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Project Task Report

# An Analysis of Critical Maneuvers In the Accidents of Young Drivers

Patricia Z. Barry

Rita B. Roper

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August 1974

PR-18

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The opinions and findings contained in this report are solely those of the authors, and are not necessarily those of the project's sponsors.

# ABSTRACT

This study is an evaluation of data on crashes of 16 through 18-year-old drivers in order to identify "critical" maneuvers. Crashes of drivers aged 16 through 18 were compared with crashes of drivers aged 35 through 44.

In this report, two hypotheses were tested: 1) that the crashes of 16 through 18-year-old drivers are more likely to involve emergency situations such as brake failures, skidding, or blowouts than the crashes of older, more experienced drivers: and 2) that the difficulty which young drivers may have with certain vehicle maneuvers will be expressed in the over-representation of these maneuvers in the crashes of young drivers when they are compared with those of older, more experienced drivers.

The data from this study indicate that there are no differences between the ability of young drivers and that of older drivers to handle emergency situations such as skids, blowouts, or brake failures. Both groups of crashes contained the same proportion attributable to emergency situations. Some caution should be exercised in interpreting these data, however, because they do not reflect any information on exposure. That is, there are no data on the influence of emergency situations in each group.

Analysis indicated that young drivers did experience difficulty with pulling into the path of oncoming traffic and that they did have a disproportionate number of rear-end collisions. It is suggested that these problems may result from inexperience in judging gap clearance and closure speeds.

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## ACKNOWLEDGMENTS

The authors wish to express their appreciation to the Traffic Records Division of the North Carolina Department of Motor Vehicles for their cooperation in collecting data for this project.

# I. INTRODUCTION

In 1969, the Department of Public Instruction began to expand the scope of its driver education program by developing 16 "multi-range laboratories" in various school districts across the state. Because the expenditures for programs using range facilities are larger than those for non-range programs, there is a need to evaluate this approach.

As a part of the evaluation, an analysis was made of accident data from crashes of 16 to 18-year-old drivers in order to identify "critical" maneuvers. The overall goal of this study was to identify the situations with which young drivers have problems, and then to use this information as a basis for recommending changes in North Carolina's Driver Education Curriculum. If, for example, it were found that the crashes of young drivers involve more skidding situations than the crashes of more experienced older drivers, some recommendations concerning the need for training in skid handling techniques might have been made.

It has been well documented that young drivers are involved in more accidents than would be expected on the basis of their numbers in the population (New York State Department of Motor Vehicles, 1973; Minnesota Department of Public Safety, 1974; National Safety Council, 1974). Furthermore, a recent study has indicated that young drivers' accident rate, controlling for driving exposure, is elevated (J. L. Recht, personal communication, June 1974). If it is assumed that this elevated accident rate is the result of a combination of inexperience and "attitudinal problems," it may seem justified to call for driver education programs to be expanded in terms of both scope and length.

Because driver education is restrained by limited funding, it is important that the curriculum be carefully screened for its relevance to reducing accidents. This study was designed to identify the specific problem areas for young drivers which could be included in a driver education curriculum at relatively low costs.

Records from crashes of drivers aged 16 to 18 were compared with crash records of drivers aged 35 to 44. Two hypotheses were tested: 1) that the crashes of 16 to 18-year-old drivers are more likely to involve an emergency situation (e.g., brake failure, skidding, blowout) than the crashes of older, more experienced drivers; and 2) that young drivers have difficulty with certain vehicle maneuvers which can be identified by comparing the crash records of young drivers with those of older drivers.

## II. METHODOLOGY

### The Sample

The sample was chosen to include equal numbers of crashes of young drivers (aged 16 to 18) and middle-aged drivers (35 to 44). The sample was chosen from North Carolina accident records of crashes which occurred in 1973; at the time the sample was pulled, information was available on all crashes through September 30. The file from which the crashes were chosen was "vehicle-oriented"--each vehicle in the crash comprised a separate record in the file. A sub-file of the total file was created which included only private passenger cars and drivers licensed in North Carolina. All crashes involving either parked cars or pedestrians were excluded. The sub-file was then sorted according to driver license number. Because license numbers are randomly assigned to applicants without reference to age, sex, race, or locality, it was assumed that sorting the accident file on driver license number would randomize all variables associated with the crash. From the sorted sub-file, drivers were selected and divided into eight categories, according to the following criteria:

1) Age group (either 16 to 18 years old or 35 to 44 years old);
2) For each age group, equal numbers of men and women;
3) For each age group and sex, equal numbers of crashes resulting in property damage and personal injury.

Only the first 200 drivers who met the necessary criteria were assigned to each category. The resulting sample contained 1600 drivers.

The accident report numbers were sent to the North Carolina Department of Motor Vehicles where photostats were made of the original accident report forms through the courtesy of Mr. Joe Register and his staff.

The sample of drivers was further reduced. Information from all the records of crashes involving young drivers was recorded, but only one-third of the records of crashes involving middle-aged drivers was used. The sample was systematically chosen from the collection of photostats; every third record was chosen as they were sorted by hand. In multi-vehicle accidents, all crashes involving a driver who was older than 64 years were eliminated.

Recording Procedures

Accident report forms are two-sided documents with most of the information checked in pre-coded boxes (see Appendix I). On the back of the form the investigating officer writes a description of the crash.

In recording the details from the accident report forms, the salient points of the narrative description were first noted on one side of a 3 x 5 card. When this information was being recorded, neither the age nor the sex of the driver was known to the recorder. Vehicles are identified in narratives by vehicle number. In reading the narrative, the recorder tried to determine which driver was "responsible" for the crash by noting the vehicle number of the driver who had made the maneuver which resulted in the accident. In crashes involving two or more vehicles, responsibility was sometimes impossible to determine; these records were eliminated from further analysis. The word "responsibility" is not used to impute fault or blame, but merely to distinguish which maneuver led to the outcome of a crash. The judgments of the recorders were checked against the recorded judgments of the investigating officer. For cases in which the two judgments did not agree, the records were carefully reviewed and a final judgment was decided upon.

After these pertinent details were recorded on the back of the 3 x 5 card, the age of the driver, the severity of the crash, the accident report number, and the designated responsibility from the front of the form were noted on the front of the 3 x 5 card. When the age of the second driver was not included in either of the age groups being studied, it was recorded as "other." All crashes involving a driver aged 16 to 18 were classified with young drivers even though the second driver may have been between 35 to 44.

Every accident report form was read and classified by two people. The summaries were compared and, where discrepancies existed, the report form was reviewed again and given a final classification. This procedure insured a high degree of reliability for the information used in the analysis.

A tabulation of accident report forms by age of driver and type of crash is presented in Table 1.

TABLE 1. TABULATION OF ACCIDENT REPORT FORMS BY AGE OF DRIVER AND TYPE OF CRASH

| | | | Totals |
|---|---|---|---|
| Crashes Involving Drivers Aged 16 to 18 (young) | | | 736 |
| Single-vehicle crashes | | 170 | |
| Two-vehicle crashes | | 520 | |
| Young driver responsible | 381 | | |
| Young driver not responsible | 139 | | |
| Multiple-vehicle crashes | | 46 | |
| Young driver responsible | 28 | | |
| Young driver not responsible | 18 | | |
| Crashes Involving Drivers Aged 35 to 44 (middle-aged) | | | 377 |
| Single-vehicle crashes | | 46 | |
| Two-vehicle crashes | | 301 | |
| Middle-aged driver responsible | 195 | | |
| Middle-aged driver not responsible | 106 | | |
| Multiple-vehicle crashes | | 30 | |
| Middle-aged driver responsible | 22 | | |
| Middle-aged driver not responsible | 8 | | |
| Total Number of Records Used in the Analysis | | | 1113 |

## III. RESULTS

### Emergency Maneuvers

The first question to be answered was whether the crashes of young, inexperienced drivers were more likely to involve an emergency situation (e.g., blowouts, skidding, brake failure) than the crashes of the older, more experienced drivers. A tabulation of crashes indicating emergency situations is presented in Table 2.

TABLE 2. EMERGENCY SITUATIONS BY AGE AND TYPE OF CRASH

| | No Emergency N | No Emergency % | Emergency N | Emergency % | Total |
|---|---|---|---|---|---|
| Single-Vehicle Crashes | | | | | |
| Young drivers | 137 | (80.6) | 33 | (19.4) | 170 |
| Middle-aged drivers | 37 | (80.4) | 9 | (19.6) | 46 |
| Total | 174 | | 42 | | 216 |
| $X^2$ (1 d.f.) with Yates Correction = 0.000 | | | | | |
| Multiple-Vehicle Crashes | | | | | |
| Young drivers R* | 384 | (93.9) | 25 | (6.1) | 409 |
| Young drivers NR* | 148 | (94.3) | 9 | (5.7) | 157 |
| Middle-aged drivers R | 205 | (94.5) | 12 | (5.5) | 217 |
| Middle-aged drivers NR | 103 | (90.4) | 11 | (9.6) | 114 |
| Total | 840 | | 57 | | 897 |
| $X^2$ (3 d.f.) = 2.4; p = NS | | | | | |

*R = "Responsible"; NR = "Not Responsible"

When the proportion of crashes due to emergency situations is compared between young drivers and middle-aged drivers in both single-vehicle crashes and multiple-vehicle crashes, no significant differences are evident. Nearly 20 percent of the single-vehicle crashes are attributed to emergency situations in each group. Approximately six percent of the multi-vehicle crashes are due to emergency situations. There is no evidence in these data that young people are any less able to handle emergency situations than older, more experienced drivers.

Table 3 displays the types of emergency situations which were found in the sample. Skidding and brake failure are responsible for the majority of multiple-vehicle emergency situations; skidding appears to be the most common cause of crashes resulting from an emergency situation. In the total sample of 1113 crashes, skidding was a factor in 10.6 percent of all single-vehicle crashes and in 4.2 percent of all multi-vehicle crashes.

TABLE 3. TYPES OF EMERGENCY SITUATIONS REPRESENTED IN THE CRASH SAMPLE

| Type of Crash | Blowout N | Blowout % | Steering Failure N | Steering Failure % | Brake Failure N | Brake Failure % | Skidding N | Skidding % | Other N | Other % | Total N |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Single-Vehicle | | | | | | | | | | | |
| Young | 8 | (24.2) | 1 | ( 3.0) | 3 | ( 9.1) | 19 | (57.6) | 2 | (6.1) | 33 |
| Middle-aged | 3 | (33.3) | 2 | (22.2) | 0 | | 4 | (44.4) | 0 | | 9 |
| Multiple-Vehicle | | | | | | | | | | | |
| Young R* | 0 | | 0 | | 6 | (24.0) | 17 | (68.0) | 2 | (8.0) | 25 |
| Young NR* | 0 | | 0 | | 2 | (22.2) | 7 | (77.7) | 0 | | 9 |
| Middle R | 0 | | 0 | | 4 | (33.3) | 8 | (66.7) | 0 | | 12 |
| Middle NR | 0 | | 0 | | 5 | (45.5) | 6 | (54.5) | 0 | | 11 |
| Total | 11 | (11.1) | 3 | ( 3.0) | 20 | (20.2) | 61 | (61.6) | 4 | (4.0) | 99 |

*R = Designated Responsible; NR = Not Designated Responsible

## Other Vehicle Maneuvers

Single-vehicle crashes. The narratives of single-vehicle crashes did not yield much information about which maneuver the driver was executing at the time of the crash. Most narratives instead described the crash outcome (e.g., "vehicle ran off road on right into ditch," or "driver lost control and car left roadway, hitting tree"). Because most of the narratives did not contain information on vehicle maneuvers, no further analysis of single-vehicle crashes was made.

Two-vehicle crashes. The narratives of two-vehicle crashes were sorted into four categories according to driver age and the designated

TABLE 4. FREQUENCY DISTRIBUTIONS OF VEHICLE MANEUVERS IN TWO-VEHICLE CRASHES BY AGE AND DESIGNATED RESPONSIBILITY

| | Young Drivers | | | | Middle-aged Drivers | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Responsible | | Not Responsible | | Responsible | | Not Responsible | | |
| Vehicle Maneuver | N | % | N | % | N | % | N | % | Total |
| Pulled into path of oncoming traffic | 104 | (27.3) | 32 | (23.0) | 41 | (21.0) | 19 | (17.9) | 196 |
| Rear-end collisions | 104 | (27.3) | 31 | (22.3) | 41 | (21.0) | 18 | (17.0) | 194 |
| Improper turns | 57 | (15.0) | 20 | (14.4) | 32 | (16.4) | 20 | (18.9) | 129 |
| Ran stop sign or red light | 25 | ( 6.6) | 14 | (10.1) | 20 | (10.3) | 15 | (14.2) | 74 |
| Passing maneuver | 18 | ( 4.7) | 13 | ( 9.4) | 13 | ( 6.7) | 4 | ( 3.8) | 48 |
| Failure to yield, improper lane change, over center line | 35 | ( 9.2) | 14 | (10.1) | 25 | (12.8) | 9 | ( 8.5) | 83 |
| Backed into road | 6 | ( 1.6) | 3 | ( 2.2) | 6 | ( 3.1) | 2 | ( 1.9) | 17 |
| Emergency situation | 23 | ( 6.0) | 8 | ( 5.8) | 9 | ( 4.6) | 10 | ( 9.4) | 50 |
| Unable to determine | 9 | ( 2.4) | 4 | ( 2.9) | 8 | ( 4.1) | 9 | ( 8.5) | 30 |
| Total | 381 | | 139 | | 195 | | 106 | | 821 |

$X^2$ (24 d.f.) = 35.86; .1 > p > .05

responsibility for each crash. Within each category nine major classes of vehicle maneuver were assigned. The frequency distributions are presented in Table 4.

Because the greatest contribution to the Chi-square value came from the class "Unable to Determine," a Chi-square value was recomputed with this class omitted from the calculation. The resulting value suggested that there were no significant differences in the frequency distributions of vehicle maneuvers among the four categories of the table [$X^2$ (21 d.f.) = 27.1; $p > .10$].

A comparison of the distribution of maneuvers of young, responsible drivers with all other drivers was also of interest. Table 5 presents a collapsed version of Table 4.

TABLE 5. FREQUENCY DISTRIBUTIONS OF VEHICLE MANEUVERS IN TWO-VEHICLE CRASHES, YOUNG RESPONSIBLE DRIVERS VS. ALL OTHERS

| Vehicle Maneuver | Young Drivers Responsible N | % | All other Drivers N | % | Total |
|---|---|---|---|---|---|
| Pulled into path of oncoming traffic | 104 | (28.0) | 92 | (22.0) | 196 |
| Rear-end collisions | 104 | (28.0) | 90 | (21.5) | 194 |
| Improper turns | 57 | (15.3) | 72 | (17.2) | 129 |
| Ran stop-sign or red light | 25 | ( 6.7) | 49 | (11.7) | 74 |
| Failure to yield, improper lane change, over center line | 35 | ( 9.4) | 48 | (11.5) | 83 |
| All other maneuvers* | 47 | (12.6) | 68 | (16.2) | 115 |
| Total | 372 | | 419 | | 791 |

$X^2$ (5 d.f.) = 14.40; $p < .05$

*This class includes: Passing maneuvers, backing into road, and emergency situations (all classes containing less than 10% of the maneuvers in all four columns of Table 3). The class "Unable to Determine" is omitted from Table 5.

The data in Table 5 suggest that there are significant differences in the distribution of vehicle maneuvers in the crashes of young drivers who are responsible for their crashes when these incidents are compared with crashes of other drivers. Both pulling into the path of oncoming traffic and rear-end collisions are over-represented in crashes of young drivers.

## IV. DISCUSSION

### Emergency Situations

These data suggest that there are no differences between the ability of young drivers and that of older, more experienced drivers in handling emergency situations such as skids, blowouts, or brake failures. Both groups of crashes contained the same proportion attributable to emergency situations. Some caution should be exercised in interpreting these data, however, since they do not reflect any information on exposure. That is, there are no data on the incidence of emergency situations in each group.

For example, it is popularly believed (although not demonstrably true) that teen-age drivers are more likely to drive old, rattletrap cars than middle-age drivers. If such were the case, we might expect more instances of brake failure in cars driven by teen-agers than in those driven by middle-age drivers. If we were to find the same proportion of crashes due to brake failure in both groups, but also were to find a higher incidence of brake failure in cars driven by teen-agers, then we would have to conclude that teen-age drivers are better able to handle brake failure than middle-age drivers. Their rate of success in handling brake failure would be higher. The data presented in this study do not reflect any exposure factors.

Since the sample was a stratified random sample, it does not represent the general population of crashes in North Carolina. The sample was chosen to include equal numbers of men and women, but men are the drivers in over two-thirds of the vehicles involved in North Carolina crashes. Equal numbers of personal injury and property crashes were included in the sample, but only 30 percent of North Carolina crashes result in personal injury (North Carolina Department of Motor Vehicles, 1973).

For the moment, however, let us make the assumption that these data reflect the true population parameters--that 20 percent of all single-vehicle crashes are the result of emergency situations, and that skidding is a factor in one-half of these crashes. In 1973 there were 125,825 crashes reported to the North Carolina Department of Motor Vehicles; approximately 27 percent of these (or 33,912) were single-vehicle crashes (North Carolina Department of Motor Vehicles, 1973). If skidding were a factor in 10 percent of these, then approximately 3300 single-vehicle crashes were due to loss of control in a skid.

The data on multiple-vehicle crashes are seriously compromised in their generalizability by their selection on severity. Injury-producing crashes were highly over-represented in our sample of multiple-vehicle crashes. In 1973 there were 80,046 crashes in North Carolina involving two or more vehicles, representing 64 percent of the total number of crashes (North Carolina Department of Motor Vehicles, 1973). Because in this sample skidding was a factor in four percent of all multi-vehicle crashes, it may be estimated that skidding accounted for about 3200 multi-vehicle crashes in North Carolina in 1973.

Although these are very rough estimates, it would nevertheless appear that there are less than 10,000 crashes per year in North Carolina attributable to skidding. What are the implications of these findings for driver education?

One rational way to answer this question would be with a cost/benefit analysis which compares the cost in dollars of training students to handle skids with the dollars saved from averted crashes.

In 1973 there were 19,669 drivers aged 16 to 18 involved in crashes (North Carolina Department of Motor Vehicles, 1973). Let us assume that 27 percent of these drivers were involved in single-vehicle incidents. (This calculation will yield an overestimate of the number of single-vehicle crashes for this age group in 1973 in North Carolina, because 27 percent of all <u>crashes</u>, not drivers in crashes, were single-vehicle involvements.) However, by assuming 27 percent were single-vehicle incidents, we may estimate that among 16 to 18-year-old drivers, there were 3167 single-vehicle crashes. If 10 percent of these were due to skidding, then skidding was a factor in 317 single-vehicle crashes in this age group. Let us assume further that 64 percent of the 11,729 drivers were involved in crashes of two or more vehicles (again with the understanding that this is a high estimate of number of crashes). If "responsibility" were distributed as it was in the sample, then of the 7506 estimated multiple-vehicle crashes, 72 percent (or 5404) were due to maneuvers of the teen-age driver. Assuming that skidding was a factor in four percent of these crashes, it may be estimated that among 16 to 18-year-old drivers, 216 multiple-vehicle crashes were attributable to skidding. Adding single-vehicle and multiple-vehicle crashes, we estimate that in 1973 skidding was a factor in less than 540 crashes among 16 to 18-year-old drivers.

Using figures on costs of crashes in 1972 obtained from the National Safety Council (J. Recht, personal communication, June 1974) and from the North Carolina Department of Motor Vehicles (1973), an average cost per crash in North Carolina can be calculated at approximately $2700. (The assumptions upon which this estimate was made are outlined in Appendix II.) If there are 540 crashes annually in which skidding is a factor among 16 to 18-year-old drivers at an average cost of $2700, then such crashes cost the state of North Carolina approximately $1,458,000 annually. This represents less than one-half percent of the total estimated annual costs of motor vehicle crashes and approximately 4.6 percent of the cost of crashes of 16 to 18-year-old drivers.

If a program of maximum effectiveness in teaching people to handle skids and avoid a consequent crash were designed, the most that could be hoped for would be a level of 50 percent effectiveness. At this maximum level, for the year following training the savings due to averted crashes would be approximately $729,000. North Carolina trains approximately 106,000 young drivers every year in its driver education classes (L. Phillips, personal communication, June 1974). If every one of these students were to receive training in handling skids, the cost of such training could not exceed $6.88 per student if it were to be cost effective. We currently spend approximately $60 per student in driver education classes (L. Phillips, personal communication, June 1974).

In order to teach skid handling techniques, some kind of skid pan must be available. Currently, North Carolina has 16 driving ranges in operation or under construction which could be used for such training. Twelve ranges have been in use for more than one year; seven have been in operation three or more years. In order to compare the cost of such training with the break-even figure presented above, a simplified cost/benefit analysis was conducted. North Carclina provided approximately $35,000 toward the construction of each of these ranges; the exact figures are presented in Appendix III. The construction cost may be amortized over a 20-year period (estimated range life) using a seven percent annual compound interest rate in order to estimate the average annual cost of each range. (This calculation does not take into account either locally contributed construction funds, which were very limited, or maintenance costs.) The average number of students taught at each range may be determined based on previous experience. Using these figures an average annual per pupil cost of approximately $7.50 for range construction has been estimated. Because this figure does not include either supplementary construction funds, maintenance costs, or equipment cost for a watering system, etc., it should be considered a minimum estimate of the cost of providing range experience in handling skids.

Thus, if one accepts the estimates of the size of the skid-related accident problem cited above, the use of the ranges to teach skid handling techniques only would not appear to be cost effective. Of course, this assumes that the other training provided on the ranges will not provide any benefit over that provided by regular non-range driver education. Attempts at determining whether the range training is resulting in additional accident related benefits over the non-range training are being conducted under this same project. On the other hand, the $6.88 in benefits above assumes a skid handling program which is 50 percent effective in reducing skid-related accidents. A more realistic estimate might well be much lower (about 10-20 percent).

Thus, these data indicate that teaching skid handling skills to novice drivers may be of questionable benefit in terms of cost effectiveness under the assumption made. While these results should not be interpreted as meaning that emergency skill training is not needed by new drivers, they do underline the need for careful study before such a program is implemented statewide. Because of its design, this study cannot measure the direct accident related benefits of such a program. It can only give some estimate of potential benefit under certain assumptions. However, these findings do point out the need for a close look at the results of a pilot program, in which the accident experience of drivers receiving emergency skills training is compared to that of a comparable control group. Administrators of the Driver Education Program in North Carolina should take a close look at the results of such an evaluation and at the results of such evaluation in other states before implementing such a program statewide.

Other Maneuvers

The data from this study indicate that young drivers experience difficulty with pulling into the path of oncoming traffic and that they have a disproportionate number of rear-end collisions. On first glance these particular problems might be attributed to inattention or willful violations; however, the fact that young drivers have fewer than the expected number of stop sign or stoplight violations tends to refute this interpretation. Rather, we believe that the greater difficulty experienced by young drivers in these two traffic situations reflects their inexperience in judging gap clearance and closure speeds. Competence in both of these judgment skills would be expected to increase with experience, and both of them could be incorporated into a driver education curriculum.

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# APPENDIX A

## Accident Report Form

LOCATION

Date of Accident 19 | Day of Week | Hour | A.M. ☐ P.M. ☐

*Do not write in this space*

Accident Occurred in ____ County ☐ In ☐ Near City or Town of ____

Outside City or Town ____ Miles ☐ N ☐ E ☐ S ☐ W of ☐ Limits ☐ Center

*Patrol Area*

On ____
Hwy. No. (I., U.S., N.C., R.P., R.U.) If No., or within corporate limits, identify by name

____ ☐ Miles ☐ Feet ☐ N ☐ E ☐ S ☐ W At or From ____ Toward ____
(0 Ft. if Intersec.) Hwy. No., or Adjacent County Line Hwy. No., City, or Adjacent County Line

| 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 ____

Other Property Damaged ____ Amt. of Dam. $ ____

## 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: ____

Owner and Address ____

## INJURY SECTION INSTRUCTIONS

Indicate which seats were occupied at the time of the collision, the degree of injury, the type of restraint used, the race, sex and age of the occupants. If occupant not injured, you do not need name and address. For type of Restraint (Res.) used: N=None, L=Lap Belt, LS=Lap & Shoulder, S=Shoulder Belt only

| 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: ____

WITNESSES Name ____ Address ____ Phone No. ____

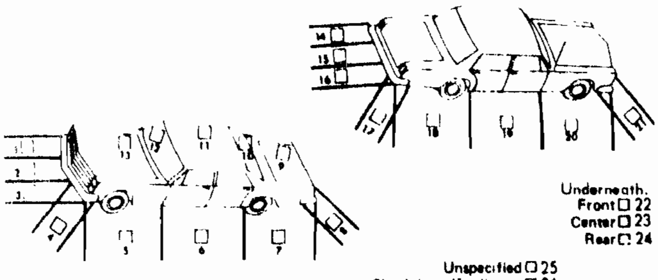
Name ____ Address ____ Phone No. ____

Arrests Name ____ Charge(s) ____ (Cit. No.) ____

Name ____ Charge(s) ____ (Cit. No.) ____

REMARKS

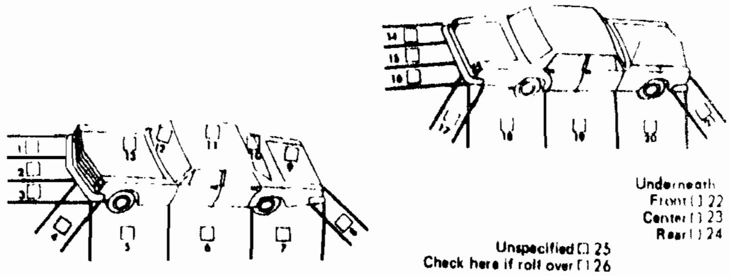
VEHICLE 1 POINT OF INITIAL CONTACT



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

| | | | | | VEHICLE 1 | VEHICLE 2 |
|---|---|---|---|---|---|---|
| 1. Locality | 9. Traffic Control | Not Operating ☐ | Not Visible ☐ | | | |
| 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 / 7. Light Condition | 13. Chem. Test | YES ☐ NO ☐ | YES ☐ NO ☐ | 19. Distance Traveled After Impact (ft.) | | |
| 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 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 ☐ a.m.
NOTIFIED ____________ ☐ p.m.
BY ____________

INVESTIGATOR ☐ a.m.
ARRIVED ____________ ☐ p.m.

AMBULANCE ☐ a.m.
ARRIVED ____________ ☐ p.m.

OTHER COMMENTS: ____________

RESERVED FOR STATE USE

| | | | | |
|---|---|---|---|---|
| 20. | 21. | 22. | 23. | 24. |
| 25. | 26. | 27. | 28 | 29. |

RESERVED FOR CITY OR OTHER USE:

# APPENDIX B

## Assumptions of the Cost Analysis

The following figures were provided by J. L. Recht, Director of the Statistics Division, National Safety Council.

TABLE AII1. 1972: AVERAGE COSTS

| | |
|---|---|
| Of a fatality . . . . . . . . . . | $82,000 |
| Of a disabling injury . . . . . . | 3,400 |
| Of a property damage crash . . . | 480 |

TABLE AII2. ACCIDENT SEVERITY RATIOS

| | Fatality/Injury Ratio | Fatality/Property Damage Crash Ratio |
|---|---|---|
| Nationwide | 1 : 35 | 1 : 280 |
| Urban | 1 : 70 | 1 : 620 |
| Rural | 1 : 20 | 1 : 110 |

<u>Accident Facts, 1973</u> edition indicates that there are 1.16 people killed for every fatal crash, and 1.5 people who sustain disabling injuries for every injury-producing crash (National Safety Council, 1974).

North Carolina summary of motor vehicle traffic accidents provides the following information (North Carolina Department of Motor Vehicles, 1973).

TABLE AII3. SUMMARY OF 1973 TRAFFIC ACCIDENT STATISTICS, NORTH CAROLINA

| | Number of Accidents | Number of Persons |
|---|---|---|
| Fatal | 1593 | 1889 |
| Nonfatal Injury | | |
| Class A | | 13359 |
| Class B | | 28332 |
| Class C | | 30381 |
| Total | 44841 | 72072 |
| Property Damage Only | 79391 | |

Based on these figures, it can be calculated that in North Carolina the ratio of people killed to fatal crashes is 1.19, a figure remarkably close to the national figures. Using all injuries, the ratio of people who sustain injuries to injury-producing crashes is 1.6, again virtually the same as the national figures from Accident Facts. However, the national figures are based on number of injuries "disabling beyond the day of the accident"; it is doubtful whether North Carolina Class C injuries would be so described.

The North Carolina fatality/injury ratio is 1 : 38, a little higher than the national figure, probably because North Carolina is primarily a rural state. The fatality/property damage crash ratio, however, is significantly different from the national figures. The low ratio of 1 : 50 probably reflects two reporting characteristics of North Carolina; 1) mandatory reporting of property damage crashes is only in effect when damage amounts to $200 or more; and 2) in other states, Class C injuries may be classified as property damage crashes rather than injury crashes.

On the basis of this information, the following computations were made in order to arrive at an average cost per crash figure for North Carolina.

TABLE AII4. COST CALCULATIONS

| Number of Units | Average Cost/Unit | Total Cost |
|---|---|---|
| 1,889 Fatalities | $82,000 | $154,898,000 |
| 41,691 A and B Injuries | 3,400 | 141,749,400 |
| 99,645 Property Damage Crashes* | 480** | 47,829,600 |
| | TOTAL | $344,477,000 |

If we now divide the estimated total cost of crashes in North Carolina in 1973 ($344,477,000) by the number of crashes which occurred in 1973 in North Carolina (125,825), we may arrive at an average cost per crash figure of $2,737.75.

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*This figure (99,645) is the sum of the number of property damage only crashes (79,391) plus two-thirds of the number of persons with Class C injuries (20,254). Two-thirds of the Class C injuries were included because a) it seemed unreasonable to include Class C injuries with the A and B injuries because the cost estimate from National Safety Council is based on injuries which are disabling beyond the day of the accident; and b) because there are 1.5 injuries for every injury-producing crash, we used only two-thirds of the number of injuries as our estimate of number of crashes.

**The figure of $480 may be an underestimate of costs of property damage crashes in North Carolina. Because reporting in North Carolina starts at $200 worth of damage, it may not include the fender-bender type of crash which has been included in the national estimates of property damage crash cost.

# APPENDIX C

## Cost Data Used in Economic Analysis

TABLE AIII. COST OF RANGE CONSTRUCTION AND NUMBER OF STUDENTS TAUGHT

| Range | State Contributed Funds | Cost/Year for 20 Yrs. (A) | Students/Year | Estimated Students/Yr. (B) | Average Cost/ Student (C) |
|---|---|---|---|---|---|
| Winston-Salem/ Forsyth I | $40,000.00 | $3775.60 | 2500/1 | 2500 | $ 1.51 |
| Charlotte/ Mecklenberg I | 35,000.00 | 3303.65 | 1453/1 | 1453 | 2.27 |
| Gaston | 35,000.00 | 3303.65 | 400/1 | 400 | 8.26 |
| Guilford | 35,000.00 | 3303.65 | 600/1 | 600 | 5.51 |
| Richmond | 35,000.00 | 3303.65 | 180/1 | 180 | 18.35 |
| Wake | 36,250.00 | 3421.64 | 1728/4 | 432 | 7.92 |
| Edenton/Chowan | 30,000.00 | 2831.70 | 861/3 | 287 | 9.87 |
| New Hanover | 40,248.06 | 3799.01 | 1683/4 | 421 | 9.03 |
| Cabarrus | 34,828.00 | 3287.41 | 3543/4 | 886 | 3.71 |
| Yadkin | 38,000.00 | 3586.82 | 1950/4 | 488 | 7.36 |
| Buncombe | 33,000.00 | 3114.87 | 1241/3 | 414 | 7.52 |
| Craven | 35,000.00 | 3303.65 | 975/3 | 325 | 10.17 |

We calculated the average annual cost per student in several ways.

1. The sum of the average cost/student divided by the number of ranges, using all 12 ranges:

$$\frac{\sum_{i=1}^{12} C_i}{12} \qquad \frac{\$91.48}{12} = \$7.62$$

2. The sum of the average cost/student divided by the number of ranges, using the 7 ranges which have been operating for three or more years:

$$\frac{\sum_{i=6}^{12} C_i}{7} \qquad \frac{\$55.58}{7} = \$7.94$$

3. The sum of the cost/year of each range divided by the sum of the number of students/year at each range, for all 12 ranges:

$$\frac{\sum_{i=1}^{12} A_i}{\sum_{i=1}^{12} B_i} \qquad \frac{\$40,335.30}{8386} = \$4.81$$

4. The sum of the cost/year of each range divided by the sum of the number of students/year at each range, for the 7 ranges which have been operating for three or more years:

$$\frac{\sum_{i=6}^{12} A_i}{\sum_{i=6}^{12} B_i} \qquad \frac{\$23,345.10}{3253} = \$7.18$$