of intoxication.

THE EMOTIONS

Altogether too little is known regarding the relationship between emotions and accident occurrence. While it is obvious that extreme anger, fear, hate, and worry will affect driving practices, it is difficult to obtain valid data and evidence as to the nature of these effects. The emotional characteristics of an individual can be measured in a clinic, but the same conditions and emotional tone may not characterize him immediately prior to the accident. Even the conditions that exist when the police arrive for an investigation immediately *following* the accident will not be the

same as those immediately *preceding* it. In some cases the driver will be seriously injured or suffering from shock. Again, his anger may have changed to fear or remorse. The investigating officer can observe reactions or possible symptoms, but these are the *result* rather than the *cause* of the accident.

Emotion is a powerful force in all behavior. G. Stanley Hall, psychologist, observed, "Our intellect is like a speck on the sea of our emotions." Certainly, in many of the traffic situations, the emotions appear to dominate. By way of illustration, consider a driver who has struck and seriously injured a pedestrian. He knows full well the penalty for hit-and-run driving. His intellect and good sense caution him to stop, render first aid, and report to the police. Instead, fear or panic overwhelms him and he drives away. Even the admonitions of the passengers accompanying him have no effect; his behavior is guided by fear.

Consider almost any one of the terrible night-accidents involving drunken drivers. There was a well-to-do citizen with friends at a country club. He had too many drinks. About midnight he started to drive his friends home. Alcohol had affected his higher brain centers—his judgment was impaired, his emotions uninhibited. His friends tried to prevent him from taking the wheel. They argued and pleaded. Angry and upset, he started —speeding recklessly, tearing around corners, taking all kinds of chances. The inevitable bad accident occurred. Yet this driver was a solid citizen, a man whose intelligence and achievements were appreciated by the community. But confused emotion, not intelligence was behind the wheel that night.

These are but two illustrations of the influence of emotions on driving. Countless others could be taken from police files, or from newspaper, coroner, or hospital records.

On the other hand, psychologists point out that certain emotions and feelings make for good driving. The love that a father has for his family and that children have for parents would tend to make them better drivers—at least when members of the family were in the car. In the same way, the admiration and respect that students have for a high school driving instructor would tend to make them follow his teachings. Fear of apprehension by the police serves as a useful deterrent, since it keeps some drivers

from disobeying regulations or from following dangerous practices.

Emotional Instability

Selling's studies [78, 77] conducted at the Psychiatric Clinic in the Recorders Court in Detroit showed the large percentage of chronic violators suffering from nervous disorders. No similar studies have been conducted in other states, but evidence seems to indicate that persons with emotional instability and those with certain personality maladjustments do not make good drivers. In the Eno Foundation study [27], for example, two types of tests were used to measure "personality adjustment" and "emotional stability."

These were administered to two groups totaling 386 drivers, half of whom were accident-repeaters and half accident-free. The first was the Cornell Word Form, a word-association test previously standardized against the results of psychiatric examination. Scores in the test range that indicated questionable or poor adjustment were made more frequently by repeaters than by the "free." On this basis it appears that there is a relationship—the degree and nature of which yet remains to be determined—between personality maladjustment and accident involvement.

The second test was designed to measure the effect of frustration and annoyance on motor performance. The Eno Foundation study [27] describing this, points out that accident-free drivers scored consistently fewer errors in the motor-performance test than did repeaters, and that even when subjected to annoyance and frustration the accident free showed improvement in successive trials. Failure on the part of the repeaters to show this same trend toward improvement seems to show that, as a group, they tend to be more upset and disturbed than the free by annoying and distracting conditions.

Nervous Disorders

Altogether too little research has been carried on in the field of nervous disorders in relation to driver performance. Certain

states may refuse to license persons with psychoses, especially those confined to institutions. Others may require a medical examination under certain conditions, as in the case of the Detroit Psychiatric Clinic. But not too much is known about the driving record of those suffering from the less serious neuroses, such as the so-called "nervous breakdown." Obviously, lack of sleep or poor physical and mental condition may tend to make a person inattentive, irritable, careless or unstable. Persons who "fly off the handle," who lack self control, or who are suffering from anxieties or fears will tend to be poorer drivers, if inferences drawn from various related skills and activities can be trusted. Habitual users of narcotics should not be allowed to drive. Some states revoke the licenses of confirmed alcoholics.

According to medical specialists, persons suffering from narcolepsy may "fall asleep" at the wheel [8]. This differs from natural sleep in that those affected by it retain consciousness but lose all muscular control, and hence can lose control of an automobile. It would seem that an undetermined but probably small percentage of the accidents in which the cause is given as "driver fell asleep at the wheel" may be due to narcolepsy.

DRIVER ATTITUDES

Attitudes play an important role in driving. Even the driver of superior skill who is well informed on safe-driving practices can become involved in a serious accident if his *attitudes* are bad. Official accident reports usually indicate such causes as "exceeding the speed limit . . . reckless driving . . . on the wrong side of the road . . . not having the right of way" . . . and the like. These physical factors may not be the *true* causes of the accidents but merely the last things that happened before the crash. Real causes may be more deep-seated. Most experts in traffic safety conclude that a faulty attitude underlies most of the acts usually given as the "causes" of accidents.

The sociologists, Park and Burgess [69] define attitude as "the tendency of a person to react positively or negatively to the total situation. Accordingly, attitudes may be defined as the mobiliza-

tion of the will of a person. Attitudes are as many and varied as the situations to which they are a response." The *Psychological Monograph* [7] defines attitude as "a disposition to act which is built up by the integration of numerous specific responses of similar type, but which exists as a general neutral 'set' and when activated by a specific stimulus results in behavior that is more obviously a function of the disposition than of the activating stimulus." Remmers [76] points out that an attitude is "a more or less emotionalized tendency, organized through experience, to react positively or negatively to a psychological object." Bogardus [11] states that "the real source of attitudes is in personal experience, especially in life histories of persons." Brody in *Education for Safe Living* [85] adds that "attitudes are more quickly *caught* than *taught*—picked up by children from their parents, their teachers, and other adults in the community."

Certain points in these definitions can be noted as of importance: (1) Attitudes are more or less emotionalized; (2) they are acquired from personal experience; (3) they are as many and varied as the situations to which they are a response. *Attitudes influence behavior.* Therefore, driving behavior that creates a hazardous situation either for the driver himself or for others, may be said to be *evidence* of bad attitude.

Certain drivers can be characterized by such terms as *road hog, cowboy, speed maniac,* and *egotistical driver* because of their display of discourtesy, bravado, boorishness, impatience, or recklessness. These traits may be the result of one's freedom or independence having been restricted by a parent, spouse, or employer. The automobile, then, may only be the medium through which the reckless, impatient, discourteous driver expresses his desires for attention, power or influence. The problem is to divert such self-expression *from* the driving activity *to* constructive rather than harmful channels.

Attitude Testing

Siebrecht [80] in 1941 developed a driver-attitude scale that had a validity and reliability of .81. It has been used widely by

supervisors of commercial fleets and by high schools for evaluating attitudes. In his original investigation, in which the scale was administered to more than 2,000 persons in various sections of the United States, Siebrecht found the group norms of school students as follows:

Groups	*Means*
Freshmen	144.10
Sophomores	151.05
Juniors	155.81
Seniors	158.15
Driver-training students	164.53
Driver-experienced students	168.20

These scores indicate that education plays an important role in the development of attitudes on the part of high school students. Seibrecht found also a high critical ratio* of 14.29 between scores made by students with driver-training experience and freshmen, or five times the minimum value necessary to establish the difference between the two groups as a significant one.

The scale consists of forty statements validated by their use on more than 200 individuals. Here is a typical item: "Drivers' examinations should be more difficult, to eliminate all but the best drivers: Strongly agree .... Agree .... Undecided .... Disagree .... Strongly disagree ...."

The person tested was asked to check the position that best indicated his attitude. No names were recorded. Nothing was at stake; students were urged to give their honest opinions.

The value of the scale to qualify an individual for a driver's license can be questioned, for if administered to someone concerned with passing a test or being selected for a job, his tendency may be to check those positions he believes will give him the best chance of passing, rather than his true attitude.

Conover [19] in 1947 utilized an adaptation of the Iowa State Multi-Attitude Scale to measure attitudes toward general driving practices. This was based on subjects' responses to words and phrases assumed to carry "certain affective connotations" relevant

* The Critical Ratio is a statistical measure of the significance that can be attached to an apparent difference between two sets of data, as, in this case, average scores.

to the principal causes of fatal traffic accidents categorized by the National Safety Council. The reliability of the Scale after refinement was found to be in the range of .82 to .85. Driver-training students were found to shift their attitudes toward safe driving in a desirable direction after receiving class-room and behind-the-wheel instruction. Further studies on the validity and application of this specific research are now being made.

Attitude Tests in the Eno Foundation Study

In the Connecticut Clinic, the subjects tested were promised immunity in so far as the results affecting their licenses were concerned. In the Michigan Clinic no immunity was promised. The Connecticut findings showed highly significant differences between the attitudes of accident-repeaters and accident-free drivers. In Michigan, even though the drivers were more serious "repeaters," the findings were not as significant. The term *significant* is used here to indicate statistical probability determined by use of the chi square test.

A brief summary of that part of the Eno Foundation study [27] concerned with attitudes is as follows:

Connecticut repeaters exhibited a stronger tendency to agree that:

—Driving is a competitive affair in which each operator is out for himself

—Almost everything can be fixed up in the courts if you have enough money

—Success is more dependent on luck than on real ability

—The decisions of judges in courts are determined mainly by their personal prejudices.

The Michigan repeaters indicated different attitudes, believing that:

—They had often been punished without cause

—If several people find themselves in trouble, the best thing for them to do is to agree upon a story, and stick to it

—It is all right to get around the law if you don't actually break it.

When questioned about their driving speeds repeaters indicated their preference for:

—Higher speeds during daylight hours

—Higher speeds at night.

When asked the number of drinks they believed they could take without their driving's being affected, 22 per cent of the Connecticut repeaters indicated "four or more," as compared to 12 per cent of the "free." It seems apparent that accident repeaters have an inflated idea of their tolerance to alcohol.

Encouraging Good Attitudes

Every effort should be made by the community to provide learning experiences that will reach all drivers and pedestrians. This means more emphasis on driver education in schools, more emphasis on driver education for adults, and more stress on safe practices through the use of the press, radio, motion pictures, posters, and other educational media.

Since attitudes result from educational experiences, and a large percentage of drivers are not well informed, efforts should be made to give them *specific* information. Newspapers and other educational media should be used to praise and encourage good driving practices and condemn bad practices. Examples of types of articles that should prove helpful to the public are:

—Statements about new regulations, their importance and advantages

—Releases from city officials regarding seasonal or holiday hazards

—Feature articles showing the need for and value of specific safe practices

—Reports of traffic-safety conferences and special awards given to communities, individuals or fleets

—Pictures illustrating good practices.

The following, though negative, have value, *in that they show specifically the effects of bad driving practices:*

—Newspaper stories illustrating bad accidents and, if possible, constructive remarks concerning the "cause" of the accidents and how they could have been avoided

—Lists of suspensions and revocations and the reasons therefor. Also the penalties imposed upon traffic offenders

—Reports of court proceedings giving further aftermaths of accidents

—Pictures illustrating effects of bad practices.

The most vivid and surest way for a driver to learn the end-product of bad attitudes and practices is (1) to be involved in a serious crash, or (2) to be an on-the-spot witness of an accident. Day-by-day vicarious experience from reading newspaper accounts of accidents, seeing motion pictures, or hearing radio programs has considerable value. Efforts to improve attitudes should be directed toward providing learning experiences that:

—illustrate the pleasure and satisfaction that come with good driving attitudes

—tend to develop dissatisfaction with bad attitudes and practices and the dire results which they may produce.

Developing Good Attitudes

Good traffic-engineering procedures will also be useful in improving attitudes. Delays because of faulty installation or timing of lights, congestion, parking difficulties and the like tend to release emotions which affect safe driving. On the other hand, good traffic-control devices, proper channeling, street markings, and other improved engineering features which expedite the flow of traffic may also improve the attitudes of drivers.

Enforcement is a strong arm to improve attitudes for those who *will* not drive properly. It is compulsory education. While enforcement will be discussed in another chapter, it is well at this time to stress certain aspects directly related to attitudes:

—A good police department, well trained and well administered, cultivates the healthy respect of motorists

—If drivers know that enforcement is strong and that punishment for offenses is fair, yet sure, they will tend to be more cooperative

—Emphasis should be placed on the police officer as a public servant aiding the motorist in good driving practices

—Bad enforcement experiences, unjust traffic court decisions, being insulted or "called down" unfairly by officers may create or encourage a

bad, emotionalized attitude on the part of drivers that will be difficult to correct

—Enforcement should be friendly, yet rigid and strong, and educationally valuable

—Sound, competent, and yet fair procedures in traffic and civil courts can be most valuable. Weak, vacillating, and politically inclined courts will have the opposite effect.

SUMMARY

Existing driver-licensing laws provide only limited protection to the users of the highway from physically and mentally deficient drivers. Driver limitations require correction and compensation.

Of major importance is the problem resulting from drivers' use of alcohol. Convicting a driver charged with driving while intoxicated is difficult. Subjective observations for estimating the degree of driver intoxication is being replaced in a number of states by the more objective method of chemical testing. The increased use of such tests for this purpose will greatly improve this phase of law enforcement.

Many faulty acts of the driver result from his attitudes and emotions. These are the basis for a large but unknown percentage of accidents. Tests for use in measuring driver-attitudes are in their initial stages. An improvement in the attitudes of a large segment of the driving population is needed to reduce accidents.

"Safety consciousness" manifests an attitude pattern that results in safe practices. Realistic experiences show that "safety consciousness" tends to be an aggregate composed of many specific factors. All of these must be acquired.

CHAPTER V

REGULATIONS, ENFORCEMENT, AND DRIVER BEHAVIOR

When persons with potentially dangerous motor vehicles share the roads, they must have some common agreements about how they will behave. Otherwise, the sharp finality of serious accidents will cancel the usefulness of the automobile.

These agreements become customs, and some are cemented into traffic laws and ordinances. They are the traffic regulations that make possible the distance-shrinking speeds and convenience of one of our greatest enterprises—highway transportation. Unfortunately, some drivers do not wish to conform to the pattern established by these regulations. The majority, however, want the minority compelled to behave. They want to avoid traffic jams and accidents.

There are important limitations to the use of rules for establishing a standard pattern of driving behavior. It is impossible to provide detailed rules for all conceivable traffic situations. Even some of the present-model right-of-way rules [74] tax the comprehension of many drivers. The one requiring yielding to the vehicle on the right is well enough understood, but the provisions for right-of-way when left turns are involved usually are not widely understood. Obviously, rules must be limited to *basic* ones for which the need is clear, the exceptions few, and the agreement between communities substantial.

Behavior that is apparent from the movement or location of the vehicle, or that can be observed by someone outside of the vehicle, can be evaluated by enforcement officers. But a number of elements of behavior that are important to safety cannot be reduced to rules and are not enforceable because there is *little or no external evidence of them.* For example, a driver should pay attention to driving, watch the roadway, and keep his mind from wandering; but unless it comes out in an accident investiga-

tion that he was tuning the radio, sorting packages to be delivered, or had dozed at the wheel, it is impossible for anyone outside of his vehicle to testify that an offense was committed!

"Reckless driving," usually indicative of bad attitude, affords another example. While reckless driving is often punishable by law, it is defined only in terms of actions which can be observed outside the vehicle. Safety educators therefore continually urge the development of attitudes that will result in courtesy, cooperation, unselfishness, alertness, caution, and other generally desirable behavior. Methods for developing those attitudes *directly by enforcement,* however, have yet to be developed. Enforcement may, indeed, stimulate a driver to be alert and cautious to avoid being caught in other violations, but this can be construed only *as an indirect* effect on mental behavior or attitude.

To comprise a sound control system based on enforcement methods now available, regulations must be limited in practice to simple elements of externally observable behavior.

Mechanics of Traffic Supervision

The activity of police in traffic is usually not limited to what is ordinarily thought of as *enforcement* (the application of compulsion). Consequently, that word is inadequate to describe them. Traffic "control" in highway transportation is not used in the sense of scheduling and dispatching as it is in commercial transportation. More frequently it is limited to the direction of traffic at a specific location either by men or mechanical devices. "Regulation" probably best describes present practices in that it connotes restricting traffic behavior within certain rather broad limits. It would seem reasonable, however, to anticipate a time when the "operation" of the highways would best be described as "supervision" as it has come to be used in industry and education where restrictive and punitive methods are minimized in favor of less negative aspects of management. By whatever name it is called, the traffic work of police departments centers around a core of basic activities for which police powers may have to be invoked. *Traffic supervision is keeping order on the public ways*

to make their use safe and expeditious and to secure the best compromise between mobility and safety at all times and places under existing conditions and established rules. It has three essential functions:

1. *Directing traffic* — indicating to drivers and pedestrians how they shall use the streets and highways and who shall have priority in their use at times and places of unusual or unexpected congestion or hazard, in areas during an emergency, and on other special occasions. It includes establishing emergency regulations when usual regulations are inadequate and special regulations have not been established to protect the public, prevent confusion, or avoid abnormal delays to street users as a whole.

2. *Traffic accident investigation* — the systematic official effort, first, to limit the seriousness of the accident by warning other traffic, giving first aid or securing medical attention, taking steps to prevent or extinguish fires, preventing pilferage or spoilage of goods, controlling bystanders, and clearing the roadway of obstructions; secondly, to find out what happened by interviewing participants and witnesses, observing physical evidence, and testing the drivers and vehicles; thirdly, to form an opinion as to why the accident happened by evaluating remote as well as immediate circumstances; and fourthly, to record and report the facts and conclusions by preparation of sketches, diagrams, or photographs, recording the results of tests, preparing an official summary, and summarizing special circumstances or conclusions.

3. *Enforcement* — first, detecting while the street or highway is being used, pertinent defects in individual behavior, vehicles or their equipment, and roadway conditions; secondly, starting immediate appropriate action to prevent such defects from endangering or inconveniencing people, to remedy the defects, and to discourage their repetition; and thirdly, reporting the activity for record purposes and when a law has been violated, arranging essential facts to facilitate prosecution, appearing and testifying in court and at other hearings, and serving warrants issued by the courts for the appearance of traffic violators. [67]

In the first of these activities, directing traffic, obedience is assumed and, except in rare cases, enforcement is unnecessary. In accident investigation, the action of enforcement follows only when the circumstances disclose violation of law evidence adequate for its proof. Enforcement proper is directed primarily at those who have willfully and intentionally violated the laws, regardless of when or how.

Supporting these three basic activities must be many administrative activities: the training of personnel, analysis of accidents as the basis of selective work-assignments, the providing of appropriate equipment of several kinds, the maintenance of com-

munications, the planning for handling emergencies and special events, the comparing of current with past accident experience to determine whether or not overall progress is being made and the comparing of local accident-rates and enforcement activities with those of other communities to determine whether or not the program is as effective as it might be.

Specialization for Traffic Supervision

Traffic work of police in both city and state has become a considerable part of all police activity. Methods employed differ enough from those of other police work to make special training and experience necessary if a good job is to be done. Few police departments are in a position to afford *all* men an opportunity to get this needed training and experience. Hence, the establishment of a traffic division in the police department comparable to the detective division has been found desirable and often necessary.

Courts, too, have found specialization necessary. The great number of minor offenders who merely want to plead guilty has led to the establishment of the familiar violations bureau in most cities. At these, standard fines may be paid for most minor violations. Experience gained by specializing in traffic cases has proved helpful to judges in making penalties effective and uniform. Holding traffic court at a special time or place helps to give it more dignity and dispatch and avoids the distasteful mixing of traffic violators with common criminals.

"NATURAL" DRIVING BEHAVIOR

In judging the effect of regulations on driver-behavior, it is well first to think of how drivers might act *without* controls. Under this imaginary absolute zero of control, people would undoubtedly tend to evolve a pattern of conduct by which they could share the roads without too much trouble. People have enough common sense to develop the customs necessary for this. They do it now on foot in filling and emptying theaters and ball parks.

They queue up at ticket and tellers' windows without enforcement. They seem to recognize some unwritten laws in trains, elevators, and busses.

Where congestion is unimportant, the majority of people would probably do about as they do now, driving at speeds that are reasonable and prudent under the conditions and with regard to actual and potential hazards; stopping before entering traffic arteries, particularly when the view is obscured; following at safe distances; and even giving some arm signals purely as courtesy gestures.

Whenever congestion does develop, however, competition between drivers introduces new elements of behavior that are not restrained by the likelihood of accident. If the demand for street space exceeds the supply, the urge of each to grab his share is as strong in traffic as it is when there is a shortage of gasoline, soap, or cigarettes. Sometimes this urge takes on certain emotional aspects characteristic of panic—like those exhibited in runs on banks and crowd stampedes at a fire. Senseless horn-tooting at bottlenecks jammed with cars, the crowding into already tangled intersections, and breaking past a long line of waiting cars on the wrong side of the road are symptoms of this condition. In metropolitan areas, therefore, unregulated traffic is unthinkable. It would produce bad delays, the blocking of important arteries by double and triple parking, and many wasteful accidents. Regulations obviously directed at reducing congestion, therefore, will be generally accepted by drivers. For example, an officer directing traffic at an overloaded intersection is commonly regarded as an "expediter." Obedience to his instructions is due more to the approval of what he does than to the fear of what he could do in case of violation.

Behavior Patterns and Safety

People have a tendency to conform to patterns of behavior established by society, even if they make little sense, provided they do not appear dangerous. This is apparent in modes of language and dress. The tendency serves a useful purpose in relation to behavior in traffic, with or without regulation. It provides a

means through which one may know largely what to expect of others on the highway. So far as practices relating to personal safety go, the pattern is set by a *minority* who consciously or "unconsciously" drive with reasonable safety for all in common traffic situations. From these good practices they are not easily deterred by the bad examples set by some drivers. Most drivers simply copy the most stable and observable patterns without question.

Thus a *driving mode* establishes itself. There are naturally some deviations by those whose convenience or whim is served by operating with a smaller margin of safety, those who want to attract attention by unorthodox driving, or those who simply fail to perceive that they are out of step.

This spontaneous mode is, in fact, the basis for most of our traffic law. *Regulations that deviate from it more than slightly are not acceptable and are hard to enforce.*

In establishing speed zones, traffic engineers are often guided by the "85th percentile"; that is, the speed at or below which 85 per cent of the drivers choose to travel, on the theory that the speed of the fastest 15 per cent is unreasonable. The mere posting of a speed sign, provided it is at all reasonable, has a marked effect on speed. Drivers going faster slow down, while drivers going slower speed up. The pattern established by the sign is followed, to some degree at least, with the result that driving speeds tend to conform to the posted speed. If only a few cars are slowed down because the posted speed is near the upper limit of what drivers would do anyhow many may be speeded up with the result that the posting of a speed sign may tend to increase average speeds.

Regulations Aimed at Congestion

Customs that are matters of congestion relief are much less spontaneous in development than those relating to safety. In fact, the spontaneously set pattern may increase rather than diminish congestion. A single car parked in a prohibited zone sets a pattern or establishes a precedent which others are eager to follow as a matter of convenience not involving hazard. One-way streets and ro-

tary traffic are examples of artificial regulations that, once established, run themselves. Parking restrictions are artificial but do not run themselves and require continual enforcement pressure to make them work. An example of self-actuating convention that relieves congestion is the tendency of drivers to seek less-traveled routes so long as time, cost, or discomfort is not increased. This serves to distribute the load on streets and helps to relieve bottlenecks.

FAULTY DRIVING BEHAVIOR

When laws, ordinances, and regulations for drivers and pedestrians correspond to the natural behavior pattern of intelligent and experienced street users, or clearly seem to relieve congestion, they will be observed within reasonable tolerances by a majority of people *without* enforcement. Regulation or control is concerned, therefore, almost exclusively with the *minority* who fail to observe the conventions and thereby cause delays and accidents. Why do people not conform? There seem to be five main reasons:

1. *Ignorance of general regulations.* Ignorance is a factor in the violation of certain regulations much more than in others. The violator simply *does not know,* for example, that he is supposed to make a left turn from the lane just to the right of the Center. No one ever told him and he does not recognize this as the accepted pattern. In a thousand drivers there is not likely to be one ignorant of the rule requiring driving to the right in meeting oncoming vehicles, but in the same thousand there may well be more than 900 ignorant of one of the left-turn right-of-way rules. Some of the unfamiliarity with rules is astonishing. License examiners still report some people who do not know they are supposed to use the lower beam in passing. Perhaps they learned to drive by daylight and whoever was teaching them never thought to mention it.

2. *Ignorance of special, local regulations.* There are two classes of local regulations. First are those which are made known by signs—regulations such as prohibited turns, one-way streets and all kinds of parking restrictions. Second are unusual local rules like the "rotary left turn" at signalized intersections abandoned not so many years ago in Cleveland and Washington. Strangers are dependent upon the conspicuousness and clarity of signs for knowledge of the first type of special local regulation and upon observation of local drivers for knowledge of the second type.

3. *Misinterpretation of rules.* Drivers sometimes misinterpret rules and therefore do the wrong thing while thinking it is correct. For example, a con-

fusing location of signals at irregular intersections, or the ambiguous motions by a traffic officer, may be misinterpreted, resulting in this sort of a situation.

4. *Inadvertence.* In some situations, the driver knows what the rules are but violates them without realizing it. Traffic light violations are frequently of this kind: the driver may be distracted or preoccupied and fail to notice the signal. Much speeding is inadvertent: driving speed goes above the limit without the driver's being aware of it, especially with a quiet and smooth-running new car; or a speedometer may be out of adjustment. Unintentional cutting of corners on left turns, overtime parking, failure to give arm signals, and following too closely are all examples of more violations of this type.

5. *Intentional disobedience.* This occurs when the driver *knows* that he is violating an established rule. For example, speeding beyond the legal limit is usually intentional, as is willfully "running" a red light or failing to stop at an observed stop sign.

The percentage of traffic misbehavior that results from each of these five circumstances is not easily determined. It depends, in any community, on many factors. Some of these are:

1. The uniformity and reasonableness of traffic regulations
2. The training available for new drivers and the stimulus to learn traffic rules produced by the examinations for a driver's license
3. Conspicuousness and clarity of signs and signals and the amount of channelization and division of roadways
4. Enforcement policy with respect to tolerances, ticket fixing, and severity of penalties.

Since most drivers' deviations from the prescribed pattern of traffic behavior go unnoticed, they are unreported—consequently they cannot be analyzed. When a study is made of the circumstances of violations that result in arrests, summonses, or warnings, two factors influence the result. The first is *enforcement policy:* if the police do little but look for excessive speed, a large proportion of the arrested violators will be violating willfully.

The second factor is that many drivers claim ignorance. Some do this in the belief that it will get them off or lessen their penalties. It follows, therefore, that the inquiry must be made *after* the case is settled.

Reducing Driving Misbehavior

What steps can be taken to decrease the amount of misbehavior in traffic?

To lessen ignorance of general regulations, a few engineering aids (such as pavement markings, or "Drive to Right Except When Passing" signs) may help. The fear of enforcement, or the dread of failure on a license examination may build up the urge to gain knowledge. But *education* is the best means to lessen the number of offenses due to ignorance.

Special local regulations must be made known principally by "on-the-spot" signs and markings. Engineering, in the main, must be relied upon to decrease ignorance with regard to special rules. Educational procedures, however, also provide help by teaching what sort of local regulations to expect, and where to expect them. Enforcement may greatly encourage diligent alertness and watching. Obviously, the threat of fines or other punishment can have but little effect on a driver who is ignorant of the established traffic behavior pattern.

Enforcement is mainly directed toward willful violation. Engineering and education have but little effect upon deliberate violators.

The other two categories, inadvertence and misinterpretation, cannot be closely associated with a specific method of attack. They occupy a kind of middle ground and may be affected by engineering, education, or enforcement, by a combination of them, or by none of them. The last possibility occurs, for example, when the violation is due to unsuspected physical or mental deficiencies. It is a matter for education if a driver is unaware of certain physical limitations. But if limitations *are* known and he fails to make appropriate allowance for them, or if these deficiencies make him behave abnormally, does it not then become a case of intentional violation—not easily controlled through enforcement?

The question of effectiveness of controls, regulation and enforcement can now be partly answered. For those ignorant of regulations, enforcement has no effect. Control is unnecessary for those whose natural manner of driving closely approximates the behavior pattern established by laws and ordinances, and who basically agree with regulations aimed at reducing congestion.

These two groups probably constitute a considerable proportion, perhaps a majority, of all drivers.

This leaves a group who can drive as they should, but do not. An important fact must be recognized at this point. This group of people is not a fixed segment of the population. *Few drivers are in this group all of the time. Most drivers are in it some of the time.* Many drivers require control only with respect to *certain* regulations. Many drivers require control only under *certain* circumstances. For example, the real or imagined urgency of a trip may result in hurried driving and a temporary disregard for regulations ordinarily observed.

Many drivers, particularly young people, are not fixed in their behavior or attitude toward regulation. Lack of well established patterns is due apparently to fluctuations in emotional balance, and to many other physical and mental factors—some of which may not have been recognized and almost none of which has been studied extensively in relation to driving. This large group of occasional (and usually minor) violators is not hard to control. The mere possibility of an enforcement pressure being present is enough to make them conform. For such drivers *supervision* is a better activity than *control* for they respond to suggestion about as well as to compulsion.

SUPERVISION AND DRIVER BEHAVIOR

The mere presence of an officer often affects drivers in such a way that those who might willfully violate do not. The distance an officer's presence is effective is known in police circles as "the halo of observance." Traffic patrolmen say that *on duty* they often detect no more than four or five violations in a day that warrant enforcement. On their days off, however, in the same area in their own cars, they see ten times as many violations in a shorter period of time!

While further study of this aspect of driving behavior is needed, preliminary studies have disclosed certain "halo effects." With respect to speed, for example, it has been found that nearly all cars within the halo going faster than the posted speed are in-

fluenced, and many going a little less than the speed limit also slow down! The sphere of influence of the halo depends much upon the conspicuousness of the patroling vehicle. The immediate effect of a patrol car on speed seems to be limited to about a mile in open country and is probably less in cities.

In moderately heavy traffic, a patrol unit moving at the posted speed or a few miles an hour below it usually finds that a procession of cars will collect behind it. This is due to the reluctance of most drivers to exceed the speed limit in order to overtake the patrol car. If the patrol unit travels at ten miles an hour faster than the posted speed, a smaller and more extended group will also trail it, probably in the belief that with the police ahead, chance of arrest is past and time can be made over the speed limit with impunity. Thus a patrol unit travelling at a high speed may actually encourage or stimulate speed violations. In certain rare occasions this trailing behavior may be used as a tactic by police units working in pairs. The leader sets an illegal pace for any who wish to trail him while the second patrolman paces them unexpectedly from some distance behind.

Behavior in the Absence of Patrol Units

Drivers in general are reasoning beings—or *calculating*. They continually reckon the risk of accident and act accordingly. Each driver, in this way, sets his own factor of safety. Unfortunately, the factor of safety reckoned is usually too *small*. With a new car and a smooth road, both designed to increase safety, most drivers at once increase speeds and thus whittle down the additional margin of safety provided by mechanical improvements. Improvements in vehicles and roads, therefore, usually result in little or no reduction in accidents. Fortunately, however, there is a net balance in favor of safety, particularly where the design of the road gives better visibility, and where the safest path at an intersection is made the *only one*—or at least the easiest one, for a driver to follow.

Enforcement makes the possibility of delay, arrest, and punishment something to be reckoned with by those who set the margin

of safety too low, or who, with regard to the regulations concerning congestion, do not consider the inconvenience to others when they do what is handiest for themselves. How much enforcement affects behavior when an officer is not near depends on how much the enforcement is to be reckoned with. In calculating this risk, the driver takes a number of elements into consideration: What is the chance of being discovered in the violation? What will be the penalty if caught? What will others think about the arrest? How much time and trouble will it involve? These and many other elements are considered.

The total effect of enforcement when no enforcement officers are present cannot be measured because there is no way to find out what behavior would have been had there never been any control.

The Effectiveness of Enforced Supervision

The effect of enforcement, by virtue of the presence of a police officer, is about the same on the intentional violator in any community. But the effect of enforcement on the violator when no officer is immediately present varies enormously from place to place. In other words, enforcement is vastly more to be reckoned with in some communities than in others. There are places where drivers have never heard of an arrest being made for many kinds of violations and, for the small number of violations on which the police do work, the chance of arrest is small and that of substantial punishment still smaller. In other communities drivers almost constantly have a feeling of *supervision,* a conviction that all violations other than minor ones can result in inconvenience, arrest, and expense. Much of this seems a matter of how frequently patrol units are seen. This in turn depends upon how many men are available.

A number of elements increase the effectiveness of traffic patrol. For example:

1. Advertising the frequency of arrests and severity of penalties makes drivers think the chances of being caught and punished is greater than they otherwise would. A dog driving sheep barks constantly. Publicity loses its

power, however, when shrewd drivers begin to suspect that the enforcement program is mostly bark.

2. The deterrent effect of possible arrest is greater if drivers believe that a violation may be detected any time, anywhere, than if they know that arrests are likely only at certain times and places, or for certain violations. If only the main streets are consistently patrolled, drivers will learn to violate with impunity on the minor ones. If patrols are out only at certain hours, violators take advantage of the other hours. A patrol assignment policy which keeps drivers guessing thereby multiplies the effectiveness of the patrol force. Concealed enforcement in which officers are not visible to potential violators keeps the public guessing and, if generally practiced, undoubtedly would increase the effectiveness of a traffic force considerably. It is likely that concealed enforcement would be the rule rather than the exception were it not for the cry of "unfair" raised principally by those caught in this manner.

3. Certain mechanical devices can increase the effectiveness of police in controlling traffic. Traffic signals are the best known. To have officers on duty to accomplish what signals accomplish in the way of directing traffic would be financially out of the question. Parking meters are appearing in increasing numbers to help police control use of curb space. Chemical tests for intoxication help to take the guesswork out of establishing the fact of drunkenness. These tests are gaining in recognition and acceptance.

4. One of the most effective methods of making violators "think twice" is to give special attention to "repeaters." This is quite acceptable to the majority who are not and who do not expect to become "repeaters." It may be done locally by increasing fines sharply for second, third and subsequent offenses either in a violations bureau or in a court. Many cities now do this. It may be done also through state driver-license machinery which can consider accidents and warnings as well as convictions, and which can accumulate the driver's experience from all parts of the state, or, for that matter, from all parts of the continent.

A number of things *diminish* the effectiveness of a given patrol force in any area:

1. The productivity of patrol activity is diluted or cut down by demands that diminish the number of supervisory contacts the average officer can make in a day. Escort duty, excessive or inconvenient court appearances, lack of proper equipment, frequent assignment to non-traffic duty, unwarranted assignment to school crossings, burdensome reports, and tedious roll calls all reduce the chances of violators being apprehended.

2. Ticket-fixing creates a group of violators who believe they are not subject to ordinary control.

3. Laxity in the routine follow-up of arrest with penalty is almost as bad as ticket-fixing, from which it often cannot be distinguished.

4. The failure of some officers, particularly non-traffic officers, to take notice when violations are committed in their presence.

5. Regulations that do not approximate the considered behavior of com-

petent and conscientious drivers make potential violators of such people, tend to undermine confidence in all traffic control, and usually turn out to be unenforceable. Freak rules create confusion and cause resentment.

Attitude toward Control

On foot, one is near enough to others to sense how they feel toward his conduct and whether or not they approve. Disapproval may be seen in one's facial expression, inflection of the voice, or gesture; but it effectively deters discourtesy, selfishness, and other objectionable conduct, at least for all but a few people. In an automobile one is largely insulated from such communication. Perhaps that is why many drivers behave less graciously on the highway than they do when face to face with other people. This circumstance leaves most of the molding of traffic behavior, so far as it concerns violators, to *official supervision.*

A recent survey [68] shows that one person in three believes that more traffic regulations are needed, whereas only one in twenty believes that there are already too many. The remainder are noncommital or are satisfied with what there are. Seventy-one per cent think existing traffic regulations should be more strictly enforced; only 1 per cent less strictly; the remainder are satisfied or noncommittal. In fact, this survey suggests that stricter enforcement would be the best way to prevent traffic accidents.

It also pointed out that those who had been given a ticket voted about the same as did the total population for stricter enforcement, 68 per cent of these people stating that traffic regulations should be more strictly enforced.

If enforcement has this public support, why is it not substantially intensified? There are several reasons: Enforcement costs money. The fact that much of this expense may be recovered in fines generally goes overlooked or is not mentioned for fear the enforcement program will be stigmatized as a "racket." Another reason is that many police departments simply do not know how to make arrests for many more minor infractions without arousing resentment; hence they limit themselves to gross violations and complaints. Finally, and perhaps most important, public

officials pay more attention to insistent squawks of a minority who complain of "abuse" and to persuasive urging of those who want tickets fixed than to surveys.

Annoyances Compared to Hazards

When people think of more regulation and stricter enforcement as the answer to the traffic safety problem, most of them have in mind some *specific* thing which to them is a greater annoyance than it is a hazard. Headlight glare, for example, probably accounts for less than one per cent of all accidents [59] and yet, out of a list of regulations suggested for universal adoption, 66 per cent favored "dimming lights for other drivers," more than they favored any other rule proposed. [68] When speed regulations are discussed, someone is certain to advocate regulation of the slow or "Sunday" driver. Even chiefs of police have urged this. Some persons approve a regulation requiring drivers to signal an intention to turn. Yet resentment is aroused when this regulation is enforced and voluntary compliance with it is extremely low.

Fortunately, many more nuisance rules are proposed than are accepted. They are aimed at all sorts of things—trucks, parking, use of warning horns, left turns, pedestrians. They are urged by persons bothered by inconveniences or delays but who would be inconvenienced little or not at all by regulations they advocate. Undoubtedly, if these regulations were to become law, they would have little effect on driving, and would receive little attention from enforcement officers. Both enforcement officers and drivers consider some regulations important and some a nuisance; some to be observed exactly and others only in a general way.

ENFORCEMENT OF DRIVER-CONTROL MEASURES

When an officer stops a driver, particularly for minor violations, he is at once confronted with an often difficult decision as to whether the violation was due to ignorance or was wilful. Theoretically, it makes no difference, but in practice the manner in

which this contact is handled will often determine its effect on the driver, particularly its effect on his attitude with respect to traffic regulation in general. Will instruction be sufficient, or should the officer set punitive machinery in motion?

The officer knows that punishment for ignorance nearly always creates resentment and usually accomplishes no more than polite instruction. He knows also that many wilful violators plead ignorance. This situation leads to one or both of two things. First, officers can simply overlook minor violations on the assumption that they are all unintentional and concentrate on those which are so serious that the chances of their being due to ignorance are remote. Second, warnings may be used as the general rule.

These are accepted as instruction by the ignorant and as reprimands by the wilful violators. Such warnings may be followed by special individual treatment. If the follow-up is systematic, warnings will have almost the same effect as arrests. This is one of the principles underlying a policy adopted in a number of Michigan cities.

Courts are faced with the same problem, plus one of determining what punishment is appropriate and effective. A ten-dollar fine for speeding ten miles an hour over the limit may be quite a jolt for a laborer trying to raise a family on less than that amount a day. But the businessman with ten times as much income may consider it a reasonable price to pay for the time he saved by traveling faster than legally allowed. What court has time to inquire into the economic status of the many violators who stream by? How can the court decide what size of fine is the dosage to cure each case? What judge wants to risk the inevitable accusation of being unfair by assessing widely varying fines for identical offenses?

Even among persons to whom ten dollars might have the same financial significance, the annoyance and stigma of appearing in court may have varying effects. To "dead-end kids," raised in the credo that "scoldin' don't hurt none," a police or court warning may merely thicken the callous of an already resistant attitude. The same comments, however, directed to the conscientious and sensitive gentlewoman from the polite side of the tracks may be

a blush-provoking rebuke resulting in a determination to avoid any occasion for its repetition. It might safely be assumed that the effect of these differences would average out were it not for the fact that in most places there is a right and a wrong side of the tracks, and areas in which the whole population may differ in resistance to enforcement pressure. Can methods be devised to test the "hardness" of an individual or of a community so that enforcement *quantity* can be measured out in standard units to secure a desired reaction?

Advantages of Follow-up of Repeaters

At the present time, the best solution seems this: treat all offenders with comparable violations alike on the *first* offense and step up the penalties sharply for subsequent offenses. Theoretically, each offender would eventually reach a point where pressure of the penalty would deter him from misbehaving. In practice, however, courts often yield to outside pressures of some kind before the violator yields to the pressure of the penalties, and so treatment is discontinued before reaching the point where it might effect a cure.

Immense differences exist between individuals, and our enforcement machinery will have to be further refined if it is to deal with extreme cases appropriately. However, if regulation has an aggregate effect on a large group of drivers, it must be having an effect on most of the drivers who make up that group.

The Enforcement Index

No extensive attempts have been made to measure the direct effect of enforcement on behavior. The only generally used device is the enforcement index, a crude comparison of these two factors. In calculating the enforcement index, the behavior of the driving public is measured only by the number of fatal and personal injury accidents, and enforcement is measured only by the number of convictions. Obviously, the number of accidents is not a good measure of the *quality* of behavior because of the

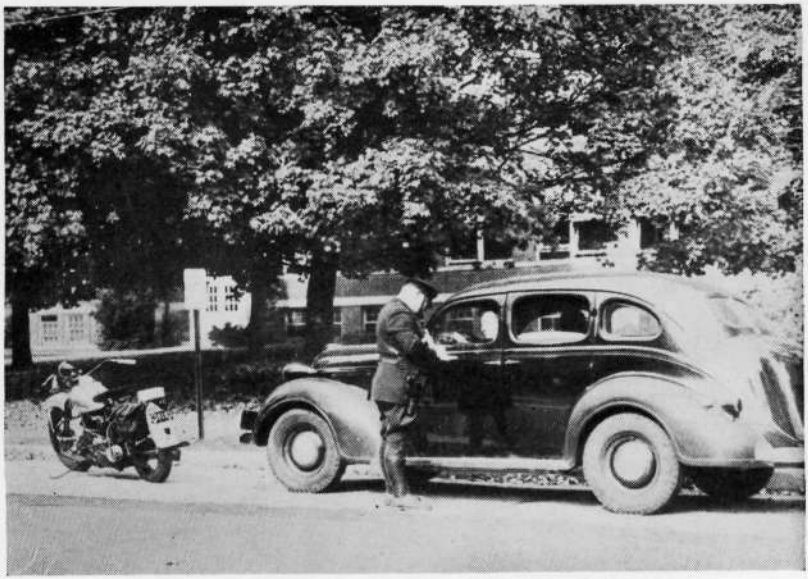


FIGURE 5. Enforcement Improves Driving Practices

Courtesy of the Accident Prevention Department,
Association of Casualty and Surety Companies

FIGURE 7. Three-level Highway Structures Facilitate Movement of Traffic and Increase Safety

influence of the volume of traffic, completeness of reporting, and a multitude of engineering factors such as street lighting, signal systems, channelization and grade separations.

Number of convictions is the crudest kind of measure for enforcement. It includes no evaluation of the severity of penalties or the effect of warnings. In spite of these defects, however, the enforcement index gives a useful idea of whether or not enforcement is *approximately* adequate. If the fear of accident itself does not keep drivers behaving so as to have fewer accidents, an equal number of convictions will add nothing appreciable to be reckoned with in day-to-day driving because the average consequences of a conviction are so much less painful and costly than those of an accident.

Thus an index of one, in a community where convictions are no more numerous than the personal injury accidents (and probably less than half as numerous as all traffic accidents) means that the enforcement is insufficient for adequate effect on accidents, or on the behavior that may be causing them. Some cities maintain an index of 20 or more. There is no information as to exactly how high the index may be forced advantageously, but one can assume that some point of diminishing returns is ultimately reached.

In the country as a whole, the enforcement index in the past decade has already been somewhere between one-half and three. A factor contributing to this figure is that many rural territories and many small cities have practically no enforcement. In these places, the effect on behavior is that which seeps in by hearsay or is carried over by drivers who travel in areas where enforcement is appreciable.

Most cities have enforcement "drives" at one time or another, directed for the most part at speed. Ordinarily these are announced with considerable "drum-beating" and result in immediate reduction in accidents. Such sporadic attempts to increase the chances of being arrested for traffic violations do not last long, however. Police officers to whom extra work had been assigned return to their usual duties; and the public, which had driven more conservatively and had become more alert for pa-

trolmen when the campaign began, soon appraises the real force and adjusts behavior accordingly.

IMPROVED DRIVING THROUGH TRAFFIC SUPERVISION

Where fundamental reorganization of traffic supervision has taken place, accident records have been substantially improved. Cities with reorganized police work have introduced specialized traffic supervision, training the necessary personnel to make it work. With few and explainable exceptions, those cities have maintained reductions in accidents ranging from 30 to 70 per cent. Thus, Cincinnati's traffic deaths were brought down in three years from 129 to 73. In Memphis, fatalities dropped from 48 to 31 the first year; in Cleveland, from 463 in 1936 and 1937, to 245 in 1938 and 1939. Detroit had 2,971 traffic deaths for a nine-year period ending January 1, 1937 but during the following nine years, after the major phase of the work of the Traffic Division of the International Association of Chiefs of Police was completed, the city's deaths from automobiles numbered 2,011. The accident rate on the basis of car registration decreased even more because of the increase in the number of vehicles using the streets.

Knoxville had a traffic death rate of 7.7 persons per 10,000 registered vehicles in 1937. Traffic supervision improvements were introduced in the following year, and in the nine years beginning with January 1, 1938, the death rate averaged 4.6. Oakland, California, had 531 traffic deaths in the six years prior to the completion of the I.A.C.P. work in December, 1939; the total for the six following years was 446 in spite of Oakland's wartime increase of traffic. Los Angeles had 1,969 traffic deaths in the four years before the changeover in December, 1941; deaths in the following four years were 1,527.

Other Factors In Improved Accident Experience

Not all of these improvements can be claimed for enforcement alone. The same civic awakening to traffic dangers that resulted

in improved enforcement methods usually stimulated engineering and educational activities in the same cities. These educational and engineering activities, however, often came earlier or later or progressed more slowly. The fact that the major drop in accidents followed the increase in regulatory effort would seem to indicate that improvement in traffic supervision was at least the principal factor.

Many cities in which no work was done by the field representatives of the International Association of Chiefs of Police also enjoyed general declines in accidents over the same decade, but, with few exceptions, these were considerably less marked. Further, many of them were probably paced by improved enforcement, because the techniques introduced by the I.A.C.P. were widely publicized and men were continually being trained from all over the United States at the Northwestern University Traffic Institute.

SUMMARY

The full possibilities of improving driver-behavior through traffic supervision or traffic control have been realized in few if any places. In both large and small cities and in rural areas, the amount or quality of enforcement at present is not sufficient to produce appreciable effect.

The public favors and will support stricter enforcement but has a tendency to ask for *additions* to existing regulations directed toward abating annoyances. Such additions often are hindrances rather than helps in traffic control for the benefit of the greatest number of road users.

Improved and *comprehensive* programs of traffic control and traffic enforcement provide a practical and logical means through which many accidents may be prevented while driver-behavior and driver-performance may be upgraded.

CHAPTER VI

HIGHWAY DESIGN, TRAFFIC CONTROL, AND DRIVING

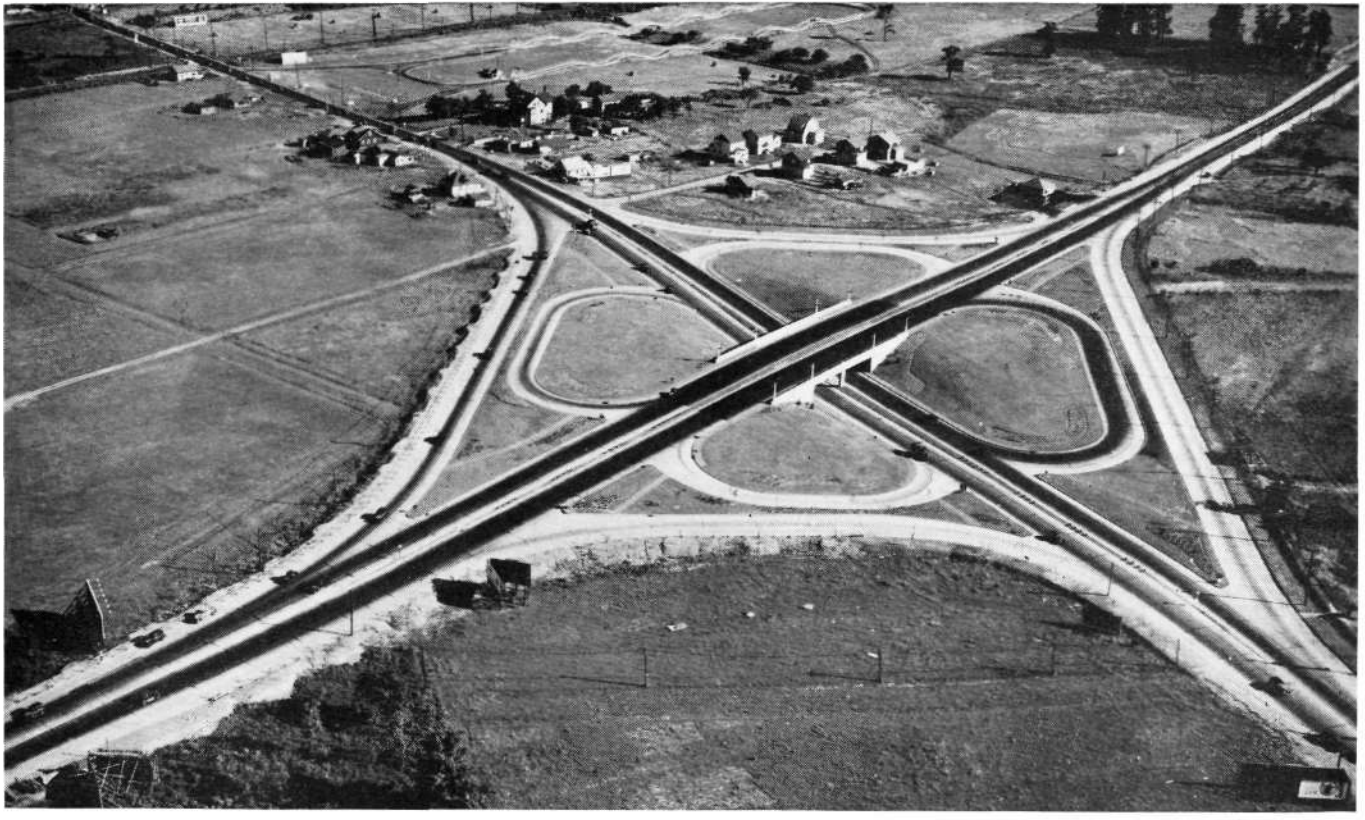
Drivers' abilities, aptitudes, and attitudes cannot be improved extensively by engineering. The engineer must accept the driver as he is and depend upon safety education and enforcement to improve driving. Engineers are more concerned with the normal driver than with the small group of abnormal ones. It would be uneconomical to design roads for the non-conforming few.

Roads affect drivers chiefly through conveniences, free movement, comfort, speed and safety. Not much is known, quantitatively, about convenience, free movement and comfort but obviously they are closely related to speed and safety. Comparative measurements of speed and safety are subject to many variables, but data presented here indicate accurately, we believe, the improvements in traffic operations that may be expected from modern geometric design and the application of traffic controls.

HIGHWAY DESIGN

State reports on fatal accidents during 1946 show that 9 per cent were caused by roadway defects—"These reported defects are usually specific flaws in the road itself." [59] Evidently, those who collect accident data, and in fact, drivers themselves, are prone to accept the roadway as the governing factor and hold motorists responsible for its use.

Theoretically, roadway design could be held responsible for nearly all accidents. Through the control of vehicle paths, the road could, possibly, separate all vehicles and keep them within an individual line of travel free from head-on, side and crossing conflicts. The extent to which physical controls in design may be utilized, however, depends upon the amount of control that drivers will tolerate. Much of the popularity of the motor vehicle



Courtesy of the Accident Prevention Department,
Association of Casualty and Surety Companies

FIGURE 6. Good Engineering Decreases Opportunities for Unsafe Driving Practices

stems from the fact that the passenger car and truck are a means of freewheeling transportation not subject to rails or timetables.

Experience has shown that a high percentage of accidents result from the human element. These accidents are a by-product of flexibility in traffic operations and road use. If the desirable degree of flexibility is to be retained, it is not possible to design accident-free roadways.

The object of highway-design is to reduce accidents to a minimum, at the same time providing a facility capable of free-moving, swift, convenient and comfortable travel. To this end, improvement in traffic operations through highway design is obtained by the following:

1. Physical elimination of unnecessary conflicts
2. Better design of curves
3. Reduction in the effect of grades
4. Provision of adequate stopping sight distances
5. Provision of frequent opportunities for safe overtaking and passing
6. Provision of adequate lane widths
7. Elimination of hazards alongside of the road.

Speeds adopted by drivers are greatly affected by road aspect. Where hazards lurk along the road, normal drivers reduce speed.

Roadways with numerous public and private intersections, with roadside parking and pedestrian crossings, give the driver a sense of uneasiness and alarm. These potential, and all too-often actual, conflicts cause accidents and congestion.

On limited-access roadways, roadside developments are barred, and pedestrians are legally denied use of the road. Interchange of traffic with other roads is allowed only at specific points where special intersection design greatly reduces the interference caused by traffic entering or leaving the facility.

The Pennsylvania Turnpike, Arroyo Seco Parkway in California and Merritt-Wilbur Cross Parkway in Connecticut are limited access roads. These highways are four or six lane divided construction with grade separations at each intersection.

The effectiveness of limited access, along with other features of modern design, is indicated in Table III. Few studies have been made of accidents by type of road and number of lanes but

the data available show that the fatal accident rate for older conventional highways is considerably higher than for limited access roads. It is interesting to note that the fatality rate for U. S. 1 is five times greater than that of the Merritt Parkway although the average speed on the Parkway is about 40 mph compared with 24 mph on U. S. 1. [18]

Table III*

FATAL ACCIDENTS PER MILLION VEHICLE MILES ON LIMITED ACCESS ROADS COMPARED WITH OTHER ROADWAYS WITH AVERAGE VOLUMES OVER 9,000 VEHICLES PER DAY

Highway	*Type*	*Fatal Accidents per Million Vehicle Miles*
Merritt Parkway	Limited Access	.025
Arroyo Seco	Limited Access	.024
Penna. Turnpike	Limited Access	.083
California Highways	4 lane—divided	.104
Rte. U. S. 1 in Conn.	4 lane—undivided	.125

* This table is based upon data included in reports from the highway departments of Connecticut and California and from a National Safety Council report dealing with accident experience on the Pennsylvania Turnpike.

Eliminating Conflicts by Dividing Highways

About one-half of the fatal accidents that result when two vehicles collide between intersections involve vehicles approaching from opposite directions. Virtually all of these accidents could be prevented on divided highways. At least four traffic lanes, of course, are needed to accommodate passing. They afford a much less hazardous passing, however, because approaching traffic, confined to its own half of the roadway, cannot interfere.

Head-on accidents are more severe than other types of two vehicle accidents. The impact of collision when two vehicles meet head-on is a function of the sum of the squares of the speeds of both vehicles.

The speed of vehicles approaching head-on is difficult for drivers to judge. Speed is judged by the change in apparent size of the moving vehicles and the rate at which it passes fixed objects along the road. At a head-on angle, the speed of the approaching

vehicle must be estimated almost entirely on the rate of visual increase in size. This factor alone will not make one's judgment accurate. Assuming it will, probably accounts for many accidents on passing maneuvers.

Table IV shows the percentage of accidents involving collisions of vehicles traveling in opposite directions on several divided and undivided roadways.

Each lane of a four-lane-divided roadway operates more efficiently than the lanes of two-and-three-lane roads because passing may be more readily accomplished. Generally, average speeds are higher and highway capacity is greater than for a four-lane-undivided roadway.

Table IV*

COMPARISON OF PERCENTAGE OF APPROACHING TYPE ACCIDENTS ON 4-LANE HIGHWAYS

Road	*Type*	*Per Cent of Total Accidents Consisting of Collisions Between Vehicles Traveling in Opposite Directions*
Merritt Parkway	4 lane—divided	2.3
Pennsylvania Turnpike	4 lane—divided	3.2
California Highways	4 lane—divided	7.6
California Highways	4 lane—undivided	13.8
U. S. 1 in Conn.	4 lane—undivided	15.4
Rural Highways	All Types	20.9
Urban Streets	All Types	4.1

* This table is based upon data included in reports from the highway departments of Connecticut and California, from *Accident Facts* and from a National Safety Council report dealing with accident experience on the Pennsylvania Turnpike.

Elimination of Conflicts at Intersections

Where traffic volumes warrant the additional cost, grade separations are the modern answer to the intersection problem. Grade separations carry through-traffic over or under other traffic streams on bridges without conflict and delay. On specially designed ramps, right and left turns are free to proceed without hindrance. Provision in design for the acceleration and deceleration of traffic leaving and entering the ramps minimizes interference with the through-traffic streams.

At the conventional intersection, through-traffic on each road must share the intersectional area, and only one traffic stream may move at one time. Therefore, with equal traffic on each cross road, capacities of the roads are cut in half at their intersection.

Grade separation intersections do not become congested, because traffic streams cross over instead of through each other and flow freely at all times.

Intersection accidents during 1946, excluding those involving pedestrians, constituted about 43% of the total urban street accidents and about 19% of the total rural highway accidents. [59] On the Merritt Parkway and the Pennsylvania Turnpike, less than 4 per cent of total accidents have occurred at grade separations. [64, 18]

Better Design of Curves

When a vehicle rounds a curve at high speed, the tendency to slide off the outside of the curve is counterbalanced by force to the inside caused by the road-bank and the gripping action of the tires. Road-banking is limited to a slope that will not cause truck loads to shift or vehicles to slide to the inside of the curve when the pavement is icy. In view of this limitation, a considerable portion of the outward side force on curves must be balanced by the gripping action of the tires.

The outward force balanced by the tires is felt by the driver and occupants of the vehicle as side-thrust. Furthermore, side-thrust causes a certain amount of *side-slip* that gradually becomes greater with increased speed. While the driver does not recognize side-slip as *skidding* until it becomes excessive, he does have a distinct feeling of instability as side-slip approaches side-*skid* proportions.

Skilled drivers know how to skid around a curve safely by careful steering. The average driver does not have this skill and may lose control when slide-skid becomes excessive. The author's detailed analysis of accidents on curves at high speed indicates that virtually as many drivers lose control and leave the road on the inside of curves as on the outside when skidding is involved.

The safe speed on curves decreases as the degree of curve increase. Table V shows that accident-experience increases as degree of curve increases up to a 50 or 60 curve whereupon the accident-experience begins to decrease. The probable explanation for this is that roads with sharp curves are generally inadequate in other respects with prevailing low speeds, and, also, drivers are more careful at locations which are obviously hazardous.

Table V

ACCIDENT RATES ON CURVES ON TWO LANE ROADS
BY DEGREE OF CURVATURE [10]

	Accident Rate per Million Vehicle Miles	
Degree of Curve	*Volume under 5,000 Vehicles per Day*	*5,000 to 10,000 Vehicles per Day*
Less than 2°	2.4	1.9
2° to 2.9°	3.3	2.5
3° to 3.9°	3.5	3.5
4° to 4.9°	3.7	3.7
5° to 5.9°	4.3	3.3
6° to 6.9°	3.9	2.8
7° to 9.9°	3.1	2.5

Thus, it can be seen that the driver's judgment of safe speeds on curves, his comfort and his driving skill are important factors in curve design. For safety and uniformity in speed, curves should be designed for the comfort of the faster group of normal drivers who will use the highway. Then, even the faster drivers are able to negotiate all curves along a route without being called upon for judgment on speed or for unusual driving skill.

Reduction of Grade Effect

The principal effect of grade on highway operations is to reduce speed on excessive up-grades. While passenger vehicles themselves are not affected by normal grades, slow speeds of trucks on two-or-three-lane roads restrict the speeds of all vehicles. Passenger vehicle drivers on narrow roads frequently find themselves trapped behind a slow-moving truck on the steeper grades with no oppor-

tunity for passing because of opposing traffic or insufficient sight-distance over the hillcrest.

Obviously, through hilly-to-mountainous terrain, where flat grades or tunnels may be considered too costly, improvement in grade operations can be obtained only by increasing the power-load ratio of trucks or by providing additional road width for passing.

The distance required to stop is affected by grade. The gravity force acting on a vehicle ascending or descending a grade is equal to about 20 pounds of force per ton-weight of vehicle for each per cent of grade. Drivers are accustomed to stopping on level, or nearly level, roadways. The additional distance required to slow down or stop on a down grade is sometimes misjudged with disastrous results.

Adequate Sight Distances

The ability of a driver to avoid an accident depends upon the distance he can see ahead. This distance must be long enough for the driver to perceive the hazard, react and stop his vehicle. While the perception-and-reaction time occurs, the vehicle proceeds at its initial rate of speed. The remainder of the distance must be enough to allow the driver to stop before striking an obstruction, or an oncoming car.

Factors in perception-reaction time are attention, type and magnitude of stimulus, mental process, or judgment, and muscular response. Under testing conditions, the braking reaction-time of a majority of drivers is 1 second or less. [53] In actual driving, however, the driver attention factor is of almost equal importance. Studies of drivers who were not aware they were being tested indicate that the average driver perceives the unexpected hazard about half as far away as he sees the expected one. [75]

Interpretation of these data in terms of road-design indicate the majority of drivers will be accommodated if a two-second perception-reaction time is allowed when high speeds are involved. This is arbitrarily increased to three seconds for low speed conditions because slow speed drivers are apt to pay less attention to driving.

Opportunities for Overtaking and Passing

On roadways where drivers have no opportunity to overtake and pass, all traffic is slowed to the speed of the vehicle ahead. Since there is usually a wide range in speeds on any roadway, all traffic is slowed to the speed of the slowest vehicle. A road becomes intolerably congested from this cause long before its maximum traffic capacity is reached.

Opportunities for passing are affected by (1) volume of traffic, (2) number of traffic lanes and (3) frequency of safe-passing sight-distances. On a two-or-three-lane road, the freedom of a driver to overtake and pass depends on whether the left lane is free of oncoming traffic or on how far he can see a clear road ahead. Four-lane divided-highways present no opposing traffic and, therefore, do not require passing sight distances.

Safe-passing sight-distances are the sum of the distances covered during the perception-reaction period, the distance the passing driver will encroach on the left lane, and the distance an oncoming vehicle will travel during the passing maneuver. Safe passing sight distances are three to five times longer than safe-stopping sight-distances.

The act of following a car at the same speed causes nervous tension. Predominance of short sight-distances tends to impair judgment and cause drivers to take foolish chances.

The potential hazard on three-lane roads where sight distances are inadequate is greater than on two-lane roads. The chances against two simultaneous passing maneuvers in the opposite direction at the same place appear to drivers to be remote enough, particularly with light traffic, to tempt them into the middle lane in spite of limited view of the road ahead. Table VI shows a comparison of fatal accidents on two, three or four-lane divided roadways in New Jersey for the years 1936 to 1942 inclusive. The rate for two-lane and four-lane-divided roadways is about the same with approximately four times more traffic on the divided roads. The fatality rate for three-lane highways is greater than both although the amount of traffic is about two-thirds of that on the four-lane roads.

Table VI

FATALITY RATE PER 1,000,000 VEHICLE MILES ON HIGHWAYS OF VARIOUS TYPES (NEW JERSEY) [65]

Type	*(Approx.) Road Mileage*	*(Approx.) Average Daily Traffic Vehicles*	*Years* 1936	1937	1938	1939	1940	1941	1942
2 lane	1,000	3,000	.11	.12	.11	.10	.09	.10	.07
3 lane	110	8,000	.18	.23	.12	.13	.11	.12	.09
4 lane (divided)	180	12,000	.12	.09	.09	.08	.08	.10	.07

Adequate Lane Widths

Numerous studies of the placement of vehicles on roadways of various lane widths have been made to determine the effect of narrow pavement on drivers. Most of these studies have been conducted on rural two-lane highways. The surprising fact shown by these studies is that drivers do not reduce speed appreciably on the roads with narrow lane widths even when meeting oncoming traffic. They tend to center the vehicle in the lane and seem to defy the approaching driver to cross the center-line. [86] However, studies show that, on two-lane pavements, eighteen feet wide, 16 per cent of the vehicles fail to keep within the proper lane even when meeting other vehicles. This decreases to 1 per cent on twenty-four-foot pavements. [42]

Table VII compares the accident rate on pavement lanes of different widths for two-lane rural highways. It can be seen that the "law of diminishing returns" applies and the decrease in accidents is small for lanes over 11.5 feet wide.

Table VII

RELATION OF LANE WIDTHS AND ACCIDENTS ON 2-LANE RURAL HIGHWAYS [10]

Lane Widths (ft.)	*Accidents per Million Vehicles (miles)*
Less than 9	5.2
9 to 9.9	3.8
10 to 11.5	3.5
Over 11.5	3.4

Traffic abhors all restrictions in roadway cross sections. Bottlenecks in road width, obstructions in and alongside the road cause driver irritations, congestion and accidents. A hazard close to the side of the road creates a zone of influence on the driver causing him, in some cases, to veer out of his lane to provide comfortable clearance. The amount of clearance depends somewhat upon the degree and frequency of hazards. Inert objects, such as a wall or high curb have less effect than a parked vehicle or pedestrian.

Curbs over which the driver cannot easily travel have been an accident causation factor on some rural highways. Drivers prefer to stop on the pavement rather than on the shoulder because of possible tire damage and discomfort when the curb is struck. When this occurs, traffic movement is obstructed and rear end collisions result.

Shoulders of adequate width and bearing strength are necessary on roads that do not provide parking lanes. Shoulders should have sufficient width to permit disabled vehicles to be parked far enough from the edge of the pavement not to affect moving cars or trucks.

Flat cut and filled slopes outside of the shoulder area decrease the number and severity of accidents which occur when vehicles run off the road. In these zones the driver can recover from a minor mishap before it becomes a major disaster. The zone should be free of all obstructions such as ditches, boulders, bridge abutments and trees. According to the 1947 edition of *Accident Facts,* in 10.5% of accidents on all rural highways, vehicles struck fixed objects alongside the roadway.

Shrubbery on the slopes outside of the road shoulder not only produces a pleasing aesthetic effect but also provides a cushioning effect against impact forces. Well-planned landscaping and beautification can do much toward reduction of the monotony experienced by drivers on limited access high speed roadways. Those familiar with accident experiences on these facilities believe that sheer boredom of comparatively hazard-free driving

over roadways with monotonous sameness of view results in drowsiness, inattention and inability to react promptly in case of an emergency.

TRAFFIC CONTROL

So far in this chapter, improvement in highway conditions by design of the highway has been discussed. Traffic conditions may also be improved *on existing roads* through the control of traffic *operation.*

Major relief of the current traffic problem must be accomplished by improvement in the operation of existing roads while new roads, where warranted, are being financed and constructed.

All traffic controls are restrictive in character. Their use requires the driver to stop, start, travel at specific speeds, and follow designated routes or paths. Controls resulting from motor vehicle laws are called traffic regulations and are subject to enforcement. Other controls may be used only in an advisory capacity to inform, guide and warn drivers. Traffic control devices are the signs, signals, and pavement markings placed on the roadway to show the driver where, when, how and what traffic regulations and advisory controls have been applied.

Traffic operations on existing roads may be greatly improved when traffic controls are properly used to accomplish one, or more, of the following purposes:

1. To increase the efficiency of street systems by prescribing routes and paths of travel
2. To improve traffic conditions for a majority of drivers by controlling a few
3. To control speeds
4. To warn the driver that an unusual hazard is ahead
5. To reduce the complexity of important driver decisions
6. To guide the driver for his personal convenience and comfort
7. To alter traffic demands to fit existing facilities.

Examples of the effect of these controls on the driver will be discussed in the remainder of this chapter.

Control of Vehicle Routes and Paths

Drivers always seek the most convenient route of travel. Convenience may be measured in time, distance, or other factors such

as comfort, aesthetic qualities. Most drivers prefer to travel a longer distance to save time and avoid the irritation of delays. Drivers familiar with an area soon seek the most convenient route to serve their purposes. Drivers not familiar with the road system have no opportunity to compare the merits of alternate routes and, therefore, follow road markings erected by authorities and shown on road maps. Often this marking unnecessarily leads inter-city traffic through the center of a city on heavily congested routes. A saving in time may be realized by those passing through the city if they are routed *around* congested areas. Thus, congestion on streets used by local traffic could be relieved at the convenience of all concerned.

The creation of one-way streets is also a form of rerouting. Traffic stems from the activities of people and people are gregarious. They eat, sleep, play and work at the same time and the same places. This similarity in living habits causes directional peak flows of traffic on certain arteries. Traffic on most city streets leading into the business district of a city is predominantly inbound during the morning peak hours and outbound during the afternoon peak hours. It has been demonstrated that traffic can move more expeditiously and safely on a given street if all traffic is moving in the same direction. One-way streets are established by routing all traffic on parallel streets so each alternate street provides travel in one direction only. Studies of one-way street operations show the following major advantages:

1. Accident hazard is decreased
2. Average speeds are increased
3. Traffic capacity of the street is increased.

Paths of vehicles on any highway may be better controlled by lane markings. More efficient use of highway width and safer conditions result when drivers can position themselves in specific channels. Centerline markings on two-way undivided highways are particularly important. Recent studies of the effect of centerline marking on narrow two-lane highways show that 56 per cent of drivers encroach on the left lane where no centerline marking is provided as compared with 12 per cent who crossed a marked centerline. [87]

Improvement Through Control of a Few Drivers

Traffic operations on a highway may be seriously impaired by inefficient use of the street on the part of a minority of drivers. In the interests of increased overall movement of traffic, it is sometimes necessary to restrict or curtail the traffic activities of the minority group. For example, parking at the curb along a street is a convenience for the relatively few drivers who wish to stop. But a recent analysis indicates that in downtown areas a forty-foot street on which parallel parking is permitted has about 55 per cent the capacity it would have if parking were prohibited. [90]

On a sixty-foot artery in Washington, D. C., parking was prohibited on alternate sides during the morning and evening peak-hour congestion. A check after the change had been made indicated a 70 per cent reduction in accidents with a marked increase in average speeds and volumes. [83]

Angle-parking takes up to three times the street width required for parallel parking with a greater reduction in width as many drivers will not use the lane adjacent to vehicles parked on an angle. A survey in one city revealed a 63 per cent reduction in accidents when angle-parking was changed to parallel. [83] Up to two and one-half times as many vehicles may be parked at an angle as compared with parallel parking but the increased parking service is greatly outweighed by the hazard and congestion caused by angle-parking where heavy volumes of moving traffic are involved.

Parking time-limits, prohibited parking at corners for safe sight-distance and elimination of double-parking are also examples of the control of street use on the part of a few drivers in the interests of safety and convenience for a majority of drivers.

Traffic on highways that carry heavy volume should be allowed to flow without interruption caused by entering and cross movements from minor intersecting roads. Where regulations permit, these roads should be designated as through highways or streets. A through-street may be designated as a roadway at which stop signs require every driver to bring his vehicle to a halt before entering or crossing, except where traffic is controlled by officers or signals.

Signals on through-streets should be coordinated to allow heavy traffic to proceed at a predetermined speed without stopping. Properly selected through-streets improve traffic conditions by moving more traffic on fewer streets with less congestion, and by reducing accidents and congestion on neighboring streets. In some cases, however, accident studies "before and after" the through-streets were created have shown an increase in pedestrian accidents.

Greater efficiency in the overall movement of traffic may also be obtained by prohibiting left-turns at intersections. The number of left turns at the average intersection is usually small in proportion to the amount of through-traffic. At a two-street intersection, left-turns must pass through streams of straight through-traffic on each street and, consequently, are responsible for a disproportionate amount of hazard and delay.

Infrequent left-turns cause more accidents than do frequent left-turns. This difference is probably the result of the surprise factor when occasional left-turns are made.

Right-turns do not seriously interfere with the movement of other traffic streams but they may create pedestrian hazards. At intersections controlled by traffic signals, right and left-turns travel over the pedestrian cross-walks when through traffic is stopped, unless a separate signal period is allowed for exclusive pedestrian movements. Where pedestrian volumes are large, the elimination of all turns may be justified in the interests of an overall improvement in traffic conditions.

Control of Speeds

There are two general applications of speed control. One is a speed-limit affecting all roads in a given area or affecting a route throughout its entire length. The other is speed-zoning applied at particular road locations where unusual hazards or deficiencies in road design require reduction in speed.

Speed-zoning at dangerous locations is considered necessary by most authorities. But the usefulness of blanket speed limits for an area or route is a controversial matter. [61] One school of

thought is that the driver is capable of selecting his own speed on sections of roadway where no unusual hazards exist. The other thought is that maximum speeds on all roads are necessary because drivers are not able to think and react fast enough at high speeds when emergencies arise. Obviously, when an unsafe act is committed at high speed, less time is available to avoid an accident, and the accident will be more severe because of the increased force of collision.

Excessive speed was reported as a contributing factor in 20 per cent of the fatal accidents in cities, and in 28 per cent of the fatal accidents in rural areas during 1946. [59] This was the most frequently reported violation. However, since speed as the cause of accidents cannot be readily separated from other causation factors, the relationship between speed and frequency of accidents has never been clearly determined.

As previously mentioned, speed-zoning is the application of a numerical speed regulation at hazardous places where reduced speed is needed. Speed zones may be established at intersections, sharp turns, narrow bridges, and through built-up sections. At each place, the maximum safe speed should be determined by traffic-engineering investigation. Engineering investigation insures that the numerical speed posted will not be unreasonably low with resulting lack of driver observance.

A number of examples have shown that speed-zoning reduces accidents. Speed-zones through a village on Long Island reduced accidents 67 per cent. [63] All curves on a 100-mile segment of highway in Indiana were speed-zoned with resultant decrease of thirty-six accidents on curves in the year following the zoning. Fifty-three persons were injured and seven killed on curves in the year before installation as compared with eighteen injured and none killed on curves during the following year in spite of a 15 per cent increase in traffic. [44]

Some authorities do not approve zoning because the stated speed is too high when roads are covered with ice or snow. This objection does not seem valid as drivers are required in many other ways, such as stopping, steering, to adjust their driving to icy conditions. In some states, speed indications on curves are provided in an advisory capacity only.

Warning of Unusual Hazards

Physical hazards in the roadway result from deficiencies in design, intersections at grade and roadside encroachments. It is generally agreed that the driver is guided in his actions by what he sees in traffic. But hazards hidden around curves and over hillcrests where sight distance is inadequate may not be seen until it is too late to stop. Hazards in full sight may not be recognized because of inattention or distractions. The element of surprise resulting from hidden hazards or the unexpected ones is the principal cause of many accidents.

Drivers may be warned of hazards in advance by the use of one or a combination of the following:

1. Signs
2. Flashing lights
3. Delineators
4. Street or flood lighting
5. Obstruction markings
6. Pavement markings.

Signs should be designed to gain the attention of the driver. Their message should be easily read at a glance and easily understood. All warning signs should be reflectorized or illuminated for night driving.

The distance a warning sign should be placed in advance of a hazard to give the driver necessary warning in terms of time depends upon: speed, legibility of sign, time for minimum glance, perception-reaction time and time required for carrying out necessary compliance. For unity, attention and accuracy of judgment, only one message should be given on each sign and each sign should be separated from others by a reasonable distance.

Signs may be more conspicuous if they are larger than usual, if placed in a demanding position or if contrasting color background, illumination, flashing lights are used. The size of the sign and degree of special treatment for attention indicate the degree of hazard.

Properly designed street and highway lighting systems increase visibility at night. Street lighting is particularly effective in the

reduction of pedestrian accidents in urban areas. Lighting of streets at isolated accident-prone intersections, railroad crossings, serve the dual purpose of providing better visibility and increased warning as the result of the special lighting treatment.

Obstructions in or near the roadway should be floodlighted so the obstacle will stand out in the driver's visual field at night. Yellow flashing lights on obstructions, in addition to floodlighting, may attract attention at a greater distance. Some authorities believe that two flashing lights on an obstruction are better than one because the driver can, after becoming familiar with them, judge his distance from the obstruction by the relative distance between the lights.

Paint stripings of contrasting color on obstructions tend to attract attention during both daylight and darkness. Pavement marking at hazards perform a variety of purposes. They may be used as lines to guide traffic into proper channels around obstructions or through intersections. They are used also to indicate the point or area of observance for stopping, passing, walking and turning and parking. Word markings, or symbols, are painted on the pavement where certain warrants exist to gain the motorists' attention.

It seems desirable to point out here that all traffic control devices should be uniformly designed, applied and operated as specified by the Manual on Uniform Traffic Control Devices. [72] Drivers' attitudes toward these devices are based on their experiences. Improper uses will result in general disrespect and disregard for them. Uniform usage is necessary for quick interpretation and automatic response. In addition, good maintenance of traffic control devices improves observance because strict enforcement is indicated.

Traffic operations at intersections depend upon speed and angle of collision. If the angle of crossing of traffic streams produces head-on collisions, accidents will be much more severe than under conditions where the streams converge and diverge at angles less than thirty degrees. At the same time, large unchannelized intersectional areas foster haphazard turnings and general driver confusion.

Through the proper application of channelizing islands at intersections, the following may be accomplished:

1. Hazardous angles of conflict may be eliminated
2. Conflict points are separated so the driver is required to make only one decision at a time
3. Traffic streams through the intersection are confined to specific channels so each driver may accurately predict what the other intends to do as indicated by his selection of channel
4. Conflict points are defined by the channels. This leaves only the time (and *not* the place) element to the discretion of the driver
5. Islands in the center of the roadways provide an area sheltered from through traffic within which crossing or left turn vehicles can wait until the path ahead is clear
6. Center islands in line with crosswalks provide a haven of safety for pedestrians
7. The speed of traffic entering the intersection from minor roadways may be reduced by bending the vehicle channel. This subjugates traffic on the side road in favor of through traffic on the major roadway.

Driver-judgment of speed and distance is subject to error because of faulty depth perception, and that driver reaction time is lengthened by multiple stimuli and need for discriminatory or interpretive thinking. [38] Traffic controls may simplify or condition the judgment that drivers must exercise in traffic.

At non-controlled intersections, drivers are required to judge the speed and distance of other vehicles on the cross street. Studies of driver behavior at these intersections [37] show that the time interval to the collision point is the main criterion by which drivers on either street decide to take precedence over vehicles on the other street. Inaccurate timing may result in accidents and confusion in the intersection.

A stop regulation for traffic on the minor crossroad gives the major traffic stream the right to proceed through the intersection ahead of cross traffic. Drivers on the minor road are denied the opportunity of quick decision and aggressiveness by the stop regulation. After stopping, driver-judgment is conditioned to the act of entering the intersection without causing interference.

Stop signs do not enjoy a high degree of voluntary obedience. The Stop provision causes delay that is often unnecessary in the

absence of traffic on the major roadway. As a result, many drivers stop only when forced to by through traffic.

Traffic signals, where warranted at important intersections, require less driver judgment than any other intersection control. A high per cent of drivers observe traffic signals. A signal also gives a positive indication of violation and is, therefore, self-enforcing. Both pedestrians and motorists expect strict observance of signals on the part of other motorists. Both have a sense of false security in the protection offered by a traffic signal.

The marking of no-passing zones is another means of controlling driver-judgment. On two and three-lane roads, no passing zones are marked on the pavement, or alongside the roadway, to condition the driver judgments in passing so far as limited sight distances are concerned.

To Guide and Inform the Driver

No one questions the need for good route markings and destination signs. Much can be accomplished toward convenience in driving by directing the driver, well in advance of turns, to his route. Inadequate route-marking causes drivers to make sudden stops and turns at intersections with confusion and possible accidents.

Regulations for the control of traffic during specific times and places must be called to the attention of motorists by traffic control devices. The educational function of enforcement is achieved only when the offender realizes that he is guilty of breaking a reasonable law which was properly called to his attention.

Social and economic activities are arranged by custom. People tend to congregate at the same places at the same time. For example, peak-traffic conditions exist in all cities during the morning and afternoon when people are reporting for work and leaving work at the same time. These traffic peaks overburden traffic facilities, whereas the facilities operate below their capacity at other times during the day.

Staggering the hours of activity for groups tends to level off traffic demands and relieve peak-hour congestion. But changes

in traffic demands by altering the living habits of people are not easy to accomplish. Deep-rooted customs and the inter-relationships of social and economic activities discourage widespread application of the staggered-hour principle.

SUMMARY

Roadway design is a significant factor in accidents, largely because of the effect of highway structures on the driver. An operator is psychologically, if not consciously, sensitive to the road he travels. Highway architects are concerned with these factors so they may be properly evaluated in the construction of new highways and in the rebuilding of existing ones.

It is not economically feasible to increase all traffic arteries to their maximum efficiency because the volume of travel does not justify it. Roads of low standards make up the major part of the nation's highway system. For this reason, traffic controls can often be used to help drivers make decisions. Controls of the type mentioned have proved of value when properly applied.

In the final analysis roads are designed for specific maximum speeds. When these speeds are ignored by a few non-conformists, accidents increase.

CHAPTER VII

ACCIDENT REPEATERS AND CHRONIC VIOLATORS

Some motorists are always having mishaps on the highway. Others may go for twenty years, driving hundreds of thousands of miles, without a reportable accident. Traffic accident-repeaters and chronic violators, frequently the same persons, constitute a real problem for traffic safety and driver improvement. These are matters of record.

A 1938 Federal Government survey in Connecticut [41] showed that 4 per cent of the 30,000 drivers licensed in the state were involved in 36 per cent of the accidents reported during a 6-year period. This means that approximately 1200 Connecticut drivers had an average accident experience *fifteen times worse* than that of all the remaining drivers in the state.

In 1948, a study of drivers in Connecticut and Michigan was made for the Eno Foundation by the Center for Safety Education, New York University.* This investigation involved a group of 193 "repeaters" who in a 10-year period had been involved in 835 accidents, with 1107 violations charged against them, and a group matched with the "repeaters" on the basis of age, sex, annual mileage, type of vehicle and occupation, who had not been involved in any accidents or charged with any violations in the same period of time. The latter had amassed a total of about 40-million accident-free motor vehicle miles.

What accounts for this wide variation in experience, some drivers covering more than 500,000 miles without an accident while others, had they driven the same mileage, on the basis of their accident rates** would have had well over 100. Why this substantial difference?

* Published by the Eno Foundation as *The Personal Characteristics of Traffic Accident Repeaters;* referred to throughout this book as the "Eno study." [27]

** Accident rate $= \frac{\text{Number of Accidents}}{\text{Mileage driven}} \times 100{,}000.$

Evaluating Accident-Repeater Records

Since accident exposure varies widely from driver to driver and from locale to locale, the absolute accident record of a driver—the fact that he has had two or five or several accidents in a given period—is not sufficient evidence for judging the seriousness of the problem. The only accurate basis on which to make this evaluation is the relationship between *accident experience* during a given period of time and *accident exposure* in terms of motor vehicle miles driven during that same period of time.

State statistics referred to in the Eno study [27] showed that the Connecticut "repeater" averaged 3.4 accidents a year, the Michigan "repeater," 5.3. These figures seem to indicate comparable "repeater problems." However, driving exposure in Connecticut differed greatly for the average repeater in Connecticut and the average "repeater" in Michigan. On this basis, the computed accident rate per 100,000 M.V.M. for the Connecticut repeater was 3.5, compared to a rate of 24.8 for the Michigan repeater. These comparative figures disclose the relative seriousness of the involved problems and show that a "repeater" should always be defined, and the problem clarified, in terms of driving exposure.

Repeaters as Violators

A driver's record of violations is usually a good indication of the safety of his driving behavior. The Eno study [27] noted a high correlation between accidents and violations. Statistics compiled by the National Safety Council indicate that in more than 80 per cent of motor vehicle fatalities some unsafe act or violation is involved. Since a record of repeated accidents is usually accompanied by a record of violations, it is highly probable that sooner or later the chronic violator will end up in an accident. Apparently something more than arrest, conviction and fine is needed in order to correct the unsafe practices indulged in by chronic violators of traffic rules and regulations.

PERSONAL CHARACTERISTICS OF REPEATERS

Several studies of "repeaters" have been made in the last two decades. In some of these, discussed in previous chapters, atten-

tion has been drawn to personal factors and characteristics related to driving ability and accident involvement. This chapter is concerned with those factors that contribute to *repeated* accidents and the critical evaluation of the findings of various researchers on the relationship of these several factors to accident experience. This survey should be of interest to those concerned with driver rehabilitation and to driver-licensing authorities, within whose power it is to rule serious repeaters off the road. The problem is to describe and locate those repeaters who might be considered questionable risks and who should therefore receive special attention.

Reaction Time

The conclusions that different researchers have drawn from their findings regarding the significance of reaction time to accidents vary. Wechsler [93] reported that individuals who had the *slowest* reactions also had the *most* accidents. DeSilva and Forbes [23] found that "repeaters" responded more slowly than nonrepeaters in a simple reaction-time test. Fletcher [29, 31] concluded that retarded simple breaking reaction was associated with accident experience. Lauer [50, 49] Wechsler, [93] and DeSilva, Robinson and Forbes [24] all observed, however, that individuals with *fast* reactions, as well as those with *slow* reactions, had many bad accidents. Brakeman and Slocombe [12, 82] Johnson and Evans, [47] and Lauer [49] indicate that accuracy of response is more important than simple speed of response. Viteles [88] found variability in reaction time to be more important than speed, *per se*. Brody [14] found no significant difference between repeaters and "free" in simple reaction time, but found that choice reaction differences (i.e., *accuracy* of response—selecting the proper response from among two or more alternatives) seemed to be important. Slocombe and Bingham [81] demonstrated reaction time and accuracy of response to be affected adversely by physiological fatigue, monotony, prolonged distraction, and alcohol. Lauer and Allgaier [51] found that there seems to be an interdependent relationship between reaction time, emotional state, and intelligence.

There is little evidence that "repeaters" and "free" can be differentiated between on the basis of simple reaction time as such. However, significant differences between the two seem to be evidenced with regard to more complex types of choice reaction—those involving discrimination, particularly under physical, mental, or emotional pressure.

Intelligence

The intelligence of repeaters and nonrepeaters has been studied both in terms of results on conventional tests of intelligence and, in the broader sense, as applied to such situations as learning, the exercise of judgment, and the estimation of speed.

Weiss and Lauer [94] found that, on the whole, the more intelligent person has the better record as a driver, unless the situation is complicated by emotional factors. DeSilva [21] found that persons with at least a high school education are better risks than those without. In the Eno study [27] results of a testing device used to compare the motor coordination and performance of *repeaters* and *free* under a variety of annoying and distracting conditions showed that the *free* group alone exhibited a learning pattern leading to improvement in successive trials. While this latter is not a function of intelligence alone, such variation between the two groups seems to support the belief that there are different types of mentalities which do not produce the same type of intelligent action upon exposure to various stimuli in the driving situation.

Intelligence tests appear to have limited value for identifying *repeaters.* Of more importance, apparently, is intelligence of the nonverbal type, as shown by behavior tests or that observed in connection with the learning ability. Obviously, persons with subnormal intelligence should be considered unfit to drive.

Knowledge, Information and Skill

A driver's knowledge of safe driving practices—how well informed he is regarding rules of the road, traffic signs and regulations, and other facts pertaining to the automobile and the high-

way—has not been studied extensively in terms of its relation to accidents. Brody [14] reported that repeaters and nonrepeaters did not differ significantly with regard to knowledge and information. In the Eno study [27], nonrepeaters were found to be better informed than were repeaters as measured by the official knowledge test of the appropriate state, either Connecticut or Michigan, and by a knowledge test of the Center for Safety Education.

While knowledge of a correct action is not always assurance that correct action will be taken, the well informed driver seems to be a better risk than the poorly informed. One effective use of knowledge and information tests for drivers is to disclose individual deficiencies and weaknesses in driver knowledge as an aid to the determination of the areas where driver education is needed.

Findings on the relationship between driving skill and safe driving are at some variance. Fletcher [29, 31] found that the repeaters he studied lacked certain driving skills. Weiss and Lauer [94] found some correlation between skill on a testing device and freedom from accidents. DeSilva [21, 23] found that among the drivers he tested those with good driving records showed a high degree of skill on a manipulative device simulating certain behind-the-wheel conditions. Brody [14] however, reported no significant differences in total driving performance of repeaters and non-repeaters when tested in actual traffic situations, and he concluded that "skill alone does not seem to insure safety in driving."

Blood Pressure and Socio-economic Status

Findings on the relation of blood pressure to accidents also have varied. Slocombe and Bingham [81] found that high blood pressure is associated with high accident rate. Brody [14] using the *case study* technique with a limited sampling of drivers, found that a large proportion of the repeaters he studied had low blood pressure.

In the Eno study [27] no significant differences in blood pressure were found between *groups* of repeaters and nonrepeaters studied clinically. In view of the lack of evidence to confirm and

support the present and limited findings, it is obvious that *a significant relationship between blood pressure and safety in driving needs yet to be established.*

Research findings pertaining to the socio-economic status of accident repeaters has not yet produced conclusive evidence that there is a relationship between the two factors. DeSilva [21] found that a low social and economic status accompanied a poor accident record, but the data of Weiss and Lauer [94], Brody, [14] and the Eno study [27] disclosed no significant relationship between socio-economic status and accidents.

Motor Performance

Motor performance or neuromuscular coordination is a complex type of behavior closely associated with many of the activities involved in the operation of an automobile. This factor, however, is apparently affected by a number of other variables and measurements are difficult to make. There is evidence, nevertheless, that motor performance may be closely associated with accident experience. Weiss and Lauer [94] demonstrated the effect of emotional factors on eye-hand coordination. DeSilva and Forbes [23] concluded that faulty motor control was related to accident experience. In the Eno study [27] results showed not only nonrepeaters as a group were initially superior to repeaters in motor performance, as measured by a type of eye-hand coordination testing apparatus, but also that repeaters seemed more susceptible than nonrepeaters to conditions imposed for the purpose of annoying and distracting the individual.

Future research will have to be relied upon to lend additional support to some of the present contentions that a positive relationship exists between motor performance and safety in driving; it also must be relied upon to explain the role of emotional factors in this relationship.

Emotional Stability and Personality Adjustment

A number of investigators have found indications that emotional factors, mental upsets, and psychological maladjustment are significant in accident experience.

Selling [78, 77] found a significant percentage of violators and repeaters emotionally unstable. He concluded that emotions, attitudes, and what he called "related personal factors" were significant in the accident experience of these individuals. Brody [14] found a significant correlation to accidents in general maladjustment, which included occupational, social, emotional, health, and home situations. In the Eno study, [27] the results of a validated test (the Cornell Word Form) indicated a stronger tendency to emotional instability and personality maladjustment among repeaters than among free. These findings seem to support the belief that a valid and reliable psychological test can be used to advantage in identifying individuals whose personalities exhibit certain maladjustments warranting special attention.

Attitudes

It has been concluded generally that a good attitude toward the responsibilities of driving, including attitude toward pedestrians, other drivers, law enforcement, and related factors is essential to safe driving.

Selling [77] found a "poor" attitude associated with accident experience. Slocombe and Bingham [81] found that accident-repeaters exhibited an attitude of noncooperation. In the Eno study, [27] a great deal of time was spent investigating the whole problem of attitudes, using the interview technique. Findings with regard to a number of specific items seemed to indicate a tendency among repeaters to what might be termed a "poor attitude."

Responses to statements pertaining to law enforcement, the integrity of the courts, and their opinions as to the so-called "right" to drive showed this pattern. In addition repeaters strongly over-estimated their capacity for alcohol, and on the average showed a stronger preference for higher speeds than did the free. Another significant fact brought out in the course of the interview, important from the standpoint of attitudes, was that the repeaters had been charged with a considerably higher

number of arrests for violations other than traffic than had the nonrepeaters.

Findings, on the whole, suggest differences between the attitudes of repeaters and nonrepeaters. While available measuring techniques require further development, standardization, and refinement, attitudes appear to be an important area for further study as part of the reeducation of accident-repeaters.

Vision

The question of vision and its importance in driving is in that different visual capabilities or functions are involved. Fletcher [32, 33] found that nonrepeaters were superior to repeaters in acuity, an observation with which the conclusions drawn by DeSilva, Robinson and Forbes [24] and by Brody [14] seem to disagree. In the Eno study, [27] some evidence was found of repeaters having poorer acuity than nonrepeaters.

Brody found [14] defective side vision (the degree to which a person can see "out of the corner of his eye" with the eye pointing straight ahead) to be significant among repeaters. In the Eno study [27] no relationship between defective side vision and accident experience was found.

Lauer and Allgaier [51] reported that eye dominance, which refers to the inability to use both eyes equally at the same time, was significantly present among repeaters. The findings of the Eno study [27] supported this conclusion.

Lauer [49] demonstrated that colorblindness was not significantly related to accidents.

Fletcher [32, 33] as well as DeSilva, Robinson and Forbes, [24] found poor depth perception (sometimes referred to as "tunnel vision" to be a factor associated with accidents. In one portion of the Eno study, [27] when the subjects being studied were carefully matched with regard to age, a larger percentage of repeaters than of nonrepeaters were found to have markedly poor depth perception.

No indication that dark adaptation is related to accidents was

disclosed in the Eno study [27]. The term dark adaptation is used in referring to the relative loss of normal visual acuity when a subject is removed from light to darkness and the length of time it takes the eyes to adapt themselves to the darkness and recover sight.

Weiss and Lauer [94] found repeaters to be deficient in ocular muscle balance, an important factor in the ability of the eyes to focus properly. Likewise in the Eno study [27] poor ocular muscle balance was more strongly noted among repeaters than among nonrepeaters.

Findings show that certain visual deficiencies are more frequently encountered among repeaters than among non-repeaters. Undoubtedly good vision and the compensating for visual defects are important in safe driving. Obviously persons with extremely poor general vision, as well as those with specific visual disabilities, should be considered as essentially unfit to drive.

CLINICS FOR DRIVERS

Following the early experimental work of DeSilva at Harvard University and Lauer at Iowa State, various types of clinics for drivers were organized in several states. A permanent clinic has been in operation in California for many years. Pennsylvania clinics have been conducted for shorter periods, in both Philadelphia and Pittsburgh, by the Pennsylvania State Police working in cooperation with city police and motor vehicle departments. Also experimental clinics have been operating in other states, such as those held in Connecticut and Michigan in connection with the Eno study.

Use of the clinical technique has been profitable in driver-testing and improvement. In Pennsylvania, where the state is testing operators of commercial vehicles as well as accident-repeaters referred to them by the police, the success of the clinical method is indicated by the fact that 90 per cent of the defective drivers processed in the clinics are reported to have been rehabilitated. According to T. L. Cahalan's report* of the drivers tested in

* Cahalan, T. L., "Safe Driver Clinics and Psychophysical Tests," *Safety Training Digest.* Center for Safety Education, New York University. 1947. Pp. 51–54.

Philadelphia, 30 per cent were found to be normal; 25 per cent were ignorant of motor laws; 15 per cent failed the road test; 5 per cent were unable to read or interpret traffic signs; 10 per cent required vision correction; 10 per cent were operating with faulty equipment; 2 per cent were crippled, glare-blind, etc.; and only 3 per cent were incapable of correction and so eliminated.

Types of Clinics

Clinics for drivers are of several types. One is the comprehensive or so-called "all-purpose" clinic. This includes the testing of a wide variety of personal characteristics. A second type uses the personal counseling technique and is organized primarily around a face-to-face interview between the traffic offender, and, for example, the hearings officer. This method has the advantage that it is often possible for a well-trained counselor to learn more through a personal interview about the basic attitudes and reactions of drivers than through the use of standardized paper-and-pencil tests.

A smaller so-called "spot" clinic, an adaptation of the all-purpose clinic, is frequently operated in conjunction with the interview. When certain weaknesses or disabilities are disclosed, drivers are referred to the *spot clinic* for a further checkup. A driver discovered to be particularly susceptible to night accidents would take the glare recovery test; or one who showed a lack of knowledge of state regulations and driving practices would be given a knowledge test. The fact that this type of clinic can be operated by one examiner assisted by a clerk gives it an advantage over the larger comprehensive clinic.

In addition to these, many commercial motor vehicle fleets and industrial concerns operate their own clinics, primarily for the selection and training of drivers. When faced with the responsibility of hiring fifty drivers out of a hundred applicants, the clinic is a distinct aid in selecting those drivers who will be the most likely to maintain good accident records. Since it is sometimes not easy to discharge an accident repeater or correct his disabilities, time spent in careful testing before selection pays for itself many times over.

Fleet supervisors may find several of the tests listed in the following pages useful in their programs. While at present there is no battery of tests that can be used with reliability to predict the future success of a driver, the combination of certain discriminatory tests can be used effectively in expediting the final selection.

Equipment and Testing Apparatus

FOR THE LARGE CLINIC

Equipment	*Testing*	*Time in Minutes*
1. Personal Record Sheet		
2. Sight Screener (or equivalent)	Acuity, depth perception, muscle balance, binocular vision	7
3. Perimeter	Field of Vision	3
4. Adaptometer	Light Adaptation	8
5. Knowledge Test*	Traffic Information	15
6. Cornell Word Form*	Personality Adjustment	10
7. Motor Performance	Stability	5
8. Attitude Test*	Attitudes	10
9. Reactometer	Selective Reaction	5

* Can be administered to several drivers at a time.

FOR THE SMALL CLINIC

It is suggested that part of the equipment listed above be used, such as items 1, 2, 3, 5, 6, 7, 8.

Operation

1. Drivers summoned to clinics would first fill out the Personal Record Sheet
2. They would then be interviewed by the examiner. In the course of the interview, certain indications of disabilities would be noted. The driver would then be sent to take specific tests at the clinic or to get a complete checkup
3. Low or failing scores in tests would indicate the need for corrective action
4. On the completion of tests, drivers would return to the examiner, who would recommend corrective action
5. A complete manual on testing procedures and corrective action would be prepared in each state
6. The clinical staff would consist of two or more examiners and a clerk.

It is not possible in this brief section to treat many of the phases of corrective action. The interview can be an excellent basis for indicating necessary corrections and aiding in the improvement of drivers. However, a consideration of the techniques of so broad a subject as interviewing cannot be included here. The following are examples of corrective action that can be taken in specific situations:

Lack of driving knowledge. The driver should study state manuals and report for a second test in three weeks. In addition he should receive special training in a driver-training course for adults (example, Detroit Courses of Police Department for Drivers).

Failure to pass state test in visual acuity. The driver should be suspended temporarily or until the condition has been corrected.

Low scores on adaptometer. The driver should be informed of his disability and be discouraged from engaging in any night driving. Slow speeds and caution should be encouraged. In serious cases the driver should consult a vision specialist.

Poor scores on Cornell Word Form. The driver should be interviewed and an attempt made to discover the source of the emotional difficulty or why he is poorly adjusted. Advice may be given by a trained counselor or the case may be referred to a social case worker or to the family physician. In some instances referrals may be made to psychiatric clinics.

Clinical Procedures

Dr. Alvhh Lauer of Iowa State University, who has operated a number of driver clinics and has contributed widely to the testing techniques and scientific literature in the field, makes the following suggestions with regard to testing procedures:

1. There is no need for high-precision apparatus when simple apparatus will give adequate results. For example, the lateral field of vision may be measured with a simply constructed perimeter.

2. Sturdiness is an essential feature of clinical apparatus. Equipment is subjected to rough treatment and must be sturdy enough to withstand constant and extreme usage.

3. The entire examination should not take more than one hour. This would include several sub-tests.

4. It is advisable that the clinic be mobile and easily portable. By having part of the equipment located on a trailer or on a separate truck, a much more economical unit may be developed.

5. The first and last contacts with the examinee should be made by a psychologist or someone trained in interviewing. This interview is the most important part of the clinic.

6. All drivers examined should fill out record forms giving personal data.

7. It is desirable that some type of central composite test be employed. The advantage of such a unit is familiar to anyone who has worked with drivers. Unless there is a steering wheel, a gear to shift, a brake or an accelerator to operate, there is a question in the untrained person's mind as to the validity of the test. A "drivometer" used at Iowa State College has given high test correlation with accident indices.

Standardization of Procedures

Dr. Lauer also adds the following suggestions for improving procedures in testing:

1. The ideal clinic must follow approved scientific procedures if results of scientific merit are to be obtained
2. Personnel must be competent and expert in testing procedures
3. Constant vigilance is necessary in testing. It is easy to secure unreliable results
4. Directions should be attached to each test and read by the examiner. It is essential that subjects being tested understand exactly what they are to do
5. The director of the clinic should be thoroughly grounded in psychology and testing methods. He should see to it that all assistants are well trained
6. At the conclusion of the clinical tests, the director or supervisor should interview all subjects. This is a most important feature. It is a question of convincing each driver that he must start on a program of self-improvement if he is to avoid accidents.

SUMMARY

1. Accident-repeaters and chronic violators constitute a real problem for driver improvement.

2. There is a wide range in the driving exposure, accident experience and violations records of accident-repeaters.

3. The seriousness of a repeater's problem can be ascertained

from his total record of accidents and violations per 100,000 M.V.M.

4. Accident-repeaters and accident-free drivers have been found to differ with regard to many personal and psychophysical characteristics. Others, however, are not typical of either group and have little discriminatory value.

5. Selective response is a more important factor than simple speed of response in differentiating between repeaters and non-repeaters.

6. Intelligence is a complex factor, especially as related to driving experience. A conventional type of intelligence test has limited value in identifying repeaters except in cases of obviously abnormal mentality. Observing behavioristic intelligence—the appropriateness of the action taken by a subject in planned driving situations under varying conditions—appears to be a reasonably sound basis for identifying "questionable" drivers.

7. Repeaters, generally speaking, are not as well informed regarding safe driving practices and regulations as are accident free drivers. One of the most important functions of knowledge tests for drivers is that of disclosing individual deficiencies and shortcomings. This information can be used effectively in driver-education and training programs.

8. There does not appear to be a positive relationship between driving skill, over a certain level of performance, and safe driving. Skill, intelligence, neuromuscular coordination, and emotional stability appear to be strongly interrelated. There are indications that an evaluation of an individual's probable driving proficiency might be obtained through a careful consideration of his total behavior in laboratory situations involving all of these factors.

9. On the basis of available experimental evidence, repeaters and free do not seem to differ significantly with regard to blood pressure; neither can they be differentiated between on the basis of socioeconomic status.

10. Repeaters as a group appear to have poorer motor control than do accident free drivers, under normal conditions as well as under emotional strain and stress.

11. Tendencies to emotional instability and personality maladjustment appear to be stronger among repeaters than among free.

12. On the whole, there seems to be a difference between the attitudes of accident-repeaters and accident-free drivers. While techniques for measuring attitudes require development and refinement, the personal interview technique seems to have good utility value in this respect.

13. Visual efficiency and compensating for visual deficiencies are highly important to safe driving. Binocular vision (the ability to use both eyes equally at the same time) and good ocular muscle balance appear to be very important. Depth perception, dark adaptation, and side vision seem to be of equal or greater significance than visual acuity *per se*.

14. Clinics for drivers are valuable investments. The clinical technique can be used to advantage in driver testing, in diagnosing drivers' problems, and in rehabilitating drivers with questionable personal characteristics or marked deficiencies.

CHAPTER VIII

DRIVER LICENSING

To the erring motorist in court for a serious traffic violation, a driver's license is a singularly valuable document. He would part with "any sum" in court fines and costs to retain it. To some drivers, it is just a piece of paper.

Some motorists obtain licenses under the "grandfather clause." This permitted those who applied within a limited period to obtain a license without any formal examination. Others have stood in line for hours waiting to take the examination. Many have had to take a test every three years or so.

Some operators have had to pay no fee for a driver's license; others have paid five dollars for the first year's license and three dollars annually thereafter. Some drivers have obtained licenses that are good until revoked; other drivers must renew their licenses annually.

Some drivers live in states where exceeding the state speed limit is punishable with a ninety-day suspension of the license; other drivers live in states where the chance of having a license suspended for any reason is almost non-existent.

It can be seen from the foregoing that *driver licensing will tend to have different effects on different people,* and that *it means different things to different people.* The fact is that properly drafted, properly administered driver-license laws can be one of the most effective means for controlling and improving drivers.

Safety on streets and highways would be increased if all drivers were granted the privilege of operating motor vehicles from the point of view that the purpose of licensing is to insure the competency of drivers and their compliance with the law.

Examinations Stimulate Better Driving

If the purpose of driver-licensing is more than a revenue measure, and if drivers are licensed to insure their competency, a licensing

authority must make certain that drivers are competent. *The only practical method by which this can be accomplished is through an examination of the applicant.* The standard examination is designed to reveal if the driver is ready for the road; if he has the necessary knowledge, skill, physical ability and (whenever possible), the proper attitudes.

The standard examination also raises the quality of driving. If the standards are high and the examination is sufficiently strict, drivers will be more likely to study the rules of the road and the principles of safe driving and equip the vehicle with special safety devices if needed. They also will be more likely to increase their driving skill through practice under competent supervision.

Statistical data are not available, but it was reported by competent observers at the Fourth Annual Seminar on Driver License Problems at Rutgers University in 1947 that in communities where emphasis had been placed on driving tests, drivers' habits were noticeably improved immediately after the tests were instituted. Correct hand signals were given, parking practices were improved, turning movements were executed correctly, and other driving maneuvers were carried out in an improved manner.

Another value of examinations, likewise not statistically measurable at present, is the effect that examinations have upon the attitude of the driver towards his license. Most drivers tend to value their license in direct proportion to the amount of effort put forth to obtain it. Proper use of good examination procedures will serve to start the new driver off in the right direction. His knowledge, physical ability, skill and attitude are more likely to be of good quality than if he is given poor superficial examination or no examination at all.

Suspensions Control Erring Drivers

The best of examinations will not identify the driver who, even though performing creditably on the test, will revert later to bad habits. Nor will it reveal the driver with an unstable disposition that may later manifest itself in a series of accidents and viola-

tions. About half of the nation's driving population—some 20,000,000 drivers—has never been examined for a license; and many thousands of drivers examined many years ago may have developed faulty driving habits or physical disabilities, or both, in the interim. Obviously, it takes more than an examination to make a licensing procedure valuable as a safety measure.

A license to operate an automobile is not a contract or property right; it is a *privilege* extended by the state, to be withdrawn when the licensee fails to live up to his responsibilities. Thus, *licensing should present the ever-present threat of withdrawal of the privilege* and so produce more careful, conscientious drivers.

Important in the control of the licensed driver is the power of *suspension.* When certain persons show by their records that they are a menace to the safety of other highway users, the licensing division usually has a number of curatives to apply. In most instances, the various remedies work. If they do not, a suspension usually brings the desired response. It is estimated that fewer than three percent of the drivers suspended ever risk a second loss of their privilege. When used together, driver examinations and threat of suspension have a valuable effect for traffic safety on the average licensed driver.

Driver-Licensing a State Responsibility

Driver licensing is a definite responsibility of the several state governments. This point is summed up by the American Association of Motor Vehicle Administrators [3]:

Under our democratic system of government the sovereign power is vested in the people. The people act through their state governments in expressing the public will and promoting their own interests.

Except for the National Defense which is vested in the Federal Government, the responsibility of the government, to the extent it can be distinguished from the people, is vested in the state governments, and it is the state governments which must take those steps which are necessary for the protection and welfare of its citizens.

The Government, in order to protect its citizens in the use of motor vehicles, has taken three principal steps. These are:

1. The enactment of traffic rules
2. The providing of peace officers to enforce traffic rules and to direct traffic
3. The licensing of drivers.

The licensing of drivers is a definite control function, and the use of driver licenses as a means of insuring compliance with the law on the part of drivers and the safe operation of motor vehicles is one of the most essential and effective means of traffic enforcement.

Every state should certainly accept its responsibility to the degree indicated by the potentiality and complexity of the driver-license law. In addition to considerations of safety, the vast network of interlacing highways and the millions of drivers and vehicles moving from state to state make imperative the need for good, uniform driver license laws.

Past experience indicates that the ultimate goal of uniform, well administered license laws can be obtained adequately through the adoption by all states of laws patterned after the Uniform Vehicle Code, Act II, Operators' and Chauffeurs' Licensing Act. [73]

PRESENT STATUS OF DRIVER LICENSE LAWS

A sound point of view regarding driver-license laws was taken in 1946 by the Committee on Motor Vehicle Administration of the President's Highway Safety Conference. [71] The conclusions reached by this committee defined certain elements basic to a sound driver-license law. The Committee stated: "The continued lack of any one of these basic elements has been found sufficient to cause any driver license law to become a nuisance, a mail-order proposition, or a revenue measure." These elements are:

A. Driving a motor vehicle on the highway is a privilege granted by the state and may be taken away from the licensee by the state for cause

B. Legislation creating a driver license law must be so drawn that provisions are made for adequate fees, limited duration of license, centralized administration, mandatory revocation for certain offenses, examination of all new drivers, broad discretionary power of suspension or revocation in certain stated cases

C. The license law must be administered on a broad, efficient basis by an adequate number of trained personnel employed by the state for the single purpose of carrying out the duties prescribed in controlling drivers through licensing

D. There must be a strong public support of a character that will insure the permanence of strict examinations and impartial suspension and revocations when warranted. [71]

Administration

All states except South Dakota have some type of driver-license law. From the first state to adopt a license law (Massachusetts) to the most recent, progress has been toward a strong, centralized type of administration. The trend has been to place administration in the office of a "Public Safety Commissioner."

In one state the chauffeur's license act is administered by one department while the operator's license act is administered by another. Twelve states follow the practice of divided administration of the law. In such organizations, examinations are usually conducted by the patrol while the issuance of licenses and the maintenance of records are administered by another division of state government.

Revenue from drivers' licenses should be expended, presumably, for highway safety. That such is the case is probably the exception rather than the rule. Fees should be sufficient to provide for adequate, qualified personnel, for necessary facilities where proper examinations of applicants may be conducted, and for an effective driver-improvement program.

Fees for new drivers range from five dollars, in Connecticut, to fifty cents in Arizona—for a license that is good until revoked. No study has been published on fee payments necessary to provide for good administration of the law. Factors influencing the amount of the fee include population, area, prevailing standard of living, disposition of funds and type of license issuance.

Duration of Licenses

In seventeen states, licenses are good for one year; in fifteen states, for two years; in seven states and in the District of Columbia, for three years; in six states for four years; and in two states, licenses are of unlimited duration.

As with duration, there is little uniformity in the expiration dates of licenses, although there is an unmistakable trend toward the birthdate plan of expiration dates. Ten states now follow such a plan; eight states use the date of issue procedure. The remainder have a fixed date of expiration that is usually the first or last day of a month. All months except February and August are represented.

The duration and expiration of licenses have an indirect bearing on the driver, as will be explained later in the chapter. Suffice to say here that licenses should be renewed periodically and on a staggered expiration system.

Chauffeurs

Some of the earliest license laws were passed primarily to control chauffeurs. To date thirty-two states have a separate license law for chauffeurs. A few other states require operators of taxicabs or buses to have an additional license, but the usual requirements for such a license are fee payments and not considerations of safety.

Chauffeurs are defined in the Uniform Vehicle Code as: (a) any person employed for the principal purpose of operating a motor vehicle; (b) a school bus driver; and (c) any person who is driving a vehicle which is carrying persons or property for compensation.

As the use of buses, semi-trailers, gasoline tankers, and other large vehicles has grown, many safety authorities have sought to re-define the classification of chauffeur licenses. Under present conditions, the general policy in most states has been to license a chauffeur on the basis of his employment without requiring him to undergo any special tests or to demonstrate his ability to pilot the type of commercial vehicle he will drive. A new amend-

ment would provide that the applicant be examined in the type of vehicle he expected to drive, his license being endorsed accordingly.

Suspension and Revocation Authority

The Uniform Vehicle Code [73] recommends that the responsibility for the suspension of the driver's license be placed in the hands of the agency that issues the license. A number of states, however, place suspension and revocation powers in the hands of the judges who try the case. In a few states, both the administrator and the judge are empowered to suspend. Such provisions do not function satisfactorily because a great many nonuniform practices are developed.

One motorist may lose his license for sixty days in a certain county for speeding; a second motorist operating under similar conditions but in a different county may be given no suspension at all. Moreover, judges at the time of trial usually do not have access to the driver's complete traffic record. Finally, there is an additional value, other than mere punishment, in driver-license suspensions: there is a strong element of driver *improvement*. This fact is being recognized in more and more states.

It is often impossible, for various reasons not always clear, for the courts to deal out justice. Some times political pressure is brought to bear and the defendant is permitted to go free, even though the mass of evidence clearly indicates that he is not a safe driver and should not be allowed to use a motor vehicle on the public streets.

"America is moving toward uniform driver licensing," stated the 1947 report of the American Association of Motor Vehicle Administrators. [1] But the same report revealed that much remains to be accomplished. It pointed out that:

23 States need a unified driver license division
22 States need a full-time chief examiner
16 States need a full-time supervisor of suspensions and revocations
27 States lack full-time state examiners
16 States lack a manual for examiners
40 States fail to retest licensed drivers of questioned ability
20 States fall short in the discretionary suspension of negligent drivers
26 States are deficient in mandatory revocations of negligent drivers.

It is obvious that if drivers are to be more effectively controlled in the interest of traffic safety, there must be a realignment of driver-license divisions, a reaffirmation of sound administrative principles, and a greater concentration of effort on the part of many states.

IMPROVING THE QUALITY OF LICENSING

What is a desirable plan of operation in driver-licensing? For the common good of the majority of the people, the driver-license division should:

1. License only those persons who demonstrate they are physically and mentally capable of operating a motor vehicle and have the necessary skills
2. Remove from the highway (for the safety of themselves and other users) those drivers who show by their record that they are not or cannot be trusted with the privilege of using a potentially dangerous weapon of destruction
3. Attempt to improve those drivers who, after being licensed, develop some deficiency in their knowledge, skill, attitude or physical ability, which affects their ability to drive safely.

Organization of a Driver-License Division

The effect of driver-licensing procedures on the individual depends mainly on the organization of, and the control exercised by, the division that issues the license. In the four decades since the passage of the first license law, much accumulated experience points to the desirability of a *separate* division (within a single department) devoted *exclusively* to the administration of the driver license law.

Where the division is relegated to the inefficient status of a semi-separate *section,* or is a wholly *subjugated bureau* in which safety measures and good licensing procedures receive secondary consideration, lives will rarely be saved through licensing. In such cases, suspensions and revocations usually become bookkeeping items with little or no backing of enforcement. Likely as not, examiners find themselves being supervised by supervisers

whose interests lie in the collection of taxes or in the enforcement of criminal and highway laws.

Once the importance of the driver license division is recognized and established, there should be at least three distinct sections set up within the division to carry on the functions of licensing: (1) the examination of drivers; (2) the issuance of licenses and the maintenance of records; and (3) the control and improvement of negligent drivers.

Obviously, for successful licensing, good personnel is needed to direct the above named sections and to coordinate the activities of the division.

License Issuance and Records

Driver-records serve two main purposes: (1) to show which drivers have paid their fee and are properly licensed; (2) to show which operators are *qualified* to continue to drive. Thus, records should be permanent and cumulative; they should be centralized to reduce the clerical cost of handling, as well as to reveal quickly all there is to be known about a driver and his performance on the highway; they should not be complicated or incomplete, or the processing cumbersome, else there is little chance that the driver with a bad record will ever be brought to light for attention.

The most satisfactory system uncovered for maintaining records on a large scale is known as the "baby folder." It combines an application form, record of examination, receptacle for subsequent records on the driver, and a summary of the driver's record. Folded, it measures eight inches by five inches, and fits a standard filing cabinet. Because of its size, it provides for the concentration of records and thus reduces the total volume of files needed to keep records. It also reduces considerably the clerical work required in handling records.

For identification purposes, a license should show the complete name of the applicant, his home address, his physical description, and his date of birth and signature. An effective plan now favored is to accumulate in the driver license division *all* records which

pertain to the driver: violations, warnings, accident and complaints. Thus, when an investigation is instigated, the accumulated record conveniently provides all the pertinent data.

To insure accuracy of name and address, only temporary receipts should be given the new applicant. The original license, after being processed and checked in headquarters, should be mailed. Many drivers who receive their license "over the counter" are known to have given false or incorrect names and addresses.

A staggered system of license renewal is an efficient one. When licenses expire continuously, no large number of extra clerks, often untrained, need be hired as is the case when there is a single expiration date. Moreover, there will not be a flood of licenses which buries the record section and prevents it from keeping up to date with the usual number of incoming violations, accident records, and requests for driver identification. The birthdate plan also seems to provide for an adequate spreading of renewal demands and, in addition, helps the applicant remember the date of expiration of his license.

Examinations

The examiner is a key figure in a driver-license division. Most often he is the department's principal representative meeting the public. He must make a great many decisions daily as to drivers' qualifications. His work is exacting and personal. Only examiners who have high qualifications should be used if examinations are to be administered in sound fashion.

Examiners should be carefully screened for employment on a basis of high standards. Specialized training should be given at the time of employment and at regular intervals during their service. Thorough training is vital because most examiners work alone and because poor work on the examiner's part seldom results in complaints. He must be completely imbued with the importance of his profession.

The examiner should be outfitted in a distinctive uniform, furnished by the state. Experience has shown that a uniformed

examiner is able to control a crowded examination station better. His uniform, a mark of distinction, implies he has been selected and trained for his responsibilities. Sidearms should not be worn.

The number of examiners employed should not be set arbitrarily, but should be arrived at through a close study of number of applicants, the number of communities served, miles to be traveled, and such factors as the amount of traffic encountered in the road-testing area. Certainly no examiner should be called upon to give more than three examinations an hour.

Above all, the examiner should have adequate time to give every applicant a *thorough* test. If the examination is to be educational as well as selective, examiners should have time to treat the applicant as an individual.

Of the thousands of localities where examinations are conducted, probably not over a hundred deserve approval for the stations in which the tests are given. States usually borrow their quarters for testing from city halls, county courthouses, garages, filling stations and other government and business establishments. Rarely is the station designed specifically for conducting an examination. As a result, the public has a vague impression of being herded, jostled, and shoved through the examination.

How much better if the station were properly lighted, designed to facilitate the flow of applicants, and equipped with the latest in testing and educational devices? One way to provide for such improvements would be to allocate funds for the purpose from income derived from license fees. There should be at least one specially constructed examination station in every county. Much could be accomplished in the way of raising the general level of driver-examinations if each state were to plan and carry through a program for the construction and maintenance of needed examination stations.

The Uniform Vehicle Code [73] does not establish standards for examinations, and leaves to the administrator the authority to set whatever standards are reasonable. The American Association of Motor Vehicle Administrators have adopted a set of standards for the original examination; it would seem appropriate that no state give less than the recommended tests. As stated

previously, since an applicant for a driver's license has natural motivation, he will exert himself in whatever way necessary in order to pass the examination. Recommended standards include: 20/40 visual acuity, to be met with or without correction; seventy per cent accuracy in the interpretation of road signs; seventy per cent accuracy in knowledge of rules of the road; and not more than an error score of 30 in the road test of driving ability.

Driver-Improvement Division

This division is concerned with the processing of drivers with bad records, with their subsequent improvement upon rehabilitation or removal from the highway. The processing division should be comprised of specialists in the techniques of driver-licensing who possess a broad background in traffic safety and who have an understanding of applied psychology.

The control of the driver with a bad record should commence at the *first* indication that he is developing a bad record. One does not have to search many driver-license files to find that all too often drivers may have as many as ten violations and three accidents before they are singled out for attention by the driver license division!

The nature of the treatment given the driver depends upon his driving and accident record, his previous licensing history, his education, age, and other factors. That record should be scrutinized by a trained and experienced person who understands some of the reasons underlying the behavior of drivers and who knows which remedies to select and apply.

The most economical method of improvement is to dispatch a simple warning letter—in one sense a "sales letter"—pointing out the dangers of accumulated offenses and appealing for co-operation in the traffic safety program. This treatment should be used only in the mildest of cases and, assuredly, should be followed up if not heeded.

A second method is the review examination. It is used when there is no record of a previous examination or where there is

reason to believe the driver has some specific deficiency in knowledge, skill or physical ability. It may be a routine, ordinary examination, or it may be more thorough in nature. If the driver fails to qualify, he should be suspended at once pending further examinations to determine his competency.

Still another approach to driver-improvement is the use of the personal interview. Such an interview, usually conducted informally, is designed to bring out factors contributing to the driver's difficulties that would not be revealed by a routine examination. It affords the department an opportunity to talk over the accident problem with the individual. If the driver's attitude during the interview clearly indicates a lack of driving responsibility, he should be suspended. Generally speaking, most drivers welcome the opportunity to discuss driving problems in such a personalized fashion and, as a result, their driving behavior may show marked improvement.

A formal hearing at which the driver must show cause why his license should not be suspended is another means of improving the driver. Testimony is recorded and witnesses are used. It is a step taken in more serious cases, or when other methods of improvement have failed. If the formal hearing is before a judge the license department stands a much better chance of winning its case if it can show that other attempts had been made in the past to correct the driver's behavior.

There remain also discretionary suspensions to be applied when the case is serious enough to take the person off the highway. The record may warrant immediate suspension, in which event no time should be lost in serving notice of suspension and in taking the license certificate away from the operator.

Suspensions and revocations should not be considered as purely punitive in nature; for they represent tools to be used by driver license divisions for improving the performance of violators and accident repeaters. The public looks to the driver license division to take action against the erring driver. No other agency has that responsibility; no other agency has the necessary facilities, records and personnel.

To achieve public support—which is absolutely essential to the successful administration of a driver license law—the administration of a state must first put its house in order. Those in authority in general state government must recognize that the driver-license law is to be used in the *prevention* of traffic accidents, not as a revenue producing measure for the state. The official immediately responsible for carrying out the licensing law must do all that he can to provide competent departmental personnel, give them adequate training, and to provide them with the facilities to do a good job.

The success of driver-license administration also depends upon the mutual support of enforcement agencies and judges and, to a lesser degree, upon the cooperation of educators and traffic engineers. To achieve this type of cooperation, the driver license division must work closely with these agencies, providing them with complete and accurate driver case histories.

The average person seldom knows the extent of suspensions and revocations or the results of examinations. Driver-licensing news releases consist in most cases of a warning to renew licenses. Small wonder public support is lacking in many states!

When the public knows where and how and when it fits into the driver-license picture, it will be more likely to support necessary appropriations for manpower and money. *But the public must be given the facts in the case.* Driver-license officials must take their case to every community in the state. Not a single opportunity should be overlooked to tell the story of licensing—its purposes, its accomplishments, even its deficiencies—to all drivers and pedestrians. The public must be given a part in formulating a better driver license law and in its administration.

SUMMARY

Driver-licensing procedures and the extent to which licensing is used as a control on drivers varies greatly from one state to another. Motor vehicle administrators are generally agreed on the necessity for higher examination standards, improved examining

techniques, and more extensive use of driver restriction powers. Important obstacles to the realization of such goals are the lack of funds and qualified personnel. Legislation should be enacted that will require appropriate license fees for the maintaining of an efficient licensing department directed and operated by high quality personnel who receive adequate security and compensation to secure their services on a permanent basis. Further, legislation is needed to bring all state driver-license laws up to the minimum requirements as established in the Uniform Vehicle Code.

The licensing recommendations described herein are not impractical or expensive. They are entirely feasible, proved in all respects by practical application. No compromise in principle need be made. Public attitude is conditioned for traffic safety; public support needs to be similarly developed. That support can be organized and used to the advantage of the licensing system. It can be organized, however, only to the extent that the public is brought into the picture. When public support is joined with a sound driver-license program, state legislative bodies will not be unmindful of necessary manpower and budgetary requirements. They will provide these resources together with laws that compare favorably with those outlined in the Uniform Vehicle Code.

CHAPTER IX

DRIVER-IMPROVEMENT THROUGH DRIVER EDUCATION

America pays high in accidents because few of us have had other than trial-and-error instruction in handling a car. Every day, more than 25,000 drivers are involved in traffic accidents. Systematic training has been given to few of our 48-million drivers; the majority merely "took it up." Friends or members of the family have given instruction—a far from satisfactory training.

A poor teacher confuses a beginner with lack of system; and inexpert drivers train pupils in their own bad habits. Inadequate skills, a lack of knowledge and understanding, and poor attitudes are usually passed along from "teacher" to the pupil. Subsequent experience alone apparently cannot be relied upon to remove the unsafe driver habits that are the end-product of a lack of systematic training.

No one has yet attempted to evaluate direct and indirect effects on the accident-record of over fifty years of inefficient trial-and-error training. All authorities hold, however, that such widely practiced instruction has been a significant factor in accident occurrence. Safety experts in all quarters—and in recent years many educators also—urge the viewpoint that society can no longer afford to look at automobile driving as a "knack that anyone can accomplish, if given an opportunity to practice on the highways."

Wrong attitudes, bad habits, lack of skill, and ignorance account for the majority of accidents. The major role in any social program that aims to eliminate these causes must be played by education. This medium provides the means by which driver improvement can be attained. Good engineering and proper law enforcement are necessary for highway safety. Education and systematic training influence the decision-making ability of the drivers. Instruction serves as *the* means through which good

attitudes of cooperation, desirable character traits, and a sense of social responsibility can be developed.

Education for driver-improvement should be directed to a number of areas. These include:

1. The preparation of new drivers through secondary schools and other public agencies
2. The upgrading of the performance of adult, experienced private passenger car operators
3. Instruction for commercial vehicle drivers and for those engaged in driving for governmental agencies
4. *General* education in safe driving for *all* drivers through effective media of public information.

This chapter presents an overview of programs and present practices used to improve drivers through education. It points out desirable procedures and plans that can be initiated in communities.

DRIVER EDUCATION IN SECONDARY SCHOOLS

Daily automobile crashes involve drivers of all ages and both sexes. Young drivers, however, have a disproportionately high share of the accidents. Since in most states drivers must be 14, 15, or 16 years of age before they can be issued licenses [2], the high school appears to be the logical place for the training of youthful drivers. This fact, and the commonly accepted education principle that training is more lasting and habits and attitudes are formed with greater facility in the early years, have made the high school the strategic center for the education of new drivers.

Formal recognition of the need for driver education—and recognition of values derived from it—has been given by professional educators. The American Association of School Administrators in 1940 discussed and endorsed driver-education in their Yearbook. [4] More than thirty-five states have issued some kind of course of study, teacher's guide, or instructional bulletin. The National Education Association, through its National Commission on Safety Education, has endorsed practical support to driver-education. [58]

Growth of Driver Education

Recent reports to various national organizations indicate a great deal of activity and interest in this work. Following is part of a recent report:

> One study reports that, based on miles driven per fatality, 16-year-olds have a record several times worse than drivers between 45 and 50. [5] Another, reported in Chapter II, shows that the age accident index for teenagers is considerably higher than for all ages.
>
> Information submitted by nearly two thirds of the states shows that 59 teacher-training courses, most of them for one week, were given in 1946, and that 170 such courses were given in 1947. No figures were reported on the number of teachers attending these courses, but it is assumed to be in the thousands.
>
> Various kinds of services in traffic-safety education are currently being provided by state departments of education. Some states report that department personnel have been assigned to stimulate and supervise school programs. Others issue policy statements for school administrators on such activities as school safety patrols and the use of driver-training cars not owned by schools, and publish guides, manuals, and other materials for teachers. State department personnel assigned to pupil transportation also conduct activities in traffic-safety education in some localities. [70]

A report of the National High School Driver Education Award Committee of the Association of Casualty and Surety Companies gives some additional facts about the growth in enrollment in high school courses:

> Reports from states show that over 480,000 students were enrolled in courses in the year 1948–49, as compared to 333,000 during the previous year. Of the 6,191 schools reporting courses in driver education, approximately one half included road instruction.

However, it should be pointed out that approximately 2,700,000 persons reach legal driving age each year. The schools still have a long way to go if they are to reach this great army of young people who want to and need to learn to drive.

A program including both classroom instruction and road training has already been introduced in many schools. Problems of scheduling, cost, qualified teachers, and suitable practice areas have restricted the matter of road training, so that today the majority of the high schools provide only classroom instruction.

Where this is offered, it can be made practical and of value to the student. Until road training can be offered, the schools should develop an effective classroom course.

State courses of study present comprehensive treatment of course units, methods of teaching, methods of organizing and conducting the courses, and student projects. A survey of courses providing teachers with materials and methods required for driver-instruction shows that the following are major units: [16]

—The Development and the Social and Economic Influence of the Automobile

—The Automobile, Its Construction, Operation, and Maintenance

—The Physical and Mental Qualifications of the Driver

—Psychophysical Tests for Drivers and Corrections and Compensations for Personal Limitations

—The Driver's Social and Legal Responsibilities

—The Fundamentals of Driving; Personal Traits and Operational Maneuvers

—Legal Requirements; Traffic Rules, Regulations, and the Police; Securing an Operator's License

—Sound Driving Practices in the City; Rural Driving Practices; Natural Laws Affecting Vehicle Operation

—Engineering for Safety; The Car and the Highway; Society's Safeguards; Benefits of the Safety Movement; Liability for Accidents

—The Pedestrian and the Bicyclist.

Evaluating the Results of High School Courses

At present, there are only meager statistical data concerning the comparative records of untrained and trained groups of drivers. A few studies have been made from the limited figures available from Delaware and Wisconsin, and from Cleveland, Ohio. In a Wisconsin bulletin, [95] it is stated that students having had only classroom instruction have 40 per cent fewer accidents, and fewer convictions and arrests for traffic violations than comparable groups who have had no driver education. The state police in Delaware, where the high schools offered both classroom instruction and behind-the-wheel training, compared the results of untrained and trained drivers of a recent four-year period. [58] They found that the untrained drivers had 46 per cent more

violations (accidents, arrests, and warnings) than the trained. The Cleveland, Ohio, study showed that students who received both classroom instruction and road training were involved in only half as many accidents as comparable student groups who had been given no instruction in high school.

No data exist from which to draw conclusions regarding the relative values of school driver-education programs of the following types:

1) Classroom courses only
2) Classroom courses and road training practice
3) Classroom courses and joint home-school driving supervision [95, 22]

An expression of the value and extent of the types of courses that schools provide has been set forth by the National Education Association [58]:

"There are two schools of thought regarding the extent to which high schools ought to go in providing driving instruction for their students. One holds that a course of instruction in driving should include behind-the-wheel training, accompanied or preceded by class work. Adherents to this view believe that classroom instruction in and of itself is not sufficient to enable would-be drivers to attain the competency needed in modern traffic. They feel that there is no reasonable procedure by which high school students can achieve the necessary proficiency in driving other than for high schools to provide instruction and guided practice in training cars in addition to class work. It is significant, however, that holders of this view believe it desirable for high schools to offer classroom instruction by itself, where the use of training cars is impractical at present.

"The other school of thought believes that high schools need offer only classroom instruction for prospective drivers. Those who hold this view believe that through good classroom instruction alone, students acquire knowledge, understandings, and attitudes which are necessary for successful driving, and that these are more important than developing manipulative skills in handling a car. They also point out certain practical considerations which make it difficult for many high schools to secure cars for behind-the-wheel training. Here also it is significant that supporters of the view suggest the desirability of high schools providing behind-the-wheel instruction wherever possible.

These two viewpoints are neither far apart nor fundamentally opposed to each other. Certainly in both cases the ultimate goal is the same—to equip high school students with ability to drive safely and efficiently. The principal difference in the two viewpoints concerns the means used to accomplish a common end.

Procedures in Road Training

The road-training procedure now followed in practically every school that offers automobile driving-practice is described as follows:

"Pupils practice in a car in groups of four, with an instructor. The schedule calls for a series of teacher demonstrations and pupil practice lessons. The amount of practice required to make a proficient driver varies. One of the outstanding characteristics of this system is thoroughness, the theory being that if pupils are to be good drivers, their driving habits and skills should be firmly fixed before their instruction is completed.

"When this plan of training is followed, dual control cars are used. The dual control consists of auxiliary clutch and brake pedals which enable the instructor to assume control of the car if necessary. To make road instruction practical, a practice street which presents actual driving situations is used. This street may be especially constructed for this purpose or be a street in the vicinity of the school which is comparatively free from traffic. It should be appropriately marked with crosswalks, parallel and angle parking lines, and center line. There should be a grade and provisions for right and left turns. It is also helpful to have the various types of traffic signs and traffic lights installed.

"After pupils reach a certain proficiency on the practice street, they drive on other streets in traffic, always in the presence of the instructor. The final step is a battery of driving tests which the pupil must pass successfully if he is to be given credit for completing the course." [4, p. 157]

Another driving-instruction plan is that of Chicago and Lane Technical High School [4, pp. 165–6.] Fundamental manipulations are practiced by an entire class at one time, with each student at the controls of a "dummy" or "instructo-car." After a series of lessons, students drive an automobile with little or no supervision by the teacher, on a specially designed driving course.

The "Home-School Supervision Plan" for driver-training has been used in Wisconsin, Texas, and a few other states. This plan:

. . . entails preparing and distributing to the parents of students enrolled in driver-education classroom courses a simple teaching manual containing the information needed to teach automobile driving. At the beginning of the semester a meeting is held at the school. The teacher informs the parents about the nature of the classroom traffic course and discusses the contents of the manual and the efficient teaching of driving. Following the plan outlined in the manual, the parents proceed to teach their children how to drive in the family car. At frequent intervals the teacher at the school provides demonstrations of the lessons and checks on the pupil's progress. Upon the completion of the course, the teacher tests the students'

driving ability before they apply for the official state driver-license road test.

This plan has a number of advantages. It solves for the school the financial and teacher problems of road instruction; it places a definite responsibility for safety upon the parents; and of major importance, it brings safety education directly into the home. The plan is only experimental at present and will obviously be displaced as schools assume a greater responsibility in providing actual driving experience for students. [85]

Cost of Driver Training

While progress has been made in providing road-instruction through schools, it is not difficult to understand why no more than a thousand schools offer this phase of driver-education. The pupils-per-teacher ratio and the per-pupil cost is relatively high in comparison with classroom instruction.

These factors and problems involving insurance, liability, training areas, and the acquisition and maintenance of training cars have served to retard the growth of road instruction. Yet the cost of training drivers that looks impressive at first glance, is in reality small in comparison with revenues derived by the state from the use of motor vehicles.

In 1941, DeSilva [22] pointed out that:

> In one year the number of new drivers applying for a license amounts to about one tenth of the total number licensed. In a state like Connecticut with approximately 450,000 drivers, the number of newly licensed drivers comes to about 45,000. But since in Connecticut about half of the new applicants for a license are already experienced drivers, the number who require training comes to approximately 22,500. At $15 each the total expense to the State of Connecticut to train its crop of beginner drivers would be $337,500. Although the third of a million dollars sounds like a great deal of money, it actually comes to only one fifth of the amount collected annually by the State Motor Vehicle Department for operators' and chauffeurs' licenses, or one twelfth of the money collected for registration of vehicles, or one twentieth of that collected for all the state's motor vehicle and driver fees and receipts.

Another pertinent point of view regarding the cost of high school driver-education courses is included in the previously quoted publication of the National Education Association [4]:

> "The question 'Can we afford to teach high school students how to drive?' is no longer relevant. With high-school-age drivers continuing to pile up the worst accident record of any age group, the truth is that we can no longer

FIGURE 8. Measuring Skid Marks in Driver Education at the Colorado College of Education

Courtesy of the Center for Safety Education, New York University

FIGURE 9. Behind-the-Wheel Instruction in a High School Driver Education Course

afford to withhold driving instruction. *The money lost through motor vehicle accidents in one year would pay for teaching over forty million persons how to drive safely and efficiently!*

"A complete one-semester course of instruction in driving, consisting of both classroom work and behind-the-wheel training, costs not more than $30 per student, and often much less. A good class-room course in driving can be provided by any high school at little added expense.

"There are approximately 25,000 public high schools in the United States with a combined enrolment of nearly eight million students. While 65 per cent of these high schools have enrolments of less than 200 students each, the combined enrolment of these small high schools is only 20 per cent of all students enrolled in public high schools. Most of them begin driving while in high school or within a few years after graduating.

"Is it unreasonable to hope that thousands more high schools will soon join the hundreds of small and large high schools now teaching our young people how to drive safely and efficiently?"

Attitude Improvement

Enforcement officials, educators, and others have asked that instruction for drivers be organized so that more emphasis is placed on *good driver attitudes*. While state courses of study and various teachers' manuals also call for such emphasis, they usually provide only a limited amount of practical assistance to the teacher for the attainment of this objective.

To provide instructional materials specifically designed to assist in the improvement of attitudes, the Center for Safety Education of New York University has recently issued a new manual for teachers. This provides a series of lessons for use in attitude-development in high school driver-education classes. [17]

EDUCATION FOR ADULTS

High school driver-education courses alone will not meet the driver-education needs of a community. To train the adults of a community who are in attendance in a high school, it will be necessary for the community to organize and conduct special courses designed to meet their needs. At present, privately owned and operated commercial driver-training schools are training only a small number. Some of these schools do an adequate job; others provide instruction of dubious quality.

Courses for adults are usually operated by local agencies (with or without the participation of schools and colleges) or by state agencies, on a non-profit basis and as a public service.

Examples of Adult Driver-Education Programs

A number of communities and states had initiated adult driver-training programs prior to the outbreak of World War II. In some cases, these were financed through arrangement with the then-active Works Progress Administration. In most cases, however, they were operated and financed solely by local communities. According to *Safety Education* [4], instruction was available throughout Pennsylvania and in Detroit, and Minneapolis. "Traffic schools" or "traffic violators' schools" were conducted in Evanston, Illinois; in San Francisco, Berkeley, San Diego, Tracy, and Piedmont, California; in St. Louis, Missouri; Wichita, Kansas; Detroit, and Milwaukee. Certain other cities offered instruction also.

Types of Adult Driver Education

Adult driver-education, such as the program in Pennsylvania, makes training available to adults who have had no driving experience. The program as established was not designed to provide a form of education or reeducation for the poor or inexpert driver who possessed a license already, nor for the traffic violator. The Pennsylvania Motor Police summarized the data for the schools in that state as follows: [4, p. 205]

Number of schools in operation	51
Number of leaders employed in schools	234
Number of leaders trained during four statewide institutes (the other leaders have been trained while in service; the 81 represent preservice training)	81
Number of automobiles contributed to the schools	75
Value of the automobiles contributed, approximately	$60,000
Enrolment in the schools May 1939	2,800
Number of graduates	4,100
Current registration waiting for enrolment	5,000

Courtesy of the Center for Safety Education,
New York University

FIGURE 10. Adult Driver Education Courses Can Raise the Level of Safe Driving in a Community

Courtesy of the Center for Safety Education,
New York University

FIGURE 11. Training for the Three E's at a Traffic Institute

The Pennsylvania Motor Police reports that out of the 4,000 graduates, twenty-one have been involved in minor accidents. Out of the twenty-one, eight have been responsible for the accidents, the other thirteen have been absolved from all responsibility. All accidents have been minor, with only property damage resulting.

In 1948, a program for beginners was set up in California. Organized by the Adult Education Section of the Los Angeles City Schools in cooperation with the Division of Drivers' Licenses of the State Department of Motor Vehicles, the instructional offerings are designed to prepare the enrollee for the driver's license examination. According to a bulletin announcing the program, two courses are offered. Course A is for adults interested in preparing for the driver's license examination and consists of a series of four meetings. The following topics are discussed:

1. Safe Driving Based on Motor Vehicle Laws
2. Driver Examining and Licensing
3. Accident-Prevention Measures
4. Sound Driving Practices

All Course A meetings are held on Monday and Wednesday evenings from 7 to 9 at evening high schools. Course B is for adults who do not read the English language and who are also interested in preparing for the driver's license examination. This course consists of a series of six meetings, at which the following topics are discussed:

1. Safe Driving Based on Motor Vehicle Laws
2. Characteristics of Streets and Highways
3. Sound Driving Practices
4. Accident-Prevention Measures
5. Police Regulation of Traffic
6. Driver Examining and Licensing

All Course B meetings are held on Tuesday and Thursday evenings from 6:30 to 9:30, also at a number of schools.

There is no tuition fee for either course. Certificates of completion are issued to students who successfully complete the courses. Neither course results in the issuance of a driver's license, but the certificate may be used as evidence of training

when applying for the license. Both courses are proving successful and may grow, under state sponsorship and local support, into a statewide program.

With regard to courses in driver education for nonschool adults, many traffic safety experts have expressed the opinion that:

1. A program of adult driver training should be encouraged and initiated by the State Department of Education as a portion of its activities, and the Department of Education should consider the training, or the guidance of the training, of adult drivers as its responsibility

2. Adult driver training should be made available on a statewide basis to all those who are eligible for drivers' licenses but who are not eligible for driving courses in high schools

3. Whenever possible, teachers of adult drivers should be obtained from the trained teaching personnel of public schools. Additional personnel who can be utilized to teach or assist in teaching are:

   a. Traffic police, and motor vehicle department personnel
   b. Personnel of automotive distributors
   c. Members of civic groups, such as the American Legion, Red Cross, etc.

4. For the untrained teacher it is suggested that a booklet be used as a basis for instruction

5. Public facilities should be used as far as possible. Classes may be held in high schools at night or on Saturdays

6. All possible channels of communication should be used, such as press, movies, radio, etc., to reach adults and advise them of the existence and value of the available driver-training courses.

Another type of adult driver-education course is the traffic violators' school or traffic school. While the nature of such schools varies in some details, such as organization, administration, and instructional procedures, *their general purpose is educational rather than punitive,* and all of them provide similar content through selected traffic-safety lessons. In the various schools, em-

phasis is placed upon driver limitations and corrective action, principles of safe driving, rules of the road, traffic ordinances, automobile safety equipment, and other topics of importance in safe driving.

In the Milwaukee, Wisconsin, Traffic Violators School . . .

> . . . accident-drivers are taught technic and civic responsibility, all phases of traffic problems are studied, and attempts are made to correct mental attitudes of drivers. The privilege of attending traffic school in preference to paying a fine is extended by the judge of the traffic court to those offenders who may reasonably be expected to profit more by instruction than by a money penalty, and to many of those who would find it necessary to serve out a moneyed fine by remaining in jail. The convicted offender is regularly sentenced and paroled on condition that he complete the traffic school course. Failure to attend without tardiness or to complete the work properly results in returning the offender to court for the revocation of his parole. In the beginning only first offenders were permitted to go to the school, but some persistent violators are now enrolled, in the court's belief that proper instruction is more effective than punishment in correcting a wrong driving attitude.
>
> The following is a brief outline of the lectures: the public's responsibility in accident prevention; rules of the road and traffic laws; proper turning movements and signals; pedestrian versus motorist; safety maintenance of motor vehicles; enforcement of speed laws versus injury accidents; and the man behind the wheel. [4, p. 203]

Specialized Adult Driver Training

The expanded American Army required by World War II and the high degree of the Army's motorization focused attention on the need for wartime driver-training. The invasion army on the Normandy beach-head was equipped with one piece of motorized equipment for every five men. Obviously, a broad driver-training program was required to prepare men who would be qualified to handle this specialized equipment.

Such a program was initiated and improved after Pearl Harbor. It resulted in training approximately 2-million competent motor vehicle operators. A War Department technical manual [91], issued in 1942, provided officers and instructors with lesson materials and procedures needed in organizing and teaching driver-training. A driver's manual [92] was issued to military personnel concerned with motor vehicle operation.

The general content and procedures of the wartime courses for military motor vehicle operators is followed today, with variations and adaptations, in the training program of the Department of the Army. In addition, civilian and military personnel who have been assigned responsibility for traffic safety receive special instruction in traffic-accident prevention and driver training at Army-conducted courses.

Commercial Vehicle Operators

Owners and operators of commercial motor vehicle fleets early recognized the importance of driver-education and training. Usually organized by individual companies, instructional programs in the last fifteen years have served as a major factor in the up-grading of driver-performance, in the increased efficiency of personnel, and in the material reduction of accidents.

A number of truck and bus companies have enjoyed these benefits, mainly as a result of their driver-education and safety programs. [57] College-conducted courses sponsored by the member organizations of the National Committee for Motor Fleet Supervisor Training resulted in more than 3100 fleet executives and supervisors, who control more than 460,000 drivers, attending supervisor training courses in the three-year period—1944 through 1947. [9] The major part of the Committee's recommended "standard" course is devoted to problems of driver-selection, training, and testing.

Such supervisor training-courses have been established at thirty colleges and universities throughout the country. They represent a successful nationwide effort to substitute systematic training for fleet supervisors (who in turn train drivers) for older trial-and-error methods.

The aims of a company-conducted training course for drivers have been stated in *Safety Supervision in Motor Vehicle Fleets* [9] as follows:

1. To eliminate the old "hit-or-miss" method of handling new drivers and supersede it with intelligent effort and activities designed to select and train an individual for the position to be filled

2. To make the driver aware of his responsibility to himself, to the organization employing him, and to other users of the highway
3. To acquaint the driver with the results of his tests in order that he may correct or compensate for any personal deficiencies that affect his driving
4. To acquaint the driver with safe driving practices, rules of the road, use of equipment, and other important factors related to safe driving.

Courses given by various firms run from ten to thirty hours. To this must be added time for actual road-training. The time given to behind-the-wheel instruction varies in accordance with the trainee's rate of learning, previous driving experience, and other factors. Following is a suggested [9] listing of topics for the classroom phase of a twenty-hour driver-education course:

Unit	*Topic*	*Suggested Time in Hours*
1.	The Role of the Commercial Vehicle in America's Transportation System; Traffic Accidents and Safety	2
2.	Driver Characteristics and Abilities and Their Effect on Driving	4
3.	Motor Vehicle Construction; Special Company Equipment	2
4.	Vehicle Preventive Maintenance and Equipment Conservation	2
5.	Elementary and Advanced Driving Principles and Techniques	4
6.	State, Local (and Federal) Rules of the Road	2
7.	Company Regulations; Accident Reporting; Forms and Records	2
8.	Fire Fighting and Fire Prevention	1
9.	Customer Relations; Passenger Handling (Buses)	1
	Total	*20 Hours*

In a number of fleets the training of drivers is not confined to new employees only. Special short-courses or refresher meetings are provided for drivers long in the service. In some organizations, individual instruction or guidance is given to those employees who have more than their share of accidents.

Other Activities

Various city government bureaus have conducted instructional programs for their vehicle operators. Organizations such as the

American Red Cross and the American Women's Voluntary Services have also provided driver-training courses. Such activities, and the specialized training given by the Army to drivers with physical handicaps, have all contributed to the improvement of the driving population.

PUBLIC INFORMATION AND PUBLIC EDUCATION

Training activities of schools and transportation agencies reach only a relatively small number. To achieve real effectiveness, they must be supplemented by broad education of the public, as well as by the support of the public at large and drivers and walkers in general. This is recognized in the various reports of the President's Highway Safety Conference.

Communities are urged to utilize to the fullest possible extent the resources of their city and state, and to marshal the strength of civic and patriotic groups and Governmental agencies. One of the reports [70] shows increased activity in this regard and emphasizes the further use of media, such as (1) competent personnel to organize and conduct programs, (2) the press, (3) the radio, (4) films, (5) safety meetings, (6) distribution of traffic ordinances, (7) other useful media.

The National Committee for Traffic Safety is presently serving as a means through which the collective efforts of its eighty-five member organizations may be guided in the interest of securing increased public support and an increased and more effective education of the American public. The Committee has coordinated for maximum usefulness this large number of national organizations which conduct programs varying in degree of activity.

Present Trends

Many national organizations are conducting public-education activities of a high standard. Magazines that enjoy a national circulation are making noteworthy contributions to safety. Many capital stock-casualty insurance companies circularize their assured with literature that deals with safe driving. Support has

been enlisted among advertisers through various media, such as The Advertising Council. Broadcasting networks, local newspapers and newspaper chains, motion pictures, and other information media are giving encouragement and assistance to local programs of public-safety education.

While these activities (increased in intensity and scope since 1946) constitute significant progress, an important point included in a guidebook [28] for state and civic officials should be noted:

It should be emphasized at the outset that *long-term planning* and *continuous action* are necessary to get results. There should be a division of responsibility. . . . From an analysis of reports that have been studied . . . there are certain types of activities that are most frequently followed. These are listed . . .

1. Systematic releases to newspapers
2. Radio programs
3. Distribution of publications, tests, brake inspection leaflets and the like
4. Motion pictures and sound slide films
5. Posters, charts, and photographs
6. Exhibits, demonstrations, clinics, vehicle inspection lanes
7. Safety conferences
8. Schools for drivers—voluntary; for violators; for drivers of commercial vehicle fleets
9. Talks at civic, fraternal, and other community organizations.

The National Safety Council has been especially active in this field, particularly in connection with the national program, "Operation Safety."

SUMMARY

America's drivers are largely a product of inefficient trial-and-error training. Limited evidence shows that efforts to reduce accidents through organized driver-instruction is encouraging.

The greatest single advance in driver instruction has been the inclusion of both classroom instruction and behind-the-wheel training in the curricula of secondary schools. The acceptance of this subject by the schools has been slow, but indications are

that the number of schools offering such instruction will increase rapidly.

To achieve accident reduction on a broad scale through training, adult education of nonschool people cannot be neglected. Only limited progress has been made in this area.

Community organizations can aid driver-education programs by supporting public-education activities in various practical ways.

The major objective of driver education is to develop in drivers the skills and attitudes necessary for safe and efficient use of motor vehicles. Education provides a means by which the decision-making abilities of the man behind the wheel may be relied upon for accident prevention.

CHAPTER X

SUMMARY AND RECOMMENDATIONS

Preceding chapters have presented an overview of certain current practices, environmental conditions and psychophysical traits that impinge upon the driver and influence his safety on streets and highways. Research findings and other data have been cited. Suggestions have been made for further research and also for a widespread application of certain principles and practices demonstrated as effective in reducing traffic accidents. The purpose of this chapter is to present a general restatement of certain major considerations and various recommendations.

Practical techniques and guiding principles for the reduction of highway accidents have been developing steadily for over two decades. With the exception of a few isolated areas, however, the country as a whole has not used to best advantage the knowledge and experience presently available. This may be due partly to the fact that the American people and their leaders have been slow to recognize the magnitude of economic and social losses from accidents. America's increasing dependence on motor transportation and the great losses incurred by accidents have resulted, in the last few years, in greater appreciation of the severity of the highway accident problem and a heightened awareness that something must be done to reduce this waste.

The President's Highway Safety Conference, first convened in 1946, is a good example of this. Officials of concerned agencies of municipal, state, and federal governments, leaders in various fields of traffic safety and key personnel in allied organizations concerned with the public welfare combined forces to devise a plan for nationwide action by which traffic accidents could be reduced. It is not likely that a traffic fatality rate reduction of 16.5 per cent would have been recorded for the first year following the President's Conference had not the program been acted upon on the state and local level and if the people in the country had not been willing to cooperate. Perhaps the reduction would

have been greater if more vigorous action had been taken in some states on the recommendations made by the Conference.

Assuredly, it is time for safety leaders and public officials to turn to the findings of traffic safety research and to analyze carefully the values and utility of available data. Further, of major importance to continued progress, is the application of research findings in the field for the solution of important problems. A logical and valuable function of officials, whose chief concern is accident prevention, is the analysis, evaluation, and application of all valid research findings in terms of need.

ACCIDENT STATISTICS

As they are collected and reported today, accident statistics provide only a limited basis for the planning of scientific accident prevention programs. Obviously, a fundamental need in any efforts designed to prevent accidents is adequate and sound knowledge of *what, where, when, how,* and of the greatest importance, *why* accidents occur. At present, adequate data of such reliability are not available from many cities and states.

In order to be of genuine value in the planning of accident prevention programs in relation to driver improvement traffic accident statistics must be:

1. Based on a large enough sample of accidents to give a true indication of prevailing conditions
2. Uniform with respect to (a) report forms used, (b) methods of collecting and recording data, (c) method of analysis of data, (d) method of filing and handling reports
3. Complete—a report should be filed for every accident as required by law
4. Readily available from a central state bureau for those agencies having a need for such data
5. Used for special studies to determine those areas which need attention
6. Conform to national standards.

These basic recommendations, to which others could also be added, form a nucleus around which an adequate accident record system may be built.

Additional recommendations given below are designed to aid in achieving a practical and useful accident records system:

1. Require that reports on property damage accidents receive the same treatment as reports on death and injury accidents
2. Rigidly enforce laws requiring certain types of accident to be reported
3. Centralize accident record bureau in both cities and states
4. Provide a sufficient number of adequately trained personnel with the proper equipment and facilities to insure a thorough and rapid processing of reports as they are received
5. Make accident facts readily available to enforcement agencies, educators, engineers, motor vehicle and financial responsibility administrators, and other interested public and private individuals and groups.

Too frequently accident records are considered as merely a by-product of safety work, or as material with which to amplify reports. The *true* function of such records is their use in the guidance and evaluation of safety programs and activities. Regardless of whether a projected effort concerns education, enforcement, engineering, or legislation, accident facts should *lead* and not follow a safety program. Through the intelligent use of facts, it is possible to have not only selective enforcement, but also selective engineering and education, thus striking at accidents where action is needed.

PSYCHO-PHYSICAL TESTS

A driver's ability to compensate for his psycho-physical limitations is a major factor in determining his driving performance. Investigators have found varying degrees of relationship between certain psycho-physical characteristics and a person's ability to drive safely. This makes such psycho-physical tests valuable as driver selection aids. In addition, they contribute materially to driver education programs. Kramer [9] has summarized these values in the following statements:

1. It is desirable to use certain psycho-physical testing devices and the data obtained from their use in a program of driver selection and driver education.

2. Data obtained from tests can be used to make drivers aware of their personal weaknesses so that remedial training, compensation, and correction can be initiated and practiced.
3. Data derived from psycho-physical tests have value in the selection of drivers, but the value of a testing device or a battery of devices is limited, providing only a partial inventory of some of the characteristics and aptitudes that are related to safe driving.
4. Certain psycho-physical testing devices can be used to secure valid data for use in selecting drivers. Others should be used for their educational value.
5. In driver selection, psycho-physical tests are only one factor, although an important one, in securing a comprehensive inventory of the driver's personal characteristics.
6. The values and limitations of each device in the battery of tests should be understood in terms of its validity and reliability and the relationship between the trait it measures and safe driving.*
7. In the selection of drivers, data secured from the use of psycho-physical tests should be evaluated with regard to other significant factors which also serve to provide a picture of driver characteristics. Such factors—and these definitely should be utilized in a comprehensive program of selection—include ratings of the driver's general health, age, physical condition, attitudes, driving skill in traffic, driving experience, literacy, accident record, and knowledge of traffic rules.

As stated above, psycho-physical tests can make an effective contribution to driver selection and education. In the case of attitudes which are not easily changed, such tests are of assistance in making drivers aware of the fallacy of some specific ideas which form the basis of certain undesirable attitudes. For example, if a driver believes he can "stop on a dime," but is shown that he cannot, through the use of the brake-reaction and stopping distance test, he will tend to have a more realistic attitude toward lower speeds and adequate following distances.

Experience has shown that psycho-physical testing devices can be used to advantage by:

1. Motor vehicle administrators—in licensing, reexamination programs, and clinical correction programs
2. Enforcement agencies—in educational programs for their psychological influence and not as a basis for conviction

* For example, it is interesting to note that, contrary to popular belief, there is little evidence to substantiate the use of color vision tests as a tool in driver selection.

3. Educational institutions—in universities for research purposes and for teacher training in safety; and in high schools for driver instruction
4. Commercial vehicle and public carrier operators—as an aid in driver selection and examination, and in driver education programs.

PERSONAL QUALIFICATIONS OF DRIVERS

Of the many elements that comprise the driving environment (driver, car, road, and traffic situation) *the driver is least predictable and most difficult to influence.* If accidents are to be controlled, driver selection procedures and the imposing of restrictions must be based on the driver's physical, mental and emotional qualifications.

Article II of the Uniform Vehicle Code places certain general restrictions on the granting of drivers' licenses. There are several terms in this Article such as *habitual drunkard, mental disability,* and *good cause* which need to be rigorously defined. For example, *good cause* to one licensing authority may seem to be quite inadequate cause to another. Restrictions placed upon drivers should be uniform within a single state and also between states.

Special attention in the licensing and selection of drivers should be directed toward persons with:

1. Physical handicaps which influence their ability to drive safely
2. Organic diseases or handicaps which may, without notice, incapacitate a driver
3. Insufficient education or mentality to read and understand the meanings of regulations and signs
4. Emotional instabilities
5. A record of habitual drinking, use of narcotics, or other drugs
6. Anti-social and hazardous attitudes.

The major problem of dealing with these people has three aspects: (a) identifying the individual; (b) proving the existence of a limitation and that it influences the individual's ability to drive; and (c) correction of the defect or, if that is impossible, restriction of driving privileges to the degree required. The solution of the problem poses certain difficulties but can be achieved

if enough effort and cooperation are put forth. Some of the corrective actions which need to be taken include:

1. More careful discrimination in the licensing of drivers
2. Detailed follow-up on persons with poor accident and violation records
3. Cooperation from physicians and other pathologists in the matter of both advising patients of the degree of their mental and physical capacity to drive and reporting to licensing authorities any serious cases that come to their attention. This latter function would serve to protect the public much in the same way as does the reporting of communicable diseases to public health authorities
4. Inauguration of schools for adult drivers under a state or community educational program
5. Use in more communities of driver clinics for the detection and treatment of drivers needing improvement
6. A greater recognition of and reliance upon chemical testing as a tool in the identification and conviction of drinking drivers
7. Directed attention and activity on the determination and improvement of specific attitudes which influence driving acts by psychologists, educators, motor vehicle officials, employers of drivers, and others.

CHRONICALLY POOR DRIVERS

Drivers with a long history of violations and accidents are responsible for a disproportionately large percentage of traffic accidents. Such drivers may be thought of as "sick" because they are suffering from physical handicaps, or from mental or emotional disturbances. While courts and motor vehicle departments could suspend or revoke the licenses of such people, corrective measures should be exhausted before resorting to punitive measures. This is not to infer that no correction should be attempted through punishment if corrective measures are not available.

Driver clinics for the detection and treatment of the chronic violator and the accident repeater can be of value to:

1. Driver licensing departments—for use in the examination of new applicants and the reexamination of experienced drivers
2. Commercial fleet operators—for use in the selection of new drivers and the education of all drivers
3. High school driver training classes
4. Municipalities—for the correction of repeaters and for use in programs of public education.

Care should be taken not to lose sight of the *educational* value of driver clinics. Individuals who are tested in clinics are not the only ones who can benefit thereby. A community-at-large can display a higher level of general interest and cooperation in safety if the clinic and its values are given wide publicity. The impression should not be created, however, that individuals attending the clinic are the only ones who need to be or can be improved! A more positive and helpful attitude to develop regarding the clinic is that *all* drivers wishing to cooperate in the community safety program can do so by going through the clinic. In this way a stigma will not be attached to drivers who are tested, as has been the case in some other types of driver improvement programs.

DRIVER EDUCATION

Education is the means by which, as a result of influencing desirable driver behavior, accidents can be reduced. Education for safety can be accomplished by programs carried on in:

1. Public schools—through the instruction of young drivers and by means of courses in adult driver education
2. Commercial fleets
3. Public education (non-school)—through radio, moving pictures, and the press.

Schools of each community should conduct a comprehensive program of safety education designed to meet present needs. These include:

1. Elementary education—emphasis throughout the curricula to provide learning experiences which will help the child to live safely; the development of knowledge and attitudes which will help him to be a safe pedestrian and, in later years, a safe driver
2. Secondary education—a continuation of the development of skills and attitudes started in earlier grades; providing for driver education and training courses
3. Education of adult drivers—night courses for professional drivers given under the auspices of the city or state adult education program; adult-driver instruction courses for private passenger car drivers conducted as a part of a city or state adult education program.

A carefully coordinated and continuous program of mass education should be conducted and directed toward the elimination of traffic hazards in the community. Activities of the press, radio, television, motion pictures, outdoor advertising, hand bills, public speakers and circular letters should be guided and coordinated by the local safety council, governmental agency or other responsible organizations. "Operation Safety," a country wide program initiated by the National Safety Council in cooperation with many traffic safety agencies, is an excellent example of a coordinated mass safety education program.

Community safety needs can be met to some extent by presently available facilities, and by the relatively small corps of professionally qualified safety personnel. Accelerated and intensified programs of safety will require an increased number of trained persons. Colleges and universities must assume the major responsibility for the preparation of teachers, traffic engineers, safety technicians and others needed for the organization and administration of programs of traffic accident prevention. They should provide college level credit courses for teachers and school administrators, institutes and seminars for professionals-in-service, graduate curricula and research programs, and for the development of instructional aids for schools, government agencies, and industry.

One major problem which hinders progress should be noted here. Administrators in colleges and universities have been slow to establish safety curricula in their institutions because they say there is not a sufficient demand for such training. On the other hand, professional safety people sometimes say that interest in such training is only mild because of either limited course offerings or none at all. In this case, and since there *is* a need for professionally trained safety people, both leaders in higher education and safety personnel should make a definite effort to develop both instructional programs *and* a desire to enroll in the courses. The release of articles to professional and trade journals, the inclusion of "open letters" in college papers, and the establishment of scholarships and fellowships for qualified individuals are just a few ways to stimulate interest in safety training.

Legislators and governmental bureau have a special responsi-

bility in public safety education. While an educational program of high merit and wide coverage may appear to be perfect on paper, it will never be of value without official support, qualified personnel, and a budget with which to operate. Taxes on motor vehicle owners and users are high, but only a small percentage of these funds are used for the specific purpose of highway safety. More efforts should be expended by legislators and officials to secure funds that can be made available for the programs of schools, departments of education, driver licensing departments, enforcement departments, statistical departments, research organizations, official safety councils, and for driver clinics. These agencies require more than funds. They require wholehearted support and cooperation.

As a weapon against accidents, education is a powerful and versatile tool; when considered in relation to its total potential effects, it has scarcely been used.

DRIVER LICENSING

The licensing of drivers is one of the more important controls that a state can exercise for highway safety. Most states, however, do not utilize this power to maximum advantage. The granting of licenses to drivers can be used to achieve the following objectives:

1. The selection of drivers who have adequate knowledge, skill, and physical and mental capacity to drive safely on the highways
2. The suspension or revocation of the privilege to drive for those who have demonstrated their inability or unwillingness to drive safely
3. The periodic reexamination of all drivers to insure their continued ability to meet the minimum safety requirements
4. The preparation of drivers, through study and road practice, to successfully pass a license examination.

It is generally admitted in many states that these objectives are far from fully realized. Even those states with the best programs feel that considerable improvement is needed. A shortage of funds for personnel and equipment is striking in all the states. Additional moneys can be made available through a number of media. One method often suggested is the charging of a license

fee sufficiently large to defray the expenses involved in an adequate licensing system.

The functions and activities entailed in a sound driver licensing system usually includes the following:

1. Examination of new applicants for licenses
2. Periodic renewal of licenses and periodic payment of fees
3. Centralized administration of licensing
4. Discretionary suspension of license when licensee's driving record warrants such action
5. Mandatory revocation of license by department when warranted
6. Restrictions upon a licensee "for cause" by department
7. Reexamination of all drivers with bad records
8. Parental consent and responsibility for minors
9. Minimum age limit for drivers
10. Instruction permit for beginning drivers
11. The maintenance of adequate records.

The adoption of such standards is necessary for national uniformity and safety. They are particularly important in states where licensing laws permit administration, local examiners, good-until-revoked licenses, inadequate fees, and limited suspension power.

There is a great need for higher standards in the selection of the personnel whose responsibility it is to administer the driver license laws. An increase in the effectiveness of examining personnel can be had through providing: (1) adequate time and equipment for the examination; (2) in-service training and intensive courses of a technical nature; (3) refresher seminars for experienced personnel; (4) personnel selected on the basis of technical qualifications rather than political affiliations; and (5) a sufficiently high salary and provisions for increases in order to secure and retain persons of competency.

ENFORCEMENT

As a means of driver control, enforcement is presently used more than any other method. Enforcement has tended to prove effective to the degree to which (1) it is used for educational as well

as punitive purposes; (2) it initiates efforts to correct the driver; (3) it is consistently applied; (4) it is uncorrupted by political interference; (5) it follows "selective enforcement" techniques; (6) it utilizes trained personnel.

Police organizations and bar associations have recognized the need for more uniform enforcement procedures and equitable and consistent convictions. The International Association of Chiefs of Police have made certain basic recommendations relating to this matter. They are: (1) give no special privileges to any group or individual; (2) put enforcement on a selective basis as indicated by an objective analysis of local needs; (3) assure sufficient enforcement action so that adequate control is maintained at all times over violations; (14) avoid "arrest quotas," "campaigns," and a disproportionate number of arrests for non-hazardous violations; and (5) provide special training for traffic officers.

The courts have an opportunity to be of great service to the cause of traffic accident prevention by taking advantage of every contact with violators and the general public to instill those attitudes that will improve driver behavior on the highway. Specific recommendations that will assist in the realization of this goal include:

1. Specially qualified prosecutors for handling traffic cases
2. The use of procedures which insure the proper disposition of the case, and eliminate the practice of "fixing"
3. Qualified judges to handle traffic cases in special traffic court sessions
4. The consideration of each case in the light of previous traffic convictions with an aim to helping the individual correct his difficulties rather than merely to guide in the imposition of punitive measures.

The traffic officer, the prosecutor, and the judge are in an ideal position to help reduce traffic accidents and improve driver attitudes. More than anyone else, enforcement officials are in touch with those drivers who cause trouble and need help—the violators. The importance of the outcome of his situation, his emotional involvement, his desire to lessen the penalty, and his wish to appear to be "good" are all factors which put the violating driver in a receptive mood for education. Such a situation lends

itself well to teaching and to learning and consequently should be utilized.

ENGINEERING

It has been said that, generally speaking, highway design and traffic control devices cannot appreciably improve attitudes. On the other hand, they can be a contributing factor in the formation of bad attitudes. For instance, narrow, two-lane, heavily-traveled roads can serve to irritate a motorist to the point where he will assume risks in passing that he would not take on roads of better design. This same example may be applied to signals, stop signs, warning signs, and other control devices.

A well engineered roadway will provide for the efficient, fast, and safe movement of traffic. Signs and other controls should be designed and placed in such a way that they contribute to the motorist's ability to use the road. Signs which cannot be clearly understood, warning devices placed too close to the hazard ahead, and confusing roadway patterns, and other factors, actually contribute to driver delinquency rather than to safe driving.

Greater cooperation is needed between highway architects, traffic engineers, safety people and psychologists to insure that highways of the future will be designed and marked so that they serve effectively as aids to safe driving. Increased funds and trained personnel are needed to assure progress in traffic engineering. Trained traffic engineers should be employed in greater numbers by city and state governments.

RESEARCH

A great deal of emphasis has been placed upon the need for research. In every area of traffic accident prevention, progress has been delayed by lack of facts. While a few research efforts of an intensive kind have been made, for the most part, research activities have been limited in scope by lack of funds, facilities, and personnel.

Through research, manufacturers and engineers have incorporated many features of safety in the automobile itself; many thousands of studies conducted on road construction and main-

tenance have resulted in greater safety on highways. However, relatively little has been done to determine the basic factors and influences which govern the behavior of the driver. This most important element calls for a great deal of research to the end that progress may be made in improving driver behavior. Past studies, unfortunately, have not penetrated deeply enough into the problem and thus have proved to be only of limited value. *Many of the problems involved in the field of driver behavior are of such magnitude as to require the organized effort of a variety of scientists and research specialists.* An extended research program is needed which would be carefully correlated with needs in the field. Individual problems should be dealt with both extensively and intensively—extensively enough to insure a sufficiently broad basis for the justification of stated conclusions, and intensively enough to provide practical solutions which will be readily applicable to problems in the field.

Inadequate and isolated efforts in safety research need to be replaced with a strong, vigorous attack which is appropriate to the serious nature of the problem and which is commensurate with the wealth and energy characteristics of our society.

* * * * *

Highway safety can be achieved only through cooperative efforts. This has been stressed in the *Inventory and Guide for Action* [70] report of the 1948 President's Highway Safety Conference:

"A Challenge to Every Citizen

It has been said—and proven many times—that a city or a state can have as much safety as it wants and is willing to pay for.

Part of the payment is, of course, money. Funds are required to provide the trained personnel, the equipment and the other facilities essential to an effective program. Not nearly enough money is available although these are expenditures which pay huge dividends, in direct economic savings, and human life and limb.

Money is only part of the price. Each community and state must also purchase accident reduction with time and energy; the time and energy of civic leaders, of public officials, of men and women in every walk of life. There is a place for everyone in the highway safety movement—and everyone is desperately needed."

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