Report No. DOT-HS-5-01259

IDENTIFICATION OF UNSAFE DRIVING ACTIONS AND RELATED COUNTERMEASURES

Lorraine S. de Savornin Lohman
Elizabeth C. Leggett
J. Richard Stewart
B. J. Campbell

University of North Carolina
Highway Safety Research Center
Chapel Hill, NC 27514

December 1976

Final Report

Document is available to the public through the
National Technical Information Service,
Springfield, Virginia 22151

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
Washington, D.C. 20590

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

This report was prepared for the Department of Transportation, National Highway Traffic Safety Administration under contract no.: DOT-HS-5-01259. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT-HS-01259		

4. Title and Subtitle	5. Report Date
Identification of Unsafe Driving Actions and Related Countermeasures	December 1976
	6. Performing Organization Code
7. Author(s) L.S. Lohman, E.C. Leggett, J.R. Stewart, and B.J. Campbell	8. Performing Organization Report No. UNC/HSRC-76/12/5
9. Performing Organization Name and Address University of North Carolina Highway Safety Research Center Chapel Hill, NC 27514	10. Work Unit No. (TRAIS)
	11. Contract or Grant No. DOT-HS-5-01259
12. Sponsoring Agency Name and Address Department of Transportation National Highway Traffic Safety Administration Office of Driver and Pedestrian Research Washington, D.C. 20590	13. Type of Report and Period Covered Final Report July 1, 1975 - December 31, 1976
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract An analysis was made of accident data from a three-county area in North Carolina to identify a set of unsafe driving actions (UDA's) and determine their relative frequencies in accidents. Through field observations at accident locations, frequencies of occurence were estimated and subsequently used to calculate relative risk factors for a selected group of UDA's (speeding, following too closely, driving left of center, running a traffic control, turning in front of oncoming traffic, and pulling in front of oncoming traffic).

The frequencies of traffic citations were estimated for comparison with accident frequency and relative risks to determine any differences in accident causation and police enforcement priorities.

Turning in front of oncoming traffic was found to be the highest risk behavior, three times that of pulling in front of oncoming traffic (which ranked second). Following too closely ranked third and running a control was fourth. Driving left of center and speeding had lower risk factors.

Although speeding was the least risky behavior, it was the one most often cited. However, when speeds were considered, the risk was much greater. Following too closely was first in accident frequency and third in accident risk, but it was rarely cited.

A characterization of each of the six UDA's is provided in terms of its dynamics, situational factors, role in accidents, relative risk factors, citation frequencies, driver profiles, and recommended enforcement policies.

17. Key Words	18. Distribution Statement
driver error unsafe driving action accident risk relative risk	Available to the public.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
None	None	vii, 83, A-38, B-9, C-8, R-1	

Form DOT F 1700.7 (8-72) Reproduction of form and completed page is authorized

ACKNOWLEDGMENTS

The execution of this project required that a great deal of effort be devoted to data collection and processing. David Cole, Lucy A. Smith, Beverly Orr, and Sheri Woods were responsible for the data collection phases of this project both in the courthouses and in the field. Without their dedication to an arduous task well accomplished during inconvenient work hours the project would not have been possible. The majority of the computer programming for the project was done by Eric Rodgman.

To all other HSRC staff who contributed to the data collection, the computer programming, and the preparation of the final report the authors express their deep appreciation.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TECHNICAL SUMMARY

The purpose of this study was to identify a set of unsafe driving acts (acts committed with the full intent of the driver), determine their frequencies in accidents, traffic citations, and the driving population in order to calculate their relative risk factors and thus determine any differences between accident causation and enforcement priorities.

The UDA's were first identified and their frequencies determined by analyses of accident data. First were examinations of computer cross-tabulations of vehicle action and violation variables (accident type, vehicle maneuver, and violation). Evaluations of individual cases were then made using the standardized information and officer narrative to identify and determine the frequency of those acts which were voluntarily committed and resulted in an accident. Thus, the presence of a mere violation did not constitute a UDA.

A concurrent analysis was made of a random sample of traffic citations on file by clerks of Superior Courts to determine the frequencies of various moving violations cited by enforcement officials.

Upon completion of these analyses six unsafe driving acts were chosen for field observation at random accident points to estimate their frequency of occurrence in the population at risk. These UDA's were speeding, following too closely, driving left of the center line, violating a traffic control, pulling in front of the oncoming traffic, and turning in front of the oncoming traffic. Some additional exposure data were collected by following randomly chosen target vehicles for a few minutes to obtain another measure of the chosen UDA's.

Bayes formula was then used to combine accident data and exposure data to calculate relative risk factors for the UDA's. Comparisons could then be made for the six UDA's on the basis of accident frequency, relative risk, and citation frequency to determine any possible differences in rankings. Also, comparisons were made of the profile characteristics of the drivers seen committing the various UDA's versus those who did not, and also versus the population to identify possibly target groups.

The results showed variation among the UDA's in terms of the relative risk of an accident and also gross differences between accident frequency, accident risk, and enforcement level for the UDA's.

Turning in front of oncoming traffic was found to be the highest risk behavior, three times that of pulling in front of oncoming traffic (which ranked second). Following too closely ranked third, followed by running a traffic control. Driving left of center and speeding had lower risk factors.

Although speeding was the least risky behavior overall, it was the most frequent behavior cited by officers, which indicates a mismatch between enforcement attention to violations and their relative risk. However, when only high speeds (70 mph) were considered, this UDA seemed to have a very high risk indeed.

Following too closely was first in accident frequency, third in accident risk, but it was also found to be very low in citation frequency. This suggests that more attention should be focused on this UDA despite the difficulty of proving it in court.

The profile data failed to show great potential in aiming enforcement efforts at target groups, and instead, indicated that greater benefit could perhaps be achieved by concentrating enforcement efforts on the unsafe driving act itself.

A characterization of each UDA in terms of its dynamics, situational factors, frequency of occurence in accidents, relative risk factor, citation frequency, driver profile, and recommendation for enforcement policies is provided.

OVERVIEW

This study addresses the question of the relative risk of an accident associated with the commission of an unsafe driving act. The common view in the highway safety field is that a driver who commits an unsafe driving act usually exposes himself to a higher risk of an accident by virtue of that unsafe action.

It is held that some of these unsafe acts are unintentionally committed presumably due to inattention, inexperience, etc. However, some unsafe driving acts happen with the conscious intent of the driver. (For example, the driver who is in a hurry, approaches a stop sign, knows the sign is there, but fails to stop anyway in order to save time.)

The usual view is that intentional unsafe driving acts are subject to control through enforcement--that detection of the unsafe act by an officer, and issuance of a citation is part of the deterrant process by which the probability of these unsafe acts can be reduced (thereby hopefully reducing the probability of an accident).

In order to meet the study goals, it was necessary to gather three sets of data and to explore the relationships among them:

Accident data: Accident data were analyzed to identify leading UDA's--unsafe acts which figured materially in the production of the accident.

Field observations: Driving data were collected by roadside observers who gathered data on unsafe driving acts seen in the traffic stream.

Citation data: Police citation data were analyzed to learn what unsafe driving acts were most often seen and acted on by police officers.

Using these three sets of data, it is possible to address two basic questions:

1. Which UDA's are identified with the higher risk of an accident?

   Answering this quesiton requires comparative analysis of the accident data and the field observation data.

To oversimplify, suppose that we found that in the accident data the UDA called following too closely accounted for 20 percent of accidents, while the speeding UDA accounted for 40 percent.

Next let us suppose that in the observations of everyday traffic we found that the following too closely UDA accounted for one percent of UDA events while speeding accounted for 50 percent.

Following too closely would (in this hypothetical example) account for only one percent of driving UDA's but 20 percent of accident UDA's. That would suggest that this particular UDA must be rather dangerous (a higher risk of accident once the UDA is committed). In contrast, speeding is 50 percent of driving UDA's (according to this example) but 40 percent of accident UDA's--i.e., not as dangerous once committed.

Thus, the accident data and field observation data can be combined to estimate relative risks to various UDA's.

2. What is the match or mismatch between the most dangerous (i.e., high accident risk) UDA's versus the ones most frequently cited by police?

   Obviously this question has implications for optimal enforcement strategy. To address issue 2 it is necessary to add the citation data to the foregoing analysis and to characterize the agreement between the "favorite" UDA's cited by officers and the UDA's that actually have the highest crash risk.

Since three data sources were necessary, three "studies" were carried out, each with its own sampling plan, analysis procedures, etc. Each of these is described in later sections. Obviously the three studies had to use data from the same geographic area and had to employ UDA definitions that were as comparable as possible. Before describing the three data collection studies, the sample area is described.

The Sample Area

Data for this study are drawn from three counties in North Carolina:

1. Wake County--city of Raleigh (state capital) and its suburbs.
2. Orange County--Chapel Hill (University of North Carolina) suburban and rural.
3. Chatham County--almost all rural.

Wake County is the most densely populated with a land area of 858 square miles and a population of 228,453. At the center of the county is the city of Raleigh, the state capital (a city of 142,000) surrounded

by about a half dozen towns and suburbs (city sizes ranging between 2,000 and 7,000) and some smaller communities all easily accessible to the city via U.S. highways. Overall 70 percent of Wake's population resides in an urban area.

Orange, the smallest of the three counties (400 square miles in area), is less urban. It contains only one highly populated area, Chapel Hill, a university town, with a population of 32,700. Hillsborough, the county seat, has a population of 1,760. This county is 50 percent urban.

Chatham County is primarily a rural area. The total population for the county is only 4,869 over a land area of 709 square miles. Only 15.9 percent of the population resides in an urban area since the only two towns in Chatham are Pittsboro, the county seat (population 1,460) and Siler City (population 4,750).

PART I: ACCIDENT ANALYSIS

Objective

The initial task of the project was to analyze a set of North Carolina accidents (a) to identify major unsafe driving acts (UDA's) and (b) to estimate a two-year frequency of each of these UDA's in the sample area under consideration. This process turned out to be much more complicated than we first imagined. As a result, a multistep procedure had to be used to identify and classify the UDA's.

Underlying Approach

The problem was to identify some common UDA's from among tens of thousands of accidents which themselves occur in various ways.

Accidents can logically be divided into a very large number of categories; in fact, it can be said that each accident is nearly unique. In order to find a common thread of UDA's, however, it was necessary to combine the accidents into as few classes as was feasible. This was done in several steps summarized as follows and described in detail later:

Step 1. About 250,000 accident involved motor vehicles were classified by accident type, vehicle maneuver, and traffic violation. A computer allocated the 1/4 million vehicles into one of 5888 categories. The two variables accident type and vehicle maneuver would somewhat describe the dynamics of the collision. The traffic violation variable would give some indication of driver error whether voluntary or involuntary although it would take a case by case subjective analysis to determine those situations not under the control of the driver.

Step 2. As expected, it was found that most of these categories contained none or only a few cases, while relatively few categories contained large number of cases. It was in fact possible to define 25 largely homogeneous accident situations; these 25 (of the 5888 total categories) accounted for 87 percent of the total.

Step 3. However, even these 25 situations had considerable overlap in terms of what was important in the situations. By combining similar categories, 14 very specific accident situations were finally defined.

Even with only 14 major accident situations, case by case study showed that the categories could contain more than one UDA, and that the UDA's could each be properly assigned to more than one of the 14 categories.

Step 4. By looking for the UDA's that figured in those 14 major accident categories, a total of 20 UDA's were identified. From this list 6 UDA's were chosen for the final work of the study.

Figure I-1 summarizes these four steps; subsequent sections of the text describe each step.

Accident analysis step 1: first reduction of accident sample into accident classes

Even though the final results are based on a three-county sample, the initial analysis used a statewide data base. This was done because the very large sample permitted much finer division of the data.

From the outset of the study we confined the analysis to one and two-vehicle crashes, thus eliminating pedestrian, bicycle, and more-than-two-vehicle crashes.

The first step was to try to place the 262,634 crash-involved vehicles into a smaller more manageable set of categories.

To do this we characterized each vehicle (vehicles in more than 90,000 two-vehicle crashes, and more than 70,000 single-vehicle crashes) according to the crash type, the maneuver of the vehicle, and the violation indicated by the officer.

These variables were taken from the police accident report form. Each accident-involved vehicle can be categorized into:

a. One of 23 accident types, and also

b. One of 16 maneuvers for each of the two vehicles, and also

c. One of 23 violation categories for each of the two vehicles.

The possible values for each of these three factors are listed in Tables I-1 and I-2.

A computer tabulation was ordered allowing space for all combinations of accident type and each vehicle's maneuver. This resulted in a potential of 23 x 16 x 16 tables (5888). Each table then provided for a frequency count for 46 violation categories (23 for each vehicle). Figure I-2 helps to visualize this large matrix.

Analysts examined the two hundred or more pages of computer printout that resulted, and as was expected, hundreds of the theoretically possible combinations in fact had zero or near zero

Figure I-1. Accident analysis flow chart.

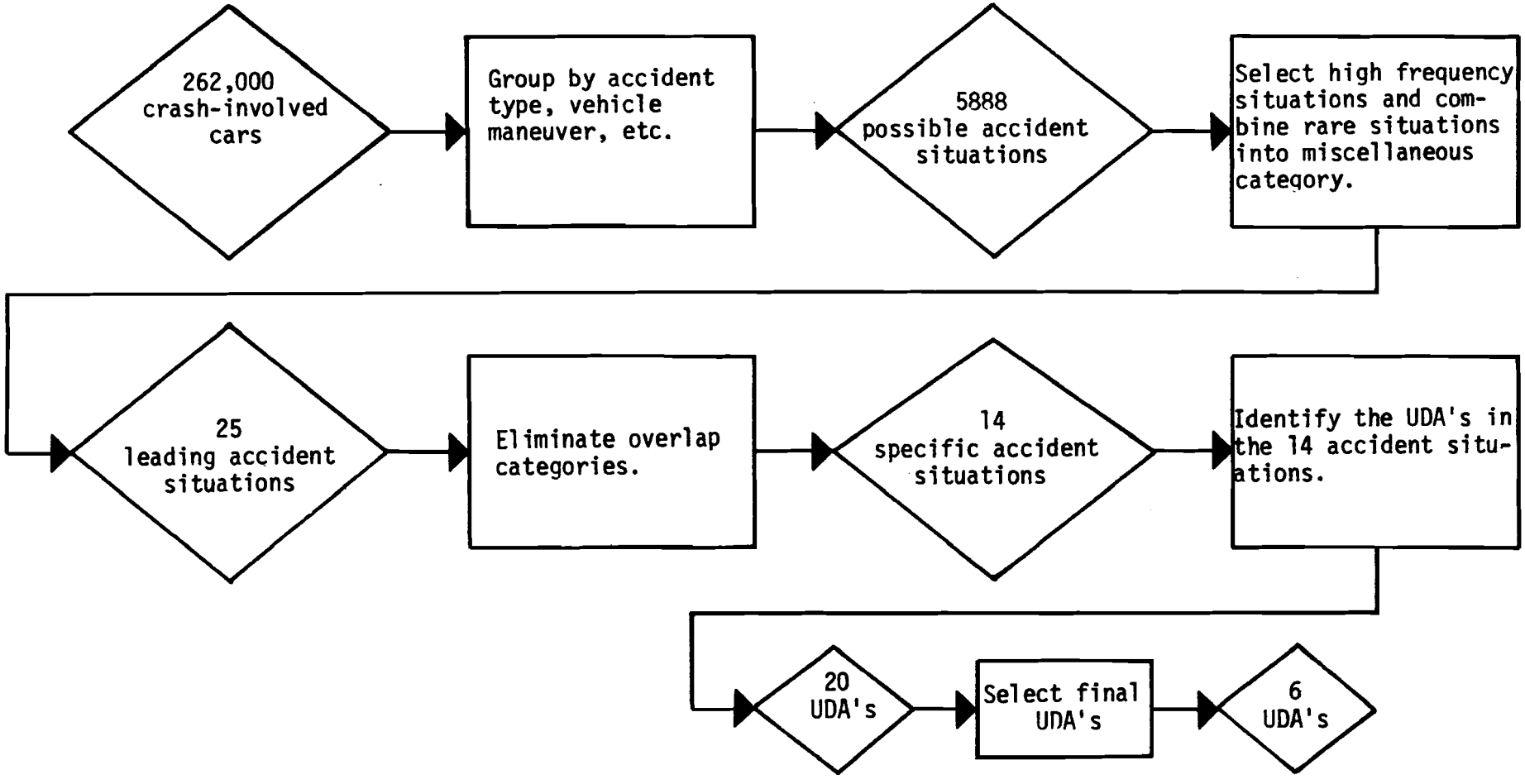


Table I-1. Accident type codes.

Accident Type	
01	Ran off road - right
02	Ran off road - left
03	Ran off road - straight ahead
04	Non-collision in road - overturn
05	Non-collision in road - other
06	Collision of motor vehicle with pedestrian
07	Collision of motor vehicle with parked vehicle
08	Collision of motor vehicle with train
09	Collision of motor vehicle with bicycle
10	Collision of motor vehicle with animal
11	Collision of motor vehicle with fixed object
12	Collision of motor vehicle with other object
13	Collision of MV with another MVs rear end - stopping or slowing
14	Collision of MV with another MVs rear end - turning
15	Collision of MV with another MV turning left from same roadway
16	Collision of MV with another MV turning left across traffic
17	Collision of MV with another MV turning right from same roadway
18	Collision of MV with another MV turning right across traffic
19	Collision of MV with another MV head on
20	Collision of MV with another MV sideswipe
21	Collision of MV with another MV at an angle
22	Collision of MV with another MV backing
23	Not stated

Table I-2. Vehicle maneuver and violation codes.

Vehicle Maneuver	Violation
01 Stopped in travel lane	(The 1st of up to 5 violations noted)
02 Parked out of travel lanes	01 Speeding below 65 mph
03 Parked in travel lane	02 Speeding 65 to 75 mph
04 Going straight ahead	03 Speeding over 75 mph
05 Changing lanes or merging	04 Failed to yield right-of-way
06 Passing	05 Driving on wrong side of the road
07 Making right turn	06 Improper overtaking
08 Making left turn	07 Disregarded stop sign or signal
09 Making U turn	08 Disregarded traffic signal
10 Backing	09 Followed too closely
11 Slowing or stopping	10 Improper turn
12 Starting in roadway	11 Improper or no signal
13 Parking	12 Improper parking location
14 Leaving parked position	13 Under influence of alcohol
15 Other	14 Reckless driving
16 Not stated	15 Racing
	16 Failed to see if movement could be made in safety
	17 Passed on curve
	18 Passed on hill
	19 Passed stopped school bus
	20 Improper lights
	21 Improper brakes
	22 Other improper driving
	23 Not stated

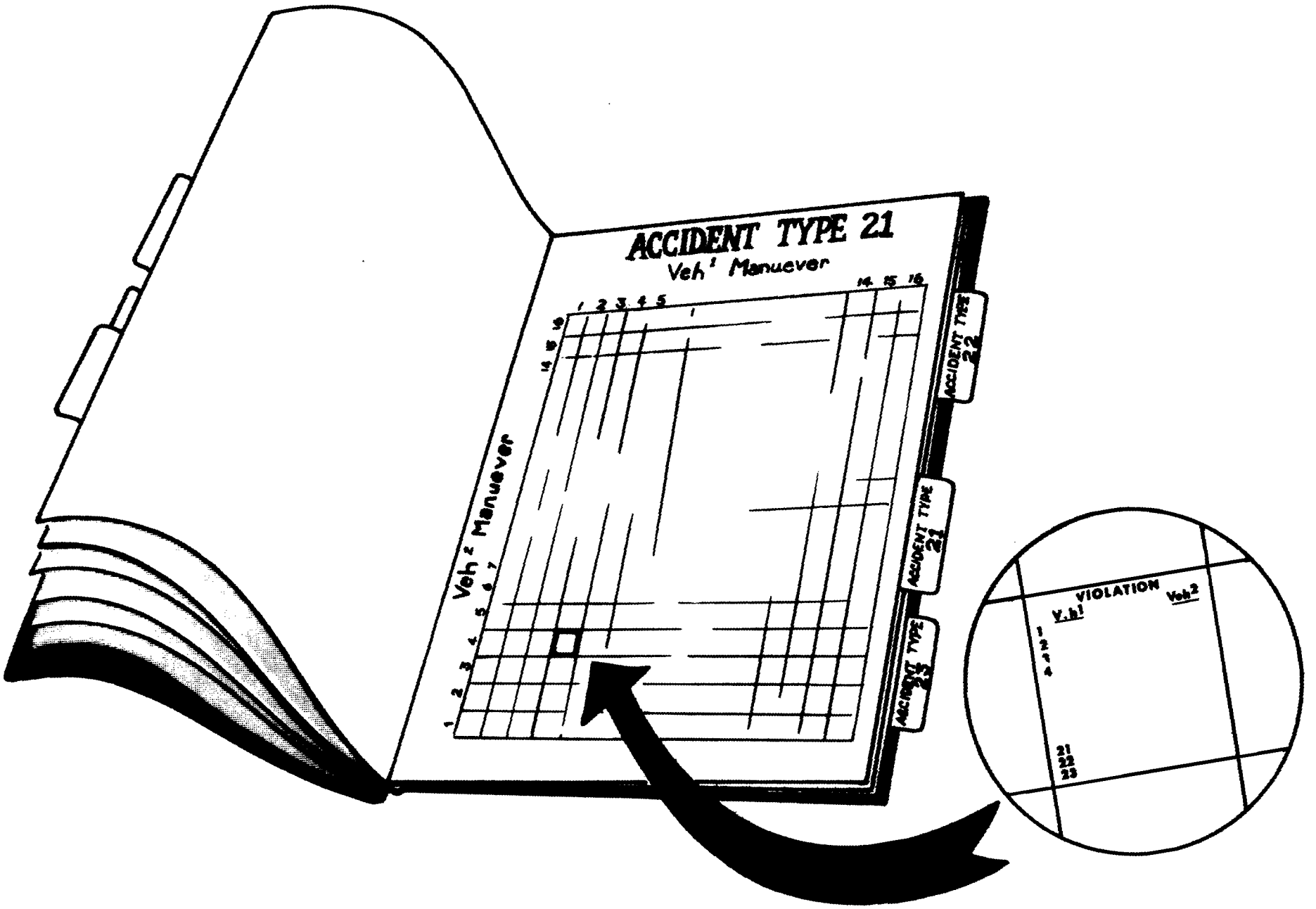


Figure I-2. Tables of vehicle 1 maneuver by vehicle 2 maneuver for each accident type.

Table I-3. Accident type 21-Collision of MV with another MV at an angle.

	Going Ahead		Going Ahead	
Speeding below 65 mph	514	(2.0)	432	(1.7)
Speeding 65-75 mph	29	(0.1)	37	(0.1)
Speeding over 75 mph	11	(0.0)	14	(0.1)
Yield right-of-way	4330	(16.6)	3924	(15.1)
Driving wrong side	563	(2.1)	478	(1.8)
Improper overtaking	20	(0.1)	22	(0.1)
Disregard stop sign	2574	(9.9)	1947	(7.5)
Disregard signal	2848	(10.9)	1924	(7.4)
Followed too closely	12	(0.0)	36	(0.1)
Improper turn	5	(0.0)	1	(0.0)
Improper/no signal	7	(0.0)	7	(0.0)
Improper parking location	0	(0.0)	0	(0.0)
Under influence	119	(0.5)	118	(0.5)
Reckless driving	34	(0.1)	28	(0.1)
Racing	0	(0.0)	0	(0.0)
Made unsafe movement	2018	(7.8)	1650	(6.3)
Passed on curve	0	(0.0)	1	(0.0)
Passed on hill	0	(0.0)	0	(0.0)
Passed stopped school bus	0	(0.0)	0	(0.0)
Improper lights	7	(0.0)	5	(0.0)
Improper brakes	114	(0.4)	56	(0.2)
Other improper driving	153	(0.6)	188	(0.7)
Not stated	12674	(48.7)	15156	(58.2)
Totals	26022		26022	

Table I-4. Accident type 21-Collision of MV with another MV at an angle.

	Going Ahead		Making Right Turn	
Speeding below 65 mph	9	(2.4)	1	(0.3)
Speeding 65-75 mph	0	(0.0)	0	(0.0)
Speeding over 75 mph	0	(0.0)	0	(0.0)
Yield right-of-way	11	(3.0)	120	(32.3)
Driving wrong side	6	(1.6)	17	(4.6)
Improper overtaking	1	(0.3)	0	(0.0)
Disregard stop sign	7	(1.9)	32	(8.6)
Disregard signal	21	(5.7)	7	(1.9)
Followed too closely	0	(0.0)	0	(0.0)
Improper turn	0	(0.0)	16	(4.3)
Improper/no signal	2	(0.5)	3	(0.8)
Improper parking location	0	(0.0)	1	(0.3)
Under influence	5	(1.3)	1	(0.3)
Reckless driving	0	(0.0)	1	(0.3)
Racing	0	(0.0)	0	(0.0)
Made unsafe movement	13	(3.5)	61	(16.4)
Passed on curve	0	(0.0)	0	(0.0)
Passed on hill	0	(0.0)	0	(0.0)
Passed stopped school bus	0	(0.0)	0	(0.0)
Improper lights	0	(0.0)	0	(0.0)
Improper brakes	2	(0.5)	2	(0.5)
Other improper driving	3	(0.8)	3	(0.8)
Not stated	291	(78.4)	106	(28.6)
Totals	371		371	

frequency. A limited number of categories had very high frequency. It is not practical to reproduce the full computer output, but to illustrate, Tables I-3 and I-4 show two of the 5888 categories. Table I-3 concerns accident type 21 (from Table I-1--two vehicles colliding at an angle), and shows the 04-04 maneuver combination (that is, each going straight ahead--see Table I-2). This category suggests, but does not uniquely define, a typical intersection right-angle collision. Table I-2 also shows the frequency distribution of violations indicated by the officer for each of the two vehicles in the 26,022 vehicles in this large category.

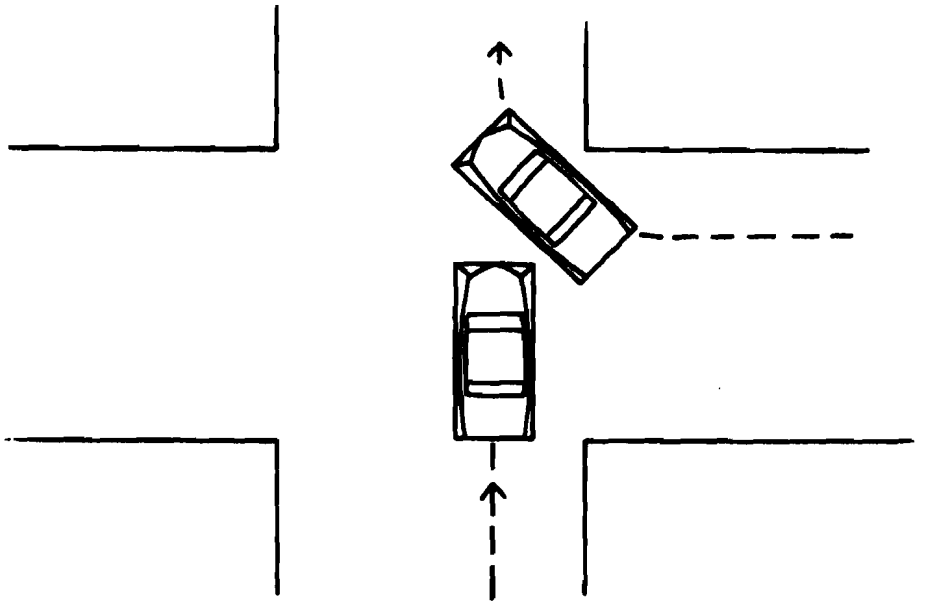
Note that the most common violations indicated by the officer were (1) failing to yield and (2) disregarding a traffic control. Thus, two quite different potential UDA's fall in the same accident subgroup.

Table I-4 shows a configuration with a much lower frequency count--an angle collision with one vehicle going straight ahead and the other turning right. Note here that the vehicle going straight ahead was much less often shown as having violated, and that the car turning right was most frequently charged with failing to yield.

The low frequency of this category (only 371) does <u>not</u> mean that this type of crash is rare in North Carolina, but indicates instead that this common type of crash can appear in more than one of the 5888 possible categories.

Once the computer output was available, we examined all of the high frequency categories. As was stated, a specific crash situation can correctly be classified into any of several categories (this probably reflects an inherent imperfection in the classification system).

Therefore, many categories were combined when they reflected the same accident configuration. For example consider an accident situation such as the one shown on the following page.



This situation could fall under at least the following six categories as defined by the described procedure.

Accident Type	Vehicle #1 Maneuver	Vehicle #2 Maneuver	
21	4	7	Collision of 2 motor vehicles at an angle, #1 going straight, #2 turning right
21	7	4	Collision of 2 motor vehicles at an angle, #1 turning right, #2 going straight
14	7	4	Rear end collision, one vehicle turning, #1 turning right, #2 going straight
14	4	7	Rear end collision, one vehicle turning, #1 going straight, #2 turning right
18	4	7	Collision 2 motor vehicles turning right across traffic, #1 going straight, #2 turning right
18	7	4	Collision 2 motor vehicles turning right across traffic, #1 turning right, #2 going straight

Step 2: reducing 5888 to 27

As a result of a tedious, time-consuming, but relatively simple examination of the computer output, it was possible to identify the

high frequency groups, to identify those which were essentially duplicates, to combine these duplicates, and then to specify 25 accident configurations. Seventeen of the categories concerned two-vehicle crashes. The remaining crashes, grouped into an 18th "miscellaneous" category, totalled 21 percent of the two-vehicle accidents.

Single-vehicle accidents were classified into eight leading crash types, accounting for 94 percent of the accidents; the remaining 6 percent were grouped into a 9th "miscellaneous" category. Each of these 25 (17 + 8) situations defines a specific accident configuration. Moreover, the 25 situations account for all high frequency accident configurations. In fact, many of the 25 categories are in the range of one percent of the total (ten of the groups account for less than one percent each). Therefore, we are confident that the classification scheme we have developed has not missed any frequently occurring crash situation. The "miscellaneous" category contains a multitude of different configurations, each of which accounts for only a tiny portion of the total.

Table I-5 shows the 25 accident situations for single and two-vehicle crashes, and the two miscellaneous categories ("others"), together with their frequencies and percentages of the total.

Step 3: case examination of the 27 accident groups

The foregoing reduction of 5888 accident categories down to 27 classes was as much as could be done solely by computer without reference to the details of individual cases. Until this point in the analysis only the computerized variables (accident type, vehicle maneuver and violation) had been used. The unsafe driving actions we wanted to define would not be synonimous with driver violations. The element of driver intent was to be considered and environmental situations specified for future observations. Subjective judgments, based on much more accident information, were in order. On the basis of a case by case analysis considering various data elements, the UDA's could more clearly and completely be defined and thus their frequencies could more precisely be estimated in the accident population.

In this step, therefore, data from individual cases were examined. This included (1) all of the digital data on the record (all fields of information recorded on tape from the actual report document), and (2) the verbatim narrative account of the crash as written down by the officer.

For each of the 27 groups (leading situations + two miscellaneous categories), 60 to 100 randomly selected cases were printed out for study.

Table I-5. Accident categories.

Accident situations for 2-vehicle accidents.

Accident Type	Maneuver Combination		N	%
	One Veh.	Other Veh.		
Parked vehicle	Parked	+ straight	8718	3.3
Parked vehicle	Parked	+ backing	2128	0.8
Rear end	Straight	+ straight	33239	12.7
Rear end	Straight	+ right turn	1786	0.7
Rear end	Straight	+ left turn	3533	1.3
Left turn same road	Straight	+ left turn	15224	5.8
Left turn same road	Passing	+ left turn	4578	1.7
Left turn across traffic or angled	Straight	+ left turn	13493	5.1
Right turn same road	Straight	+ right turn	3693	1.4
Right turn across traffic	Straight	+ right turn	2672	1.0
Head on collision	Straight	+ straight	3404	1.3
Sideswipe	Straight	+ straight	8153	3.1
Sideswipe or angled	Straight	+ changing lanes or merging	5538	2.1
Sideswipe or angled	Straight	+ leaving parked position	1603	0.6
Angled	Straight	+ straight	33603	12.8
Backing	Stopped	+ backing	2020	0.8
Backing	Straight	+ backing	4373	1.7
Others			40923	15.6

Accident situations for single-vehicle crashes.

Accident Type	Maneuver	N	%
Ran off road left or right	Straight	53761	20.5
Ran off road left or right	Turning	2140	0.8
Ran off road left or right	Changing lanes, merging or passing	1500	0.6
Ran off road straight ahead	Straight	1752	0.7
Noncollision, overturn or other	Straight	2088	0.8
Collision with object	Straight	2107	0.8
Collision with animal	Straight	3549	1.4
Unknown accident type		2474	0.9
Others (including 636 collisions with train)		4582	1.7
		262634	

Approximately 2000 cases were printed. We selected 60 to 100 narratives per accident situation to reduce the bulk of the printout and the level of effort required for analysis (about 1/2 to 1 1/2 man days were required to analyze cases in each of the 27 categories).

We then used the following guidelines to determine whether the 27 categories could be further reduced.

a. Within each of the 25 specified accident situations, the narratives and other case details were to portray a rather homogeneous situation. Cases within a given category were to uniformly reflect one or two UDA's in the context of a rather specific crash situation.

b. The two miscellaneous categories were to be very heterogeneous. They were not to reflect any major new UDA's. Such UDA's that were found in the miscellaneous categories were either to be very rare or to be of a type already reflected among one or more of the 25 classified groups of accident situations.

c. Any significant departure from the above two requirements set the stage for combining accident situations and thus collapsing the categories into fewer than 27 groups for the subsequent three-county analysis.

The task of analyzing the 2000 cases involved reading the case materials and visualizing the situation through a judgmental synthesis of the case information. To illustrate, the process is described in general terms below.

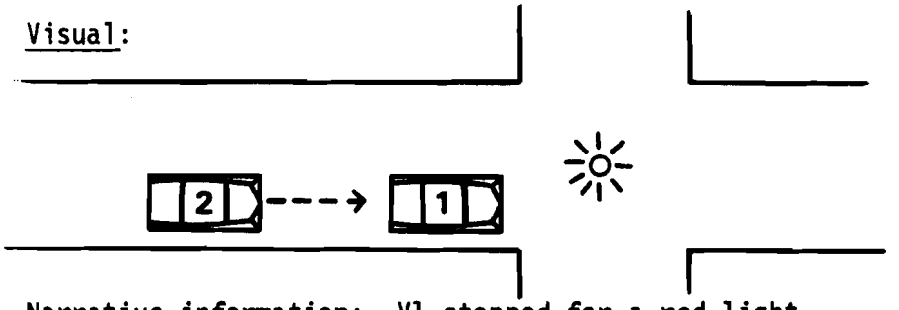
Cases were analyzed by combining information from the narrative with information from the accident report form. More specifically, the variables checked on the accident report form are road type, locality, speed limit, road feature, road condition, light condition, weather, traffic control, vehicle type, accident type, vehicle maneuver, vehicle defects, road defects, speed prior to the accident, direction of travel, physical condition, sobriety, and driver violations. Additional information was obtained from the narrative on the accident report form, which gives the officer's description of the crash and in some cases reflects the opinions of the drivers involved.

As a first step, accident and narrative information were combined in order to visualize the situation. The main variables used in this step were direction of travel, vehicle maneuver, accident type, and road feature. Within each of the 27 major categories these tend to be the same for each accident, although some differences do exist, such as left turn versus right turn and driveway versus intersection.

Secondly, each case was checked for information indicating factors other than UDA's which could have caused the crash. Other possible accident causes are: mechanical failure, driver physical condition, weather conditions, locality, and road conditions or other factors mentioned in the narrative (e.g., sunglare, animals in the road). Of course many of these factors have to be evaluated in combination with the speed and the maneuver of the vehicles involved in order to determine whether a UDA was involved (i.e., making a turn at 55 mph in a 55 zone on an icy road was considered a UDA).

After it had been determined that the accident was caused by an unsafe act on the part of one or both of the drivers, variables such as speed, vehicle maneuver, accident type, violations indicated, and narrative information were evaluated in order to identify the type of UDA. A specific case example is given below:

Visual:



Narrative information: V1 stopped for a red light
V2 failed to stop, hit V1

Accident information: Crash occurred in the city* at a stoplight,* speed limit 25 mph,* no bad road conditions* or weather conditions.* Speed V1 was 0 mph;* speed V2 was 5 mph,* indicating V2 was slowing. Physical condition of drivers normal.* No violations indicated for V1,* V2 charged* with "failed to see if maneuver could be made in safety."*

UDA: V2 must not have allowed enough distance to stop.

UDA: Following.

*This represents specific variables checked on the case information.

If a driver committed two UDA's in the same accident, the action most directly related to the crash was counted. For example, when a driver, both speeding and running a stop sign, hits a vehicle entering the intersection from the other road, the stop sign violation was considered as the UDA. In the UDA, following, this meant that a driver, both following too closely and speeding or speeding for the conditions, was considered to be following because of the insufficient distance he maintained for his speed.

This also applied when both drivers in an accident were involved in an unsafe act. For example, when one vehicle turned left without giving a signal and another vehicle passed the turning vehicle without blowing his horn, both UDA's were included ("no signal" and "passing a turning vehicle"). However, in accidents where the turning vehicle made the turn suddenly without signalling or made a left turn while indicating a right turn with the signal, the passing vehicle was not considered to be involved in an unsafe maneuver. Only when the two UDA's were equally "important" to the crash were both actions considered, as when two vehicles turned too wide entering an intersection.

Reports with too little information were classified "unknown," while some of the more ambiguous cases were classified as "questionable" (for example when two vehicles changed lanes to the middle lane at the same time, coming from the left and the right-hand lane respectively).

Once the 2000 individual case record data were examined patterns began to emerge, and it was clear that the cases could be grouped into fewer than the 27 categories derived in the previous step.

At the same time an effort was made to reduce the size of the miscellaneous categories defined in the preliminary analysis by studying the infrequently reported accident type-maneuver configurations and combining these with the existing accident categories when similar dynamics were identified. The 17 accident categories for two-vehicle crashes and the 8 accident categories for single-vehicle crashes were combined, using information obtained in the preliminary narrative analysis. In this way, categories with like dynamics were combined, while at the same time the two miscellaneous files were reduced in size by including more crash configurations in the new accident categories.

The above procedure resulted in a total of 14 new classes: 1) 10 new accident categories; 2) two relatively small miscellaneous files, one for single-vehicle crashes and one for two-vehicle crashes; 3) "not stated" accidents (e.g., accidents on private property) and 4) the more-than-two vehicle accidents. Figure I-3 shows how the 27 categories were thus reduced and combined.

To summarize what was done up to this point using statewide data:

1. We placed 260,000 vehicles in 5888 groups.
2. We combined categories and eliminated low frequency categories and thus reduced the 5888 categories to 27 (with only 13 percent of cases falling to the "other" category).
3. We randomly selected 2000 cases from among the 27 computer defined categories and, based on the individual case data, we determined that the groups could be further reduced to 14 accident categories (from which well-defined UDA's were selected).

Having established this methodology based on statewide data, the next step was to deal with the three-county data that comprise the sampling area.

Step 4: determining the UDA's in the three-county area

Next, we used the computer to select out the subset of 1973 and 1974 accidents from Chatham, Orange and Wake Counties, a total of 26,272 accidents (not counting pedestrian crashes).

This set of 26,272 crashes was then sorted into the 14 categories defined in the previous step. Table I-6 shows how the three-county data was divided among the 14 categories. Next, a procedure was employed to select randomly 100 cases from each of the 14 categories. (Actually the random process varies slightly so that a total of 1412 cases were selected--any given category yielded one or two cases more or less than the 100 sought.)

Each individual case with its officer narrative was examined independently by two analysts. Each analyst sought to conclude what UDA, if any, had contributed to the crash.

Figure I-3. Final accident categories.

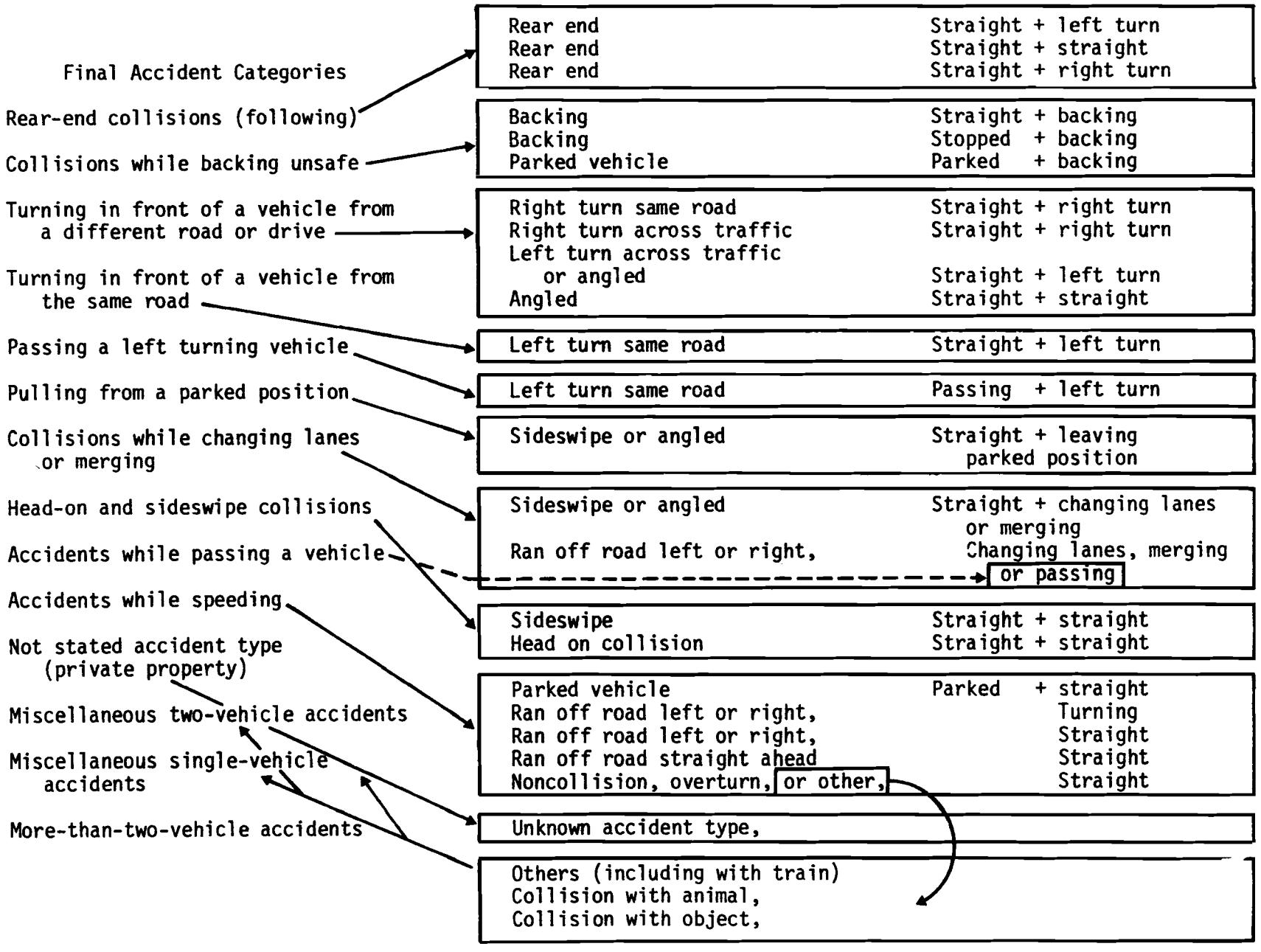


Table I-6. Frequencies for final accident categories.

Accident Categories	Frequencies
1. Rear-end collisions (following)	4161 (15.8%)
2. Collisions while backing unsafe	1343 (5.1%)
3. Turning in front of a vehicle from a different road or drive	5209 (19.8%)
4. Turning in front of a vehicle from the same road	1518 (5.8%)
5. Passing a left turning vehicle	254 (1.0%)
6. Pulling from a parked position	229 (0.9%)
7. Collisions while changing lanes or merging	1224 (4.7%)
8. Head-on and sideswipe collisions	1076 (4.1%)
9. Accidents while passing a vehicle	319 (1.2%)
10. Accidents while speeding	4975 (18.9%)
11. Not stated accident type (private property)	3069 (11.7%)
12. Miscellaneous two-vehicle accidents	903 (3.4%)
13. Miscellaneous single-vehicle accidents	698 (2.7%)
14. More-than-two vehicle accidents	1294 (4.9%)
	26272

If, upon comparing their conclusions, the two analysts were in disagreement, they evaluated the case again. Even so, there were cases which remained unclassifiable.

When all cases had been analyzed, many UDA's were identified. Data on the leading 20 UDA's are listed here.

The estimated frequency of these UDA's in the total three-county area was derived from extrapolating from the frequency of the UDA in the sample of cases drawn out for analysis back to the size of the group from which the case sample was drawn.

Table I-7 lists the top 20 UDA's and their estimated frequencies. Appendix A is a lengthy set of examples illustrating the information we used in deciding that a case indicated a given UDA. Also Appendix A discusses problems in observing that behavior in the field.

The final task was to select from the list of UDA's those actually to be observed in the field. The selection of this final group of UDA's was based on:

1. Frequency in accidents.
2. Severity (its frequency in fatal crashes).
3. Observability in the field.

The frequency was already taken into account by the foregoing process. We also made judgments regarding observability based on practice field tests. In addition we wanted to give consideration to UDA's in fatal crashes to consider the severity aspect.

The files of 1973 and 1974 accidents for the three-county sampling area contain 141 fatal crashes. A total of 118 accidents could be matched with the narrative file for a narrative analysis. Table I-8 shows the UDA's ranked according to their frequencies in fatal crashes.

Seven members of the HSRC staff reviewed the list of UDA's and selected six on the basis of frequency, observability, and accident severity for field observation.

Table I-9 shows the final list of UDA's which were observed and for which relative risks were calculated after the field observations were completed.

Table I-7. Identified UDA's in the three-county sampling area.

		Estimated Frequency
1.	Following	4193
2.	Pulling in front of traffic at a road or drive	2361
3.	Backing unsafe	2297
4.	Turning in front of oncoming traffic	1226
5.	Speeding too fast for the weather conditions or location (below or at the speed limit)	1179
6.	Running a stop sign or light	1151
7.	Changing lanes or merging in front of traffic	1138
8.	Speeding (above the speed limit)	980
9.	Turning too wide or sharp	903
10.	Driving left of the center line or on center line	743
11.	Turning from the wrong lane	533
12.	Driving under the influence	317
13.	Driving too close to the right side of the road	317
14.	Passing a turning vehicle	314
15.	Improper parked or stopped vehicles	293
16.	Pulling from a parked position into traffic	289
17.	Hit a parked vehicle while leaving parked position (or drive) - not backing	212
18.	No signal or improper signal	129
19.	Going straight in a turning lane	86
20.	Crossing the line of a lane in the same direction	78

Table I-8. Fatal UDA list.

1.	Speeding		39
	Speeding in a curve	8	
	Speeding elsewhere	28	
	Speeding while passing	1	
	Speeding while passing on the right (in 24 accidents speed of 20 mph or more above the speed limit were found)	2	
2.	Driving left of the center line		16
	Left of the center line	14	
	Left of the center line in a curve	2	
3.	Pulling in front of traffic from a road or drive		11
4.	Speeding for weather conditions or locality		8
	Too fast for a curve	2	
	Too fast for a bridge	1	
	Too fast for weather conditions	5	
5.	Ran a traffic control (stop sign or light)		5
6.	DUI (14 drivers were indicated as having a DUI violation. However, many more drivers had been drinking prior to the crash)		3
7.	Passing with oncoming traffic		3
	With oncoming traffic	2	
	With oncoming traffic at hill	1	
8.	Failed to yield to a train		3
9.	Pulled from a parked position in front of traffic		1
10.	Turned in front of oncoming traffic		1
11.	Passing too close to vehicle (ran vehicle off the road)		1
12.	Too close to right side of the road		1
Other causes:			
	Racing in the road + brake failure		1
	Pedestrian crossed in front of vehicle		1
	Children darted out in the road		1
	Occupant jumped out of the vehicle		1
	Trailer swing		1
	Non-UDA's (mechanical defects, sudden illness, skids)		11
	Unknown		11
	Questionable		1
			120

Table I-9. UDA's chosen for field observation.

1.	Pulling in front of traffic from a road or driveway	2361
2.	Turning in front of oncoming traffic	1226
3.	Running a stop sign or traffic light	1151
4.	Following too closely	4193
5.	Speeding (above the speed limit)	980
6.	Driving left of the center line or on the center line	743

Effects of the Energy Crisis

One may ask, did the energy crisis in 1974 have an effect on the rankings and therefore the selection of major UDA's? Could it be possible that certain categories identified in the 1973-1974 accident data could have changed position in the 1975 ranking in accident frequency? An attempt was made to answer these questions by comparing the accident data for the three one-year periods.

Rather than using the time consuming method of analysis as in the 1973-1974 data, comparisons were made of the percentage distributions on the accident variables (accident type, violation, and vehicle maneuver) for each of the three years. It can be argued that if the percentage breakdown of these variables remains the same, the UDA rankings should not change due to the strong relationship between these variables and the UDA's.

Percentage breakdowns on these variables produced by computer tabulations are shown in Tables I-10, I-11, and I-12.

The only relevant difference found was a two percent decrease in speeding violations in 1975 from 1973 and 1974, as shown in Table I-11. Small fluctuations of two percent or less can also be found for other values. However, none of these differences was considered significant enough to change the ranking of the UDA's in accidents.

Table I-10. Percentage distributions for accident type: 1973-1975.

Accident Type In	1973*	1974	1975
Ran off road - right	9.2%	8.9%	8.8%
Ran off road - left	5.2	4.9	4.9
Ran off road - straight	0.5	0.4	0.4
Overturn	0.4	0.4	0.4
Other non-collision	0.3	0.3	0.3
Motor vehicle with pedestrian	0.9	1.8	1.7
With parked vehicle	5.7	6.1	5.8
With train	0.1	0.1	0.1
With bicycle	0.4	1.1	0.9
With animal	0.7	0.8	0.9
With fixed object	0.5	0.5	0.5
With other object	0.3	0.2	0.3
Rear-end collision, stopping	18.9	18.0	17.5
Rear-end collision, turning	3.1	3.1	3.0
Turning left, same road	9.4	8.8	9.8
Turning left, across traffic	6.9	6.2	5.2
Turning right, same road	2.1	2.3	2.2
Turning right, across traffic	1.8	1.5	1.4
Head on collision	1.9	1.7	1.6
Sideswipe collision	8.1	7.1	6.9
Angle - collision	16.4	17.3	17.9
Backing - collision	3.2	3.1	3.2
Not stated	3.9	5.4	6.4
	100%	100%	100%
Vehicles:	(242883)	(249102)	(265958)

*1973 accidents without supplemental research information are not included. Nearly all these units were farm-vehicles, bicycles and pedestrians.

Table I-11. Percentage distributions for first reported violation: 1973-1975.

Violation #1	1973*		1974		1975	
Speeding < 65 mph	9.0%		9.1%		6.9%	
Speeding 65-75 mph	1.2	10.8	1.2	10.7	1.1	8.4
Speeding > 75 mph	0.6		0.4		0.4	
Failed to yield	5.5		5.1		4.9	
Wrong lane	3.6		3.5		3.5	
Improper overload	1.2		1.1		1.0	
Disregard stop sign	1.7		1.5		1.5	
Disregard traffic signal	1.4		1.5		1.6	
Following	3.5		3.1		4.7	
Improper turn	1.4		1.0		0.6	
Improper/no signal	0.4		0.4		0.3	
Improper parking	0.3		0.3		0.3	
DUI	1.4		1.6		1.5	
Reckless	0.6		0.6		0.6	
Racing	0.0		0.0		0.0	
Safe maneuver violation	10.2		11.1		11.9	
Passing on curve	0.0		0.0		0.0	
Passing on hill	0.0		0.0		0.0	
Passing school bus	0.0		0.0		0.0	
Improper lights	0.0		0.0		0.1	
Improper brakes	0.4		0.4		0.4	
Other improper driving	1.4		1.5		1.6	
Not stated, no violation	56.1		56.4		57.1	
	100%		100%		100%	
	(242883)		(249102)		(265958)	

*1973 accidents without supplemental research information are not included. Nearly all these units were farm-vehicles, bicycles and pedestrians.

Table I-12. Percentage distributions for vehicle maneuvers: 1973-1975.

Vehicle Maneuver In	1973*	1974	1975
Stopped in lane	7.4%	6.7%	6.6%
Parked out of lane	3.0	3.4	3.2
Parked in lane	0.7	0.7	0.6
Straight	56.4	55.4	54.8
Changing or merging	1.9	1.9	1.9
Passing	2.6	2.2	2.2
Right turn	3.2	3.2	3.1
Left turn	9.9	9.5	9.4
U-turn	0.2	0.2	0.2
Backing	2.2	2.2	2.2
Slowing/stopping	5.5	4.8	5.0
Starting in road	1.8	1.8	1.9
Parking	0.1	0.1	0.1
Leaving parked position	0.5	0.6	0.5
Other	0.3	0.4	0.4
Not stated	4.3	7.0	7.8
	100%	100%	100%
	(242883)	(249102)	(265958)

*1973 accidents without supplemental research information are not included. Nearly all of these units were farm-vehicles, bicycles and pedestrians.

PART II: ANALYSIS OF CITATIONS GIVEN FOR TRAFFIC LAW OFFENSES

In the preceding part of this study, accidents were analyzed to identify important UDA's and to estimate their frequency in the three-county sampling area.

In this part of the study, police enforcement activity is analyzed. Where citations were issued by police in response to a driver UDA (as defined in Part I), it then became possible to characterize the enforcement attention devoted to a UDA in relation to the relative accident risk caused by that UDA.

It is of interest to know the degree to which police enforcement activity is aimed at truly high risk UDA's. The concept of selective enforcement is based on the idea of policy directives which externally manipulate the probability that a given behavior will be detected. Because there is much relevance in considering match-ups or mismatches between enforcement policy and actual accident risk associated with a UDA, a sample of citation data was selected for analysis.

Note, however, that there is no intention here to imply that enforcement priorities should necessarily be directed solely to the highest risk UDA's. It would be possible to have a low frequency UDA that has a very high risk of a crash once the UDA occurs. However, the number of crashes resulting from that UDA could be less than that resulting from a much less risky UDA which, however, occurs rather frequently. This will be discussed to a greater extent later in the report.

Sampling-Data Collection

This phase of the study began concurrently with the accident analysis phase. Consequently the UDA's to be considered had not yet been identified; therefore, all traffic law citations were sampled.

The year selected for analysis was 1974. All citations written by all enforcement officers in each of the three counties were filed at the County's Office of the Clerk of Superior Court. The filing process is basically the same in all three counties.

Once a citation reaches the Clerk of Superior Court, it is assigned a file number. The citations are numbered in sequence upon receipt with the first citation of each year starting with number one. This citation file includes non-traffic offenses such as fishing without a license, larceny, and murder, as well as traffic citations.

After the citation reaches the Clerk's office, two to three months are required before the case is heard. The day the case is tried, a person from the Clerk of Superior Court's office notes the disposition or verdict on the bottom of the citation. The case is then placed in the inactive file. The 1974 citation information was used in order to be certain that a complete citation file was available.

A representative and proportionate sample from each of the three counties was desired. Since the total file was unmanageably large, every 12th citation of the 1974 files in each county was selected for the sample. This procedure assured the proportionate sample for each county and at the same time provided for the proper seasonal weighting.

As mentioned, the citation file includes non-traffic offenses. Because these were not relevant to the project, they were discarded, as were traffic citations that did not involve an unsafe driving act (i.e., driving without a license, improper tires, etc.). Table II-1 shows the total number of citations (both traffic and non-traffic), the number of traffic citations, and the number of cases sampled.

Table II-1. Traffic citations for the three counties.

	Total Citations	Traffic Citations	Sample Size
Chatham	6123	3980	287
Orange	14565	9848	636
Wake	80121	50718	2901

These samples included citations issued in both accident and non-accident situations. For the purposes of this study, only the non-accident situations were selected from the sample. Thus, the samples were further decreased as shown in the following table.

Table II-2. Non-accident citations for the three counties.

	Number of non-accident traffic citations in sample	Percentage of the traffic citation sample
Chatham	250	87.1%
Orange	572	89.9%
Wake	2367	81.6%

Citation Data Processing and Analysis

Data from each citation form in the sample was recorded on an optical scanning sheet for computer processing (see Appendix B).

The citation form itself contained 12 violation categories and an "other" category to be described by the officer. Since the officer can write in any of several violations here (usually the less common ones), we needed a system that would allow for classifying a larger number of violations. For instance, in this task we used the Annual Activity Report of the driver license section of the Division of Motor Vehicles. This report lists statewide data on a variety of violations. From this list of violations we set up 29 categories for analysis. Table II-3 is a list of these categories. The violation listed on each citation case file was classified where possible into one of these categories.

However, there were significant problems in working with these data:

1. The citation case file contains no supplementary information (like that which is found in an accident narrative). Therefore, we had no way to eliminate violations caused by external circumstances or physical impairment. We had to assume each was in fact a UDA.
2. The citation list contained ambiguous categories such as "failed to see if maneuver could be made in safety." Obviously this terminology could be applied to several UDA's involving backing, turning, merging, etc. This limitation made it impossible to match the citation list and the UDA list on a one-to-one basis.
3. Whenever a citation form showed two charges, only the first charge was coded for analysis.

For each sample, frequency counts were made for all of the 29 citation categories. The next step was to estimate the frequencies

Table II-3. Citation listing.

Citations Used in Analysis	Citations Coded
Speeding	Speeding x mph in a y mph zone Exceeding posted speed
Speeding for conditions	Driving too fast for existing conditions or driving at a greater speed than was reasonable and prudent under existing conditions and exceeding a safe speed
DUI	Driving under the influence of alcohol or drugs
Running a traffic control	Failure to stop at a duly erected stop sign. Running a red light
Failure to see	Failure to see safe movement or failure to see movement that could be made in safety
Failure to see before starting	Failure to see before starting that such movement could be made in safety
Failure to see before stopping	Failure to see before stopping that such movement could be made in safety
Failure to see before turning	Failure to see before turning from a direct line that such movement could be made in safety
Reckless	Reckless driving without due caution and circumspection and at a speed and in such a manner as to endanger persons and property
Left of center	Failing to drive on right half of roadway (driving wrong side of road)
Wrong way	Going wrong way on one-way street (or dual lane highway)
Illegal or improper passing	Illegal (improper) passing Illegal passing on curve Illegal passing on hill Illegal passing at an intersection
Illegal U-turn	Illegal or improper U-turn
Failure to reduce speed	Failure to reduce speed
Failure to yield	Failure to yield right-of-way

Table II-3 (continued).

Citations Used in Analysis	Citations Coded
Failure to yield at a sign	Failure to yield at a duly erected yield sign. Failure to yield right-of-way at duly erected stop sign
Following	Following too closely
Improper turn	Improper turn
Improper use of lane	Improper use of traffic lane
Improper or no signal	Improper signal. Failure to give sign
Negligent driving	Negligent driving
Hit and run	Hit and run
Racing	Racing
Too slow	Driving below minimum speed
Passing a stopped school bus . . .	Passing a stopped school bus
Improper backing	Improper backing
Improper lights	Failure to dim lights
Other improper driving	Other improper driving
Not stated violation	Not stated

of these citations in the entire county for 1974. To do this a multiplicative factor needed to be calculated. This was determined by:

$$\frac{\text{total non-accident traffic citations per county}}{\text{sample size for non-accident traffic citations per county}}$$

Table II-4 presents the information necessary for the calculation of the multiplier for each county. The sample frequencies from Tables II-1 and II-2 are presented in columns 1 and 2 respectively. The percentage of non-accident citations in the total sample (column 4) is calculated by dividing column 3 by column 2. This percentage was then used to estimate the total number of non-accident citations per county (column 5). This estimate, together with the number of non-accident citations in the sample, gave the multiplier as shown in column 6.

For each county the frequencies for the 29 accident categories were multiplied by its respective multiplier to estimate the number of non-accident traffic citations in that county for 1974. The frequencies for the 29 categories were then combined across counties to give the total frequency for the area. Table II-5 presents these estimates for each county and the total for the area in rank order by frequency.

Enforcement Strategies in 1974

It is recognized that different enforcement strategies were used in 1974 (the year of the energy crisis). These strategies might influence the frequencies and types of citations issued during that year.

Traffic citations issued by the highway patrol in the three-county sampling area were compared for 1972, 1973, 1974, and 1975. Table II-6 shows the percentage distribution of non-accident citations issued by the highway patrol for those four years. It can be seen that the percentage of speeding violations issued in 1972-1975 remained approximately constant. An increase in citations for speeding between 65 and 75 mph and a reduction in the "over 75 mph category" is shown in 1974. There was a further increase in 1974 for overall speeding citations as well as for the "between 65 and 75 mph" category.

Table II-4. Estimates used for calculation of non-accident frequencies for the three counties.

	Total Traffic Citations in 1974	Sampled	Non-accident Citations in Samples	% of Non-accident Citations in Total Sample	Estimated total Non-accident Citations (using percentages in column 4)	Multiplier
Chatham	3980	287	250	87.1%	3467	3467/250
Orange	9848	636	572	89.9%	8853	8853/572
Wake	50718	2901	2367	81.6%	41386	41386/2367

Table II-5. Estimates of non-accident citation frequencies for the three counties in 1974.

	Chatham	Orange	Wake	Total
Speeding	2094	6129	23027	31250
Ran a control	388	1068	10421	11877
DUI	430	820	2815	4065
Wrong lane	0	0	1241	1241
Improper passing	194	108	542	844
Wrong way	0	0	734	734
Left of center	111	77	455	643
Illegal U-turn	0	16	560	576
Reckless	28	170	210	408
Speeding for condition	97	93	175	365
Following	42	108	157	307
Not stated	14	16	245	275
Yield at sign	42	16	157	215
Didn't see, turn	0	31	157	188
Headlights	14	93	70	177
Improper turn	0	0	175	175
Didn't yield	0	46	70	116
Didn't reduce speed	0	16	52	68
Racing	14	0	35	49
Passing school bus	0	0	35	35
Improper signal	0	16	18	34
Didn't see, start	0	31	0	31
Improper backing	0	0	18	18
Other driving	0	0	18	18
Didn't see	0	0	0	0
Total	3468	8854	41387	53709

Table II-6. Percentage distributions of highway patrol moving traffic charges.*

	1972		1973		1974		1975	
Speeding Below 65 MPH	11.3		14.3		7.2		4.6	
Speeding 65-75 MPH	49.1	69.2	46.4	68.9	58.3	69.4	64.8	73.3
Speeding 75 MPH Or Over	8.8		8.2		3.9		3.9	
Exceeding Safe Speed	1.9		2.5		1.8		1.7	
Below Minimum Speed Limit	0.0		0.0		0.0		0.0	
Impede Traffic	0.0		0.0		0.0		0.0	
DUI, 1st Offense	10.8		8.6		8.4		7.5	
DUI, 2nd or Subs. Offense	0.4		0.5		0.6		0.8	
Wrong Way in One Way Road	0.2		0.2		0.2		0.3	
Racing	0.2		0.2		0.1		0.0	
Reckless Driving	1.2		1.1		1.1		1.1	
Following Too Closely	0.6		0.9		0.8		0.6	
Driving on Wrong Side of Road	2.3		2.4		2.5		2.3	
Failed to Yield	0.4		0.6		0.5		0.4	
Failed to See Movement Safe	0.5		0.6		0.5		0.5	
Improper Turn	0.0		0.1		0.0		0.1	
Passing on a Curve	0.2		0.3		0.2		0.2	
Passing on a Hill	0.3		0.4		0.3		0.2	
Other Improper Passing	3.0		3.1		2.6		2.1	
Passed Stopped School Bus	0.1		0.0		0.1		0.0	
Stop Sign or Signal Violation	4.7		5.5		6.4		4.7	
Improper or no Signal	0.0		0.1		0.0		0.0	
Pedestrian - Drunk	1.5		1.4		1.2		1.2	
Pedestrian - Other	0.0		0.0		0.0		0.0	
Improper Lights	0.3		0.3		0.2		0.2	
Improper Brakes	0.1		0.1		0.2		0.1	
Other Improper Equipment	0.0		0.0		0.1		0.0	
Defective Tires	0.3		0.2		0.6		0.9	
Vehicle Over Dimension	0.0		0.2		0.0		0.0	
Load on Vehicle Not Secure	0.5		0.7		0.6		0.3	
Driver License Restriction	0.5		0.4		0.6		0.7	
Improper Use of Lights	0.2		0.2		0.6		0.6	
Other Hazardous Traffic	0.4		0.3		0.2		0.2	
	(100%)		(100%)		(100%)		(100%)	
	14827		14653		16458		18348	

*Citations issued by the municipal police and sheriff departments were not available on a county by county basis.

PART III: FIELD DATA COLLECTION

In order to address the question of relative risk of an accident, field data were collected on the population at large. This information was combined with accident data to calculate the relative risk of an accident. Two different methods of observation were used:

1. The primary observations were made by observing drivers passing through points identified as "dangerous." This is called the "point method" and accounts for the bulk of the field data effort.
2. The second method was to follow randomly selected vehicles for a short time and to observe them in that way (trip method).

The specific set of UDA definitions, sampling, and analysis procedures that was required for each of these methods is described below.

Point Data

During the months of August and September, observational data were collected at 41 locations in the three-county area to provide hourly estimates of the frequency of the six UDA's. We elected to conduct our observations at 41 randomly selected accident sites. Accident sites were selected by definition to be places where UDA's could occur. (We wanted to eliminate locations where even such a violation as running a stop sign might not be dangerous.)

The sites were selected by using the same accident data files used earlier in the accident analysis. In order to assure a large enough sample of observable locations, a total of 99 accident cases were randomly drawn from the files. We then chose to eliminate private property sites from the observations. With these sites excluded from the sample, the proper number of single, two-vehicle, and multi-vehicle accidents were drawn resulting in a sample of 41 accident locations plus some alternate sites.

As a preliminary procedure each of the 41 sites was visited to pinpoint the location and to check to see whether there would be parking facilities at the site. (It was also necessary to obtain special permission for some parking facilities.) The place of the accident was pinpointed as exactly as possible from the information on the report form

giving highway or road numbers with a diagram of the scene drawn by the investigator. The site extended as far as the observers were able to see to collect the appropriate data. While surveying the site the team drew a sketch of the site so that preliminary plans could be made for the most efficient manner to collect data at that site. Of particular importance were driveways and other details which the investigating officer may neglect to include in the accident diagram. Since it was found that some sites could not be used due to a lack of parking facilities, substitute accident sites were selected on the basis of similar road structure, road feature, number of lanes, speed limit, and locality.

The accident sites were then assigned times in the observation schedule. A schedule had been devised to provide for data collection during four time periods; weekday day, weekday night, weekend day, and weekend night. We wanted both busy and nonbusy hours to be covered in the observation times. Specifically, the schedule used the following time slots and the corresponding hours for the observations.

13 weekday mornings	7:30 - 10:30 am
16 weekday afternoons	3:00 - 6:00 pm
4 weekday nights	8:00 - 11:00 pm
3 weekend mornings	9:00 - 12:00 am
5 weekend nights	8:00 - 11:00 pm

In matching sites with time slots, the parking problems were considered and some controls kept on the four time periods. Assurances were made that the group of sites for each of the four time periods included at least one location from each of the following:

1. A site where all six UDA's could possibly occur.
2. A site where speeding in a 55 zone could occur.
3. A lower speed zone.
4. A site where pulling in front and turning in front from a road could be seen.

This information could be determined from the sketch of the accident site and accident report.

Practice periods before the actual observations began enabled the observation team to develop the best techniques for detection of each of the six UDA's, the best manner of observing and recording data, and the most efficient use of manpower.

It was found that all six UDA's could not be detected at once with the observation techniques developed and the manpower available. It was easier for the observer to concentrate on one UDA at the time, selecting one driver, determining whether he committed a particular UDA, and noting profile characteristics of the driver. Thus, although theoretically all UDA's should have been observed within the same hour for analysis purposes, with one or two observers required to observe for each UDA, and with a team of only three observers, it took a minimum of two to three hours to collect data at a site.

It was also determined that, in heavy traffic, an observer could not observe and record data on all drivers passing through the site. A random method of selecting a driver was developed using a reference point, such as a tree or telephone pole. The first vehicle to pass that reference point was chosen as the target vehicle. Driver profile and behavior were observed and recorded. Once the recording was accomplished the next vehicle to pass the reference point was selected as the next target. Of course, traffic was at times light enough for the observers to record profile and behavior data for all the drivers. This was noted by the observer for use by the statistician later. This random method of selection was used for all six UDA's when necessary.

It was also found that at times more than one maximum of four "observation points" could be watched at once such as in the case of driveways.

Prior to the actual data collection, each site was drawn up in detail from the earlier sketch to determine where the UDA's had occurred.

The result was an individualized plan for each site that allowed for a one-hour observation for each of the six UDA's (at some sites, it was not possible to observe all six UDA's--e.g., driving left of center could not be observed on a one-way street). At intersections, the division of observations between the two roadways was done according to traffic

conditions. The order in which the UDA's were observed was random. Figure III-1 illustrates the coordination of observers and the division of time for one of the observation sites.

As a consequence of this prior planning, the team was better organized at the site and the observation time was reduced to a minimum. In addition, the probability of error was reduced: some UDA's may not have been scheduled for observation if each site had not been previously examined to determine which UDA's are possible at that location.

Upon arrival at the site, the general procedure for the actual observations was to find the planned parking space for Hour 1, fill out the cover sheet, and distribute the coding sheets. Reference points were set up for use in the speeding and following data and the appropriate measurements were taken for the speeding UDA.

Just before the observation hour, a five-minute volume count was taken at the site for all lanes and all directions of travel, including appropriate driveway traffic. Other five-minute volume counts were taken after each observation hour. If two roadways were to be observed, the team changed parking positions between observation hours to facilitate collection of speeding and following data for both roadways. After completing the observation plan, the team used the observations to extrapolate the UDA frequencies at the site.

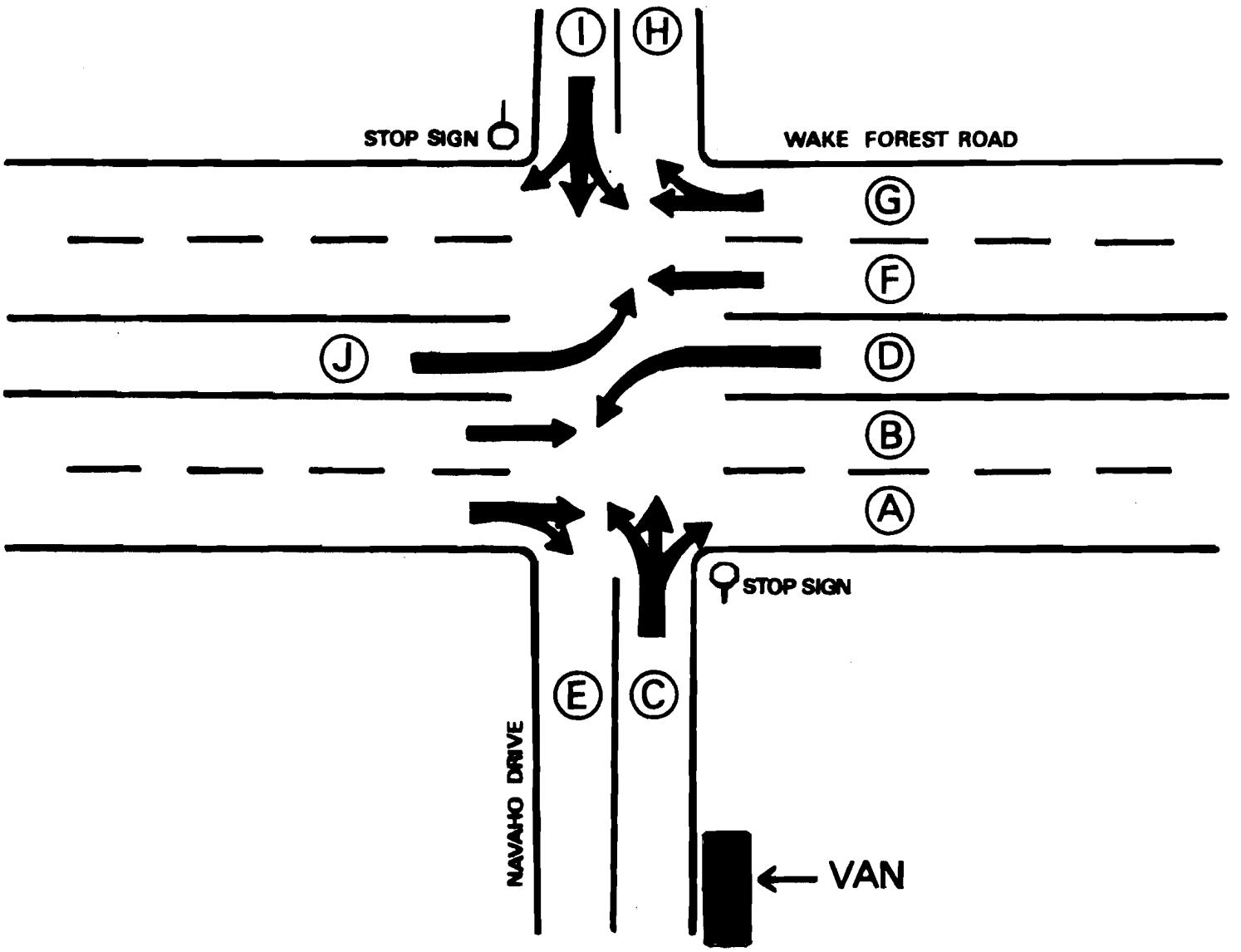
The techniques and definitions used in the UDA observations are discussed below:

1. Speeding.

   Speeding data were collected for only one lane of roadway and one direction of travel at a time. Generally, the lane closest to the observers was used for the observation.

   The observers defined a segment of roadway using two reference points, measured it, and recorded the distance. Then, as one observer identified specific vehicles and clocked them with an electronic digital timer to the nearest one-hundredth of a second between the reference points, the other observer recorded the driver's profile characteristics and the vehicle's time (see Figure III-2).

   Because the vehicles' average speeds were not computed until later, speeders were not identified at the scene.



Time Period	UDA			Observation Point
Hour 1	Pulling in front:	1 observer	1 hour	C
	Traffic control:	1 observer	1 hour	C
	Turning in front:	1 observer	1 hour	D
Hour 2	Speeding:	2 observers	1/2 hour	A
	Following:	2 observers	1/2 hour	A,B
	Left of center:	1 observer	1 hour	E
Hour 3	Following:	2 observers	1/2 hour	C
	Speeding:	2 observers	1/2 hour	C

Figure III-1. Sketch and observation plan for one of the 41 observation sites.

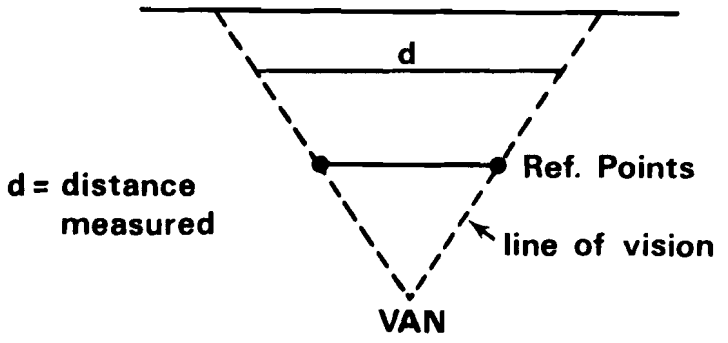


Figure III-2. Sample set-up for speeding observations.

2. Following.

The electronic digital timer was also used to measure the duration of the gap time between pairs of vehicles. As in the speeding observations, a reference point was chosen and a first vehicle randomly selected. The gap time (the period between when the rear of the first vehicle and the front of the following vehicle passed the reference point) was measured and recorded. Two observers were needed, one to time the vehicle and the other to record the time and profile data.

Gap times of .7 seconds or less were defined as following too closely. This definition was chosen on the basis of previous monitor studies where a gap time of .7 seconds or less was considered a violation. If a five-second time period elapsed and no second vehicle appeared, then another first vehicle was selected.

3. Traffic control.

One observer was responsible for recording the behavior of drivers approaching intersections or driveways governed by traffic controls.

Running a control was defined by either of the following conditions:

Running a stop sign--any vehicle entering the intersection without slowing sufficiently to check for traffic. This definition also applied to right-on-red situations. Obviously, only flagrant violations were counted. A driver slowing down at the sign to check for traffic was not counted as a violation.

Running a red light--any vehicle entering and passing through an intersection on a red light only (e.g., if the light was yellow when the driver entered the intersection, and it changed to red while he was still driving through the intersection, it was not considered a violation).

4. Driving left of center.

   Only one observer was needed for this UDA. Any vehicle whose wheels crossed the center line but was not in the process of passing another vehicle was recorded as having committed this UDA.

   At locations where there was a curve present in the roadway, the observation time was divided between the two directions to obtain data for both sides of the curve.

   This definition is more pronounced than that used in the accident analysis where vehicles may not have actually crossed the line but were on or too near the line.

5. Turning in front of oncoming traffic.

   Left turning lanes and through traffic past driveways were observed where any left turns across traffic could be made.

   The definition for this UDA required the observer to make a subjective judgment as to whether a dangerous situation actually existed by noticing any slowing, stopping, changing lanes, or other avoidance maneuver on the part of oncoming traffic.

6. Pulling in front of a vehicle.

   All roadways and drives were observed where a vehicle could enter a roadway and interrupt a free flowing traffic pattern.

   As with turning in front, the definition was subjective: any vehicle that entered a roadway and forced other traffic to make avoidance maneuvers (e.g., without allowing other traffic to comfortably control slowing, stopping, changing lanes, etc.).

   Since pulling in front by this definition could be noted as a result of running a traffic control, only those vehicles first coming to a full stop and then conflicting with the oncoming traffic were noted as having committed the UDA.

Data recorded.

The observation data were recorded on two forms.

(1) A cover sheet used to describe the location including locale variables (highway type, location, county, speed limits), time and day of the observation, a detailed sketch of the location with the observation points labeled, reference points for speeding and following, volume counts for every direction of travel, and driveways locations.

(2) An observation sheet used to record which UDA was being observed, whether or not the UDA was committed, the observation point (up to four maximum), the driver profile, and gap time (for following too closely) or speed time (for speeding).

The time when the observation was conducted was recorded in the margin along with any relevant comments.

The profile data recorded for every target vehicle (except the first vehicle in the following too closely data) consisted of the following:

Vehicle type:	passenger car truck motorcycle other
Driver race:	white black other
Driver sex:	male female
Driver age:	youth - college age or less adult - 21-54 years of age elderly - 55 or older

The observers determined as accurately as possible which description was the most accurate, and checked the corresponding space. This information was later keypunched for data processing (see Appendix C for data format).

An Alternative Observational Technique

A focal point of this total study effort is the process of observing UDA's in the traffic stream. The observations obtained using the point method yielded estimates of the frequency of occurrence of each of the UDA's at the sites where they were observed. There was, however, no straightforward way of extrapolating these frequencies to reflect the situation in the three-county area. The estimated frequencies obtained through the point observations were used to determine quantities ("relative risks:" they are described more fully in a later chapter), but they could not be used to estimate the conditional probabilities of an accident given the commission of a UDA. Accordingly, we thought it desirable to examine a second technique for observing cars.

Whereas the main effort was based on fixed point observation of many cars as they pass by, the second method was based on following a few cars one at a time and observing them in traffic for several minutes.

The frequency of occurrence of each of the six UDA's was estimated by following a random sample of drivers for a fixed period of time, and noting whether one of five specific UDA's was committed. (The sixth UDA, following too closely, could not be observed using this method.)

Sampling and method of selecting vehicles.

From the set of 41 accident sites used in the fixed point method, 20 were used as points of origin. Ten sites were drawn randomly from the 41. On each day of data collection, the team began at one of these 10 sites.

At the site, a vehicle was selected randomly and followed until one of the following conditions was met:

1. The driver committed one of the five UDA's.
2. The driver terminated his trip.
3. We lost the driver.
4. A five-minute time period had elapsed.

Each of these signaled the end of an observation and required the team to choose another target. As a rule, the team pulled off to the side of the road upon termination of the observation, and recorded the data on that observation. The procedure for selecting another vehicle would be to flip a coin to determine a direction of travel and select a vehicle traveling in that direction as the next target. In practice, this "next vehicle" was the one most convenient to fall behind as the team itself moved into traffic. In congested areas or busy traffic where it was difficult to stop and pull off, the team would select as the next target a vehicle in front and not change direction. A timer was set at the beginning of each observation.

The process of selecting a target, following that target, and recording data was repeated for an hour's duration, after which they broke off and drove on to the closest accident site of the 41, where they began again.

This method of selecting and following vehicles did not limit the observations to the accident sites, because vehicles were

followed some distance and in all directions from the site. Therefore, only the first observation was certain to have originated at the site. Figure III-3 shows the pattern of travel for one of the one-hour observation periods.

The times for data collection were approximately the same as in the previous method. Some time was allowed for travel between sites.

3 weekday mornings	7:30 - 8:30 am 9:00 - 10:00 am
4 weekday afternoons	3:00 - 4:00 pm 4:30 - 5:30 pm
1 weekday night	7:30 - 8:30 pm 9:00 - 10:00 pm
1 weekend night	7:30 - 8:30 pm 9:00 - 10:00 pm
1 weekend morning	9:00 - 10:00 am 10:30 - 11:30 am

Methods of detection.

Practice periods enabled the team to develop techniques for detecting UDA's and recording data, and to test the sampling method. Because the team was driving behind the target vehicle rather than observing at specific fixed points, the methods for detecting the UDA's varied from those used at the fixed points. These perceptual changes made detection dependent on the distance between the team and the target vehicle and the obstructions imposed by other vehicles in traffic.

In general, the observers attempted to follow the target at a safe and inconspicuous distance, with one team member driving and the second team members of the team observing the target vehicle and other traffic.

The following definitions describe the conditions used by the team to determine whether a UDA was committed.

1. Speeding.

   If, in trying to maintain a reasonable gap between the van and target, the team accelerated more than five mph above the speed limit and the gap continued to widen, the target vehicle was judged to be speeding 5 mph over the limit. If the gap in this situation narrowed as the team accelerated, the team continued to follow the target and speeding was not noted. No attempt was made to calibrate an exact speed, as was done in the fixed point observations.

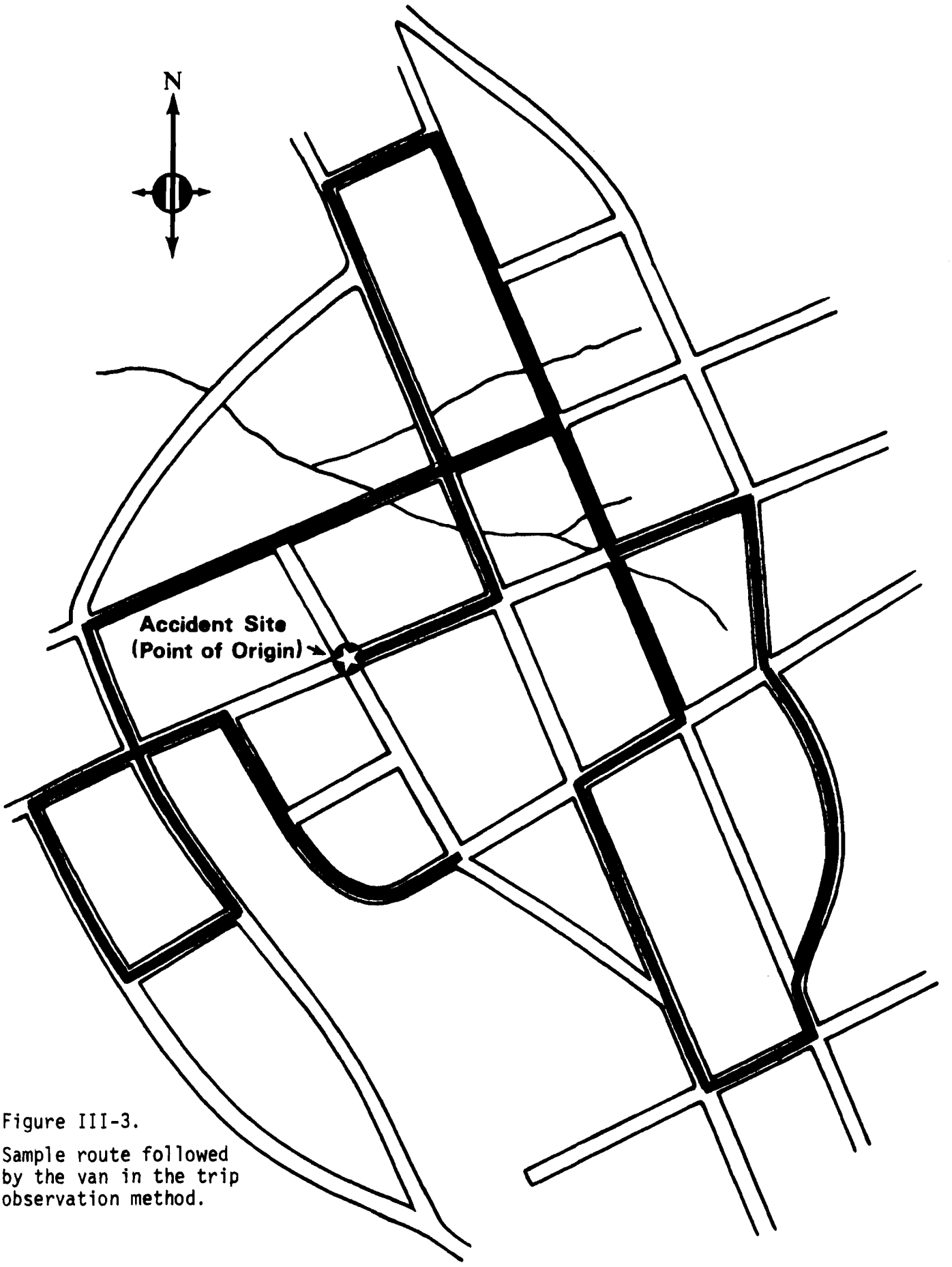


Figure III-3.

Sample route followed by the van in the trip observation method.

2. Running a traffic control.

   If the target did not stop at a stop sign or a red light, this UDA was noted. Those targets which rolled or "creeped" through the sign were not considered to have committed this UDA, nor were those who went through a yellow light. Only flagrant violators were noted. Because the team was not situated at an intersection, detection was not as good as in the fixed point observation method.

3. Pulling in front of oncoming traffic.

   Pulling in front was noted by evidences of slowing, stopping, or changing lane behavior of oncoming traffic as the target vehicle pulled out into traffic.

4. Turning in front of oncoming traffic.

   Any vehicle turning left across traffic and causing the oncoming traffic to slow or stop was considered to have committed this UDA.

5. Left of center.

   Any vehicle whose wheels crossed the center line for any period of time was considered to be driving left of center. The team was aware of extenuating circumstances (narrow roadway, bumps, or parked cars) and considered them before deciding whether the target vehicle had committed a UDA. Observers in the fixed point method may not have been as aware of extenuating circumstances as the observers using the trip method.

6. Following too closely.

   This was the only one of the six UDA's that was not monitored with the mobile method of observation. In practice sessions, the observers realized that they were unable to accurately and objectively determine whether the target vehicle was following too closely. Therefore, rather than have data based upon subjective judgments, project leaders deleted this UDA from the mobile observations.

Information recorded.

A coding scheme was developed for using regular coding sheets to record the data in the format prescribed in the coding manual. These sheets were later keypunched for computer analysis (see Appendix C for the data format).

The information recorded consisted of the following:

1. Which UDA was committed, if any.
2. The number of miles traveled per observation.

3. The time followed per observation.
4. The driver information - age, sex, race, vehicle type (same as in the point method).
5. Time and location variables at the termination of the trip. These variables were the same as in the point method.

PART IV. ANALYSIS OF FIELD DATA: COMPUTATION OF RELATIVE RISKS AND CONDITIONAL PROBABILITIES

Combining the results of field data with those from the accident analysis produced two measures of accident risk: 1) relative risks as computed by Bayes theorem (the risk of an accident relative to "other" behavior using the point data); and 2) conditional probabilities (the probability of an accident given the occurrence of a particular UDA based on vehicle miles). The extent to which the results of these two methods are comparable is discussed later.

Analysis of Point Data and Calculation of Relative Risks

Extrapolation procedures.

The first major task of the point data analysis was to calculate hourly frequencies for each of the 6 UDA's and the "other behavior" category at each site. As described in the data collection section, not all lanes and directions of travel for all UDA's were observed, and even when data were collected, the random method of selecting vehicles was used where all traffic could not be observed and recorded. The procedure for estimating the behavior frequencies at each site consisted of the following steps:

(1) Determining rates of occurrence at observation points where data were collected.

(2) Estimating the total hourly frequencies where data were collected and not all vehicles were observed.

(3) Estimating total hourly frequencies where the UDA could have occurred.

(4) Estimating the total number of UDA's at each site.

(5) Estimating total hourly volume at a site to derive estimates for the "other behavior" category.

Step 1.

For each sample of observational data at an "observation point" (onelane-one direction of travel, or a driveway), the rate of occurrence for the particular UDA observed at that point was determined by:

$$\frac{\text{number of vehicles observed committing the UDA}}{\text{total number of vehicles observed}}$$

These tallies were made after the observation team returned to HSRC. In the case of speeding, the speeders were identified from the posted speed limit, the measured distance between the two reference points, and the time it took the vehicles to pass the two points.

Step 2.

In cases of heavy traffic where a random sample of vehicles was observed, the hourly frequencies had to be estimated. This was done by the following calculation:

Estimated number of occurrences =
(observed UDA rate) x (estimated hourly volume)

The estimated hourly volume was obtained from the average of the five-minute volume counts taken just prior to, and immediately following, the hour during which the observations were made. Of course, this procedure was not necessary when all vehicles were observed for an hour.

Step 3.

As described in the data collection section, not all lanes or directions of travel were observed (e.g., speed data were collected in only one lane of travel). This required some extrapolation at the site, where it was assumed that UDA rates (where UDA was possible) in opposite or adjacent lanes were the same as in those that were observed. Volume in those lanes, however, may have been different. Since volume counts were taken at all points and for all directions of travel at the site, some estimates of hourly frequency could be made based on the five-minute volume counts. Thus, estimated frequencies for a UDA at an observation point for a lane which was not observed could be calculated in the same manner as in Step 2, using the appropriate volume estimate.

Step 4.

For each of the 6 UDA's of interest, a total hourly frequency was obtained by summing all the estimated hourly frequencies calculated at the site (all lanes of travel and all driveways).

The "other behavior" category was estimated as described in Step 5.

Step 5.

An estimate of the average total hourly volume through a site

was obtained by summing the estimated volumes on all lanes through the site. This number represents a time average since the volumes were taken over a two or three hour period as hourly figures.

Under our working assumption that a driver, while passing through a site, commits at most one of the six UDA's, a seventh behavior category (the "all other" category) is defined as being composed of all drivers passing through the site who do not commit any of the UDA's. The frequency at a site for this category is estimated as the average total hourly volume minus the sum of the estimated frequencies of the six UDA's.

Table IV-1 shows the results of all these calculations for the 41 sites in each of the four time periods.

Time of day - day of week factors.

Had observations been made uniformly over the week, estimates of the total number of UDA's of a given type could have been made by summing the estimated frequencies for that UDA over the 41 observation sites. Due to logistic constraints, however, a disproportionate number of sites were observed during weekday daytime hours. Thus, in order to obtain more realistic estimates, the following weighted sum was used to obtain the estimated UDA frequencies:

$$F_j = \sum_{\alpha=1}^{41} w_\alpha f_{j\alpha}, \quad j=1,\ldots,7. \qquad (1)$$

where F_j is the overall estimated frequency of occurrence of the j^{th} UDA (including no UDA), $F_{j\alpha}$ is the estimated frequency of occurrence of the j^{th} UDA at the a^{th} site, and w_α is a weighting factor for the α^{th} site determined by the time of the week during which the a^{th} site was observed. The weighting or scale factors were determined to transform the actual site by time of week distribution to a uniform distribution of site observations over time of week. That is, to a distribution with 35.7 percent of the observations being made during both weekday day and night periods, and 14.3 percent occurring during weekend day and night periods. The actual percentages and scale factors are shown in Table IV-2.

Table IV-1. Estimated UDA and other behavior frequencies.

	Location	Speed	Follow	Pulling	Turning	Left Center	Traffic	Other	Total Av. Hr. Vol.
Weekday - Day	1	0.00	0.00	3.38	0.00	0.00	9.66	1051.96	1065
	2	17.85	0.00	9.86	0.00	45.23	63.27	1429.79	1566
	3	0.00	0.00	0.00	0.00	0.00	0.00	8.00	8
	4	72.00	3.65	0.00	0.00	0.00	0.00	204.35	280
	5	0.00	0.00	0.00	0.00	2.26	0.00	45.74	48
	6	117.26	9.06	0.00	0.00	0.00	0.00	973.68	1100
	7	31.35	15.40	0.00	0.00	0.00	0.00	861.25	908
	8	108.95	72.61	0.00	1.00	0.00	35.75	1641.69	1860
	9	204.00	0.00	0.00	0.00	0.00	19.33	1632.67	1856
	10	96.09	0.00	2.00	0.00	47.02	7.00	150.89	303
	11	21.51	3.33	0.00	0.00	0.00	0.00	283.16	308
	12	4.78	0.00	1.67	0.00	0.00	0.00	469.55	476
	13	35.30	18.44	24.58	0.00	4.98	1.31	2324.59	2409
	14	0.00	0.00	0.00	0.00	0.00	0.00	8.00	8
	15	6.52	0.00	0.00	0.00	7.13	0.00	602.35	616
	16	0.00	0.00	0.00	0.00	7.58	105.17	1393.25	1506
	17	0.00	181.77	1.00	0.00	3.23	2.17	1083.83	1272
	18	0.00	0.00	0.00	7.92	86.58	26.83	1375.67	1497
	19	122.91	33.72	0.00	0.00	0.00	0.00	1295.37	1452
	20	54.71	4.66	0.00	0.00	7.14	1.44	289.05	357
	21	13.51	0.00	0.00	0.00	0.00	0.00	1582.49	1596
	22	138.64	78.20	2.00	0.00	0.00	0.00	2989.16	3208
	23	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20
	24	19.14	0.00	21.90	0.00	0.00	1.46	1628.50	1671
	25	0.00	12.00	0.00	0.00	10.09	0.00	243.91	266
	26	0.00	5.25	0.00	0.00	4.36	0.00	738.39	748
	27	517.01	16.16	4.00	0.00	7.45	1.00	489.38	1035
	28	0.00	61.95	30.38	0.00	0.00	34.06	2809.61	2936
	29	10.80	179.09	0.00	6.75	6.43	24.78	2025.15	2253
	Total	1592.33	695.29	100.77	15.67	239.48	333.23	29651.23	32628

Table IV-1 (Continued).

	Location	Speed	Follow	Pulling	Turning	Left Center	Traffic	Other	Total Av. Hr. Vol.
Weekday - Night	30	43.00	0.00	0.00	0.00	0.00	0.00	452.00	495
	31	10.84	5.78	0.00	0.00	0.00	0.00	779.38	796
	32	57.68	6.00	0.00	0.00	0.00	4.06	320.26	388
	33	475.62	0.00	0.00	0.00	0.00	0.00	286.38	762
	Total	587.14	11.78	0.00	0.00	0.00	14.06	1838.02	2441
Weekend - Day	34	8.44	0.00	0.00	0.00	6.00	0.00	91.56	106
	35	1.82	0.00	0.00	0.00	0.00	0.00	74.18	76
	36	0.00	0.00	0.00	0.00	0.00	0.00	200.00	200
	37	9.69	0.00	0.00	0.00	34.14	2.90	49.27	96
	38	0.00	18.64	0.00	1.00	0.00	0.00	1117.36	1137
	Total	19.95	18.64	0.00	1.00	40.14	2.90	1532.37	1615
Weekend - Night	39	92.46	0.00	0.00	0.00	0.00	0.00	747.54	840
	40	29.33	32.40	0.00	0.00	1.00	18.88	1751.39	1833
	41	50.47	0.00	0.00	0.00	8.50	1.00	108.03	168
	Total	172.26	32.40	0.00	0.00	9.50	19.88	2606.96	2841

Table IV-2.
Time of day - day of week distribution for the 41 accident sites.

	Number of Sites	Percentage	Scale Factor
Weekday - daytime	29	70.7	.505
Weekday - nighttime	4	9.8	3.659
Weekend - daytime	3	7.3	1.954
Weekend - nighttime	5	12.2	1.173
	41	100.0	

It may be noted that the weightings reduce the weekday-daytime frequencies by nearly one-half and increase the weekday-nighttime frequencies by more than three-and-one-half.

Table IV-3 shows the frequency distributions of the UDA's for each of the four observation time periods. Table IV-4 shows the same distributions following the application of the adjustment factors of Table IV-1. The adjusted frequencies can then be combined with accident data to yield estimates of relative risk.

Relative risks.

From Bayes theorem, an expression for the probability of an accident given a specific UDA is given by:

$$P(\text{accident}/UDA_i) = \frac{P(UDA/\text{accident})\ P(\text{accident})}{P(UDA_i)}$$

This expression cannot be used directly because no data are available from which to estimate P(accident). On the other hand, ratios of such conditional probabilities can be estimated since, in that case, the factor P(accident) cancels out.

In particular, consider the quantities:

$$(1)\quad R(UDA_i) = \frac{P(\text{accident}/UDA_i)}{P(\text{accident}/\text{"other behavior"})}, \quad i=1,\ldots,6.$$

These quantities, following Hurst (1970), are termed the relative risks of the various UDA's relative to the "other behavior." Expanding the right hand side of (1) leads to:

$$(2)\quad R(UDA_i) = \frac{P(UDA_i)/\text{accident})}{P(\text{"other behavior"}/\text{accident})}\ \frac{P(\text{"other behavior"})}{P(UDA_i)}, \quad i=1,\ldots,6.$$

Table IV-3. Raw UDA Frequency Estimate by Time of Week.

UDA Category	Weekday Day	Weekday Night	Weekend Day	Weekend Night
Speeding	1592.33	587.14	172.26	19.95
Following	695.29	11.78	32.40	18.64
Pulling in Front	100.77	0	0	0
Turning in Front	15.67	0	0	1.00
Left of Center	239.48	0	9.50	40.14
Traffic Control	333.23	4.06	19.88	2.90
Other	29651.23	1838.02	2606.96	1532.37

Table IV-4. Adjusted UDA Frequency Estimates by Time of Week

UDA Category	Weekday Day	Weekday Night	Weekend Day	Weekend Night
Speeding	804.13	2148.35	336.60	23.40
Following	351.10	43.10	63.31	21.86
Pulling in Front	50.89	0	0	0
Turning in Front	7.91	0	0	1.17
Left of Center	120.94	0	18.56	47.08
Traffic Control	168.28	14.86	38.85	3.40
Other	14973.87	6725.32	5094.00	1797.47

The numerator and denominator of the first factor on the right hand side of (2) can be estimated from the accident data while those of the second factor can be estimated from the field observation data.

Let F_j, $j = 1,2,\ldots,7$ denote the estimated total frequency of occurrence of the j^{th} behavior (F_7 denotes the frequency of "other behavior") and let A_j denote the number of accidents in the 1973-1974 North Carolina data involving the j^{th} behavior type. Then, using an abbreviated notation:

$$P_j = P(\text{behavior } j) = \frac{F_j}{\sum_{j=1}^{7} F_j}, \quad j=1,\ldots,7;$$

$$PA_j = P(\text{behavior } j/\text{accident}) = \frac{A_j}{\sum_{j=1}^{7} A_j}, \quad j=1,\ldots,7;$$

and

$$R_j = R(UDA_j) = \frac{PA_j}{PA_7} \cdot \frac{P_7}{P_j}, \quad j=1,\ldots,7.$$

By definition, of course, $R_7 = 1$.

Table IV-5 shows the total adjusted UDA frequency distribution, the estimated UDA probabilities P_j, the conditional UDA probabilities PA_j, and the relative risks R_j. By definition the "other" behavior category has a relative risk of 1.

It is of interest to note that the relative risk for speeding appearing in Table IV-5 has a smaller value, (i.e., 0.7). This may be the result of two factors. First, the "other" category does not necessarily indicate safe driving and may, in fact, include behaviors that are more unsafe than exceeding a speed limit by more than five miles per hour. Secondly, the relatively few sites observed during weekday nights yielded a very high proportion of speeding UDAs. When this speeding frequency is multiplied by its adjustment factor, the resulting adjusted frequency contributes a very large part of the total speeding frequency. This sampling error may be partially responsible for the very low relative risk associated with speeding.

Table IV-5. Relative risks.

Behavior Category	Total Adjusted Frequency	Probability of Behavior	Conditional Probability of Behavioral/Accident	Relative Risk
Speeding	3312.48	.1008	.0418	.6511
Following	479.37	.0146	.1788	19.2445
Pulling in Front	50.89	.0015	.0923	93.5869
Turning in Front	9.08	.0003	.0523	296.9944
Left of Center	186.58	.0057	.0317	8.7664
Traffic Control	225.39	.0070	.0491	11.2407
Other	28590.66	.8702	.5541	1.00
Total	32854.47	1.00	1.00	

Table IV-6. Range of relative risks.

	Weekday Day	Weekday Night	Weekend Day	Weekend Night
Speeding	1.40	.24	1.13	5.77
Following	13.76	50.62	25.79	26.61
Pulling in Front	49.48	---	---	---
Turning in Front	179.47	---	---	149.16
Left of Center	7.06	---	15.80	2.18
Traffic Control	7.87	39.25	11.53	46.68
Other	1.00	1.00	1.00	1.00

Since it was necessary to make many assumptions, approximations, and extrapolations in order to obtain estimates of the frequencies from which the relative risks were determined, it would seem that no meaningful sort of confidence limits can be associated with the estimated relative risks. It would seem to be appropriate, however, to attempt to obtain some measure of the sensitivity of the estimated relative risks to the observed UDA frequencies. This could be done by varying the UDA frequencies in some systematic way and computing a range of relative risks. Since some indication of the way that the UDA frequencies may vary can be obtained from the four frequency distributions of Table IV-3, these frequencies were used to calculate four other sets of relative risks. These are shown in Table IV-6. When the observed frequency of a given UDA was zero, no relative risk was computed. It might seem possible to obtain a lower bound for relative risk in this case by replacing the zero by one. In practice, however, a single observation of a UDA would give a non-zero UDA rate which would be multiplied by an estimated traffic volume. Thus, a single observation might give rise to an estimated UDA frequency considerably greater than one. For these reasons no attempt was made to estimate relative risks for zero frequencies.

Table IV-6 shows the resulting relative risks calculated for the four different time periods. The computations were made using in each case the same conditional probability estimates.

The results from Table IV-5, together with the overall relative risks from Table IV-4, are shown graphically in Figure IV-1 in the form of interval ranges for the relative risks. The ranges are shown on a logarithmic scale with the overall relative risk indicated for each range. A fairly clear ranking of the relative risks seems apparent from Figure IV-1 and Tables IV-4 and IV-5. From least risky to most risky the UDA's would appear to be speeding, driving left of center, following too closely, running a traffic control, pulling in front, and turning in front, with following and running a traffic control being of about equal risk.

It is important to note that the relative risks calculated were dependent on the degree of danger used to define the UDA and that this was inherently not the same for all six. Obviously, in defining

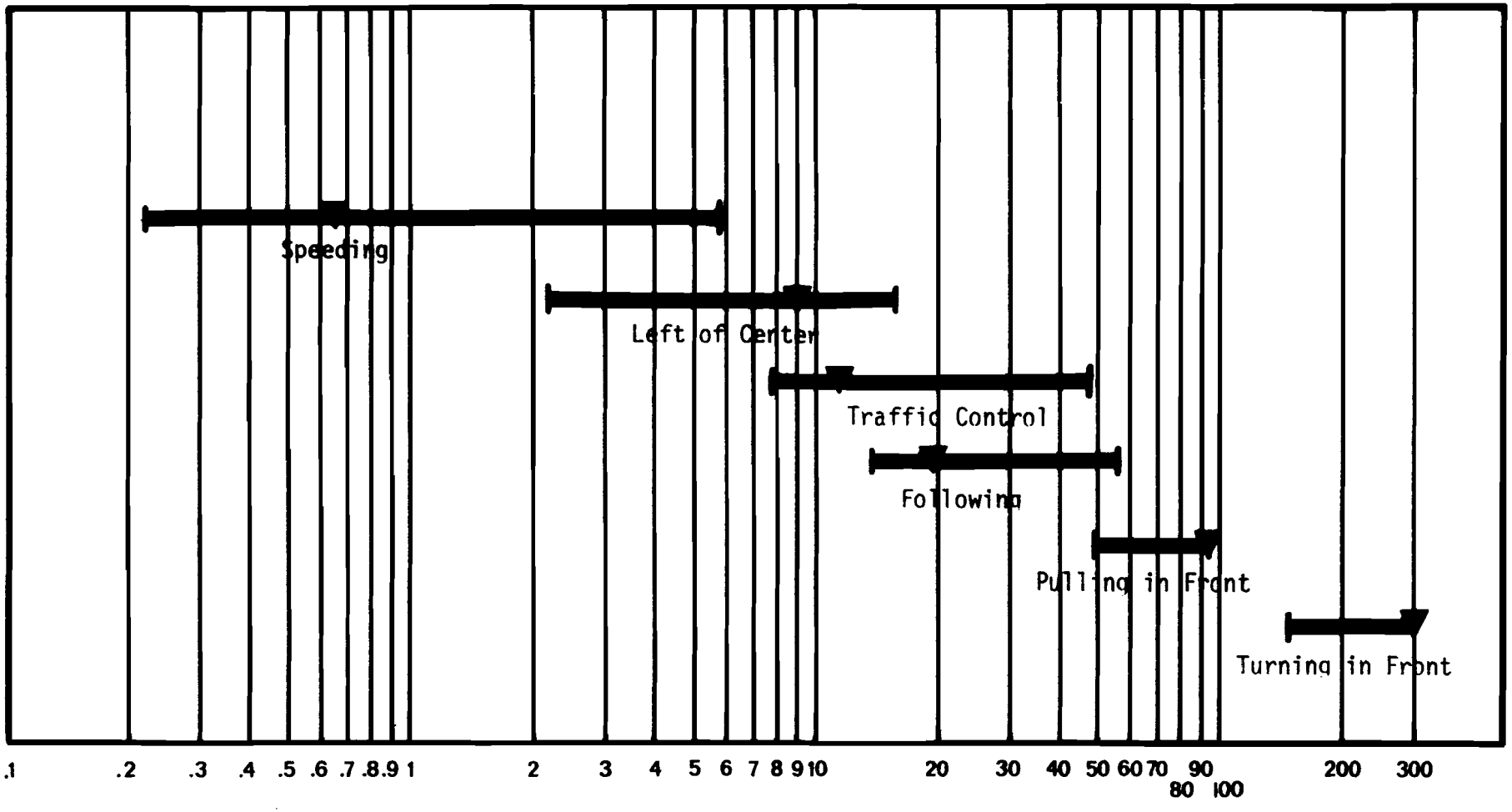


Figure IV-1. Relative risk ranges (▼ denotes the relative risk based on the overall weighted frequencies)

an unsafe driving act, there are varying degrees of danger associated with the act. The degree of nearness of oncoming traffic, the speed, and gap times between following vehicles, all had to be considered in collecting field data. The more stringent the criteria used in first identifying the act, the closer one comes to defining an accident. By the same token, the more stringent the criteria, the less frequently the act will be observed, thus, in effect, increasing the relative risk factor.

For the UDA's chosen for field observation for which risk factors were subsequently calculated, the degree of danger could not be the same. The three UDA's, speeding, driving left of center, and running a control, did not demand the presence of oncoming traffic to any degree. The results show these three acts to be less risky than pulling in front and turning in front, which inherently demand the presence of oncoming traffic.

After dividing speeding behavior into two categories (1) speeding in a 55 or over zone and 2) speeding in other zones), relative risks were again calculated. The results of this procedure were:

	Relative Risks
Speeding 55 or over zone	2.9647
Speeding other zone	.4017

This shows that speeding five mph or more over the limit in a 55 mph or more zone is more risky than the other behavior, while driving this amount over the limit in a lower zone is very low risk in comparison to other behavior.

A look at those locations where the highest frequencies of speeding occurred did show that these were points in urban areas where speed limits were changing and drivers either failed to slow down for the lower limit or were speeding up in anticipation of a higher speed limit. In particular, a night observation of this type weighed heavily in the analysis.

Although accidents do occur from 1-5 mph over the limit in the lower zones, the majority of the vehicles are traveling at higher speeds and seldom are citations issued at just 5 miles over the limit. For the 55 mph zone, a higher percentage of accidents occurred at (1-5) mph over the limit than in the lower zones, but no citations

Table IV-7. Relative risks for speeding.

	5 mph. or More Over		≥ 10 mph Over		≥ 15 mph Over	
Turning	296.9944		314.7775	316.0075	319.0015	320.2338
Pulling	93.5869		99.1906	99.5781	100.5216	100.9100
Following	19.2445		20.3968	20.4765	20.6705	20.7504
Traffic Control	11.2407		11.9138	11.9603	12.0737	12.1203
Left Center	8.7664		9.2913	9.3276	9.4159	9.4523
Other	1.0000		1.0000	1.0000	1.0000	1.0000
Speeding	*0.6511		1.6937	*1.8226	6.1385	*6.7224
	*.4017 lower zone	*2.9647 ≥55 zone	*1.3394 lower zone	*5.1892 ≥55 zone	*4.8198 lower zone	*95.5930 ≥55 zone

* Includes accident cases where no estimate of speed prior to impact was recorded but information in the narrative portion implied high speeds.

were issued at those speeds. Relative risks are also computed when speeding is defined as exceeding the posted speed limit by more than 10 mph and by more than 15 mph.

The results of computing relative risks for at least 10 mph and 15 mph over the limit are shown in Table IV-7. It can be seen from this table that, at 10 mph over the limit, speeding is a riskier behavior than the "other" behavior, and that it is even higher at 15 mph over the limit. Figure IV-2 depicts the relative risks for speeding overall, speeding in a 55 zone, and in a lower zone for the three speeding definitions.

Analysis of the Trip Data and Calculation of Conditional Probabilities

Using the trip data, the UDA frequencies and mileage sums were tallied to calculate an estimate of the rate of UDA's per mileage unit for each of the four time periods (weekday-daytime, weekday-nighttime, weekend-daytime, and weekend-nighttime).

The rate r_j for each UDA for a specific time period is given by

$$r_j = \frac{n_j}{\text{miles traveled}} \qquad j=1,\ldots,5$$

where n_j represents the frequency of UDA, for the time period.

Table IV-8 shows the frequencies, rates, and miles traveled for each time period for the five UDA's for which data were collected.

Table IV-8. UDA frequencies, (rates/mile), and observation miles.

	Weekday Daytime	Weekday Night	Weekend Daytime	Weekend Night
Speeding	20(.0966)	3(.1091)	3(.0775)	3(.0794)
Left Center	4(.0193)	0(0)	0(0)	2(.0529)
Traffic Control	1(.0048)	0(0)	0(0)	0(0)
Pulling in Front	1(.0048)	0(0)	0(0)	0(0)
Turning in Front	0(.0000)	0(0)	0(0)	0(0)
# miles followed	207.0	27.5	38.7	37.8

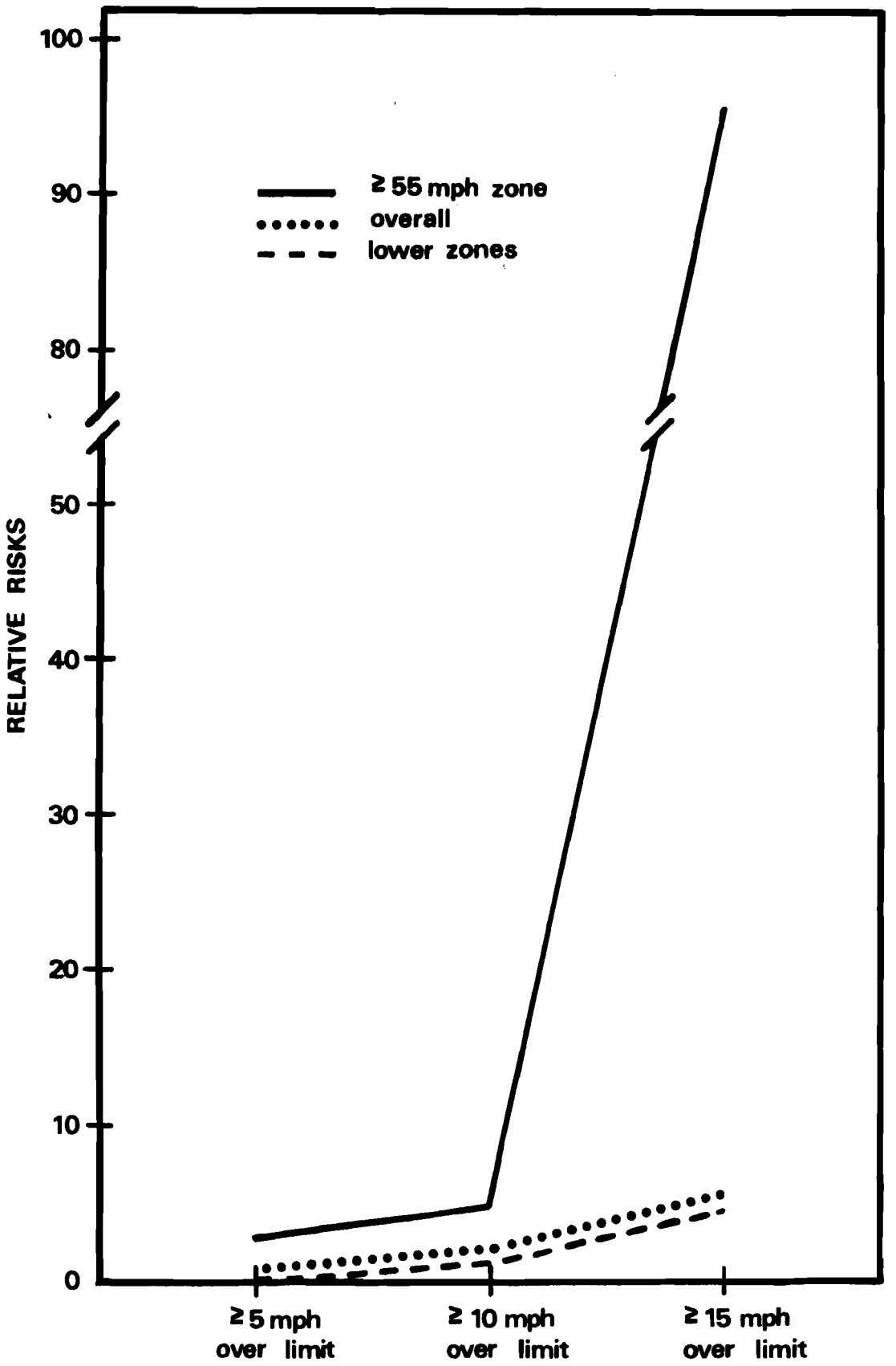


Figure IV-2. Relative risk for speeding.

Extrapolation procedures.

In order to estimate the frequencies of UDA occurrence for the two-year period (1973-74), a mileage estimate for the three-county area was required. With 1975 estimates provided by the Planning and Research Branch of the North Carolina Department of Transportation, and allowing for five percent less travel per year, mileage figures for each of the two years were determined:

1974	total miles for the 3 counties combined	2,360,750,000
1973	total miles for the 3 counties combined	2,242,712,500
	total	4,603,462,500

As with the point analysis, considerations were made for time of day and day of week factors - the amount of travel for each of the four time periods may be disproportionate. To account for these factors, percentage distributions of mileage by hour of day and day of week based on 1970 census figures as reported in Nationwide Personal Transportation Study Report No. 10 (p. 29) May 1974, and Report No. 8 (p. 59) August 1973 were used. Assuming independence of marginal distributions, the proportion and number of miles traveled for each time period were estimated as shown by Table IV-9.

Table IV-9. Proportion and mileage distribution for area, 1973-1974.

	Week	Weekend	
Day	.5225 2419.12×10^6	.2155 992.05×10^6	.738
Night	.1855 853.94×10^6	.0765 352.16×10^6	.262
	.708	.292	

Estimates of the frequency of UDA occurrence for the two years could then be calculated by multiplying the above rates with their corresponding mileage estimates determined by time of day - day of week. Table IV-10 gives these frequency estimates in units of 10^6.

Table IV-10. UDA frequencies for the area, 1973-74.

	Weekday Day	Weekday Night	Weekend Day	Weekend Night	Total
Speeding	223.69	93.16	76.88	27.96	431.69
Left of Center	46.69	0	0	18.63	65.32
Traffic Control	11.61	0	0	0	11.61
Pulling in Front	11.61	0	0	0	11.61
Turning in Front	0	0	0	0	0

Calculation of Conditional Probabilities

Conditional probabilities of an accident given a UDA can finally be computed from the formula:

$$(3) \quad \text{Prob}(\text{acc.}(\text{UDA}_j)) = \frac{\text{Number of accidents involving UDA}_j}{\text{Number of UDA}_j \text{ occurrences}}$$

the results of which are shown in Table IV-11.

Table IV-11. Probabilities of accidents given UDA's.

UDA	Accident Frequency	Prob(Acc./UDA)	Scaled Prob(Acc./UDA)
Speeding	980	.0000023	1.00
Left of Center	743	.0000114	6.26
Traffic Control	1151	.0000991	63.91
Pulling in Front	2165	.0001865	81.09
Turning in Front	1226	>.0001056	>36.17

The first column of Table IV-11 shows the two-year accident frequencies (1973-1974) for the three-county area broken down by UDA. The second column gives conditional probabilities of an accident given a UDA determined by formula (3) above. The last entry in this column is a lower bound for the probability of an accident given an occurrence of turning in front, which is computed under the assumption of a single observation of turning in front during a weekday daytime observational period (instead of the zero occurrences actually observed). Finally, the third column shows the conditional probabilities scaled by dividing each by the constant, .0000023, in order to put them on a scale of

roughly the same order of magnitude as the relative risks given in previous sections. Of course, these scaled values can no longer be considered probabilities.

Table IV-12 shows a comparison of the scaled accident probabilities and relative risks previously estimated with the UDA's ordered from least risky to most risky in terms of the relative risks.

Table IV-12. Comparison of relative risks and accident probabilities.

UDA	Relative Risk	Accident Probability(Scaled)
Speeding	.6511	1.00
Left of Center	8.7664	6.26
Traffic Control	11.2407	63.91
Following	19.2445	---
Pulling in Front	93.5869	81.09
Turning in Front	296.9944	>36.17

From the comparisons that can be made from Table IV-12, it seems that the two methods are in quite good agreement concerning the ranking of the relative danger associated with the various UDA's. Of course, no point estimate is available for the scaled accident probability for turning in front. The scale factor was chosen to bring the scaled accident probability for speeding in line with its relative risk. Of the UDA's for which point estimates of conditional probabilities of accidents exist, only the one for violating a traffic control appears to be very much out of line numerically with the corresponding relative risk. This may not be unexpected since, by the trip method, very little time was spent observing drivers at points where traffic controls were present. This may tend to result in relatively few observations of traffic control UDA's which in turn would cause this UDA to appear more dangerous.

Profile Data

In collecting data on UDA frequencies, we also simultaneously gathered data to characterize the age, sex, race, and vehicle type of those who were observed committing a given UDA versus those who were not.

The idea,of course,was to try to characterize the "who,when,and where" of a UDA, and to contrast this with the population at large. This contrast differentiates the characteristics of the target population from those of the population at large, thereby enabling the formulation of strategies to maximize the prospects of locating the target groups and bringing countermeasures to bear on them.

In addition, these relationships can be compared to the similar defining characteristics of those receiving citations for the given UDA. In this way obvious mismatches might indicate a less than optimum enforcement strategy.

First, let us consider some of the contrasts with regard to the UDA's by taking each in turn.

Following too closely.

Table IV-13 shows the four variables, contrasting those observed for vehicles following too closely with those for vehicles confirmed not to be following too closely (called non-UDA's).

First with regard to vehicle type, trucks and motorcycles were substantially over-represented in the UDA group.

With regard to age, youthful drivers were over-represented in the UDA group.

With regard to sex, there was no substantial trend.

With regard to race, blacks were substantially under-represented.

Thus trucks and youthful drivers seem somewhat over-represented. However, it could be misleading to focus on these groups as targets because, while they are proportionately over-represented, they are not absolutely over-represented. Thus, it is still true that cars and adults are the predominant categories associated with the following too closely UDA. A paradox regarding this UDA is that adult drivers are somewhat under-represented, relative to the non-UDA population, but nevertheless, still consititue the biggest class.

Speeding.

Comparing the two percentage distributions, it can be seen that there is a larger proportion of passenger cars and motorcycles represented in the UDA group than in the non-UDA group. Concentration of enforcement on motorcyclists would be of little benefit because the Table IV-14 indicates that they represent only 1.6

Table IV-13. The four variables for the following too closely UDA.

Vehicle Type			Driver Age		
	UDA Group	Non UDA		UDA	Non UDA
Car	66.7	83.4	Youth	24.4	13.7
Truck	27.1	15.7	Adult	75.6	80.5
Motorcycle	6.3	0.5	Elderly	0.0	5.8
Other	0.0	0.5			
Total	48	1546	Total	45	1395

Driver Sex			Driver Race		
	UDA	Non UDA		UDA	Non UDA
Male	67.4	65.4	White	91.3	81.8
Female	32.6	34.6	Black	8.7	17.6
			Other	0.0	0.5
Total	46	1394	Total	46	1415

Table IV-14. The four variables for the speeding UDA.

Vehicle Type			Driver Age		
	UDA Group	Non UDA		UDA	Non UDA
Car	86.1	82.9	Youth	22.7	14.3
Truck	12.0	15.7	Adult	71.5	76.8
Motorcycle	1.6	0.6	Elderly	5.8	8.9
Other	0.4	0.8			
Total	251	3024	Total	172	2631

Driver Sex			Driver Race		
	UDA	Non UDA		UDA	Non UDA
Male	68.8	67.7	White	69.8	80.5
Female	31.3	32.3	Black	30.2	19.1
			Other	0.0	0.3
Total	176	2649	Total	179	2680

percent of the UDA group. On the other hand, passenger cars comprise 86.1 percent of the UDA group (only slightly more than their representation in the non-UDA group), implying that selective enforcement would not be of great benefit either.

From Table IV-14, youths appear to be substantially over-represented. However, the largest proportion of the UDA (71.5 percent) and the non-UDA (76.8 percent) populations are adults.

Very little difference is noted for driver sex; males are a larger proportion of both the UDA and the non-UDA samples.

There is substantial difference between the proportion of blacks in the UDA and non-UDA populations. However, because almost 70 percent of the speeding population is white, there would be little benefit from concentrating enforcement efforts on blacks.

Left of center.

Trucks, motorcycles, and other vehicles are under-represented in this UDA,leaving passenger cars as the prime culprits.

Table IV-15 shows that youths are quite over-represented. The proportion of youths driving left of center was twice that of youths in the non-UDA group. However, adults still comprise the largest group of offenders (more than half of the UDA population).

Little difference can be detected in the driver sex variable.

With regard to race, blacks are substantially over-represented in the UDA group as compared to the non-UDA group. However, equal numbers of whites and blacks appear to commit this UDA.

Pulling in front.

Trucks were over-represented in this UDA population, 25.7 percent as compared with 15.6 percent in the non-UDA population. However, the data also indiate that 74.3 percent of those pulling in front were passenger cars. Therefore, focusing only on trucks would not be an effective countermeasure.

With regard to the driver variables, there are some substantial differences. Adults comprise 96.4 percent of the UDA group and only 74.6 percent of the non-UDA group. Focusing on adults could be an effective countermeasure.

While there appears to be a larger proportion of women drivers in the UDA group than in the non-UDA group, over half the UDA group was

Table IV-15. The four variables for the left of center UDA.

Vehicle Type			Driver Age		
	UDA Group	Non UDA		UDA	Non UDA
Car	85.5	79.9	Youth	25.9	17.1
Truck	14.5	19.1	Adult	65.5	74.9
Motorcycle	0.0	0.6	Elderly	8.6	8.0
Other	0.0	0.5			
Total	69	1752	Total	58	1599

Driver Sex			Driver Race		
	UDA	Non UDA		UDA	Non UDA
Male	68.9	69.6	White	50.8	74.3
Female	31.1	30.4	Black	49.2	25.4
			Other	0.0	0.3
Total	61	1639	Total	63	1672

Table IV-16. The four variables for the pulling in front UDA.

Vehicle Type			Driver Age		
	UDA Group	Non UDA		UDA	Non UDA
Car	74.3	82.2	Youth	3.6	17.8
Truck	25.7	15.6	Adult	96.4	74.6
Motorcycle	0.0	0.5	Elderly	0.0	7.6
Other	0.0	1.7			
Total	35	882	Total	28	765

Driver Sex			Driver Race		
	UDA	Non UDA		UDA	Non UDA
Male	58.6	69.8	White	64.5	66.9
Female	41.4	30.2	Black	35.4	32.7
			Other	0.0	0.3
Total	29	798	Total	31	810

male. Therefore, it appears that there would be little benefit from selective enforcement based on driver sex.

Few differences can be seen between the UDA group and non-UDA groups with regard to race.

Turning in front.

Only passenger cars and adult drivers were observed committing this UDA.

More males than females committed the UDA and this proportion is higher in the UDA group than in the non-UDA group.

Whites constitute a large percent (80 percent) of the UDA group; this percentage is also higher than that in the non-UDA group.

Traffic control.

Trucks and other vehicles are over-represented in the UDA population but the majority of the UDA group is passenger cars.

The adult group is very slightly over-represented (a difference of 3.3 percent between the UDA and non-UDA populations) and constitutes 86.1 percent of the UDA group.

Females are also over-represented proportionately in the group of UDA offenders. However, the largest portion of the UDA group is male.

The same is true for blacks; they are slightly over-represented (a difference of 3 percent), but 71.1 percent of the UDA population is white. Thus, concentrated enforcement effort on this minority group would not be of great benefit.

In summary, about the only time that this profile data can be of real assistance is in those few instances in which the most frequent UDA category is also over-represented. For example, in following too closely white drivers are the most frequent offenders and they are also slightly over-represented. There are one or two other such examples, but they are generally based on rather small samples. The general conclusion is that there is little indication within the UDA data to warrant the focusing of enforcement efforts on specific motorist groups for specific UDA's. Perhaps officers should focus instead on specific UDA's, no matter who commits them. This may be a better

Table IV-17. The four variables for the turning in front UDA.

Vehicle Type			Driver Age		
	UDA Group	Non UDA		UDA	Non UDA
Car	100.0	85.2	Youth	0.0	9.53
Truck		14.0	Adult	100.0	80.6
Motorcycle		0.3	Elderly	0.0	9.9
Other		0.5			
Total	10	608	Total	8	556

Driver Sex			Driver Race		
	UDA	Non UDA		UDA	Non UDA
Male	77.8	60.2	White	80.0	75.2
Female	22.2	39.8	Black	20.0	24.2
			Other	0.0	0.5
Total	9	563	Total	10	573

Table IV-18. The four variables for the traffic control UDA.

Vehicle Type			Driver Age		
	UDA Group	Non UDA		UDA	Non UDA
Car	73.2	82.5	Youth	8.3	14.7
Truck	24.4	16.1	Adult	86.1	78.8
Motorcycle	0.0	0.8	Elderly	5.6	6.4
Other	2.4	0.6			
Total	41	1963	Total	36	1629

Driver Sex			Driver Race		
	UDA	Non UDA		UDA	Non UDA
Male	63.2	69.1	White	71.1	74.7
Female	36.8	30.9	Black	28.9	25.0
			Other	0.0	0.3
Total	38	1698	Total	38	1733

enforcement tactic than focusing on a specific driver group because of its statistical over-representation.

PART V. CONCLUDING COMMENTS

Now that we have estimates of both the number of accidents and the accident risk for each of the six UDA's, the question is, what are the countermeasure implications of the results from both types of data?

One approach would be to deal only with the implications from the data in risk terms. Using only the risk estimates, one could conclude that the highest ranking candidate UDA for countermeasure purposes is "turning in front of an oncoming vehicle." This UDA has a relative risk more than twice as high as the next highest ranking UDA, "pulling in front of an oncoming vehicle," and is estimated to have a relative crash risk nearly fifty times as high as speeding.

The relative risk hierarchy gives us the estimate that the accident risk induced by pulling in front of an oncoming vehicle is some 300 times higher than the risk associated with "other" (primarily non-dangerous) behavior. It follows that as often as one could detect this behavior and bring to bear an effective countermeasure, then one would be focusing on a behavior much more likely than a random behavior to be associated with a crash. Thus, it follows that it would be highly desirable in terms of efficiency to focus on such a critical behavior.

However, this approach is not entirely unambiguous. Consider the following hypothetical figures:

	Number of UDA's per unit exposure	Probability of a crash	Number of accidents
UDA #1	500,000	.00006	30
UDA #2	1,000	.0192	20

relative risk of #2 is 320 times greater than #1

Here UDA #2 refers to a very high risk but a very low frequency UDA. The UDA is not committed very often but when it is, a risk of a crash is 320 times greater than for UDA #1. However, because of the low frequency, the high risk only results in about 20 crashes per unit exposure. This

accounts for even fewer crashes than UDA #1 which is a much less risky UDA but which because of its great frequency results in 30 crashes per unit exposure.

Now toward which UDA is the countermeasure to be directed? Shall we try to attack the UDA that produces the most crashes in terms of an absolute number? Or shall we direct our attention toward a rare but extremely risky UDA even though it produces fewer crashes than the more frequent but less risky UDA?

Another question is whether the proposed countermeasure is any more effective on one UDA than the other. Since our UDA occurs 500,000 times for the other 1000 times, what are the implications in terms of finding those who commit the UDA? If one knew how to reach the 1000 UDA "committers" more easily than the 500,000, then it seems that one might more economically reduce the 20 crashes from that group rather than the 30 from the other group.

In the data from this study one can see the contrast in the relative risks and the actual accident frequencies. In view of that, quite a number of candidate strategies could be enunciated. Two or three examples follow.

First, one might elect to downgrade enforcement against very high speeds above 70 mph on the open highways. The rationale for this might be that, of the six UDA's, it is the lowest one of all when jointly considering both its crash frequency and accident risk. Indeed, in looking at the data, one might wonder why speed enforcement has so long been so cherished as a behavior to search out and punish.

Standing against this, however, is the widely held belief that enforcement of and compliance with the 55 mph speed limit was the major reason for the dramatic recent reduction in the highway death toll, conveniently ignoring the probably equally profound influence of (1) the oil embargo, (2) the deep recession, and (3) the seat belt interlock.

At the other end of the scale is an enforcement strategy aimed at the UDA "pulling in front of an oncoming vehicle." This UDA is estimated to figure in more than twice the crashes of speeding, and in terms of risk is estimated to have a relative risk that is 13 times higher than speeding. Furthermore, "pulling in front" is a UDA that occurs at somewhat specific places. Often this UDA occurs when a person approaches a stop sign, stops,

and then pulls out without sufficient regard for oncoming traffic. In view of the relative ranking, this implies that officers should be as much or more aware of the motorists behavior after stopping as he is in whether the motorist stops at the traffic control.

Next, let us examine the six UDA's in terms of the following factors:

- relative crash risk
- accident frequency
- number of citations

UDA	Citations	Accidents	Relative Accident Risk
Following too closely	307	4193	21
Pulling in front	215	2361	101
Turning in front	363	1226	320
Stop sign-signal violation	11877	1151	12
Speeding	31250	980	7
Driving left of center	643	743	9

First we note that the three highest risk UDA's which are above the three highest in terms of accident frequency, are the three lowest in terms of citation frequency.

Similarly the two highest in terms of citation frequency, are among the three lowest both in terms of accident frequency and relative accident risk.

Thus, there is an enormous mismatch between enforcement practice and the UDA crash involvement.

Following too Closely

This UDA is one in which the trailing vehicle follows the lead vehicle at the same speed, but at an insufficient distance to avoid a dangerous situation if the lead vehicle maneuvers suddenly.

This UDA is successively more likely to occur with increased traffic volume and decreased opportunity to pass.

Those seen committing this UDA were primarily in passenger cars (though trucks were over-represented) and were adult, male, and white.

This UDA had a relative risk of 21, 3 times as great as speeding (the lowest risk of the six UDA's).

There are a large number of crashes attributed to following too closely - 4193 - the top ranking of the 6 UDA's and almost twice the value of the second ranked UDA.

In stark contrast, the violation following too closely is virtually never enforced--receiving only about 1/100th the attention of speeding.

Despite the difficulty of enforcing this violation, much more attention should be paid to it by officers. Moreover, judges and prosecutors will have to be indoctrinated as to the legitimacy of this type of enforcement action.

Turning in Front

Turning in front of oncoming traffic occurs when a vehicle turns into a driveway or roadway across oncoming traffic in such a way that some avoidance maneuver (slowing, stopping, changing lanes) must be made on the part of the oncoming traffic. The closer the oncoming traffic, the more dangerous the situation.

This UDA tends to occur most in high volume places where oncoming traffic is dense and drivers may feel pressured into taking chances. The drivers seen committing this act were all in passenger cars, were all adult, and were primarily male and white.

This UDA shows the highest relative risk factor, an extremely high 320, three times the factor for pulling in front. Turning in front is second only to following too closely in terms of its frequency in accidents.

Enforcement of this UDA is difficult to assess since there is no citation which depicts the UDA exactly. Ambiguous citations "safe movement" and "failure to see before turning from a direct line" could be given for this UDA but might be issued for other unsafe driving acts as well. The citations, "improper turn" and "didn't see before turning" were combined to provide an estimate for its citation frequency which is still very low although other UDA's could be implied by these violations.

In light of the risk and the frequency of accidents due to this UDA, officers should be attentive to vehicles turning in the face of oncoming traffic and issue citations to those drivers who take chances when making turns.

Running a Traffic Control

The UDA running a traffic control is exemplified by the driver who approaches a traffic sign or light and does not stop. If traffic is approaching from an angle on the intersecting roadway, an accident may result.

Naturally this UDA can only occur at intersections having a stop sign or light. It seems more likely to occur at times and places where there is little traffic and the driver is able to see that no traffic is present and there is, in his judgment, no compelling need to stop.

Running a control is one of the three less risky behaviors, a risk factor of only 12. In comparison with other UDA's, the number of accidents is moderate, about 1/4 the number caused by following too closely and slightly less than turning in front of, a much more risky behavior.

Most notable however is the number of citations issued for sign or light violations, 11,877, a very large number in comparison to the other UDA's with the exception of speeding. The reason may be that an enforcement officer can more easily observe motorists approaching traffic controls to determine whether or not they stop and does not need to watch the oncoming traffic as in the case of pulling and turning.

Officers may want to be more cognizant of this UDA in high volume situations where it may be more risky to run a control.

The drivers who run controls are still primarily those in passenger cars (73 percent) although a disproportionate number of truckers and motorcyclists were observed committing the act.

Adults, males, and whites are the prime culprits although females and blacks are over-represented in the UDA population as compared with "others."

Driving Left of or on the Center Line

For this UDA, one vehicle is driving over or on the center line on a two-way roadway such that if oncoming traffic presents itself from the opposite direction, a collision could result.

This UDA is more likely to occur with decreased traffic volume and with poor driver condition.

Drivers of passenger cars appear to be more likley to commit the act and motorcycles less likely as indicated by the observational data.

Youths and elderly persons are over-represented in the observation group. Females and blacks are also over-represented in comparison with the "other" population.

In terms of risk, this UDA is one of the least risky behaviors only slightly more risky than speeding.

In comparison with the other UDA's the fewest number of accidents are associated with the act; it ranks below speeding in frequency.

In terms of citations, it is cited to a small degree which may be somewhat compatible with the risk and number of accidents associated with it.

Pulling in Front

This UDA is characterized by a vehicle first coming to a stop at a sign or driveway and then entering the roadway without allowing sufficiently for oncoming traffic. In the observations this oncoming traffic was in close enough proximity such that some avoidance maneuver was necessary on the part of the oncoming traffic, changing lanes, stopping, slowing. An accident may have resulted had not the avoidance maneuver been made.

Pulling in front will occur more frequently in high volume situations where gaps between vehicles are small and the opportunities to enter the roadway are few.

The observational data shows that the majority of the UDA's are committed by passenger cars although trucks are over-represented.

The drivers are almost all adults (96 percent), both male and female (with females slightly over-represented), and mostly white (a slightly higher proportion of blacks committing the UDA).

This UDA has an extremely high relative risk, second to turning in front of and ranks high in accident frequency, second to following too closely; 2361 accidents resulted from this behavior.

Citation matching is somewhat difficult for this UDA. Looking at the frequency of the citation "failure to yield at a sign," this may be the least cited of all UDA's, although the officer might cover this UDA with a "safe movement" citation. (We did not use this citation in the comparison: because of its ambiguity, it could have been used to cite other UDA's or violations.)

Considering the large risk and the number of accidents that result from this UDA, officers should direct their attention to drivers who, although they may obey a traffic sign, may pull out into traffic too soon.

Speeding Above the Posted Speed Limit

This UDA is defined by the driver who exceeds the posted speed limit to some degree. This may be a point speed or an average speed depending on the method of detection being used. In our observations, an average speed was determined and for the first relative risk factors, at least 5 mph over the limit was used to note a speeder.

Speed plus various other environmental conditions can produce an accident. Speeding while passing, poor weather conditions, curves, and other unexpected traffic in the roadway can cause the driver to lose control and collide with other vehicles or obstacles.

As Table IV-7 and Figure IV-2 indicate, the risk associated with speeding is less in lower zones than in 55 mph zones. This difference increases as the definition becomes more stringent, considering only the worse speeders.

Speeding observation data indicated that, although most speeders are passenger cars, trucks and motorcycles are over-represented.

Adults comprise the largest category while youths are over-represented as compared with the other population.

Again, as with other UDA's, males and whites are the prime groups but females and blacks are over-represented.

Speeding, by our first definition, appears to be the overall least risky behavior, even less risky than the "other" category. However, this relationship changes position when speeds exceed the posted limit by at least 10 mph.

In terms of accident frequency, however, the number is relatively low, 980 speeding accidents, 1/4 as many as for following too closely.

However, the number of speeding citations is enormous compared with those issued for other UDA's. The recommendation may be made that less attention should be given to speeding violations except where situational factors render them more dangerous.

The risk associated with speeding seems to be quite in harmony with the common police practice of not issuing a citation except when the degree of speeding is several miles per hour over the limit.

Also, it seems that being substantially over the 55 mph limit (15 mph over) is much more associated with crashes than the same degree of excess over a lower limit such as a 35 mph zone.

APPENDIX A

Descriptions of the Twenty Largest UDA Categories

This appendix describes the 20 largest UDA categories as defined in the case by case analysis .

1. Following

In following accidents, the driver accused of the unsafe driving act was not maintaining enough distance for stopping when the car in front of him slowed down or came to a stop.

In a majority of the cases, the first car is slowing down or stopping, while the following car is traveling in the same direction. However, in some crashes the following car caused a rear end collision while changing to the next lane. Also included were crashes in which the first vehicle was already stopped and the second vehicle did not allow enough distance for stopping.

Examples are:

A. Accident information: Vehicle 1 = car, slowing, 15 mph. 35 mph zone, heading east, charged with speeding less than 65 mph.

Vehicle 2 = car, stopped, 0 mph in 35 mph zone, heading east, no charge, no violation.

Rear end, slowing or stopping accident, city street, residential area, "other" road feature (e.g., no intersection, driveway, etc.), rain, stoplights.

Narrative: "Vehicle 1 and 2 were traveling east in the 1700 block street, when vehicle 2 stopped for traffic and vehicle 1 traveling, made contact."

Cause: Both vehicles traveling at normal speeds in the same direction, made contact when vehicle 2 stopped for traffic ahead of him. The stoplight and rain do not seem to be of any influence. The accident probably happened near an intersection with stoplights.

B. Accident information: Vehicle 1 = car, stopped, unknown speed, 35 mph zone, heading south, no charge, no violation.

Vehicle 2 = car, going straight, 15 mph, 35 mph zone, heading south, charged with failed to see if maneuver could be made in safety.

Rear end turning accident, city street, business area, intersection, no control.

Narrative: "As vehicle 1 was waiting to turn left, vehicle 2 struck vehicle 1 from behind."

Cause: Vehicle 2, approaching the intersection at a normal speed, failed to stop in time to avoid hitting vehicle 1. The distance between vehicle 1 and vehicle 2 was insufficient for braking.

C. Accident information: Vehicle 1 = car, going straight, unknown speed, 25 mph zone, heading east, no charge, no violations.

Vehicle 2 = truck, changing lanes, 4 mph, 25 mph zone, heading east, charged with failed to see if maneuver could be made in safety.

Rear end slowing accident, city street, residential area, "other" road feature, no control.

Narrative: "Vehicle 1 traveling east on street, vehicle 2 was traveling in same direction of vehicle 1 and vehicle 2 started to change lanes of traffic and hit vehicle 1 in left rear."

Cause: Vehicle 2 apparently was following vehicle 1 too closely to avoid hitting vehicle 1 in rear while turning to the next lane.

D. Accident information: Vehicle 1 = 2 axle truck, slowing, 20 mph, 35 mph zone, heading south, charged with following.

Vehicle 2 = car, slowing, 3 mph, 35 mph zone, heading south, no charge, no violation.

Rear end slowing accident, city street, business area, intersection, stoplights, rain.

Narrative: "Vehicle 1 stated that he was almost stopped at traffic lights when struck by Vehicle 2. Vehicle 2 stated that he was applying brakes to stop. Stated front brake took hold, but rear brakes didn't, causing him to hit vehicle 1."

Cause: Although the narrative indicates vehicle 2 is following vehicle 1, the accident form reports vehicle 1, the truck, as following. The brake failure was considered the cause of the accident.

2. Pulling in Front of Traffic From a Road or Driveway

Drivers under this class were involved in an accident caused by pulling in front of another vehicle from a driveway or another road at an intersection. The driver could be either turning or going straight ahead prior to the accident.

Although the intersections might have been controlled by a stop sign (or traffic light in "right turn on red"), the narrative in these cases did not mention the vehicle running the control. A distinction between Running a traffic control and Pulling in front of traffic was made, using the description of the accident by the investigating officer in combination with the violations reported.

Examples are:

A. Accident information: Vehicle 1 = car, going straight, 5 mph, 60 mph zone, heading south, charged with yield violation.

Vehicle 2 = car, going straight, 50 mph, 60 mph zone, heading west, no charge, no violation.

Accident at an angle, US highway, open country, intersection, stop sign.

Narrative: "Vehicle 1 traveling east on RPR 1701 approached intersection of US 64, stopped, and then pulled onto US 64 into the path of vehicle 2 which was traveling west on US 64. Vehicles made contact in the west-bound lane of US 64."

Cause: Vehicle 1 stopped for the stop sign and then pulled in front of vehicle 2. The narrative does not mention any obstructions to view or other causal related factors.

B. Accident information: Vehicle 1 = car, starting in the roadway, 10 mph, 55 mph zone, heading east, charged with yield violation.

Vehicle 2 = going straight, 45 mph, 55 mph zone, heading south, no charge, no violation.

Accident at an angle, rural road, driveway, loose material on road, no control.

Narrative: "Vehicle 2 traveled south, vehicle 1 traveled east on drive, pulled out in path of vehicle 2."

Cause: Vehicle 1 going 10 mph, pulled from a drive into the path of vehicle 2. The narrative does not mention any obstructions to view or other related factors.

C. Accident information: Vehicle 1 = car, going straight, 30 mph, 55 mph zone, heading north, no charge, no violation.

Vehicle 2 = car, left turn, 5 mph, 55 mph zone, heading west, charged with yield violation.

Accident at an angle, NC highway, business area, driveway, no control.

Narrative: "Vehicle 1 was traveling north on NC 50 when vehicle 2 entered highway from a grocery store and pulled into path of vehicle 1. Driver 1 stated she saw vehicle 2 pull out and she applied brakes but was unable to avoid same. Driver 2 stated he looked south, then north and pulled out and did not see vehicle 1 until he was in the roadway."

Cause: Since driver 2 stopped and looked both ways but did not see vehicle 1 coming, the cause of the accident was not considered a UDA.

3. Backing Unsafe

Backing in an unsafe manner includes all drivers backing into a vehicle (moving, stopped or parked) or an object, providing no other cause of accident was reported. Whenever the narrative stated that the driver's view was obscured in some way (for instance by trees, parked cars, sun glare), or that a defect caused the driver to lose control of the vehicle, the case was dropped.

Also cars rolling backwards into another vehicle or object were not considered to be UDA's.

Examples are:

A. Accident information: Vehicle 1 = car, backing, 10 mph, 35 mph zone, charged with failed to see if maneuver could be made in safety, heading south.

Vehicle 2 = car, parked out of travel lane, east, legally parked, 0 mph, 35 mph zone, no charge, no violation.

Collision with parked vehicle, city street, residential area, driveway, dark with street lights, no control.

Narrative: "Vehicle 1 backed out of driveway into vehicle 2."

Cause: The driver of vehicle 1 apparently backed out of his drive without taking enough precaution to avoid hitting the parked vehicle, which no information in the report indicates to have been hidden from the view of the driver.

B. Accident information: Vehicle 1 = car, going straight, 20 mph, 25 mph zone, heading north, no charge, no violation.

Vehicle 2 = car, backing, 5 mph, 25 mph zone, heading west, charged with failed to see if maneuver could be made in safety.

Backing accident, city street, near playground or school, no control.

Narrative: "Vehicle 1 was northbound on Pullen Road when vehicle 2 backed out of Pullen park drive into the door of vehicle 1."

Cause: Driver 2 failed to see vehicle 1 coming while backing out of a driveway.

C. Accident information: Vehicle 1 = car, backing, 3 mph, 35 mph zone, heading south, charged with other improper driving.

Vehicle 2 = car, stopped in travel lane, 0 mph, 35 mph zone, heading north, no charge, no violation.

Backing accident, city street, business, intersection, rain, stop and go signal.

Narrative: "Vehicle 1 stopped for a red light, but then decided to back up and go into the store lot and did not see vehicle 2 and backed into vehicle 2."

Cause: Driver 1, after stopping in the road, backed into the vehicle behind (points of contact were for 1: rear end distributed, for 2: front end distributed). There is no reason to believe that driver 1 could not see vehicle 2.

D. Accident information: Vehicle 1 = car, stopped, 0 mph, 25 mph zone, heading east, no charge, no violation.

Vehicle 2 = car, backing, 3 mph, 25 mph zone, heading west, no charge, no violation.

Backing accident, city street, intersection, business area, dark and street lights, stop and go signal.

Narrative: "Vehicles were waiting for stoplight and vehicle 2 rolled back striking vehicle 1."

Cause: No unsafe driving behavior involved.

The UDA unsafe backing covers a variety of situations and locations (including a large number of private parking lots), making it difficult to sample locations for field observation.

Furthermore, we feel that, if a location for field observation could be found, it will be very difficult for the observers to decide whether the driver is paying enough attention to his surroundings to be backing in a safe manner.

4. Turning in Front of Oncoming Traffic

The unsafe maneuvers in the fourth UDA category are Turning left at a drive or intersection in front of oncoming traffic and Making a U-turn in front of oncoming traffic or at a place where traffic can not be seen ahead of time.

Contrary to the UDA Pulling in front of traffic, both vehicles involved in accidents of this category are traveling on the same road, but in opposite directions.

Examples are:

A. Accident information: Vehicle 1 = car, left turn, 10 mph, 35 mph zone, heading north, charged with failed to see if maneuver could be made in safety.

Vehicle 2 = car, going straight, 25 mph, 35 mph zone, heading south, no charge, no violations.

Left turn same road - accident, city street, business area, intersection, rain, dark and street lights, stoplights.

Narrative: "Vehicle 1 pulled across the travel lane of Wake Forest Road into the path of vehicle 2 which was going south on Wake Forest Road."

Cause: Driver 1 turned left in front of vehicle 2, when apparently the distance between vehicle 2 and the intersection was too small to allow such a maneuver. There is no information stating that driver 1 did not see vehicle 2 coming.

B. Accident information: Vehicle 1 = car, left turn, 10 mph, 55 mph zone, heading south, charged with failed to see if maneuver could be made in safety.

Vehicle 2 = car, going straight, 50 mph, 55 mph zone, heading north, no charge, no violation.

Left turn same road - accident, rural road, open country, no control, driveway.

Narrative: "Vehicle 1 going south on RP 1006 made a left turn into private drive across path of vehicle 2 which was going north. Vehicle 2 struck vehicle 1 in right rear quarter panel."

Cause: Driver 1 turned left into a drive when this was unsafe because of oncoming traffic.

C. Accident information: Vehicle 1 = car, going straight, unknown speed, 25 mph zone, heading west, no charge, no violation.

Vehicle 2 = car, leaving parked position, unknown speed, 25 mph zone, heading east, no charge, violation: failed to see if maneuver could be made in safety.

Left turn same road - accident, city street, residential area, intersection, no control.

Narrative: "Vehicle 1 was going straight ahead and 2 started from the parked position, apparently made a U-turn and vehicle 1 hit same."

Cause: Driver 2 made a U-turn at an unsafe moment in front of Vehicle 1.

D. Accident information: Vehicle 1 = car, left turn, 3 mph, 35 mph zone, heading north, charged with improper turn.

Vehicle 2 = truck, going straight, 38 mph, 35 mph zone, heading south, no charge, no violation.

Left turn same road - accident, city street, business area, driveway, rain, no control.

Narrative: "Vehicle 1 going south in right lane, driver stated he saw 1 turning and he tried to pull to center lane; vehicle 2 making left turn, driver stated he didn't see 1."

Cause: Since driver 2 stated he did not see vehicle 1 coming, the case was dropped.

5. Speeding too Fast for the Weather Conditions or Location (Below or at the Speed Limit)

On the accident report form the speed limit and the speed prior to the crash for every vehicle involved are noted. It is to a great extent these two variables that make the difference between Speeding, Speeding too fast for the conditions and Non-UDA.

If a driver was going faster than the speed limit allowed and the crash was speed-related, the UDA was classified as Speeding. In crashes where the driver was going below or at the speed limit, but weather, road conditions or road features indicated a lower speed to be prudent, the UDA was classified as Speeding for conditions. Depending on the conditions, speeds, 5 or 10 miles below the speed limit were considered unsafe. Accidents occurring at lower speeds were usually considered non-UDA crashes.

Examples are:

A. Accident information: Vehicle 1 = car, going straight, 30 mph, 35 mph zone, heading north, no charge, no violation.

Ran off road, left, city street, residential area, other road feature, snowing, dark, no street lights, no control, cloudy.

Narrative: "Vehicle 1 hit icy curve, lost control, ran off left side of road, hit fire hydrant."

Cause: A speed of 30 mph in a 35 mph zone was considered too fast for the weather conditions (snow) and the road feature (icy curve).

B. Accident information: Vehicle 1 = car, going straight, skidding out of control, heading east at 25 mph, 25 mph zone, no charge, violation: driving on the wrong side of the road.

Vehicle 2 = car, going straight, heading west, 10 mph, 25 mph zone, no charge, no violation.

Sideswipe, rural road, residential area, other road feature, icy road, no control.

Narrative: "Vehicle 1 lost control on icy road and sideswiped vehicle 2 that was approaching from the opposite direction."

Cause: A speed of 25 mph in a 25 mph zone on an icy street was considered unsafe for the conditions.

C. Accident information: Vehicle 1 = car, going straight, heading east, 15 mph in a 35 mph zone, no charge, no violation.

Vehicle 2 = car, parked out of lane, legally parked, east, no charge, no violation.

Collision with parked vehicle, city street, residential area, other road feature, icy road.

Narrative: "Vehicle 1 was traveling east on Clark Avenue. Vehicle 2 was parked on the south curve of Clark Avenue facing east. Vehicle 1 lost control, unable to guide in roadway, spun around and struck vehicle 2 in rear. Vehicle 1 then spun around and struck vehicle 2 in left side."

Cause: The driver was going 20 miles below the speed limit at 15 mph, which was considered a safe speed for the circumstances.

6. Running a Stop Sign or Light

This class of UDA's includes all drivers not falling into the category Pulling in front of traffic. The distinction is made by using the description of the accident and the violations indicated by the officer. Very often the distinction had to be made, using the officer's words in describing the accident, e.g., "pulling from a stop sign" as opposed to "running a stop sign."

Running a traffic control assumes that the driver committing the UDA did not have enough time to check for traffic at a stop sign or that he ran a red light if the control is a traffic signal.

Examples are:

A. Accident information: Vehicle 1 = car, going straight, 40 mph, 35 mph zone, heading south, charged with stop sign violation.

Vehicle 2 = 2 axle truck, heading east going straight at 35 mph, 35 mph zone, no charge, no violation.

Accident at an angle, rural road, residential area, intersection, stop sign.

Narrative: "Vehicle 1 ran stop sign and struck vehicle 2."

Cause: Even though driver 1 was going too fast, the fact that he ran the stop sign was considered the cause of the accident. The narrative does not indicate that the driver checked for traffic.

B. Accident information: Vehicle 1 = car, going straight, heading east, 20 mph, 25 mph zone, charged with a traffic signal violation.

Vehicle 2 = car, left turn, 2 mph, 25 mph zone, heading south, no charge, no violation.

Left turn across traffic - accident, city street, business area, at bridge or underpass, dark and street lights, stop signal.

Narrative: "Vehicle going through the intersection on a green light; vehicle 1 failed to stop for red light in his direction of travel hitting vehicle 2."

Cause: The narrative states that vehicle 1 ran a red light.

C. Accident information: Vehicle 1 = car, going straight, heading south, 25 mph, 45 mph zone, no charge, no violation.

Vehicle 2 = car, going straight, heading east, 5 mph, 45 mph zone, no charge, stop sign violation.

Accident at an angle, rural road, open country, intersection, dark, no street lights, icy road, stop sign.

Narrative: "Vehicle 2 applied brakes, struck ice, started sliding, unable to stop, slid into intersection and struck vehicle 1 in the right side."

Cause: Since vehicle 2 was traveling well below the speed limit, the crash is not considered to be caused by speed. Driver 2 failed to stop for the stop sign because of the skid.

The first question that comes to mind when considering the UDA Running a control, concerns safety. Does the definition of an unsafe driving action include 1) all drivers running a control or 2) only those that ran a control when other traffic was near? Since our description of the UDA in the accident analysis assumes that the driver in question did not have enough time to check for traffic we feel the first definition to be more accurate.

This definition, however, raises the question how to observe the driver checking for traffic if he does not come to a complete stop at a stop sign.

Although this problem has been discussed at various meetings, no decision has yet been made.

7. Changing lanes or Merging in Front of Traffic

This UDA describes vehicles pulling in front of traffic from a parallel lane or merging lane, when two or more vehicles are traveling in the same direction.

Examples are:

A. Accident information: Vehicle 1 = car, changing lanes, heading north, 20 mph, 35 mph zone, charged with failed to see if maneuver could be made in safety.

Vehicle 2 = car, going straight, heading north, 18 mph, 35 mph zone, no charge, no violation.

Sideswipe accident, city street, business, other road feature, no control.

Narrative: "Vehicle 1 was traveling north on S. Person Street, when it started to change traffic lanes and struck vehicle 2 on the right front fender."

Cause: Apparently driver 1 failed to check for traffic and changed lanes in front of vehicle 2.

B. Accident information: Vehicle 1 = car, slowing, heading north, 50 mph, 60 mph zone, no charge, no violation.

Vehicle 2 = car, going straight, heading north, 55 mph, 60 mph zone, no charge, no violation.

Sideswipe accident, US Highway, open country at the end or beginning of a divided Highway, no control.

Narrative: "Vehicle 1 was traveling north on US 64 bypass when a vehicle coming up onto the belt line from a ramp, ran vehicle 1 out of the right-hand straight lane into the left straight lane thus . . ." (no more information printed).

Cause: An unknown vehicle caused the accident by merging onto US 64 in front of vehicle 1.

C. Accident information: Vehicle 1 = car, going straight, heading west, 20 mph, 45 mph zone, no charge, no violation.

Vehicle 2 = car, changing lanes, heading west, 25 mph, 45 mph zone, charged with failed to see if maneuver could be made in safety.

Sideswipe collision, city road, business area, other road feature, rain, no control.

Narrative: "Vehicle 2 attempted to switch lanes and collided with vehicle 1 and vehicle 2 used turn signal. Collision occurred when vehicle 1 slid on wet surface."

Cause: Vehicle 2, changing lanes, skidded on the wet road going 25 miles per hour. A speed 20 miles below speed limit was considered safe for the conditions.

In the UDA Changing lanes or merging in front of traffic, the safe gap between vehicles will once again have to be defined. Since the safety of the maneuvers depend on the distances between vehicles it follows that, for changing lanes or merging to be called unsafe, other traffic must be present.

Decisions concerning the sampling of field observation points will also have to be made. As in the Following-UDA, observations could be taken en route or from a fixed point along the road. Another possibility would be to observe from a location above road level such as an overpass or building. This method, however, could make it difficult for the observers to record all the information requested.

8. Speeding (Above the Speed Limit)

The Speeding-UDA includes all drivers involved in an accident caused by a speed greater than the posted speed limit.

In some cases speeding was found in combination with other unsafe driving acts such as running a stop sign, following or passing, but only the UDA directly related to the crash was taken into account (example A, UDA 6).

Examples are:

A. Accident information: Vehicle 1 = car, going straight, heading west, 50 mph, 35 mph zone, charged with speeding less than 65 mph.

Ran off road, right, US highway, residential area, intersection, rain, dark road, no street lights, yield sign.

Narrative: "Vehicle 1 traveling west on bypass just after leaving US 1 exit ramp when it lost control and went off the right side of the road and finally stopped down a 25 ft. embankment."

Cause: Driver 1 lost control of his vehicle when traveling 15 miles per hour above the speed limit.

B. Accident information: Vehicle 1 = 2 axle truck, going straight, heading east, 30 mph, 45 mph zone, no charge, no violation.

Vehicle 2 = 2 axle truck, going straight, heading west, 50 mph, 45 mph zone, charged with speed less than 65 mph.

Overturn - accident, rural road, open country, other road feature, other control device.

Narrative: "Vehicle 1 traveling east on RP 1370. Vehicle 2 traveling west on RP 1370 exceeding the speed limit, lost control in a curve and overturned several times. Rocks that were being hauled on vehicle 2 were thrown into the left door glass of vehicle 1."

Cause: Driver 2 lost control in a curve, doing 50 miles per hour.

C. Accident information: Vehicle 1 = 2 axle truck, ran off the road, right, heading south straight ahead, drinking but unable to determine impairment, charged with speeding less than 65 miles per hour, rural road, residential area, driveway.

Narrative: "Vehicle 1 traveling south on RP 1445, dozed off at wheel, lost control in curve, ran off road on right, hit driveway pipe water pump house, hit several trees, left scene, went home."

Cause: Accident was caused by the physical condition of the driver (sleep).

9. Turning too Wide or too Sharp

In these unsafe maneuvers the vehicle is using an unsafe path to turn by turning outside the proper lanes of travel, thus striking approaching vehicles, parked vehicles or objects such as sign posts.

Examples are:

A. Accident information: Vehicle 1 = car, parked legally outside of travel lane, 0 mph, 35 mph speed zone, facing east, no charge, no violation.

Vehicle 2 = car, going straight, heading west, 15 mph, 35 mph zone, no charge, violation: other improper driving.

Collision with a parked vehicle, city street, residential area, dusk.

Narrative: "Vehicle 1 was parked about 75 feet east of Cimore Street along the north curb of Washington Street when vehicle 2 attempted to make a right turn from Washington Street onto Cimore Street coming from the east, turning too short, causing the right front of vehicle 1 to collide with the right side of Vehicle 1 (?)."

Cause: Vehicle 2 struck a parked vehicle while turning too short to the right.

B. Accident information: Vehicle 1 = car, vehicle 2 = 2 axle truck, vehicle 3 = 2 axle truck.

Accident on private property. No other information available.

Narrative: "Vehicle 1 in city parking lot 219 West Morgan Street. Subject struck vehicle 2 and 3 while attempting to turn around in lot."

Cause: Vehicle 1 struck two other vehicles while turning too wide in a parking lot.

C. Accident information: Vehicle 1 = car, going straight, 25 mph, 25 mph zone, heading south, no charge, no violation.

Vehicle 2 = car, going straight, 30 mph in a 25 mph zone, heading south, charged with speeding less than 65 mph.

Sideswipe collision, city street, residential area, intersection, rain, no control.

Narrative: "Vehicle 1 had made a left turn onto Lakeside Drive from Vandorc Spring Road. Vehicle 2 was following vehicle 1. Vehicle 2 failed to decrease speed while he was making his trun, side-swiped vehicle 1 on left side."

Cause: Although vehicle 2 also turned left too sharp (therefore hitting the left side of the car in front), the UDA was labeled Speeding, since the failure to reduce speed probably also caused the failure to turn properly.

10. Driving Left of Center

This category of UDA's describes vehicles driving left of the center line or too near the center line to avoid an accident. Also considered were vehicles driving left of the center line in curves, e.g., cutting across the curve in the road.

This category does not include drivers passing other vehicles.

Examples are:

A. Accident information: Vehicle 1 = car, going straight, 40 mph in a 35 mph zone, heading north, charged with driving on the wrong side.

Vehicle 2 = car, going straight, south, 30 mph, 35 mph zone, no charge, no violation.

Sideswipe accident, city street, residential area, other road feature, no control.

Narrative: "Vehicle 1 and 2 were traveling in opposite directions on Canterbury Road. Vehicle 1 drove left of center and struck vehicle 2. Point of impact 150 ft. south of curb of Wade Avenue and 20 ft. of east curb of Canterbury Road."

Cause: Vehicle 1 was driving left of center line prior to the accident. The speed at which vehicle 1 was traveling was not considered to be the cause of the crash, since in the proper lane, vehicle 1 would have avoided hitting vehicle 2.

B. Accident information: Vehicle 1 = bus, going straight, 15 mph, no speed zone, heading north, no charge, no violation.

Vehicle 2 = car, going straight at 35 mph, heading south, charged with driving on the wrong side.

Sideswipe crash, rural road, residential area, driveway, loose material on surface of road, no control.

Narrative: "Vehicle 1 was traveling north on RUR 1910, saw vehicle 2 coming, slowed down and moved over to the far right-hand side of the road, ran in ditch to try to avoid colliding with vehicle 2, but was still struck by vehicle 2. Vehicle 2 was traveling south on RUR 1910 in the center of the road and collided with vehicle 1."

Cause: Driver 2 caused the accident by driving left of the center line in a curve.

C. Accident information: Vehicle 1 = 2 axle truck, going straight, 30 mph, 35 mph zone, no charge, no violation, sideswipe accident, city street, business area, other road feature, no control.

Vehicle 2 = truck, left scene.

Narrative: "Vehicle 1 traveling east on street inside lane met truck going west on street and the truck knocked the outside rear view mirror off."

Cause: Apparently the unknown truck was driving too close to the center line to avoid an accident.

D. Accident information: Vehicle 1 = car, going straight, east, 35 mph, 35 mph zone, no charge, no violation.

Vehicle 2 = car, going straight, west, 35 mph, 35 mph zone, no charge, no violation.

Sideswipe accident, city street, other road feature, residential area, no control.

Narrative: "Vehicle 2 struck vehicle 1 on left side."

Cause: Too little information for the identification of the accident cause.

Although this UDA category does not include identified passing UDA's, the possibility does exist that a number of the accidents were caused by passing, but could not be recognized due to the limited information. Often the reason of the driver for being left of the center line was not reported.

11. Turning from a Wrong Lane

The following unsafe maneuvers are covered by the UDA Turning from a wrong lane:

1. Making a left turn from an outside lane.

2. Making a right turn from an inside lane.

3. Turning left or right from a lane assigned only to traffic going straight ahead.

Going straight ahead in a turning lane was considered a separate UDA.

Examples are:

A. Accident information: Vehicle 1 = car, going straight, heading south, 5 mph, 35 mph zone, no charge, no violation.

Vehicle 2 = car, right turn, 5 mph, 35 mph zone, heading south, charged with failed to see if maneuver could be made in safety.

Right turn same road - accident, city street, business area, drive, no control.

Narrative: "Vehicle 1 going straight ahead in outside lane. Vehicle 2 in inside lane attempted right turn, struck left rear of vehicle 1."

Cause: Driver 2 made a right turn from the inside lane in front of vehicle 1.

B. Accident information: Vehicle 1 = car, going straight, 10 mph, 25 mph zone, heading north, no charge, no violation.

Vehicle 2 = 2 axle truck, left turn, 10 mph, 25 mph zone, north, charged with improper turn.

Left turning, same road - accident, city street, business, intersection, stoplight.

Narrative: "Vehicle 2 traveling north on S. Wilmington Street; vehicle 1 made left trun onto E. South Street from a straight trhough lane only and struck vehicle 2 in right front."

Cause: Driver 1 made a left turn from a wrong lane.

C. Accident information: Vehicle 1 = car, left turn, north, 5 mph, 25 mph zone, no charge, no violation.

Vehicle 2 = car, left turn, 10 mph, 25 mph zone, north, no charge, no violation.

Left turn same road - accident, city street, business area, intersection with stoplight.

Narrative: "Street was under construction and detour signs were erected for approximately 2 months until this afternoon in lanes 1 and 2 had to turn left and a dotted line indicated the turn travel lanes. This is still in the street, people are not used to the barricades being down yet, vehicle 2 turning left and driver said he was turning left. Also I made into a left turn only today."

Cause: Confusing information. Because of the new situation the cause of the accident was labeled non-UDA.

12. Driving Under the Influence

Upon request, the unsafe actions of a driver under the influence were classified in the appropriate UDA classes. Whenever this was not possible, the accident was moved to this category.

Examples are:

A. Accident information: Vehicle 1 = 2 axle truck, going straight, 20 mph, 30 mph zone, charged with DUI, fatigued, drinking ability impaired, hit fixed object, city street, business area, near a bridge, rain, no control.

Narrative: "Vehicle 1 going east on W. Peace Street when he lost control and ran the car into a vehicle left fender."

B. Accident information: Vehicle 1 = car, 50 mph, 55 mph zone, going straight, ran off road, right, drinking, ability impaired, charged DUI, US highway, open country, dark, no street lights.

Narrative: "Vehicle 1 was traveling south on US 15 and ran off the right side of the road. Vehicle 1 was out of control, overturning in the road and rolling into the ditch bank."

Cause: In both accidents (A and B) the loss of control was considered to have been caused by the impaired driving abilities of the drinking driver.

13. Passing a Turning Vehicle

The UDA Passing a truning vehicle describes drivers passing a left turning vehicle on the left or a right turning vehicle on the right-hand side. In accidents where the passing UDA showed up in combination with the UDA No signal, both UDA's were taken into account if the passing vehicle failed to blow his horn.

Exceptions were made for sudden turns and improper turning signals (e.g., indicating a right turn, but making a left turn). In these accidents only the turning UDA was considered.

If the accidents in the UDA category occurring at intersections and other no-passing-zones are separated and combined with other types of crashes in no-passing-zones, a new UDA "Passing where not allowed" could be formed with a rank number of 18.

Examples are:

A. Accident information: Vehicle 1 = car, left turn, south, 10 mph, 55 mph zone, no charge, no violation.

Vehicle 2 = car, passing at 60 mph in 55 mph zone, south, charged not stated violation: improper overtake.

Left turn same road - accident, US highway, open country, driveway, dark and street lights, no control.

Narrative: "Vehicle 1 making a left turn off US 15, vehicle 2 southbound pulled out to pass and struck 1 in the left rear. Vehicle 2 left scene before investigating officer arrived."

Cause: Vehicle 2 attempted to pass a vehicle turning left into a drive.

B. Accident information: Vehicle 1 = car, left turn, heading south at 15 mph, 60 mph zone, no charge, no violation.

Vehicle 2 = car, passing, 60 mph, 60 mph zone, south, no charge, improper overtake as violation.

Left turn same road - accident, highway, open country, intersection, no control.

Narrative: "Vehicle 1 making a left-hand turn and vehicle 2 proceeding to go around hitting vehicle 1 in left side."

Cause: Vehicle 2 attempted to pass a turning vehicle at an intersection.

C. Accident information: Vehicle 1 = car, left turn, 45 mph, 35 mph zone, north, charged with improper turn.

Vehicle 2 = car is passing, 45 mph in 35 mph zone, north, no charge, no violation.

Left turn same road - accident, rural road, open country, driveway.

Narrative: "Vehicle 1 was slowing down with no signal on, vehicle 2 was traveling behind vehicle 1, vehicle 2 pulled out to pass blowing her horn, when she got beside vehicle 1, vehicle 1 started turning left and turned into vehicle 2."

Cause: Although various violations were committed (speeding, no signal, improper turn), the cause of the accident was considered to be "Turning while being passed."

14. Driving too Close to the Right Side of the Road

Vehicles driving too close to the right side of the roadway and colliding with parked vehicles, objects or the right-hand curb are covered by this UDA class.

Examples are:

A. Accident information: Vehicle 1 = car, parked legally, out of travel lane, 0 mph, 35 mph zone, facing east.

Vehicle 2 = car going straight east, 25 mph, 35 mph zone, not stated charge, no violation stated.

Collision with a parked vehicle, city street, residential area, intersection, dark with street lights, no control.

Narrative: "Vehicle 1 parked and vehicle 2 came by and sideswiped vehicle 1, failed to stop at scene."

Cause: Apparently vehicle 2 came too close to the side of the road, therefore sideswiping vehicle 1.

B. Accident information: Vehicle 1 = car, going straight, 20 mph, 35 mph zone, charged with speeding less than 65 mph.

Collision with a fixed object, city street, residential area, intersection, dark and street lights, no control.

Narrative: "Vehicle 1 was proceeding down Pritchard Avenue exit, struck curb and continued to strike curb until it struck the bridge and continued on 36 ft. until it came to a stop. Officer note: I found the car wrecked parked in street as it was left at time of accident without lights or other warning devices at bridge on 63-73."

Cause: Vehicle 1 struck the curb of the road.

15. Improper Parked or Stopped Vehicle

UDA's of this nature were found in combination with other UDA's or singly, when for instance cars were parked at a dangerous location outside the view of oncoming traffic.

Examples are:

A. Accident information: Vehicle 1 = truck, going straight, south, no charge, no violation, speed 35 mph in 45 mph zone, ran off road, right, NC highway, open country, soft shoulders.

Narrative: "Vehicle 1 traveling south proceeded around a sharp curve to right, observed two unknown vehicles sitting in highway, couldn't stop in time to avoid striking the vehicles, swerved to right, ran off road on right, struck ditch and overturned on right side, when vehicle 1 overturned it struck a utility pole doing damage to windshield and cab of tractor and trailer."

Cause: The two unknown vehicles causing the accident were stopped at a dangerous location.

B. Accident information: Vehicle 1 = car, backing north at 3 mph, 10 mph zone, charged with failed to see if maneuver could be made in safety.

Vehicle 2 = car, parked in lane of travel, facing west, improper parking location.

Collision with parked vehicle, city street, school location, other road feature, dark with street lights, no control.

Narrative: "Vehicle 2 parked in traffic lane was struck by vehicle 1 while backing from a parking place into the traffic lane."

Cause: Both violations, unsafe backing and improper parking, were considered to have caused the accident.

16. Pulling from a Parked Position into Traffic

Pulling out from a parked position along the roadway can intervene with traffic going in the same direction, but also with traffic from the opposite direction when the vehicle leaving the parked position crosses the center line. Both situations are included in this UDA.

Examples are:

A. Accident information: Vehicle 1 = car, leaving parked position, heading south, 5 mph, 25 mph zone, no charge, violation: failed to yield.

Vehicle 2 = car going straight south, 15 mph, 25 mph zone, no charge, no violation.

Sideswipe collision, city street, residential area, intersection, stop sign.

Narrative: "Vehicle 1 pulled out of a parking space and failed to yield to vehicle 2."

Cause: Vehicle 1 pulled in front of traffic going in the same direction, while leaving parked position. The narrative does not indicate that vehicle 2 could not be seen.

B. Accident information: Vehicle 1 = car leaving parked position, going north, 15 mph, 55 mph zone, charged with driving on the wrong side.

Vehicle 2 = car, going straight south, 15/55 mph, no charge, no violation.

Accident at an angle, rural road, open country, other feature, no control, dusk.

Narrative: "Vehicle 1 pulled off from parked position, vehicle 1 pulled into side of vehicle 2."

Cause: While pulling from a parked position, vehicle 1 crossed the center line and struck traffic going in the opposite direction.

C. Accident information: Vehicle 1 = car, going straight, east, 25 mph, 20 mph zone, charged with failed to see if maneuver could be made in safety.

Vehicle 2 = car leaving parked position, 5 mph, 20 mph zone, east, also charged with a safe maneuver violation.

Accident at an angle, city business street, median crossover, no control.

Narrative: "Vehicle 2 stated he looked back and saw vehicle in right lane, but saw a truck and a vehicle in center lane, when he pulled out the vehicle exchanged lanes, vehicle 2 hit vehicle 1 in right side."

Cause: The correct UDA is questionable since both maneuvers occurred at the same time.

17. Hit a Parked Vehicle While Leaving a Parked Position (or Drive) (Not Backing)

This UDA covers many situations, all which resulted in a collision with a parked vehicle. Unfortunately the unsafe act could not be defined more specifically with the available information. It is likely, that many of the involved drivers are turning too wide or sharp out of their driveways or parking spaces. Vehicles moving in and out of a parking space while parking were also included.

As opposed to backing accidents, no vehicles were found striking parked vehicles while leaving a drive.

Examples are:

A. Accident information: Vehicle 1 = car, vehicle 2 = car.

Accident on private property; no other information is available.

Narrative: "Vehicle 2 was parked on private property at 1311 St. Mary's in a parking lot and vehicle 1 was leaving a parking space in the same parking lot and struck vehicle 2."

Cause: Vehicle 1 struck a parked vehicle while leaving a parked position.

B. Accident information: Vehicle 1 = car, parking, 5 mph, 35 mph zone, east, no charge, no violation.

Vehicle 2 = car, parked out of lane, legally, no charge, no violation.

Collision with a parked vehicle, city street, business area, other feature, no control.

Narrative: "Vehicle 2 was parked in 1200 block of street when vehicle 1 started to park and struck vehicle 2."

Cause: Driver 1 struck a parked vehicle while parking his car.

18. No Signal or Improper Signal

Most signal violations were found in combination with another unsafe driving act such as passing a turning vehicle.

In one narrative, however, the improper turning signal was considered the only cause of the accident (example A).

This category of UDA's also includes two collisions caused by both vehicles not giving a signal in a passing-turning situation.

Examples are:

A. Accident information: Vehicle 1 = car, making a left turn, 10 mph, 35 mph zone, west, charged with improper turn.

Vehicle 2 = car, passing, 20 mph, 35 mph zone, west, no charge, no violation.

Left turn same road - accident, city street, residential area, intersection, no control, rain.

Narrative: "Vehicle 1 made left turn in front of vehicle 2 while vehicle 2 was passing vehicle 1. Vehicle 1 had right signal on when vehicle 2 was passing."

Cause: Vehicle 1 turned left while indicating a right turn.

B. Accident information: Vehicle 1 = 2 axle truck, left turn, defective rear lights, 25 mph, 60 mph zone, east, no charge but failed to see if maneuver could be made in safety.

Vehicle 2 = car, passing east, 55 mph, 60 mph zone, no charge, no violation.

Sideswipe, highway, open country, intersection, no control.

Narrative: "Vehicle 1 and vehicle 2 traveling east on US 64. Vehicle 2 came up on vehicle 1 traveling slow. Vehicle 2 started to pass vehicle 1. Vehicle 1 started to make a left turn just as vehicle 2 started to pass. Vehicle 1 had no left turn signal and did not give a hand signal."

Cause: Vehicle 1 received a signal UDA for not indicating the left turn and vehicle 2 received a passing UDA for passing a slowing vehicle at an intersection.

19. Going Straight in a Turning Lane

This UDA describes all accidents caused by vehicles going straight in a turning lane. Other improper lane use was described by the UDA Turning from a wrong lane. Since turning from a wrong lane would be more likely to occur at the spur of a moment, these two UDA's were separated.

An example is:

A. Accident information: Vehicle 1 = car, going straight, 5 mph, 25 mph zone, west, no charge, no violation.

Vehicle 2 = car, left turn, 10 mph, 25 mph zone, west, charged with improper turn.

Left turn same road - accident, city street, business area, intersection, stoplights.

Narrative: "Vehicle 1 was making a left turn in a lane designated to go straight or turn left. Vehicle 2 went straight in a lane designated as a left turn only and hit vehicle 1."

Cause: Vehicle 2 went straight in a turning lane. Since the accident form information for the vehicles does not seem to match the narrative information, profile data cannot be gathered.

20. Crossing the Line of a Lane in the Same Direction

This UDA includes the accidents caused by drivers colliding with vehicles going in the same direction in the parallel lane of travel, providing the drivers were not in the process of changing lanes.

Examples are:

A. Accident information: Vehicle 1 = 2 axle truck, going straight north, 5 mph, 25 mph zone, no charge, no violation.

Vehicle 2 = car, going straight, north, 5 mph, 25 mph zone, no charge, no violation.

Sideswipe collision, city street, business area, other road feature, stop and go signal.

Narrative: "Vehicle 1 and vehicle 2 both traveling north on W. Wilmington Street. Vehicle 1 sideswiped vehicle 2 with its glass holders located on sides of vehicle 1."

Cause: Vehicle 1 was driving too close to the parallel lane.

B. Accident information: Vehicle 1 = car, going straight, heading north, 25 mph, 25 mph zone, no charge, no violation.

Vehicle 2 = 2 axle truck, stopped in travel lane, heading north, 25 mph, 25 mph zone, no charge, no violation.

Sideswipe accident, city business street, other feature, dark with street lights, no control.

Narrative: "Vehicle 1 and vehicle 2 going north, vehicle 1 went over to right and struck vehicle 2 on his right."

Cause: Vehicle 1 drifted to his right, striking a vehicle stopped in the right lane.

APPENDIX B

Collecting Citation Data

This appendix includes the optical scanning sheet used by HSRC researchers in recording citation information in the three counties.

The following instruction manual explains the manner and content of the information as it was coded from the traffic citations.

HSRC TRAFFIC CITATIONS CODING FORM

CITATION NUMBER

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

HOUR OF DAY

0 1 2 5 6
0 1 2 3 4 5 6 7 8 9

MONTH

J F M A M J J A S O N D

DAY OF WEEK

M T W T F S S

COUNTY

C O W

RESIDENCE

1 2 3

CITATION

TYPE

0 1 2 3

0 1 2 3 4 5 6 7 8 9

SPEED

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

SPEED ZONE

0 1 2 3 4 5 6 7
0 5

CONDITIONS

AREA

B R S O

WEATHER

C O R S

VISIBILITY

C R S F

TRAFFIC

H M L N

TYPE OF ACCIDENT

A F I P N O
A F I P N O
A F I P N O

TYPE OF ROADWAY

1 2 3 4 5 6 7

DRIVER

LICENSE NUMBER

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

TYPE OF LICENSE

1 2 3

RACE

W N O

SEX

M F

YEAR OF BIRTH

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

VEHICLE

MAKE

0 1 2
0 1 2 3 4 5 6 7 8 9

TYPE

1 2 3 4 5

YEAR

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

0123456789

LICENSE NUMBER

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

0123456789

VERDICT

1 2 3 4 5 6 7

CODER ID

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

UNC PRINTING DEPT.
UNCCC
10/75

CODING INSTRUCTIONS FOR HSRC CITATION
ANALYSIS OF UNSAFE DRIVING ACTIONS

IMPORTANT! Do not pull from files any non-UDA citations--driving while license was suspended, revoked; or without license; driving without displaying current inspection sticker; or any mechanically-related violations (defective brakes, tires, etc.). ALSO, pull only motor vehicles citations which involved a passenger car. Ignore the "Vehicle Type" variable on coding form.

FILL IN ONLY ONE BOX IN EACH ROW FOR EACH VARIABLE ON CODING FORM.
LEAVE BLANK ANY VARIABLE THAT IS NOT STATED, UNKNOWN, OR NOT APPLICABLE.

COUNTY

C = Chatham
O = Orange
W = Wake

RESIDENCE

Refer to "listing of Cities by Counties" to determine whether the driver lived in the same county where he was cited.

1 = County residence
2 = Other N.C. residence
3 = Out-of-state
4 = Student residence (if school adress and permanent home address are given). Mark where box "4" would normally appear on coding form.

CITATION NUMBER

Use the number following "74 CR" or "74 CRD" located in the top right-hand corner of the citation. Beginning with the first row, mark one number in each row until the complete citation number has been recorded. Do not mark any "left-over" rows.

(HOUR OF DAY, MONTH, AND DAY OF WEEK in which citation was issued are found in top right-hand corner under "Affidavit and Warrant.")

HOUR OF DAY

01 = 1:00 to 1:59 a.m.	13 = 1:00 to 1:59 p.m.
02 = 2:00 to 2:59 a.m.	14 = 2:00 to 2:59 p.m.
03 = 3:00 to 3:59 a.m.	15 = 3:00 to 3:59 p.m.
04 = 4:00 to 4:59 a.m.	16 = 4:00 to 4:59 p.m.
05 = 5:00 to 5:59 a.m.	17 = 5:00 to 5:59 p.m.
06 = 6:00 to 6:59 a.m.	18 = 6:00 to 6:59 p.m.
07 = 7:00 to 7:59 a.m.	19 = 7:00 to 7:59 p.m.
08 = 8:00 to 8:59 a.m.	20 = 8:00 to 8:59 p.m.
09 = 9:00 to 9:59 a.m.	21 = 9:00 to 9:59 p.m.
10 = 10:00 to 10:59 a.m.	22 = 10:00 to 10:59 p.m.
11 = 11:00 to 11:59 a.m.	23 = 11:00 to 11:59 p.m.
12 = 12:00 to 12:59 p.m.	24 = 12:00 to 12:59 a.m.

If uncertain whether AM or PM, add 50 to the relevant one of the first 12 codes above, e.g. 11:17 would be coded as 61.

MONTH

(in order of boxes from left to right)

J = January
F = February
M = March
A = April
M = May
J = June
J = July
A = August
S = September
O = October
N = November
D = December

DAY OF WEEK

M = Monday
T = Tuesday
W = Wednesday
T = Thursday
F = Friday
S = Saturday
S = Sunday

*CITATION TYPE

Code the UDA violation or charge that was made against the driver. DO NOT PULL FROM FILES ANY NON-UDA OFFENSES such as driving while license was suspended or revoked, driving without displaying current inspection sticker, or any mechanically-related violations (defective brakes, tires, etc.). In the event that two charges are made, indicate the first one only.

Ø1 = Speeding _____ mph in a _____ mph zone

Ø2 = Driving under the influence of alcohol/drugs

Ø3 = Failure to stop at a duly erected stop sign

Ø4 = Running red light

Ø5 = Failure to see safe movement or failure to see movement that could be made in safety

Ø6 = Failing to see before starting that such movement could be made in safety

Ø7 = Failing to see before stopping that such movement could be made in safety

Ø8 = Failing to see before turning from a direct line that such movement could be made in safety

Ø9 = Reckless driving

1Ø = Without due caution and circumspection and at a speed and in such a manner so as to endanger persons and property

11 = Failing to drive on right half of roadway (driving wrong side of road)

12 = Exceeding posted speed

13 = Illegal (improper) passing

14 = Illegal passing on curve

15 = Illegal passing on hill

16 = Illegal passing at an intersection

17 = Exceeding safe speed

18 = Failure to reduce speed

19 = Failure to yield right-of-way

2Ø = Failure to yield right-of-way at duly erected yield sign

21 = Failure to yield right-of-way at duly erected stop sign

22 = Driving too fast for existing conditions or driving at a greater speed than was reasonable and prudent under existing conditions

23 = Following too closely

24 = Improper turn
25 = Going wrong way on one-way street (or dual lane highway)
26 = Improper use of traffic lane
27 = Failure to give sign
28 = Improper signal
29 = Negligent driving
30 = Hit and run
31 = Racing
32 = Driving below minimum speed
33 = Passing stopped school bus
34 = Improper backing
35 = Other improper driving

SPEED AND SPEED ZONE

If 01 (speeding violation) was marked for citation type; indicate the actual speed given and the speed zone. Code "99" for any speed 99 mph or higher

CONDITIONS

AREA

- B = Business or Industrial
- R = Residential section
- S = Near School or Playground
- 0 = OC (Open Country or Undeveloped)

WEATHER

- C = Clear
- O = Overcast or cloudy
- R = Rain
- S = Sleet, Snow, Hail, or Icy

VISIBILITY

- C = Clear
- R = Rain on windshield
- S = Sleet, Snow, or Hail
- F = Fog, Smoke, or Dust

TRAFFIC

- H = Heavy
- M = Medium
- L = Light
- N = None

TYPE OF ACCIDENT

Mark only one row if only one type of accident. But if there was an injury and property damage, for example, mark "I" in the first row, "P" in the second row, and leave the third row blank.

- A = Yes (Mark this only if officer wrote "Yes")
- F = Fatality
- I = Injury
- P = Property Damage
- N = NA (Near Accident)
- 0 = None or No Accident

TYPE OF ROADWAY

Refer to "On Highway No./Street" block on citation to determine type of roadway. (If street name is given, code "6"--local street)

- 1 = I (Interstate)
- 2 = U.S.
- 3 = N.C.
- 4 = RPR (Rural Paved Road)
- 5 = RUP (Rural Unpaved Road)
- 6 = Local Street
- 7 = Other

DRIVER

LICENSE NUMBER (N.C. only)
Before marking rows, refer to "State" block--next to "Driver's License No."--to determine if it is an N.C. number. Leave blank when out-of-state license.

TYPE OF LICENSE
1 = OL (Operator's License) or OLR (Operator's License--Restricted)
2 = CL (Chauffeur's License) or CLR (Chauffeur's License--Restricted)
3 = LP (Learner's permit)

RACE
W = White or Caucasian
N = Negro or Black
O = Other

SEX
M = Male
F = Female

YEAR OF BIRTH
Mark each row for each of the last two digits of the year in which the driver was born

VEHICLE

MAKE
Record the make of the vehicle using the following numerical coding:

13 = American Motors
03 = Buick
11 = Cadillac
25 = Capri
02 = Chevrolet
07 = Chrysler
24 = Colt
26 = Cricket
18 = Datsun
06 = Dodge
19 = Fiat
08 = Ford
12 = Imperial
10 = Lincoln
09 = Mercury
16 = MG
04 = Oldsmobile
20 = Opel
05 = Plymouth
01 = Pontiac
17 = Renault
21 = Simca
22 = Toyota
23 = Triumph
14 = Volkswagen
15 = Volvo
29 = Other

YEAR
Mark each row for each of the last two digits of year of vehicle

VERDICT (lower right-hand corner of citation)
1 = Guilty as charged
2 = Guilty of lesser offense
3 = Not Guilty
4 = Waiver
5 = PJC (Prayer for Judgment continued upon payment of cost)
6 = Nol Pros
7 = Other

CODER ID
Each person coding will be assigned a number

APPENDIX C

The formats for both the point and trip observations which were used to record the data for computer analysis.

UDA Point-Observations Format

Location Variables (all recorded on Card 1)			Column Number
Location number	01-41 (see list) ØØØØ-125Ø		1-2
Begin time	24 hour clock	ØØØØ = midnight	3-6
End time	24 hour clock	125Ø = noon	7-10

Day of week — 11

1=Monday
2=Tuesday
3=Wednesday
4=Thursday
5=Friday
6=Saturday
7=Sunday

County — 12

1=Chatham
2=Orange
3=Wake

Locality — 13

1=Business
2=Residential
3=School/playground
4=Open country

Highway class — 14

1=Interstate
2=U.S.
3=N.C.
4=Rural paved road
5=Rural unpaved road
6=City street

Road feature — 15

1=Bridge or underpass
2=Driveway (usually not used)
3=Alley intersection
4=Intersection
5=Non-intersection median crossover
6=End or beginning of divided highway
7=Straight road
8=Curve
9=Hill

Weather 16

1=Clear
2=Cloudy
3=Light rain, drizzle
4=Heavy rain
5=Snowing
6=Fog
7=Sleet or Hail

Visibility 17

1=Clear
2=Rain on windshield
3=Light rain, drizzle
4=Heavy rain
5=Snowing
6=Fog, smoke, haze
7=Sleet or hail

Traffic control 18

1=Stop sign
2=Yield sign
3=Stop and go
4=Flashing signal with stop sign
5=Flashing signal without stop sign
6=Other device
7=No control present

Highest speed zone at site 19

1=20 mph
2=25 mph
3=35 mph
4=45 mph
5=55 mph

Light condition 20

1=Daylight
2=Dark-lit
3=Dark-unlit

Number of driveways at the site 21

Possible 1-9

Estimated frequency of UDA's at the site

Speeders (≥ 5 mph over the limit)	0-9999.99	22-28
Following	(same)	29-35
Left of center	(same)	36-42
Pulling in front	(same)	43-49
Turning in front	(same)	50-56
Traffic controls	(same)	57-63

Estimated frequency of "other" behavior at site	0-999.99	64-70
Total estimated hourly volume	0-9999.99	71-77

Observation Interval Variables (all recorded on Card 2)

UDA observed — 1

1=Speeding
2=Following
3=Left of center
4=Pulling in front
5=Turning in front
6=Traffic control

Begin time — 2-5

Use 24 hour clock
ØØØØ = midnight
12ØØ = noon

End time — 6-9

(same as above)

Batch number — 38

Observation Point Variables (four possible observation points)
Col. (10, 17, 24, 31)

Type of point

1=Roadway
2=Driveway

Speed limit (11-12, 18-19, 25-56, 32-33)

Actual speed limit if the observation was on a roadway

Distance measured between reference points

Recorded for speeding observation
ØØØ.Ø - 999.9 ft.
(13-16, 20-23, 27-30, 34-37)

Driver Variables (Recorded on cards following)

UDA committed (?) (possible four places to be recorded) (1-2, 3-4, 5-6, 7-8)

10=yes
01=no

Vehicle type 9-12

1000=passenger car
0100=truck
0010=motorcycle
0001=other
0000=not stated

Driver race 13-15

100=white
010=black
001=other
000=not stated

Driver sex 16-17

10=male
01=female
00=not stated

Driver age 18-20

100=youth
010=adult
001=elderly

Speed or gap time 21-25
(recorded to the nearest hundreth of a second, decimal included as a punch, for speed data)

0-99.99 seconds

Sequence number for the observation interval 26-28

001-999

UDA Code for the "Trip Method"

Note: All variables represent conditions at the conclusion of each observation.

Column	
1-2	Accident location number
3	County 1 = Chatham 2 = Orange 3 = Wake
4	Locality 1 = Business 2 = Residential 3 = School/Playground 4 = Open country
5	Highway class 1 = Interstate 2 = U.S. 3 = N.C. 4 = RPR 5 = RUR 6 = City street
6	Road feature 1 = Bridge or underpass 2 = Driveway 3 = Alley intersection 4 = Intersection 5 = Non-intersection median crossover 6 = End or beginning of divided highway 7 = Straight road (non-intersection) 8 = Curve 9 = Hill
7	Traffic control 1 = Stop sign 2 = Yield sign 3 = Stop and go signal 4 = Flashing signal with stop sign 5 = Flashing signal without stop sign 6 = Other device 7 = No traffic control present
8	Weather 1 = Clear 2 = Cloudy 3 = Light rain, drizzle 4 = Heavy rain 5 = Snowing 6 = Fog 7 = Sleet or hail
9	Visibility 1 = Clear 2 = Rain on windshield 3 = Sleet, snow, hail 4 = Fog, smoke, haze 5 = Dust 6 = Glare

Column

10 Light condition
1 = Daylight
2 = Dusk
3 = Dawn
4 = Darkness (street lighted)
5 = Darkness (street not lighted)

11 Day of week
1 = Monday
2 = Tuesday
3 = Wednesday
4 = Thursday
5 = Friday
6 = Saturday
7 = Sunday

12-15 Time of day (24-hour clock)

16 Vehicle type
1 = Passenger
2 = Truck
3 = Motorcycle
4 = Other

17 Driver race
Ø = Unknown
1 = White
2 = Black
3 = Other

18 Driver sex
Ø = Unknown
1 = Male
2 = Female

19 Driver age
Ø = Unknown
1 = Youth
2 = Adult
3 = Elderly

20 UDA (first detected)
Ø = Other
1 = Speeding
2 = Left of center
3 = Traffic control
4 = Pulling in front of
5 = Turning in front of

21 Nature of trip
1 = Ongoing
2 = Begin trip

Column	
22	Why the observation ended 1 = Trip terminated 2 = Lost vehicle 3 = Followed until UDA occurred 4 = Time lapsed
23-24	Speed zone
25-27	Total number of miles traveled (nearest tenth)
28-29	Total number of minutes vehicle was followed (nearest tenth; not to exceed 5.0 minutes)

APPENDIX D

The North Carolina Standard Accident Report Form

TRAFFIC ACCIDENT REPORT

N. C. Department of Motor Vehicles DMV-349 (Rev. 1-1-73)

Do not write in this space

Patrol Area

LOCATION

Date of Accident 19 — Day of Week — Hour — A.M. ☐ P.M. ☐

Accident Occurred In _____ County ☐ In ☐ Near City or Town of _____

Outside City or Town _____ Miles ☐ N ☐ E ☐ S ☐ W of ☐ Limits ☐ Center

On _____ Hwy. No. (I., U.S., N.C., R.P., R.U.) If No., or within corporate limits, identify by name

☐ Miles ☐ Feet (0 Ft. if Intersec.) ☐ N ☐ E ☐ S ☐ W At or From _____ Hwy. No., or Adjacent County Line Toward _____ Hwy. No., City, or Adjacent County Line

ACCIDENT TYPE

Ran off Road			Non-Collision in Road		Collision of Motor Vehicle in Road With:						
1. Right	2. Left	3. Straight Ahead	4. Overturn	5. Other in Road	6. Pedestrian	7. Parked Vehicle	8. Train	9. Bicycle	10. Animal	11. Fixed Obj.	12. Other Obj.

Collision of M.V. in Road With Another M. V.

13. Rear End Slow or Stop	14. Rear End Turn	15. Left Turn Same Roadway	16. Left Turn Cross Traffic	17. Right Turn Same Roadway	18. Right Turn Cross Traffic	19. Head On	20. Sideswipe	21. Angle	22. Backing

VEHICLE NO. 1

No. of Vehicles Involved ☐

Driver: First _____ Middle _____ Last Name _____

Address: _____

City: _____ State: _____

Is above address same as on Driver's License? Yes ☐ No ☐

Race/Sex: _____ Driver's Lic: _____ State: _____

Date of Birth: Month Day Year _____ Specify Restriction: _____

Member of Armed Forces Yes ☐ No. ☐ Veh. Year: _____ Veh. Make: _____ Veh. Type: _____

Lic. Plate No. _____ State: _____ Year: _____

VIN _____ ODOM. — — — — — • —

Owner: _____

Address: _____

City: _____ State: _____

Parts Damaged (TAD) _____ Amount of Damage $ _____

Drivable: Yes ☐ No ☐ Vehicle Removed to: _____

By: _____ Authority: _____

VEHICLE NO. 2 or PEDESTRIAN

Driver: First _____ Middle _____ Last Name _____

Address: _____

City: _____ State: _____

Is above address same as on Driver's License? Yes ☐ No ☐

Race/Sex: _____ Driver's Lic. _____ State: _____

Date of Birth: Month Day Year _____ Specify Restriction: _____

Member of Armed Forces Yes ☐ No. ☐ Veh. Year: _____ Veh. Make: _____ Veh. Type: _____

Lic. Plate No. _____ State _____ Year: _____

VIN _____ ODOM. — — — — — • —

Owner: _____

Address: _____

City: _____ State: _____

Parts Damaged (TAD) _____ Amount of Damage $ _____

Drivable: Yes ☐ No ☐ Vehicle Removed to: _____

By: _____ Authority: _____

Other Property Damaged _____ Amt. of Dam. $ _____ Owner and Address _____

INJURY SECTION INSTRUCTIONS

Give injury class, restraint used, race, sex and age of all occupants in the space corresponding to the seat occupied. Names and addresses are necessary for persons who were injured. For type of Restraint (Res.) used: N – None, L – Lap Belt, LS – Lap and Shoulder, S – Shoulder Belt only, YR – Child Restraint System.

K=Killed | A=Incapacitating | B=Nonincapacitating – Injury other than K or A evident at the scene | C=No visible sign of injury but complaint of pain, momentary unconsciousness | O=No injury

SEAT	Inj cl	Res usd	Race, sex	Age	INJURED NAMES AND ADDRESSES First Name Last	SEAT	Inj cl	Res usd	Race sex	Age	INJURED NAMES AND ADDRESSES First Name Last
Left Front					DRIVER 1	Left Front					DRIVER 2 OR PEDESTRIAN
Center Front						Center Front					
Right Front						Right Front					
Left Rear						Left Rear					
Center Rear						Center Rear					
Right Rear						Right Rear					

Total No. Occupants _____ Total No. Inj. _____ | Total No. Occupants _____ Total No. Inj. _____

Injured taken to: _____

ADDED BY _____ (Initial)

MARKS

WITNESSES Name _____ Address _____ Phone No. _____

Name _____ Address _____ Phone No. _____

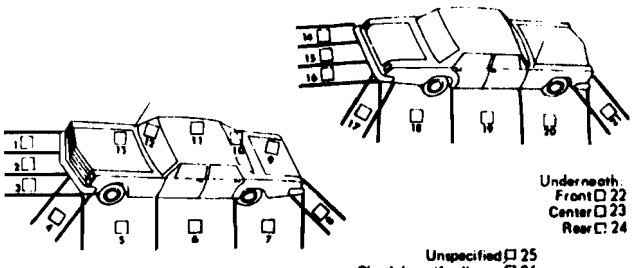
Arrests: Name _____ Charge(s) _____ (Cit. No.) _____

Name _____ Charge(s) _____ (Cit. No.) _____

Sign Here _____

Officer's Rank and Name _____ Number _____ Department _____ Date of Report _____

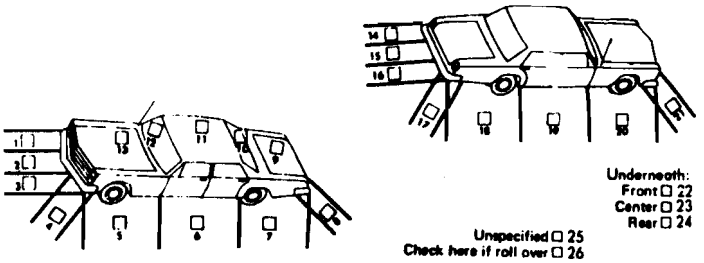
VEHICLE 1 POINT OF INITIAL CONTACT



Underneath:
Front ☐ 22
Center ☐ 23
Rear ☐ 24

Unspecified ☐ 25
Check here if roll over ☐ 26

VEHICLE 2 POINT OF INITIAL CONTACT



Underneath:
Front ☐ 22
Center ☐ 23
Rear ☐ 24

Unspecified ☐ 25
Check here if roll over ☐ 26

1. Locality	9. Traffic Control	Not Operating ☐	Not Visible ☐		VEHICLE 1	VEHICLE 2
2. Speed Limit	10. Object Struck			15. Veh. Maneuver		
3. Road Feature		DRIVER 1	DRIVER 2 or PED.	16. Veh. Defects		
4. Road Surface	11. Sobriety			17. Estimated Speed		
5. Road Defects	12. Physical Cond.			18. Tire Impressions(ft)		
6. Road Condition	13. Chem. Test	YES ☐ NO ☐	YES ☐ NO ☐	19. Distance Traveled After Impact (ft.)		
7. Light Condition						
8. Weather	14. Ped. Action					

INDICATE NORTH

Vehicle 1 was Traveling ☐N ☐E ☐S ☐W on

Vehicle 2 was Traveling ☐N ☐E ☐S ☐W on

DESCRIBE WHAT HAPPENED:

Vehicle 1	Vehicle 2	VIOLATION INDICATED
☐	☐	1. No. Violation Indicated
☐	☐	2. Excessive Speed
☐	☐	3. Yield Violation
☐	☐	4. Left of Center
☐	☐	5. Passing Violation
☐	☐	6. Stop S. or Yield S. Vio.
☐	☐	7. Traffic Signal Vio.
☐	☐	8. Safe Movement Vio.
☐	☐	9. Too Close
☐	☐	10. Improper Turn
☐	☐	11. Improper or No Signal
☐	☐	12. Improper Parking Location
☐	☐	13. Other Improper Driving

(describe) _____

EMERGENCY ASSISTANCE INFORMATION

INVESTIGATOR NOTIFIED ☐ a.m. ☐ p.m.
BY _____

INVESTIGATOR ARRIVED ☐ a.m. ☐ p.m.

AMBULANCE ARRIVED ☐ a.m. ☐ p.m.

OTHER COMMENTS: _____

RESERVED FOR STATE USE:

20.	21.	22.	23.	24.
25.	26.	27.	28.	29.

RESERVED FOR CITY OR OTHER USE:

REFERENCES

Hunter, W.W., Bundy, H.L., & Daniel, R.B. An assessment of the effectiveness of the following-too-closely monitor. Chapel Hill: University of North Carolina Highway Safety Research Center, June 1976.

U.S. Department of Transportation, Federal Highway Administration. Nationwide personal transportation study Report No. 10, May 1974, No. 8. Washington, D.C.: Author, August 1973.