POLICE ENFORCEMENT PROCEDURES FOR UNSAFE DRIVING ACTIONS. VOLUME I: SUMMARY

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December 1980

Prepared for
U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

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This volume is one of a three-volume final report prepared under this contract. The other volumes are: *Volume II: A Review of the Literature* and *Volume III: Field Studies.*

16. Abstract

This volume presents the major findings of the literature-review, telephone-contact, and site-visit activities that were carried out in the course of this study. It places police enforcement practices in a risk-management context and presents operational definitions of the unsafe driving acts (UDAs) of speeding, following too closely, and driving left of center. The primary focus of this study is the speeding UDA.

This review summarizes current police deployment, surveillance and detection, apprehension, and presanctioning/sanctioning practices related to speeding; makes recommendations concerning specific aspects of police procedures directed at speeding; and explores both enforcement and nonenforcement approaches to the management of the speed UDA.

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Kent B. Joscelyn, J.D.
Principal Investigator

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Principal Investigator

CONTENTS

CHAPTER ONE
INTRODUCTION

This report presents the major findings of a study of "Police Enforcement Procedures for Unsafe Driving Actions." The study was conducted by staff of the Policy Analysis Division of the Highway Safety Research Institute (HSRI) of The University of Michigan under the sponsorship of the National Highway Traffic Safety Administration (NHTSA) under contract number DOT-HS-8-01827. Two other reports present more detailed information. These reports are:

- Volume II: A Review of the Literature, and
- Volume III: Field Studies.

The study examined police enforcement strategies and tactics for three unsafe driving actions (UDAs): speeding, following too closely, and driving left of center. As the study progressed, the speeding UDA became the primary focus of the study. Thus, speeding and the police response to this unsafe driving behavior are treated in greater detail in these reports than the other UDAs.

OBJECTIVES

The general objective of this project was to identify and assess police enforcement strategies and tactics for reducing the incidence of speeding, following too closely, and driving left of center.

Specific objectives were to:

- collect, collate, and analyze published materials describing police enforcement procedures directed at violations of laws pertaining to the three subject UDAs,

- document current procedures for enforcing applicable laws on these UDAs to validate data from the literature search and to identify new information not reported in the literature,

- describe in more detail enforcement procedures for the speed UDA in several police agencies at the state and local levels of government, and

- synthesize the results of all the information collected into a series of recommended police enforcement practices under current and future conditions.

Volume II, A Review of the Literature, presents the results of project activities performed in accomplishing the first specific objective. Volume III, Field Studies, contains materials needed for accomplishing the second and third specific objectives. The present volume summarizes the findings and recommendations developed in accomplishing the last specific objective.

BACKGROUND

Studies that have examined traffic crash causation have consistently shown that unsafe driving actions (UDAs many of which are expressly prohibited by traffic laws) are a major cause of traffic crashes. NHTSA, as part of a broad research and action program to reduce the traffic crash risk, has sponsored a series of studies to identify the risk associated with unsafe driving actions and to develop methods to reduce their occurrence. Unsafe driving actions that occur frequently, are involved in serious crashes, and appear to result from driver decision-making, were established as a priority for early study. The premise was that reduction of the incidence of such actions should reduce the overall crash risk. Further, acts that flowed from deliberate driver decisions should be more susceptible to intervention through safe driving conformance strategies including police enforcement, than non-deliberate acts committed by a driver.

Earlier studies (Hiett et al. 1975) developed initial definitions of unsafe driving actions. Other studies (Lohman et al. 1976) attempted to assess relative priority among the various unsafe driving acts in the context of the rate of involvement in crashes. These studies led NHTSA to identify three types of unsafe driving actions for more detailed examination. Two studies were then planned to be conducted in parallel. One study,

"Identification of General Deterrence Countermeasures for Unsafe Driving Actions" (contract number DOT-HS-7-01797), was designed to develop broad, general risk-management strategies and tactics to address the unsafe driving actions. The second (this study) was designed to review and assess police enforcement strategies and tactics for the three unsafe driving actions. HSRI started both studies in the fall of 1977.

As the studies began, it became apparent that the existing definitions for the three UDAs lacked operational specificity. To develop adequate estimates of the risk posed by the particular acts and to determine the nature and extent of current risk-management responses, adequate operational definitions were necessary. Thus, an initial task of both the Police Enforcement project and the General Deterrence project became the development of operational definitions and a preliminary assessment of the risk associated with each of the three UDAs. This effort was primarily conducted under the first project. The initial results are reported in Volume III of the final report of that project (Jones, Treat, and Joscelyn 1980a). NHTSA had recognized the need for better definitions and better data on the unsafe driving actions prior to the start of the two projects discussed above. A third project was developed by NHTSA to develop such information for a broad range of unsafe driving actions. This study, entitled "National Analysis of Unsafe Driving Actions and Behavioral Errors in Accidents" (contract number DOT-HS-8-02023), was started in the fall of 1978 and involved the study team members of the present project.

The management and technical direction of the three projects was coordinated at NHTSA and HSRI. The results of the definitional studies established that earlier findings that the following-too-closely UDA was a priority UDA were not supported, particularly when the UDA is defined in legal terms, as is relevant for police enforcement action. Also, the driving-left-of-center UDA did not appear to result from the type of driver decision-making process that was reasonably susceptible to new driver-oriented interventions. For example, many crashes that involve driving left of center occur through loss of control by the driver (such as attempting to avoid a bicyclist). The driver did not deliberately plan to drive left of

center. (Chapter Two of this report discusses these points in greater detail). The definitional studies also showed that the speeding UDA in all its forms was a significant factor in traffic crashes. These findings led NHTSA and HSRI study team members to focus the first two studies primarily on the speeding UDA. The third study continues to examine a broader range of unsafe driving actions and will lay the foundation for future studies that will address strategies and tactics to reduce the occurrence of priority UDAs, i.e., those UDAs that are found to be among the major causes of traffic crashes.

ENFORCEMENT: A RISK MANAGEMENT APPROACH

As society has sought to manage the risk of traffic crashes, it has relied primarily on one major risk management system--the Traffic Law System. Prior studies have described the general process through which society approaches management of the traffic crash risk (Joscelyn and Jones 1978) and have detailed the functioning of the Traffic Law System (Joscelyn and Jones 1972). A brief description of the enforcement function is provided here as a framework for the reader who may be unfamiliar with specific terminology and theoretical constructs that underlie the use of police enforcement procedures to reduce the occurrence of unsafe driving actions.

Enforcement is one of four top-level functions performed by our Traffic Law System (TLS) in managing traffic crash risk. The four functions and their primary objectives with respect to controlling driver behavior are:

- **Law Generation:** develop laws and regulations defining risk and proscribing risky influence behavior,
- **Enforcement:** influence individual behavior to reduce risk and initiate formal TLS action against accused risk takers,
- **Adjudication:** determine fact and law in a particular event involving an individual charged with a law violation, and
- **Sanctioning:** apply the system response that is intended to modify behavior to ensure that risk-generating events do not recur. (Jones and Joscelyn 1976)

Accomplishment of these functional objectives, theory holds, **deters** drivers from committing UDAs by creating an expectation of punishment that out-weights the expected benefits of the UDA. Deterrence is created among drivers who have not been punished for a law violation but believe they might be (general deterrence), and among drivers who have been punished and want to avoid being punished again (special deterrence).

Enforcement as performed by police agencies uses both general and special deterrence strategies, as is implied by its functional objectives. To support general deterrence, enforcement must create a credible threat that drivers will be apprehended if they commit the UDA. It is immaterial whether such a threat actually exists; it is necessary only that the driver believe that it does. Over the long term, however, it is necessary to have a "real threat" to maintain driver beliefs. Enforcement supports special deterrence by apprehending drivers committing UDA's and taking the initial step in a process that can lead to the imposition of legal sanctions. Here, the enforcement threat must be actual rather than perceived, since no punishment can be imposed unless the driver is caught.

Clearly, though, special deterrence supports general deterrence if the unpleasant results of enforcement action against drivers who are caught become known to drivers who have not been caught. Also, the mere presence of enforcement units engaged in special-deterrence activities can have a general-deterrence effect on drivers. A similar effect can be obtained if drivers **believe** that special-deterrence activities are occurring at a given location.

The literature (see Volume II) and our contacts with police agencies (see Volume III) both indicate that the top-level enforcement functions are primarily special deterrence in nature. General deterrence is accomplished in the course of performing these special-deterrence functions that we define as follows:

> **Deployment:** placing enforcement units at the most appropriate places or at the most appropriate times,
>
> **Surveillance and Detection:** watching for traffic law

violations and determining when a violation has occurred,

Apprehension: pursuing and stopping drivers who have been observed violating a traffic law, and

Presanctioning: initiating action leading to the imposing of sanctions on traffic law violators (e.g., issuing a citation).

Thus, any general deterrence accomplished directly by enforcement is due mainly to the manner in which these functions are performed. These general-deterrence effects are often enhanced by an additional, more informal, Public Information and Education (PI&E) function that may or may not be performed by the police.

SCOPE AND APPROACH

It must constantly be kept in mind that enforcement is only one function of a societal **system** that must operate as a whole process to achieve optimal effect. Thus, the law-generation component must provide a sufficient basis for enforcement operations and must identify target risks and sanctioning alternatives. Adjudication processes must operate fairly and efficiently, and sanctioning authorities must be willing and able to select appropriate punishments for guilty drivers. For this reason, our study considers police enforcement procedures within the context of the Traffic Law System and the environments in which it operates.

Our approach is to treat each of the four top-level enforcement functions separately. Both general-deterrence and special-deterrence strategies are considered. Two basic perspectives are taken in this functional analysis:

- a **description** of different procedures for performing the enforcement functions, and
- an **analysis** of the performance and estimated highway safety impact of the procedures.

The description provides information about how each function is performed and identifies the requirements (personnel, equipment, facilities, etc.) for performing each function. The analysis is concerned primarily

with the effects of different functional procedures on the accomplishment of functional objectives believed to be related to ultimate highway safety objectives. For example, the use of ummarked patrol cars for surveillance and detection is considered in terms of the effect on surveillance-and-detection performance (e.g., number of speeders detected), and apprehension performance (number of citations issued) as well. The possible effect of this procedure on the general-deterrence performance of these two functions is also considered. Highway safety impact as measured by number of violations, traffic flow variables, and number of crashes are treated where data exist. Information needs for more complete analyses are indicated.

The information for the descriptions and the analyses was developed in three separate substudies. First, relevant literature on police enforcement of traffic laws was examined. The literature review was a part of a larger review conducted in conjunction with the general deterrence project. This larger review dealt with a wide variety of countermeasures, including adjudication, social-influence, public information, and citizen-participation countermeasures. The police-procedures component of the review sought information on the what and how of enforcement countermeasures as well as their effect. The results of the literature review are reported in Volume II.

The second substudy gathered descriptive information on police procedures used in thirty-one state and local jurisdictions in the United States. The objectives were to determine the extent to which enforcement practices identified in the literature were currently being used by police agencies and to identify any additional practices that had not been described in the literature. Descriptions of the procedures were sought, along with policies that were reflected in agencies' selection of procedures. Outcomes (that is, stops, citations, and convictions) were considered, as well as external influences (for example, legal factors) that help determine agencies' choice or use of procedures. The information was developed through telephone contacts with police officials at the thirty-one agencies. The second substudy is reported in Volume III.

The third substudy involved more detailed investigations of police enforcement procedures used by four agencies at the state, county, and municipal levels. A case study approach was used to develop the telephone-contact information in greater depth and to develop additional information on major factors affecting the selection, use, and effect of various procedures.

The case-study sites were selected on the basis of a number of attributes that defined a broad range of procedures and operating conditions. The sites were:

- Washtenaw County, Michigan;
- Cincinnati, Ohio;
- Tucson, Arizona; and
- California.

The first site was a sheriff's department; the next two were municipal police departments; and the last was a state highway patrol agency. Information for the case studies was collected through on-site discussions with police officials and with staff from interfacing agencies (e.g., courts) in the four jurisdictions. The case studies are also reported in Volume III.

The reader is cautioned that data available from the police and most other operational agencies of the Traffic Law System are insufficient to support rigorous evaluations of the highway safety impact of their activities. Often, even basic performance data are not available at the level of detail desired. Thus, the ultimate effect and worth of different procedures can only be inferred through analyses that are, in the end, mostly subjective. We have exercised great care in making these judgments and have subjected them to the scrutiny of our research colleagues and of practitioners. Our findings are not based entirely on scientific evaluations and should not be interpreted as such. They flow from a synthesis of available information, ranging from considered opinion to controlled experiments. We invite our readers to examine our data and develop their own conclusions on their validity and implications.

ORGANIZATION OF THIS VOLUME

This volume has five chapters. Following the introduction, Chapter Two presents the operational definitions of the three unsafe driving actions of interest and an assessment of their risk. Chapter Three summarizes current procedures used by the police to enforce speed laws. Special- and general-deterrence considerations are presented, including both sanctioning practices of adjudication agencies and pre-sanction activities of the police.

Chapter Four presents our recommendations for actions to be taken by police agencies in implementing a speed enforcement program under current laws and conditions.

Chapter Five critically examines the reasonableness of the premises underlying current police procedures and suggests alternative approaches for future consideration.

CHAPTER TWO
OPERATIONAL DEFINITIONS OF SPEEDING, FOLLOWING TOO CLOSELY, AND DRIVING LEFT OF CENTER

The results of our effort to develop operational definitions of the three subject unsafe driving actions (UDAs) are summarized in this chapter. The detailed results of the definitional study are presented in a separate volume published under the general deterrence project (Jones, Treat, and Joscelyn 1980b).

This chapter also presents the results of a preliminary risk analysis of these three UDAs. The purpose is to provide a basis for making decisions about the allocation of scarce police resources among the UDAs. Risk figures are presented in terms of percentage of all crashes in which the UDA is a cause. The figures are taken from the above-cited definitional study and are based on data presented in the literature and on special analyses of existing accident files at HSRI. Finally, this chapter briefly summarizes the characteristics of crashes involving these UDAs and indicates the degree to which the UDA-caused crashes were conscious and intentional.

SPEEDING

Two types of speeding UDAs were identified: the absolute-speed UDA and the relative-speed UDA. The **absolute-speed UDA** is defined as follows:

> The absolute-speed UDA is the act of driving a vehicle at a speed in excess of a maximum legal limit, or, in a normal driving environment, at a speed below a minimum limit.

Speed in this case is measured relative to the roadway. The limit may be set by any legally recognized authority. A "normal" driving environment is that associated with roadway usage under baseline or design conditions, for

example, dry pavement, no construction, and "average" traffic density. Examples of the absolute-speed UDA include:

- driving any vehicle above the 55 mph national maximum speed limit;
- driving any vehicle above the posted maximum speed limit in a school zone during specified hours; or
- driving a special vehicle (e.g., a tandem-trailer gasoline transport) above the legal limit for that class of vehicle.

The **relative-speed UDA** was defined as:

> The relative-speed UDA is the act of driving a vehicle at a speed that is so different from the speeds of vehicles around it that the risk of a traffic crash exceeds that which is societally tolerable.

Here, speed is measured in one of the following ways:

1) As a difference in absolute speeds between two vehicles.

2) As a difference between the absolute speed of a subject vehicle and the mean speed of a sample of vehicles that contains the subject vehicle. This difference may be expressed either in units of speed (e.g., miles per hour) or in units of standard deviation from the mean of the sample of vehicles.

Subject to other conditions defined below, we assume that the relative-speed UDA occurs when the speed of the subject vehicle is greater than a speed not being exceeded by ninety-five percent of vehicles in the traffic stream. A relative-speed UDA also occurs where the speed of the subject vehicle is less than a speed being exceeded by ninety-five percent of vehicles in the traffic stream. Examples of the relative-speed UDA are:

- A vehicle traveling 35 mph when ninety-five percent of the vehicles in the same traffic stream are traveling 50 mph or more.
- A vehicle traveling 50 mph on an expressway when ninety-five percent of the vehicles in the same traffic stream have slowed to 35 mph because of snow.

The absolute-speed UDA is reflected in speed limit laws, whereas the relative-speed UDA is dealt with by such laws as driving too fast for conditions and reckless driving. Relative-speed UDAs are also reflected in speed limit laws in most jurisdictions because of the methods that are used to set and enforce the limits. Such methods result in the establishment of speed limits at the eighty-fifth percentile level (Joscelyn, Jones, and Elston 1970).

Three classification rules were defined to make the definitions mutually exclusive. They are:

> **Rule 1:** The absolute-speed condition dominates the relative-speed condition for maximum speed limits.
>
> **Rule 2:** The relative-speed condition dominates the absolute-speed condition for minimum speed limits.
>
> **Rule 3:** Poor driving conditions (e.g., icy roads) remove minimum speed limits.

The results of applying these rules to various combinations of conditions are summarized in Table 2-1.

The "too fast" and "too slow" dimensions of speed-related UDAs require that we explicitly define another top-level variable for classifying UDAs. This variable classifies all speed UDAs as either speed-too-fast or speed-too-slow and leads to the following four types of speed UDAs:

Type 1 - too fast, absolute
Type 2 - too fast, relative
Type 3 - too slow, absolute
Type 4 - too slow, relative

Table 2-2 shows the estimated involvement percentages of these four types of speed UDAs in the general population of non-pedestrian crashes nationwide. All types combined appear in about 28% of such crashes. All speed-too-slow UDAs occur in 10% of these; speed-too-fast UDAs occur nearly twice as often (18%) as speed-too-slow UDAs. Some 10% of the speed-too-fast UDAs are classified as absolute (Type 1), and 8% are relative (Type 2). The data did not permit the speed-too-slow UDAs to be

TABLE 2-1

CLASSIFICATIONS OF POSSIBLE UDAs

Absolute Speed of Subject Vehicle	Mean Speed of Traffic Flow		
	Higher Than Maximum Limit	Lower Than Minimum Limit	Within Both Limits
Higher Than Maximum Limit	Absolute (too fast)	Absolute (too fast)	Absolute (too fast)
Lower Than Minimum Limit	Absolute (too slow) Under Good Conditions; Relative (too slow) Under Poor Conditions	Relative (too fast or too slow)	Absolute (too slow) Under Good Conditions; Relative (too slow) Under Poor Conditions
Within Both Limits	None	Relative (too fast)	Relative (too fast or too slow)

TABLE 2-2

ESTIMATES OF CRASH INVOLVEMENT FOR THE SPEED-RELATED UDAs

Type of Speed UDA	Percent of all Crashes	
	Range	Best Estimate
1-Too fast, absolute	4-16	10
2-Too fast, relative	5-12	8
3-Too slow, absolute	Not known	--
4-Too slow, relative	Not known	--
All too fast (Types 1 & 2)	9-28	18
All too slow (Types 3 & 4)	5-20	10
All absolute (Types 1 & 3)	Not known	--
All relative (Types 2 & 4)	Not known	--
All types	14-48	28

Source: Treat et al. 1980

broken down further into absolute or relative categories.

Characteristics most common among all types of crashes caused by speed-too-fast UDAs (i.e., Types 1 and 2) are listed in Table 2-3. The table also lists characteristics that tend to distinguish crashes caused by speed-too-fast UDAs from other crashes. Detailed breakdowns of crash characteristics by type of speed-related UDA are not available.

Our analyses indicate that speed-too-fast UDAs and each of their component types are overwhelmingly conscious and intentional. Our clinical assessments suggest that impairment (e.g., by alcohol) is a major factor in the relatively small percentage of unconscious and unintentional speed-too-fast UDAs that cause crashes.

FOLLOWING TOO CLOSELY

Our definition of following too closely (FTC) is as follows:

> The FTC UDA is the act of driving a vehicle following another vehicle such that the time separation between the two vehicles is so short as to create a societally unacceptable level of crash risk.

"Following" is defined as driving at about the same speed as a lead vehicle when both vehicles are in the same lane of traffic. "Time separation" is defined as the distance between the two vehicles divided by their speed. The time separation consists of two major components, a component due to the reaction time of the following driver and a component due to the difference in braking capacity of the two vehicles. Generally speaking, time separations should be greater than one to two seconds to avoid an unacceptably high risk of an FTC-caused crash.

Note that this definition explicitly excludes instances of "gross inattention" and that the term "reaction time" includes a component for allowing a driver to **recognize** a stopping maneuver by a lead vehicle. Thus, actions involving a delayed response by a following vehicle to a stopping or stopped vehicle are excluded from this category of UDAs.

About 1% of crashes nationwide involve this UDA as a causal factor. Characteristics associated with FTC crashes are listed in Table 2-4. Such

TABLE 2-3

CHARACTERISTICS OF CRASHES CAUSED BY THE SPEED-TOO-FAST UDA

CRASH VARIABLE	MOST FREQUENT VALUE	MOST FREQUENT VALUE RELATIVE TO VALUE FOR CRASHES IN GENERAL
Crash Severity	Low	Very High
No. of Vehicles in Crash	About the same for one and more than one	One
Impact Configuration	Intersecting	Sideswipe, rearend
Driver Age	Young	Young
Driver Sex	Male	Male
Road Type	City Streets	Secondary and Interstate
Road Lane Configuration	Two-lane	Four-lane divided and Two-lane
Road Alignment	Straight and level	Curves and/or hills
Precipitation	None	Rain & Snow

SOURCE: Jones, Treat, and Joscelyn 1980b.

TABLE 2-4

CHARACTERISTICS OF CRASHES CAUSED BY THE FTC UDA

CRASH VARIABLE	MOST FREQUENT VALUE	MOST FREQUENT VALUE RELATIVE TO VALUE FOR CRASHES IN GENERAL
Crash Severity	Low	Low
No. of Vehicles in Crash	Multiple	Multiple
Impact Configuration	Rear end	Rear end
Driver Age	Young	Young
Driver Sex	Male	No difference with respect to sex
Road Class	City Streets; U.S. & state turnpike	Interstate & turnpike U.S. & state turnpike
Road Lane Configuration	Four or more lanes, divided and nondivided	Four or more lanes, divided and nondivided
Road Alignment	Straight and level	Straight and level
Precipitation	None	Rain

SOURCE: Jones, Treat and Joscelyn 1980b

crashes are predominantly of the low-severity, rear-end type involving young males on straight-and-level stretches of four-or-more-lane city streets and turnpikes. Data suggest but do not show conclusively that FTC UDAs are most often the result of conscious and intentional driver actions.

DRIVING LEFT OF CENTER

The definition used for this UDA is as follows:

> The DLOC UDA is the act of driving a vehicle over or on the center line of a two-way, two-lane road when not passing or turning.

We estimate that about 10% of all crashes nationwide involve this UDA as a cause. Crashes that were caused by a noncontact, "phantom" vehicle are included in this figure.

DLOC crashes tend to be much more severe than other types of crashes (see Table 2-5). Most often, DLOC-caused crashes involved more than one vehicle on two-lane, straight-and-level city streets in any weather. However, DLOC-caused crashes occurred more frequently on curved or hilly country roads and state secondary roads than did crashes in general. Snowy weather also was overrepresented in DLOC-caused crashes. There are strong indications that drivers in DLOC-caused crashes are far more likely to be cited for drunk driving than drivers in crashes in general.

Relatively few crashes (about 3%) appear to involve a conscious and intentional commission of DLOC. DLOC-caused crashes that are conscious and intentional, but not due to environmental factors (e.g., poor visibliity, need to avoid a bicyclist) are rarer still.

SUMMARY AND CONCLUSIONS

Operational defintions of three unsafe driving actions (UDAs) were developed using data from the literature and accident files at HSRI. **Speed-related** UDAs were divided into four basic types:

Type 1 - too fast, absolute
Type 2 - too fast, relative

TABLE 2-5

CHARACTERISTICS OF CRASHES CAUSED BY THE DLOC UDA

CRASH VARIABLE	MOST FREQUENT VALUE	MOST FREQUENT VALUE RELATIVE TO VALUE FOR CRASHES IN GENERAL
Crash Severity	Low to moderate	Very high
No. of Vehicles in Crash	Multiple	Multiple
Impact Configuration	Head-on	Head-on; Sideswipe
Driver Age	Young	Young
Driver Sex	Male	Male
Road Class	City streets	County roads; state secondary roads
Road Lane Configuration	Two-lane	Two-lane
Road Alignment	Straight and level	Curve, hill, or both
Precipitation	None	Snow

SOURCE: Jones, Treat and Joscelyn 1980b

Type 3 - too slow, absolute
Type 4 - too slow, relative

The absolute-speed UDAs (Types 1 and 3) occur when a vehicle is driven in excess of an appropriately established maximum speed or, in a normal driving environment, at a speed below an appropriately established minimum limit. Relative-speed UDAs (Types 2 and 4) occur when a vehicle's speed is so different from that of vehicles around it to create unacceptably high risk of a crash. Studies indicate that unacceptably high risk occurs at speeds less than the fifth percentile speed of traffic and at speeds greater than the ninety-fifth percentile speed.

The **following-too-closely** (FTC) UDA occurs when a vehicle follows another vehicle at a distance such that the time separation between the two vehicles is so short as to create unacceptably high risk of less than one to two seconds. Studies indicate such risk at time separations of less than one to two seconds.

The **driving-left-of-center** UDAs occur when a vehicle crosses the centerline of a two-way road when not passing or turning.

Speed-related UDAs are by far the most prevalent of the three. We estimate that some 28% of all crashes nationwide are caused, at least in part, by these UDAs. More than half of these are caused by speed-too-fast types that are predominantly conscious and intentional.

The FTC UDAs are the least prevalent of the three, appearing as a causal factor in only about one percent of crashes. FTC-caused crashes tend to be less severe than crashes as a whole. Most FTC UDAs that cause crashes appear to be deliberate.

DLOC UDAs are moderately prevalent, but usually are not conscious and intentional in the crashes they cause. Environmental factors accompany a large percentage of crashes that involve DLOC. Only a very small percentage of crashes (i.e., less than one percent) would appear to involve DLOC UDAs that would be an appropriate target for enforcement countermeasures. Thus, such countermeasures could have, at best, only a minimal effect on overall crash frequency.

Thus, speed-too-fast and speed-too-slow UDAs should be given high

priority by police agencies. Violations of statutes relating to FTC and DLOC should trigger enforcement action when observed, but large-scale, nationwide campaigns and large expenditures of funds for manpower and equipment are not indicated.

CHAPTER THREE
SUMMARY OF CURRENT PRACTICES

This chapter presents a brief overview of procedures currently being used by police agencies to enforce speed laws in the United States. The material is drawn from the literature and from discussions with police administrators and patrol officers in state and local enforcement agencies around the country. The source material for this chapter is contained Volumes II and III of this study.

A synopsis of police traffic services in general is presented first to provide a context for the more detailed summary of enforcement practices which follows. The discussion of enforcement practices is organized along functional lines and deals separately with each of the functional areas defined in Chapter One, viz.:

- deployment,
- surveillance and detection,
- apprehension, and
- presanctioning/sanctioning.

The chapter closes with a discussion of some of the procedural elements that are related to general deterrence.

We are limiting the discussion in this chapter to speed UDAs because our research indicates that few law enforcement agencies have specific procedures for enforcing following too closely (FTC) or driving left of center (DLOC) laws. The relative priorities among the three UDAs recommended in the preceding chapter are already recognized by the vast majority of police agencies in this country. Most enforcement action against the FTC and DLOC UDAs is taken in the course of routine surveillance activity or after the occurrence of a traffic crash. DLOC citations are often used as an indicator of drunk driving, thus initiating actions associated with drunk-driving procedures.

OVERVIEW OF POLICE TRAFFIC SERVICES

As noted in the introduction to this volume, enforcement is one of four major traffic functions carried out by the police. To understand enforcement it is necessary to view it in relation to the other three functions. In their landmark study of police traffic services in the mid-1960's, Fennessy et al. (1968) defined these functions as follows:

- traffic law enforcement,
- accident management and investigation,
- traffic direction and control, and
- general motorist services.

We find this definition to apply equally well today, although the functional categories developed by Joscelyn (1971, p.328) are more appropriate for some analyses.

The first of these functions, shortened simply to "enforcement" here, has been described in general terms in Chapter One, and will be discussed in more specific terms in other sections of this volume. Its purpose is to control driver behavior, either through police presence or by apprehending traffic law violators for further action by adjudicative and sanctioning elements of the Traffic Law System (TLS). Thus, enforcement serves as a case finder for these two elements.

The second function, **accident management and investigation,** includes all police activities that are performed in connection with a traffic crash. These activities consist primarily of accident reporting, on-scene and follow-up accident investigation, traffic law enforcement arising from the accident, traffic direction at the accident scene, and preparing other necessary reports on the accident (Baker and Stebbins 1964).

The third function of police traffic services, **traffic direction and control**, is concerned with telling drivers and pedestrians where they may or may not move or stand, controlling vehicle or pedestrian movement at some particular place on the road (e.g., an intersection), and escorting vehicles and pedestrians from one point to another (International Association of Chiefs of Police 1961).

The last function, **general motorist services,** includes such activities as assisting stranded or disabled motorists, helping motorists who have become the victims of criminal acts (e.g., robbery), and providing information to motorists. The police also provide a variety of services that support the operation of the TLS and the larger Highway Transportation System. These services include public information and education, driver license examination, vehicle inspection, court services, maintenance, operating "pounds" for abandoned or junked vehicles, and investigation of hit-and-run incidents and stolen car cases (Fennessy et al. 1968).

Our contacts with police personnel indicate a continuation of the trend away from separate organizational units consolidating the police traffic services functions. Most agencies seem to rely on their general patrol units for these functions, although many local agencies have separate units for special **enforcement** activities (e.g., patrolling selected roadways). In some jurisdictions, these units are responsible for most of the traffic enforcement activity and also do most of the accident management and investigation. Also, some agencies have more than one traffic unit. For example, a county police agency might have one unit for selective traffic enforcement and another unit for providing traffic enforcement services to selected local jurisdictions in their county.

Officers may be assigned to special traffic units on a part-time or a full-time basis, depending on the jurisdiction. Some special units are made up of overtime volunteers from a regular patrol unit.

The number of police officers who provide police traffic services depends upon the type of police agency (e.g., state, county, or municipal), the nature of the jurisdiction served, and the management style and priorities of the agency. There are no hard data available on the number of patrol-hours devoted to police traffic services in different agencies because few agencies keep records in a form that would provide such data. However, surveys of police agencies do provide data on the total number of police officers employed, and this gives us some idea of the upper limit of the available personnel resources for police traffic services.

These data indicate that municipal police departments in the United States had an average of about 2.5 sworn officers per thousand population in 1975 (U.S. Department of Commerce and U.S. Department of Justice 1977). Large cities tend to have larger police/population ratios and small cities tend to have smaller ratios. Of the cities we contacted in this project, Washington, D.C., and Baltimore, Maryland, had about 5.5 sworn officers per thousand population, while Albuquerque, New Mexico, and Lincoln, Nebraska, had only about one sworn officer per thousand population.

The police "density" measured in this way is also less for state enforcement agencies than it is for county agencies, which is in turn less than it is for municipal agencies. The state agencies we contacted had ratios of from about .2 to .5 officers per thousand population; county agencies were in the .5 to 2.0 range.

Large amounts of money are required to pay for police traffic services, but, again, estimates of these amounts are hard to come by. The U.S. Department of Justice (1978) estimated that $9.5 billion in direct expenditures were spent on state and local government police protection in fiscal year 1976. Anecdotal reports by local-level police administrators suggest that some 15-20% of their expenditures are in the area of police traffic services. State-level agencies undoubtedly spend a larger fraction of their budget in this area, in some states approaching 100%. Thus, an estimate of about $2 billion per year for police traffic services nationwide would appear to be conservative. This amounts to more than 10% of the amount spent for **all** activities of the **total** criminal justice system (courts, corrections, police, etc.) in state and local jurisdictions.

These funds buy the services of some 100,000 full-time equivalent police officers who must be spread over three shifts and millions of miles of roads. Thus the task of the individual officer in enforcing traffic laws and in providing other traffic services is enormous. The police traffic services functions are in constant conflict in competing for these scarce manpower resources. For example, an officer may be taken away from enforcement activities to investigate an accident or to help a motorist whose car has

broken down. Thus, the resources available for the enforcement functions are only a fraction of those that support police traffic services in general. This situation is made even worse by the fact that the conflicting demands are likely to be most frequent at times of relatively high overall crash risk, for example, during high-speed, high-density flow on an expressway in bad weather. The inherent constraints on police effectiveness imposed by these resource limitations should be kept in mind when assessing current procedures or when designing new procedures that remain labor intensive. More will be said about this subject in Chapters Four and Five.

The remaining sections of this chapter discuss current police enforcement procedures in more detail. Procedures for each of the four major subfunctions of enforcement are discussed separately.

DEPLOYMENT

The police enforcement process starts with the placement of enforcement units at locations where they can influence traffic flow. Ideally, the objective would be to select the procedures and resources to be used at times and places so as to minimize overall crash risk in a jurisdiction. We found that most police agencies approach this problem subjectively using experience supported by violation and/or accident data to determine where and when to place enforcement units. Their final decisions on deployment are strongly influenced by practical operational constraints, such as the resources available and the need to enforce other traffic and non-traffic laws.

When more formal deployment methods are used, they are usually a part of some **selective enforcement** scheme. It is based on the principle that patrol units should be allocated as a function of the number of crashes (or sometimes violations) of different types that occur at different times in a jurisdiction. Traffic volume may also be a factor. Often the function in question is judgmentally determined, and when it is not, it is usually linear. Some agencies (for example, Tucson, Arizona) use computers to keep track of crashes and violations at different locations, but less formal tools (for example, pin maps or even officer's judgment and

experience), are more common. Selective enforcement appears to be more common among agencies that have special traffic enforcement units, but most agencies seem to have some form of it.

Some police agencies with selective enforcement programs use indices for deciding where and when given units should be deployed. The indices are based on workload or fraction of a jurisdiction's total "hazard" at given places and times. Algorithm or "cookbook" procedures appear to be used infrequently for deploying police units for traffic law enforcement. Citizen complaints seem to play a relatively minor role in making deployment decisions.

A few police agencies have used computerized information systems to support the deployment process. Such a system was used experimentally by a state police post in Indiana to provide real-time information on traffic flow and historical data on traffic crashes (Jones and Joscelyn 1972).

Type of traffic-law violation is another important factor influencing deployment decisions. Many large police agencies analyze accident reports to determine which violations should receive the highest priority. As might be expected, rural areas and areas with limited access highways emphasize speeding violations of the 55 mph national maximum speed limit. For example, the California Highway Patrol issues some 90 percent of its speed citations for maximum speed violations; most of these violations occur on rural and limited-access roads where the posted speed limit is 55 mph.

In urban areas, violations other than speed--such as right-of-way violations--tend to be emphasized. In most areas, drunk driving is given high priority. Few police agencies place a high priority on following too closely (FTC) or driving left of center (DLOC). As noted above, FTC and DLOC laws, are usually enforced during routine surveillance or after a crash. DLOC violations are often used as an indicator of drunk driving.

Standard police procedures call for the total service area in a jurisdiction to be divided into components called beats. Command-level staff determine the beat structure of a jurisdiction and overall patrol

allocation among beats. Some agencies allow their patrol officers considerable discretion on where and when to patrol within a beat, while others do not. Among the jurisdictions we contacted, special traffic enforcement teams generally had less patrol-officer discretion than did general patrol units.

In the time dimension, patrol assignments are broken down into shifts. At least three shifts are defined; some agencies have more to provide overlapping coverage at peak times. These usually occur (for traffic) in the morning and late afternoon. Special traffic patrol units are used most commonly in the morning and afternoon rush hours and in the late evening and nighttime. The nighttime patrols usually concentrate on drunk driving violations.

In general, the traffic safety effect of the different schemes for allocating or deploying police units is not known. NHTSA evaluated selective traffic enforcement programs it sponsored (PRC Public Management Services, Inc. 1974). The evaluation found that a "patrol-and-cite" strategy using selective enforcement methods reduced traffic crashes. Other deployment methods were not studied so that it could not be said what fraction of the observed effect was due to the selective enforcement approach alone.

SURVEILLANCE AND DETECTION

The type of equipment used for detection and speed measurement seems to have the most influence on the procedure selected for surveillance and detection. Radar is by far the most common and widely used device for speed measurement today. Police radar units use the Doppler effect to measure the change in frequency between the radio signal transmitted and the signal reflected from a moving object. Radar units are attached to vehicles or to a fixed mount. Hand-held units are also used.

Radar units may be used in a moving or nonmoving model. At present, the trend seems to be toward radars that can be used in either mode, although some agencies (for example, Tucson, Arizona) use nonmoving radar exclusively.

Nonmoving radar is used nearly always from parked patrol cars or motorcycles to measure the speed of approaching or departing vehicles. Hand-held radars (sometimes called speed guns) are popular in such instances because they can be aimed at vehicles in both directions, and because they are portable and thus suited for use on motorcycle patrol.

Moving radar is aimed in the patrol vehicle's direction of travel. The target vehicle's speed is determined by subtracting the patrol vehicle's speed from the target vehicle's speed.

As with any measuring instrument, radars produce measurement errors. Radar errors have become a source of controversy among radar proponents and critics, with the result that some courts have ruled that radar speed measurements cannot be offered as evidence of guilt. However, most courts appear willing to accept radar speed measurements as reliable, but require it be shown that proper procedures were followed by the police and that the measurements were not seriously affected by environmental influences (for example, heavy traffic).

The most common backup procedure for measuring speed is pacing. Either speedometers or odometers are used in pacing a target vehicle. The speedometer is the preferred instrument. A police officer will attempt to position the patrol vehicle to the right rear of a target vehicle in the driver's blind spot. The officer then tries either to maintain the same speed as the target or to maintain a speed at which a stop would be made. In the former case, the stop would be made if the police vehicle's speedometer reading exceeded the tolerable speed; in the latter case, this target would be stopped if it were observed to be pulling away from the police vehicle.

Odometer pacing is relatively rare. A speedometer is used to hold a steady speed, and an odometer is used to determine whether the distance between the police vehicle and the target is decreasing, remaining constant, or increasing. An odometer reading is taken when the target passes a checkpoint (for example, an overpass), and another reading is taken when the police vehicle passes the checkpoint. The difference between the two readings is the distance between the two vehicles. This

procedure is repeated again to determine the change in distance between the two vehicles.

Odometer pacing is best suited to open stretches of highway with distinct markers, such as overpasses; these are common in some western states. Of the agencies we contacted in this study, only the California Highway Patrol reported using odometer pacing.

Stopwatches are used in a few agencies to measure the time required by target vehicles to travel known distances. They are used mostly in conjunction with aircraft "spotters," although a few agencies still use them in special circumstances (for example, in school zones).

VASCAR (Visual Average Speed Computer And Recorder) has been used widely in the past, but appears to be infrequently used today. It computes speed from two time marks provided by the operator and from the pre-entered distance between the two data points.

Automated detection devices, such as ORBIS III, have been used experimentally in this country and operationally in Europe (Glauz and Blackburn 1980). Typically, they determine speed by pavement sensors or radar and automatically photograph violators, their vehicles, their speeds, the violation date, time, and location. The information is used as a basis for warning letters or, rarely, for prosecution. In Europe citations are sent out to vehicle owners. None of these devices are known to be operating now in the United States, but NHTSA is beginning to test their operational feasibility in several locations.

Finally, most departments use visual observation as a means of confirming radar speed measurements, that is, identifying violators after radar has indicated that a violation has occurred. Some states—including California and Arizona--permit an officer to testify to a driver's speed based on their visual determination alone. Other states, such as Michigan, do not allow such determinations.

As indicated in the above discussion, the use of the various measurement techniques in surveillance and detection is strongly influenced by the kinds of vehicles that are available for traffic law enforcement. Automobiles are used most frequently, but motorcycles are popular too—

especially in warmer climates, downtown areas, and on congested freeways. Tucson's entire traffic unit uses motorcycles. Aircraft (mostly fixed wing) are used by a considerable number of state agencies, especially in remote areas. Helicopters are used by some larger local level agencies in more urbanized areas.

The agencies tend to favor marked vehicles over unmarked ones. In fact, covert techniques in general are far less common than overt techniques. Some departments have explicit policies discouraging the use of disguise or concealment. Despite this, individual officers do conceal their vehicles on occasion while "running radar," especially when they need to write additional tickets to meet quotas. The reason given most often for the preference of overt techniques is that they have a greater deterrent effect.

Of the markings used to create such a deterrent effect, light bars atop cars are highly rated by police. Other markings believed to have impact are bright and contrasting colors and clear police insignia. Some agencies believe that motorcycles provide an effective visual indicator of a deterrent threat.

Police tend to position their vehicles as single units rather than in groups. In the solo configuration, a single officer performs the apprehension and presanctioning/sanctioning functions as well as surveillance and detection. When teams are used, they are used more in conjunction with stationary radar and with aircraft. Typically, one unit of the team (a ground vehicle or an aircraft) will measure speeds, and a second unit will apprehend the specified vehicle. If both units are ground vehicles, they will sometimes switch roles for the next violator, that is, the apprehending vehicle will become the detector and vice versa.

APPREHENSION

A police officer will initiate action to apprehend a speed-law violator if the officer determines that the violator is exceeding the speed limit plus some speed "tolerance." An agency's tolerance policy may range from unwritten and unofficial (a 5 or 10 mph tolerance is used in most

jurisdictions) to official written policies (such as the California Highway Patrol's stop/cite/warn guidelines) (see Volume III, Chapter Nine).

Reasons given by police administrators for having tolerances include:

- there are far more speeders than officers, so only the higher risk drivers can be dealt with;
- tolerances compensate for officers' measurement errors or drivers' speedometer variations; and
- tolerances help "sell" a citation.

In addition, officers are often given discretion whether to stop, warn, or cite, depending on the conditions surrounding a violation (for example, poor weather, traffic conditions, a poor "attitude" by the driver).

The amount of the speed tolerance varies from agency to agency. In our contacts with thirty-one jurisdictions nationwide, thirty reported speed tolerances ranging from 5 to 15 mph. Five mph and ten mph were most common. The California Highway Patrol has a two-tiered tolerance: at 5 to 9 mph over the limit the officer **should** stop; at 10 or more mph over the limit the officer **shall** stop and **should** cite.

Once a decision is made to stop a violator, the procedures used in the apprehension depend on the patrol configuration. For solo units, the detecting unit also does the apprehending; one or more "catch" units are used in the team approach. If the solo unit is moving, it must be able to turn around quickly to make the stop. Thus, this configuration is used only where road and traffic conditions permit this maneuver. If both units are moving, the unit traveling in a direction opposite that of violator sometimes does the detecting and radios to a unit trailing the violator to make the stop. A similar team technique may be used when both vehicles are parked.

Pursuit procedures for cooperative drivers are fairly standard among police agencies. The patrol vehicle is positioned behind or at the side of the violator's vehicle, and flashing lights or hand signals are used to signal the violator to stop. A siren is used only when the driver fails to respond to other signals.

Procedures for pursuing drivers who attempt to escape vary considerably. Most agencies appear to rely on the officer's judgment for deciding when to initiate, conduct, or terminate hot pursuit. Some agencies place restrictions on the officer's decision (e.g., only pursue for speed violations of 20 mph over the limit), and a few caution against hot pursuit or discourage it altogether.

The pursued vehicle is pulled over to the side of the road or to the curb on city streets. The berm or median strip may be used on divided highways. Side streets are often used for pulling over vehicles detected speeding on busy city streets. The police car is positioned behind the violator one-fourth to one-third of a car width from the violator out toward the road. This protects the officer from oncoming traffic as he stands at the violator's vehicle. Most agencies we queried have the policy that the violator's vehicle be approached from the driver's side, but the California Highway Patrol reportedly encourages its officers to approach from the passenger side. The officer's personal safety is the major factor in deciding how the approach should be made.

The officer may check the vehicle's registration number and the driver's license after the stop. Some agencies do this routinely, and others do it only if they are suspicious of the vehicle or the driver. Typically, the officer asks the driver for the driver's license and explains the posted speed limit and the speed at which the driver was traveling. The officer may allow the driver to view the radar reading if radar was used for measuring speed.

PRESANCTIONING/SANCTIONING

After the stop, the police officer first must decide whether to release or arrest the driver. Formal arrests for speeding violations are very rare. Nearly always, the driver is given a verbal or written warning, or is given a citation requiring an appearance before an adjudicative agency or to post bond or collateral pending appearance.

Police policies on warnings versus citations vary widely. In some agencies, warnings are seldom given, and in others they may account for

half or more of all enforcement actions. Most agencies appear to use warnings only occasionally and when the speed was not excessive or when the accuracy of the speed measurement was questionable. Verbal warnings appear favored over written warnings that are given most commonly for equipment violations. Agencies that do give written warnings seem to have a relatively high ratio of warnings to citations.

The charged speed appearing on the citation is not necessarily the measured speed. Some agencies round off the measured speed down to next lowest multiple of five to account for possible measurement inaccuracies or other factors. "Rounding down" is less likely to occur when radar is used. Some agencies indicate a lower speed on the citation because the number of points assessed against the driver's license increases with increasing speed over the limit. Their reasons for doing this seem to be: a belief that a driver getting such a "break" would be less likely to contest a charge, a belief that the points assessed in this manner are too harsh in some cases, and a belief that the judge would reduce the charged speed in court anyway.

Conviction rates for speeding are high, probably in excess of 90% of those charged. Fines (usually of the order of $50, including court costs) are the most common sanction by far. Driver license suspensions are imposed for serious violations and for too many points accumulated from past violations. Jail sanctions are extremely rare. Adjudication procedures for traffic offenses range from the more informal administrative to full-blown court trials, but most procedures are simple to allow for rapid case processing. In some jurisdictions, nominally "criminal" procedures have come to resemble those in states that have "decriminalized" traffic offenses; one way of doing this is to assign referees to hear and dispose of cases in which a driver pleads guilty. Few charges are contested; many jurisdictions allow "paying out" the citations for less risky violations by mail. Trials, when they do occur, are usually very short, of the order of five to ten minutes.

Some judges stated that the recent "Miami radar decision" has caused doubts among their colleagues about the reliability of moving radar, and

challenges to the reliability of radar appeared to be more frequent. Still, acceptance of radar measurements taken from a properly working and correctly operating device is the rule. Police report pacing to be generally accepted, though viewed as somewhat less accurate than radar. Visual observation, to be accepted, has to be accompanied by a showing of the officer's experience and skill in estimating speeds.

Convictions are required to be reported to the state's Department of Motor Vehicles in most states, but not all courts meet this requirement or report their convictions in a timely manner. Their failure to do so can have a significant effect on enforcement and sanctioning outcomes, since drivers' records are often used as a basis for decision-making in these two functions.

GENERAL DETERRENCE CONSIDERATIONS

Although the explicit functions of traffic law enforcement are aimed at special deterrence, they are clearly designed (at least implicitly) to support general deterrence as well. The most obvious way of creating an atmosphere of police presence is to place more police units on the road. The resource constraints that limit such a strategy were indicated earlier in this chapter. The effect of these constraints on actual intensity of enforcement as measured by number of police units per mile can be illustrated by considering available statistics from state-level enforcement agencies.

Data in the Federal Bureau of Investigation's Uniform Crime Reports (1979) show that there were 10.2 miles of primary highway per state police or highway patrol officer in the U.S. in 1978. More densely populated smaller states generally had fewer miles of highway per officer (Maryland had only 0.7), while less densely populated, larger states had a higher figure (North Dakota had 68.7). Many of the officers included in these figures probably were not actively engaged in traffic law enforcement. Other officers performed this function only part time and all performed other duties. Thus, the number of miles of primary highway miles per officer was probably closer to 50 than to 10 nationwide. This means that

a driver traveling these roads at the national maximum speed limit would encounter, on the average, about one police unit per hour. Research indicates that nearly all this time would be spent outside of the "halo" of police effect.

Research has indicated several promising strategies for increasing a driver's **perception** of enforcement intensity without increasing the **actual** intensity. One such strategy is the use of scheduling techniques to achieve the maximum carry-over effect of police presence (see, for example, Brackett and Edwards [1977]). These strategies are rarely used today in day-to-day operations. The major strategy for this purpose in current use is public information and education (PI&E).

PI&E campaigns use mass media and other techniques to "spread the word" about enforcement activity. They include press conferences, news releases, and public service spot announcements for use by newspapers, radio stations and television stations. Billboards, bumper stickers, placemats at restaurants, and a wide variety of techniques and material also are used. Many police departments in larger jurisdictions have full-time PI&E specialists and even PI&E departments. They provide speakers to schools, colleges, community groups, and other organizations to discuss highway safety.

Police agencies have mixed reactions to the value of citizens band (CB) radio in promoting general deterrence. Some believe CB helps enforcement by keeping speeds lower, while others believe it hinders enforcement by alerting unsafe drivers and reducing the overall credibility of the enforcement threat. There appears to be no widespread use of CB radios among police agencies. Most agencies do not provide the radios to patrol units; some allow officers to use their own CB's in their patrol cars.

Many jurisdictions use roadside signs to warn drivers about enforcement activity (for example, "Speed Check Zone" or "Radar Speed Measurement Ahead"). A few jurisdictions have used visual speed indicators to advise drivers of their speeds as meassured by induction loop detectors in the pavement.

Other factors that influence the general-deterrence effect of police

enforcement include visibility of enforcement symbols, patterns and configuration of patrol, and the type of vehicle used by the police. Police procedures with respect to these factors were summarized earlier in this chapter. We note here that our discussions with police officials around the country indicate a lack of a consistent rationale or policy with respect to these factors.

For example, most agencies favor conspicuously marked and placed patrol cars with the rationale that this enhances the general-deterrence effect. However, some agencies prefer disguised or hidden patrol cars (or at least some mix of overt and covert units) in the belief that this creates a perception that any car could be a police car or that a police car could be anywhere, and thus enhances general deterrence. Similarly opposing views are presented on patrol configurations and on type of patrol vehicle.

It appears that the personal preference of police managers and individual patrol officers have a strong influence on the strategies and tactics that ultimately are selected. Undoubtedly, operating constraints (for example, legal, budgetary, and political) also strongly affect the final choice. Clearly, though, there is no basic sourcebook or body of information available to police managers to support a methodical analysis of available alternatives for traffic law enforcement.

SUMMARY AND CONCLUSIONS

Traffic law enforcement is only one of four functions performed by law enforcement agencies in providing police traffic services. The other three functions are accident management and investigation, traffic direction and control, and general motorist services. In most police agencies, these functions are performed by regular police units in the course of general patrol activities, although many agencies do have separate units for special enforcement activities. Often, these units do the accident investigation for the department, freeing general patrol units for other duties.

The amount of police resources available for police traffic services is extremely small compared to the task at hand. We estimate that less than 100,000 full-time equivalent police officers are available nationwide to

enforce all types of traffic laws nationwide. These officers must be spread over three shifts and many miles of primary and secondary highways. The average state police and state highway patrol officer, who must detect most violations of the 55 mph national maximum speed limit, has an estimated patrol territory of about 50 miles nationwide. The need to perform other traffic services tends to increase this territory substantially.

The first step in the enforcement process is the **deployment** of patrol units to locations where they can affect traffic flow. Most larger police agencies use accident and violations data to aid them in deciding where and when to place police units, but the decision process itself tends to be informal and subjective. Resource availability (for example, numbers of radar-equipped patrol cars) and demands for other kinds of police services strongly influence the final choice. Sophisticated analytical techniques for allocating resources among different procedures have not been widely used operationally because of a general lack of data on the effects of the various procedures on violations, traffic flow, and traffic crashes.

The most common procedure for surveillance and detection of speed-law violators involves the use of radar mounted in patrol cars. Motorcycles and aircraft are used in some circumstances by some agencies. There appears to be a slight preference for "stationary" radar (as in parked vehicles). Agencies strongly favor the "solo" approach in which a single vehicle performs surveillance and detection as well as subsequent enforcement functions. "Overt" procedures using conspicuously marked and placed vehicles are preferred over "covert" procedures in which vehicles are disguised or hidden.

Pacing using a speedometer is sometimes used as a backup to radar for measuring speed. Odometer pacing is used infrequently. A few agencies still use stopwatches to measure elapsed time required to travel a known distance and calculate speed as the quotient of time and distance. This method is used today almost always in conjunction with spotter aircraft. VASCAR, a computerized version of time-distance measurement of speed, was once used by many agencies, but is less popular today. Automated

detection devices have been used experimentally, but have not been adopted by police agencies for operational use in this country. Visual observation by police officers is used sometimes to confirm speed measurements made by other methods.

Speed "tolerances" are used by nearly all agencies for determining whether a driver should be apprehended. Officers typically allow a driver five to ten mph over the posted speed limit before initiating action to apprehend. The detecting vehicle does the apprehending for solo configurations; separate "catch" vehicles are used for team configurations. The officer's judgment is the usual basis for determining whether to pursue an escaping vehicle.

A stopped vehicle is usually approached from the driver's side by the police officer who parks the patrol vehicle behind that of the suspected violator. The driver is asked to show the driver's license and is told what his measured speed and the speed limit were. The driver's license and/or the vehicle registration number may be checked during the stop.

The usual **presanctioning** action by the police is the issuance of a citation requiring the driver to appear before an adjudicative agency or to post bond or collateral pending appearance. Verbal warnings are often given for less serious offenses, but written warnings are relatively uncommon. Physical arrests are very rare for speed violations.

Nearly all speeding citations are "self-adjudicated;" that is, the driver agrees to accept the sanction without a formal adjudicative hearing before a judge or administrative officer. A relatively small fine is the usual sanction and is sometimes accompanied by actions against the driver license (for example, suspension for too many accumulated points).

All of these enforcement-related functions are designed, at least implicitly, to provide general deterrence as well as special deterrence of speed-law violators. The use of saturation techniques to create a strong perception of an enforcement threat among drivers in general is not feasible in most jurisdictions because of the large amounts of roadway mileage that have to covered by relatively few officers. Public information and education (PI&E) programs are used to increase a driver's

perception of enforcement intensity without increasing the actual intensity.

Police agencies are less consistent in their use of other strategies and tactics for increasing the general-deterrence effect of traffic-law enforcement. Individual preference and operating constraints have a greater influence on their choices in this respect than do research findings. The unavailability of information in a useful form appears the main reason why police rely on experience rather than "science."

CHAPTER FOUR
RECOMMENDED PRACTICES AND PROCEDURES UNDER CURRENT CONDITIONS

This chapter is a synopsis of speed-law enforcement procedures indicated by current knowledge to be best suited for general use today. The choice of these recommended procedures was made by synthesizing research findings drawn from the literature with information obtained from police practitioners. A trail to this literature is provided. The procedures recommended here are consistent with the principles of deterrence and the results of experimental research, but go beyond what has been "proven" by scientific inquiry. The necessity to extrapolate scientific findings to make operationally useful statements is dictated by the lack of research (both experimental and evaluative) on the fundamental elements of traffic law enforcement.

The discussion follows the same outline of the preceding chapter. Nominal procedures for each of the four major functions of traffic-law enforcement are discussed in turn and variants appropriate for special circumstances are indicated. Elements of the procedures that best promote general deterrence are then summarized. Again, the discussion is limited to procedures for speed UDAs for the reasons cited at the beginning of Chapter Three. This does not imply a recommendation that statutes related to following too closely (FTC) and driving left of center (DLOC) not be enforced. On the contrary, enforcement action is indicated in instances where these two UDAs are observed in the course of routine surveillance and patrol, and are found to be creating high risk. However, special procedures and large-scale enforcement campaigns against them are not warranted in most jurisdictions.

DEPLOYMENT

Some form of selective enforcement procedure should be used to determine where and when patrol units should be deployed. The procedure should be supported by data describing the numbers of different types of traffic crashes as a function of location, time of day, day of week, weather condition, special events, and other relevant variables. Traffic flow data on speed distributions also should be provided, if available (Jones and Joscelyn 1972).

Personnel should be assigned to analyze and present these data for use by management and operational staff. If possible, computerized equipment should be used to store and process the data. (PRC Public Management Services, Inc. 1974; Franey, Darwick, and Robertson 1972; Rutherford 197la,b)

Existing multi-purpose, general-patrol units should be supplemented with special traffic units that can provide a strong enforcement threat at selected, high-priority locations when needed. An attempt should be made to develop a strong **esprit de corps** among the officers in this unit so that the assignment will be regarded as prestigious and professionally rewarding. Some degree of discretion should be allowed these units in selecting specific locations and tactics within assigned areas.

Shift structures of general patrol units should be adjusted to meet the varying demands for service that occur at different times of day, days of the week, seasons, and at other times. Traffic law enforcement needs should be considered along with other service demands in designing shifts and beats as well. Overlapping shifts are a standard practice in most large police departments and are consistent with traffic law enforcement needs.

SURVEILLANCE AND DETECTION

Radar speed measuring equipment is recommended for most applications when statutes and governmental practices permit its use. In general, it is preferrable to have radar units that can be used in either the stationary or

the moving mode. Each mode has its advantages and disadvantages.

Stationary radar is especially useful for special units operating under selective enforcement procedures at specific, high-priority locations. Under these circumstances, coverage of long stretches of highway is not required and parked vehicles may be used for surveillance and detection. Radar can be used in either solo or team configurations (Darwick 1977). The latter are indicated when large numbers of apprehensions are expected, or when both directions of expressway traffic are being monitored and there are no turnarounds available. Finally, while using stationary vehicles conserves fuel, they are not as flexible as moving vehicles for enforcing some violations that require a suspect to be observed for a relatively long period of time.

Moving radar is often more appropriate for general patrol units that must enforce a wide variety of laws, including laws unrelated to traffic. However, it is more difficult to use properly than stationary radar and is more open to challenges in court (U.S. Department of Transportation 1980b; Michigan State Police 1979; Blackmore 1979). Also, the moving mode is better suited for the solo configuration and thus requires a roadway where a rapid turnaround can be made.

Whether used in a stationary or a moving mode, radars are relatively expensive instruments to purchase and maintain, and officers must be carefully trained in their use. Other devices and techniques should be used as a backup or under conditions not suited for radar. Speedometer pacing is foremost among techniques that can be used by moving vehicles (Witheford 1970; Darwick 1977). It is passive and thus not affected by radar detectors. It requires no extra equipment and can be used in heavy or light traffic by either special or general patrol units. However, it is best used on roads that have multiple lanes and could create additional risk because of the need for the police vehicle to travel at about the speed as the violator vehicle. Also, its results tend to be less acceptable in court unless the police agency carefully and consistently calibrates its speedometers.

Odometer pacing is not recommended for most jurisdictions. It requires

long, straight sections of road and excessive fuel to "play" the driver. Reference points along the highway are needed, and the procedure is difficult to use in heavy traffic.

The stopwatch can be used effectively under special conditions when permitted by law. It is passive, cheap, and well-suited to team tactics and to heavy traffic. It is especially applicable to tactics that involve aircraft and to situations where radar is impractical (for example, some school zones) (Kukla 1979). Its major disadvantage is its need for reference points of known distance apart and for associated conversion tables for determining speed from elapsed time data. A variation of the stopwatch, VASCAR, eliminates the need for a conversion table, but at a considerable increase in acquisition and maintenance cost (Darwick 1977; U.S. Department of Transportation 1980; Milardo 1974).

Visual observation or "eyeball" techniques should be used only as a backup for other techniques or as a last resort. They can be used in some situations where accurate measurements are not needed (for example, against flagrant violators who slow down too quickly to obtain a speed reading with some radar units), but are generally too inaccurate to obtain a conviction for most speed-law violations.

The automobile is the best vehicle for general-purpose speed-law enforcement in most jurisdictions. It is suitable to more police activities, has an all-weather capability, can be used at all times of day, can carry more equipment, and is generally safer than alternative types of vehicles.

The motorcycle is a useful supplement to the automobile where weather conditions permit its use (Booth 1978; Baker 1954). It is particularly useful in high-density traffic and is effective at speedometer pacing when the objective is to catch violators. It is the least expensive vehicle to acquire and operate. Its main limitations are its lack of flexibility and its relative unsafeness.

Aircraft also can be used effectively in an agency's fleet of vehicles (Rasmussen 1977; Craig 1975). They are best used in jurisdictions that have large areas to cover. Straight sections of road without heavy traffic generally are required. Aircraft must operate as a part of a speed

enforcement team with ground units apprehending violators identified by the aircraft. Their main drawbacks are their cost (both acquisition and operating) and their lack of flexibility in other uses.

Overt procedures are best for the majority of surveillance and detection operations (Council 1970; Joscelyn, Bryan, and Goldenbaum 1971; Dougherty 1977; Reinfurt, Levine, and Johnson 1973). Highly visible, conspicuously placed patrol cars should be used to "advertise" the enforcement threat. Light bars and distinctive colors enhance the effect. Motorcycles can be used effectively in an overt mode (Booth 1978). Covert procedures should be used to augment the overt procedures in special situations, but should play a relatively minor role overall. The Maryland State Police Bus and Truck (BAT) Patrol is an example of such an application against drivers who violate speed laws when overt units are absent, but may hesitate to do so when covert units may be present (Clark 1978). Statutes and regulations will determine the extent to which covert procedures can be used in many jurisdictions.

We note that most police agencies have policies advocating overt procedures (see Volume III of this report). Often, these policies are not followed by patrol officers who see a greater need to write citations (perhaps to fill a quota). Covert procedures are then used because they are more effective for this purpose. Police agencies should take measures to ensure that their overt procedures are actually being used.

Solo units should be used as the basic patrol configuration for routine patrol (Darwick 1977). When large numbers of apprehensions are made, team configurations are preferable. Also team configurations are essential for some applications (for example, when aircraft are used). However, team configurations are feasible only when courts can (and will) accept citations written by officers who did not observe the violation.

Nearly all police activity against speed-law violators is in enforcing maximum speed limits. Research has established that driving too slow can create just as much risk as driving too fast (See Chapter Two). Police agencies should develop programs for enforcing existing laws relevent to too-slow driving. Where necessary, legislatures should modify statutes to

appropriately define speed-too-slow risk and to provide suitable sanctions for violating those statutes.

APPREHENSION

The sheer volume of traffic law violations and the relatively small amount of police resources available to deal with them preclude the apprehension of all violators detected by police units. Police agencies should establish a clear policy for deciding which violations to take action against. The central factor to be considered in such a policy is the amount of risk it causes (Joscelyn and Jones 1978). In the case of speeding, there is clear evidence that risk begins to increase rapidly at speeds exceeding the 95th percentile speed of traffic (Solomon 1964; Research Triangle Institute 1968; Jones, Treat, and Joscelyn 1980). Thus, vehicles exceeding this speed should be given priority under most circumstances.

In most highway traffic, the 95th percentile speed corresponds to some ten miles per hour over the mean speed of traffic and some five mph over the 85th percentile speed at which most highway speed limits were set prior to the 55 mph NMSL. Furthermore, fundamental fairness dictates that there be some tolerance in the enforcement threshold because of uncertainties in speed measurement by drivers and police officers as well. A tolerance of five to ten mph would be consistent with both risk and fairness considerations and also is consistent with the practice of most enforcement agencies (see Volume III of this study). We recommend the adoption of such a tolerance as a standard for the enforcement of speed laws in a normal driving environment.

We do not recommend "hot pursuit" of fleeing speed-law violators under most circumstances. Studies show that the risk created when police engage in hot pursuit usually is greater than the risk created by a simple traffic violation (Fennessy et al. 1970).

The detailed procedures for interacting with motorists after a stop has been made are beyond the scope of this study, so no specific recommendations will be made here. We do note the importance of

obtaining driver/vehicle information for "suspicious" vehicles or when flagrant violations are involved.

PRESANCTIONING/SANCTIONING

Formal citations are the most appropriate presanctioning action when there is clear evidence that a driver has exceeded the maximum speed limit plus a reasonable tolerance. Warnings should be used only in borderline cases or under special conditions (for example, lack of speed-limit signs). Citations are preferred because they provide entry into the formal adjudication and sanctioning components of the Traffic Law System. This allows not only punishments to be invoked against guilty drivers, but also driver records to be established for subsequent identification of risk (Joscelyn and Jones 1972; McGuire and Peck 1977; Jones et al. 1976).

Rounding down the measured speed recorded on the citations to the next five mph is recommended. Such a practice helps account for measurement errors and is consistent with the requirement for fundamental fairness.

In general, the formal sanctions provided by adjudicative agencies are not severe enough to have much of a deterrent effect on most drivers. No court appearance is required for most speeding violations, so even the punishment provided by this inconvenience is not realized. Thus, the severity of sanctions should be increased and related to the risk created by the violation. For risky and deliberate violations, fines and points should be increased and driver license suspensions imposed more frequently.

Considerable preparation will be required prior to instituting system change programs for increasing sanctions. The necessary statutory basis must be established, and adjudication and sanctioning authorities must be persuaded to participate in the program. The support of the general public and special interest groups also will be essential (Joscelyn and Jones 1972).

Finally, we note that consistent and timely reporting of speeding convictions by adjudicative agencies would improve the operation of the sanctioning process and the enforcement function as well. Incorporation of this information into an effective interstate driver records system would

further enhance its utility (Jones et al. 1976).

PROMOTING GENERAL DETERRENCE

Police agencies should establish a Public Information and Education (PI&E) component within their organization (U.S. Department of Transportation 1978). The functions of this component should be:

- to provide information on enforcement activities and their effect on the rate of apprehension and subsequent punishments,
- to identify target groups and media for reaching those groups,
- to provide representatives for appeals to various target audiences,
- to work with other media personnel and with local organizations and groups in developing and operating PI&E programs, and
- to assist in evaluations of PI&E programs.

Police agencies should use overt procedures as their primary mode of enforcement. Patrol units should be highly visible and conspicuously placed. The perceived intensity of enforcement should be increased through the use of optimal scheduling techniques (Brackett and Edwards 1977), and through the use of roadway signs and markings (Dart and Hunter 1976). For example, pavement markings used by aircraft in determining the speed of vehicles on the ground can have a deterrent effect even when the aircraft are not present (Saunders 1978). As noted earlier in this chapter, overt procedures should be augmented with covert procedures but the latter should play a secondary role in an agency's total program for enforcing speed laws.

SUMMARY AND CONCLUSIONS

Recommended nominal procedures for enforcing speed laws under current conditions include the following essential elements:

Deployment

- using selective enforcement to determine where and when to deploy traffic law enforcement units,
- supplementing general patrol units with special patrol units that can provide a strong enforcement threat when needed at selected locations, and
- designing shift and beat structures that consider traffic law enforcement needs along with other enforcement needs.

Surveillance and Detection

- establishing radar as the primary method of speed measurement,
- using a mix of stationary and moving radar determined by special patrol and general patrol needs and by the jurisdiction's operating environment,
- backing up the radar capability with speedometer pacing and elapsed time measurement,
- using the automobile as the general-purpose vehicle for speed-law enforcement,
- incorporating motorcycles and aircraft into the vehicle fleet as appropriate for local conditions,
- relying on overt procedures as the primary enforcement strategy and using covert procedures as a secondary strategy to add an element of unpredictability to the enforcement threat,
- using solo units for routine patrol, supplemented by team configurations for high-volume apprehensions and for special applications (e.g., with aircraft), and
- enforcing minimum speed limits as well as maximum speed limits.

Apprehension

- establishing a speed tolerance for apprehension of five to ten mph over the limit, and
- not engaging in "hot pursuit" of fleeing speed-law violators, except under special circumstances.

Presanctioning/Sanctioning

- Using citations rather than warnings when there is clear evidence that a stopped vehicle exceeded the speed limit plus a tolerance,
- reducing the charged speed by five mph below the measured speed to account for measurement errors,
- imposing more severe sanctions on speed-law violators, and
- reporting speeding convictions to the state driver licensing authority.

A formal public information and education component should be established within police agencies to increase drivers' perception of the enforcement threat. Overt procedures, optimal scheduling techniques for patrol units, and roadway signs and markings associated with traffic law enforcement also should be used to enhance the general-deterrent effect of current police enforcement procedures.

CHAPTER FIVE
RECOMMENDATIONS FOR THE FUTURE

This chapter recommends actions to develop future directions for police enforcement procedures for speed related UDAs. The recommendations flow from the analyses conducted under this study, and evaluation of the research literature, and an exchange of views with leading police practitioners and researchers.

The data that characterize present police operations and the nature and extent of the risk that is created by speed-related UDAs suggest that it is time for the United States to examine the basic premises that underlie speed law enforcement and our expectations of what can be achieved by existing police resources.

BACKGROUND

Reliance on the Traffic Law System as the major risk-management system to deal with the traffic crash risk is a condition that has evolved. The experience in the United States is similar to that of most other nations. Laws have been passed to provide common expectations about future events (e.g., that we will all drive on the right side of the roadway). Laws prescribe correct behavior and proscribe behavior believed to create risk. Laws are enforced to reduce risk through the general and special deterrence concepts previously discussed.

It was foreseeable that with a legal system in place to deal with societal risks that our society would use a legal approach to deal with the traffic crash risk as it emerges in the 1980s. While the decision to use the existing criminal justice system was deliberate, there is little evidence that any general evaluation was undertaken to determine if it were capable of dealing with the problem. General evaluations were also not undertaken to assess the impact on the justice system of using it to deal with the

traffic crash risk.

We have reached the current state of the Traffic Law System in 1980 more by default than by plan. Studies have been undertaken to describe the system and to assess methods for improving its functioning. Many of these studies are described in the literature search report of this study. A common characteristic, that many of the studies reported in the literature search, is that they accept without question the premises underlying the system. Some of the critical premises include:

- the target of the system action will be the individual driver;
- the driver must be detected and apprehended while committing (or shortly after committing) the proscribed unsafe driving action;
- the apprehension must be undertaken by a fully qualified law enforcement officer who must stop and personally identify the driver to provide an evidential basis for later system action;
- the driver will be provided the due process safeguards associated with the criminal legal process including the right to trial, confrontation of witnesses, and proof beyond a reasonable doubt of the charges; and
- the driver will have full rights of appeal through the criminal and civil courts to ensure that due process has been rendered.

These premises flow from the fundamental principles that support the use of the criminal law process to manage serious societal risks that are labeled crimes. Crimes generate losses that are significant to society as do traffic crashes. In general, however, crimes have associated with their commission an element of malicious intent that is usually absent from driving behavior.

If it were possible to consider for the first time the use of the legal system to manage the traffic crash risk, one can suggest some of the evaluations that would logically be undertaken to assess the feasibility of using the traditional legal approach. One study would be an attempt to

assess the level of police resources that would be required to deal with unsafe driving actions. One could, for example, estimate the number of police officers required to deal with one unsafe driving action (e.g., speeding). Below, we present a top-level illustration of such an assessment. This estimate is best characterized as a "back of the envelope" computation designed to provide a rough estimate to place an issue in perspective. More precise calculations would be required to support decision-making. Even a "ballpark" estimate, however, is useful for initial review of proposed actions.

FORECASTING POLICE RESOURCES NEEDED FOR SPEED LAW ENFORCEMENT

A good starting point for an assessment of resources required to deal with a problem is an estimate of the magnitude of the problem. Speed-related unsafe driving actions include several classes of acts (See Chapter Two). For the purposes of this assessment, we will consider only the speed-too-fast UDA. Under this definition, the fastest five percent of drivers on the highway are considered to be exceeding the societally tolerable definition of risk. In any one period of time, five percent of the drivers are by definition engaged in this UDA. Similarly, not less than five percent of the miles driven within a given highway set are driven by drivers who are speeding.

Estimates of total vehicle miles traveled in the United States each year are approximately 1.4 trillion miles (National Safety Council 1980). Five percent of this total would be 80 billion miles. This represents a minimum estimate of the miles driven by drivers committing the speed-too-fast UDA each year in the United States.

If we remember that most speed limits are set at the eighty-fifth percentile travel speed, the number of drivers not in compliance with maximum speed limits would be fifteen percent of the drivers. If we follow the same logic as used above to estimate the miles driven by drivers committing the speed-too-fast UDA to derive an estimate of miles driven by drivers who are driving faster than a posted maximum limit we

can estimate that not less than 240 billion miles are driven each year in excess of the posted maximum speed limits. Note that this estimate assumes that only fifteen percent of the drivers exceed the posted maximum limit. Data on speed-law compliance on interstate highways indicate that about one-half of the drivers are exceeding the posted 55 mph maximum limit (U.S. Department of Transportation 1980a). The estimate of 240 billion miles is therefore as a conservative estimate of miles driven in excess of posted limits. Note also that our estimate of miles driven at high risk--the miles driven by the fastest five percent of drivers--is also a conservative estimate, even though at 80 billion miles per year it is a staggering figure.

The estimate can be expressed in several other terms. A year has approximately 8,766 hours. If the 80 billion miles per year are assumed to be distributed evenly over the hours in a year, 9 million miles are driven each hour at speeds that significantly increase the risk of a traffic crash. Another approach would be to assume some average distance traveled to represent an "average" speed-too-fast violation. If the average "speeding trip" were to be ten miles, then each year eight billion speed-too-fast UDAs are committed. If evenly distributed over the hours in a year, then 900,000 speed-too-fast UDAs occur each hour.

The United States highway system has approximately 3 million miles of surfaced roadways. If we were to assume that the miles driven at high speed each hour were distributed evenly among the surfaced highways, each mile of highway would have three drivers per hour who were committing the speed-too-fast UDA. This is a conservative estimate as it assumes the drivers are committing the act constantly for the entire mile of our hypothetical highway. If each driver sped for only a half mile, the number of drivers would have to double to six. For our purposes, three drivers are enough to worry about, but remember it is a conservative number.

Let us now estimate the police resources that would be required to detect, apprehend, and issue a citation to each of these drivers. If each individual officer can issue six citations an hour--this assumes that each contact takes ten minutes and all drivers plead guilty--then an officer can

cover two miles of highway. For those that expect greater productivity from an officer, we will suggest that some individuals will not plead guilty, requiring the officer to leave the roadside and attend court. Thus, we submit that the six citations per hour reflects a conservative upper limit for officer activity. One would need 1.5 million officers on duty at any one hour to cite all violators. If we assume an officer works 2,000 hours per year, the total number of officers needed climbs to roughly 6 million to provide around-the-clock coverage.

The concept of deterrence does not assume that every risk taker will be caught and punished. Rather explicitly the concept of deterrence is based on the principle that punishment of some risk takers will be sufficent to deter others. Unfortunately, we do not know how many is enough. Research studies suggest the halo effect around a police car lasts several miles in either direction. Significant increases in citation activity have shown reduction in speeding UDAs as a reaction to perceived police enforcement action occurs. Assuming that one had to cite only one-sixth the violators to achieve deterrence would reduce the requirement for officers from 6 million to 1 million. Other assumptions would produce other estimates. The point remains, however, that a quick, relatively conservative assessment of police personnel requirements to implement a deterrence approach to deal with only the speed-too-fast UDA produces an estimate that is an order of magnitude larger than the police resources now estimated to be available to deal with all unsafe driving actions. (In Chapter Two, we estimated that approximately 100,000 full-time police officers were performing traffic functions at an annual cost of approximately $2 billion.)

We present this rough assessment not as a model for estimating requirements for law enforcement resources but as an illustration of the seeming incongruity between design requirements and available resources. Several other similar calculations have been made with essentially the same result. **The number of police one would project as necessary to handle only the speed-too-fast UDA in the manner required by the Traffic Law System is about ten times more than are now available**

to handle all traffic law violations, respond to traffic crashes, and answer motorists' demands for service.

Available data suggest that in the range of ten to twenty million traffic citations are given each year for speed law violations. We estimated that, on the average, over 900,000 speed-too-fast violations occurred each hour. More than three times as many (2,700,000) drivers exceed posted maximum speed limits. While these are estimates derived by using averages, they support the conclusion that only a very small fraction of drivers who commit speeding violations are cited. In fact, it would be theoretically possible to issue in one day all the citations that are now issued in one year.

In summary, existing police resources are not sufficient to deal with the large number of speed violations that are committed each day. Only a very small fraction of people who exceed the maximum posted speed limits are actually cited. We estimate that only about one violator in ten thousand is cited. While we have derived this estimate using a different method, different data, and a different time period, this estimate is of the same magnitude as that of Gordon Sheehe (1963) who estimated a one-in-7,600 chance of detection for speeding in the early 1960s. More recently Commissioner Glen B. Craig of the California Highway Patrol estimated that for every driver cited 22,000 violators go unapprehended (Craig 1980). The implication of these data is that it is unlikely that a significant increase in speed law enforcement can be achieved using present methods and present resources. Further, it is unlikely, given current revenue problems at the state and local level, that existing police traffic resources will increase in the near-term future. Thus, rethinking the underlying premises of traffic law enforcement appears required.

EXAMINING EXPECTATIONS

While many facets of the police traffic enforcement issue need examination, a critical issue is what can we reasonably expect to achieve with existing resources. The energy crisis of 1974 and the associated reduction in the availability of imported oil led to the imposition of the 55

mph NMSL. Following the imposition of the limit, fuel consumption dropped and there were fewer traffic crashes and associated losses. A few studies were undertaken in the 1975-76 time period to examine the effects of the 55 mph limit. The results were not in close agreement, nor the methods used sufficiently rigorous to conclusively support the findings. Rigorous studies intended to examine the topic in greater detail were considered but were not funded. In general, the safety benefits and fuel savings associated with the 55 mph speed limit are not well established. While some aggregate estimates have been developed, disaggregate estimates (e.g., by roadway type) are difficult to find, let alone substantiate.

Despite this lack of knowledge, there has been general support for the 55 mph speed limit from both safety and energy constituencies. Congress has enacted legislation that provides fiscal penalties for States if substantial compliance is not achieved with the 55 mph limit. The information developed above on the present and projected levels of police resources needed to deal with speed-law violations suggests that sufficient enforcement resources do not exist to achieve substantial compliance with the 55 mph limit in the face of widespread public noncompliance.

It seems appropriate to examine, on a priority basis, the premises that underlie the presumption that non-voluntary compliance with the 55 mph limit can be enforced with existing police resources following current police practices and procedures. Such an examination need not involve large-scale demonstration efforts. It could, more appropriately, rest on more rigorous modeling, simulation, and analysis of existing data that pursued in detail the "back of the envelope" calculations developed above. The issue to be addressed can be framed as follows:

1. Given that police traffic enforcement procedures supplemented by public information and education will be used in a deterrence context (special and general) to produce compliance with the 55 mph national maximum speed limit, what levels of police resources will be required to achieve the compliance levels now mandated by law?

2. What are the benefits associated with achieving the compliance levels mandated by law in terms of fuel savings and risk reduction?

Provision of adequate police resources will require a significant expenditure of funds, use of fuel, and place at risk both police officers and the public. Selection and implementation of such a strategy should flow from a substantial analysis that at least supports the expectation that the benefits to be gained will exceed the costs.

The present national policy seems to have emerged without rigorous analysis. We are unable to identify carefully completed, openly published studies that fully address the issues. These should be undertaken to provide an adequate basis for the debate that is sure to emerge as compliance levels become increasingly stringent with the passage of time.

The examination of the expectations surrounding the 55 mph limit should be only the starting point for examination of the premises underlying our perception that traditional enforcement approaches should be the primary approach to manage the risk of speed-related UDAs. Violations of the 55 mph limit have high visibility. Other less publicized violations, particularly those associated with the relative-risk speed-too-fast UDA, are a significant safety problem. These UDAs occur with very high frequency—at a rate that makes it impossible for existing police resources to deal with more than a very small fraction of violators. The same type of analysis suggested for the 55 mph maximum limit should also be undertaken for other speed related UDAs.

While the present effort has not allowed us to pursue the issues with sufficient depth to allow us to speak with certainty, preliminary analyses suggest that it will be impossible to achieve significant reductions in speed-related UDAs without gross increases in enforcement effort. Further, it will be impossible to allocate scarce state and local fiscal resources to obtain significant increases in police traffic resources. We believe the present data are sufficiently persuasive to also warrant an analysis of alternatives to traditional police procedures and practices for dealing with speed-related UDAs.

EXAMINING ALTERNATIVE RISK-MANAGEMENT METHODS

The examination of current police practices and the response of the driver to the deterrent approach does not suggest that the fundamental concept is flawed. In fact, it appears that relatively minimal police resources have been remarkably effective in obtaining general compliance with speed laws. These data strongly support the continuation of present police practices and the concept of deterrence.

What is not supported is the labor-intensive nature of the present system design. The use of highly trained police officers to focus on the individual driver through the application of the most formalistic rules of society seems inconsistent with the nature of the risk that is to be managed. Most speeding UDAs are relatively straightforward acts. They create risk and should be deterred. Using the same approach that is used to deter deliberately planned crimes seems unnecessary. Similarly, since the most common sanction is a relatively small fine with little social stigma attached, provision of the full safeguards of the criminal law system seems equally unnecessary. This does not suggest that driving acts that are deliberate, reckless, or criminal in context should escape the attention of our formal system of justice. What is suggested is consideration of a system design that more nearly matches system activity with system goals. Thus, we suggest for discussion an approach that would focus on the vehicle rather than the driver. Such an approach would supplement, not supplant, existing traffic laws and police enforcement procedures.

The heart of such an approach would rest on making it a **civil** offense to operate a vehicle in violation of a posted maximum or minimum speed limit. The focus of enforcement would be the vehicle, not the driver. Proof of the offense would be evidence that the vehicle violated the limit. The registered owner of a vehicle found to have violated a posted limit would be subject to a civil sanction—a monetary penalty. Enforcement of the sanction could be accomplished through a central record system linked to vehicle registration and titling. All existing penalties would have to be

cleared before a vehicle could be re-registered or the title transferred. The sanction could constitute a lien on the vehicle. Consideration could be given to the use of civil process to seize and sell vehicles in the event that civil penalties were not paid. (A more detailed analysis of the vehicle-based approach can be found in Ruschmann et al. 1979.)

The adoption of such an approach would facilitate the implementation of technological approaches that are capable of remote sensing speed law violations and automatically providing an evidential record of the violation. Simple forms of this technology can be seen in devices such as the ORBIS II and the Multanova that photograph vehicles that are in violation and provide a record of the speed, time, and location of the violation. More sophisticated technology capable of scanning license plates and recording the data together with collateral data (speed, time, and location) has been developed, but the lack of a demand for it has limited its commercial availability. A nation that has the technology to conduct overhead reconnaissance capable of photographing a car from over one hundred miles in the sky can develop reliable equipment for the observation and measurement of speed law violations on the nation's highways.

Such technology has not been developed and implemented because as a nation we have chosen to use a highly formal, legal approach to deter the incidence of speed-related UDAs. The legal constraints that now exist create requirements for very costly, labor-intensive approaches. These requirements exist as a matter of policy, not as a matter of constitutional law.

We suggest that it is time to carefully examine existing policy to determine if alternative approaches should be considered. One alternative would be to introduce a vehicle-based enforcement system. Before undertaking such an approach, careful analyses should be conducted to determine the costs, benefits, and social consequences. Our present driver-based approach was reached without careful analysis. It appears to have significant limits that interfere with the goal of managing the traffic crash risk. Attempting to adopt a new system, however, without identifying the associated constraints would be repeating the errors of the

past and could be "jumping from the frying pan into the fire."

SUMMARY AND CONCLUSIONS

In the United States the use of traffic law enforcement to achieve speed law compliance is the predominant risk-management approach for speed related UDAs. Reliance on the traffic law system, a subsystem of the criminal justice system, as the primary risk-management system has evolved. It was not planned. A general presumption exists that existing police resources are adequate to manage the risk of speed-related UDAs. We estimate that less than 100,000 full-time equivalent police officers are available nationwide to take action against all types of traffic violations.

A simple estimation procedure indicates that over 240 billion miles are driven each year in the United States in excess of the posted limits. Over 80 billion miles are driven each year at speeds that create an intolerable risk of a traffic crash. This can be stated as 9 million miles driven each hour or, if each speeding trip is ten miles in length, as 900,000 speed-too-fast UDAs every hour. We estimate that 10 to 20 million traffic citations are issued each year for speeding violations. The detection rate is about one violator in ten thousand.

The number of police projected as necessary to handle only the speed too fast UDA in the manner required by the Traffic Law System is about ten times more than are now available to handle all traffic law violations, respond to traffic crashes, and answer motorists' demands for services.

These estimates suggest that we should carefully examine our expectations of what can be achieved with existing police traffic resources. More rigorous analyses need to be undertaken to develop more precise estimates of police resources required to achieve speed law compliance. Current expectations, as reflected by compliance requirements for the 55 mph NMSL established by Congress for the several states, should be examined to ascertain the level of resources necessary to achieve compliance and the associated costs, benefits, and social consequences.

Similar analyses should be undertaken to examine the expected costs, benefits, and social consequences associated with reliance on traditional

enforcement approaches for other speed related UDAs as well.

Our preliminary analyses suggest that it will be impossible to achieve significant reductions in the frequency of occurrence of speed-related UDAs without gross increases in enforcement resources. Further, it will be impossible to allocate scarce state and local fiscal resources to support significant increases in police traffic resources. We recommend further analyses of these issues. We also recommend concurrent analysis of alternatives to traditional police procedures and practices.

One alternative that should be examined is the development of a civil law approach focused on the vehicle instead of the driver. Such an approach would supplement, not supplant, existing driver based traffic laws. A vehicle-based approach would allow the use of technology to detect and record violations. Sanctions would consist of a civil fine (similar to a parking ticket) assessed against the registered owner of the offending vehicle.

The findings of our analyses support the concept of deterrence and current police procedures and practices. We do not suggest that there should be any lessening of police effort focused on speed-related UDAs. If any lessening should occur, it should be in society's expectation of what the police can achieve with the resources currently available.

We believe that the present design of the Traffic Law System creates fundamental constraints that limit the effectiveness of the deterrence approach. Because state and local governments cannot allocate significant additional resources to police traffic enforcement, gains in managing the risk of speed-related UDAs will have to come from increased efficiency. Changing the focus of the enforcement process from the driver to the vehicle should be considered as one approach to increase effectiveness and efficiency.

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