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**Trucks: An Analysis of Accident
Characteristics by Vehicle Weight**

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Chapel Hill, North Carolina**

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The UNC Highway Safety Research Center was created by an act of the 1965 North Carolina General Assembly. A three-point mandate issued by the Governor authorized HSRC to 1) evaluate the state's highway safety programs, 2) conduct research, and 3) instruct and train other working professionals in highway safety.

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ABSTRACT

The federal standard for driver licensing requires that drivers be examined for ability to operate the class(es) of vehicle(s) for which they are being licensed. To obtain better information on which to base procedures for licensing operators of large trucks, an analysis was performed of a year's sample of truck crashes reported in North Carolina. Trucks were divided into three groups, namely: (1) large trucks (three-axle trucks and tractor-trailers); (2) intermediate trucks (two-axle trucks more than 24,000 pounds Gross Vehicle Weight [GVW]); and (3) small trucks (two-axle trucks weighing 24,000 pounds GVW or less).

Major findings include the following:

1. Larger trucks are more likely to be involved in single vehicle crashes than are cars or smaller trucks.
2. According to the investigating officer's report, the large truck crashes are hardly ever related to the truck driver's use of alcohol prior to the crash or to other physical conditions such as sleep or fatigue.
3. In single vehicle crashes truck drivers are just as likely to be killed as car drivers.
4. When a car collides with a truck, the car driver nearly always sustains a more severe injury than the truck driver. A relatively high proportion of the accidents involving large trucks and cars are fatal accidents.
5. Truck drivers appear to encounter difficulties in getting their vehicles stopped whether because of brake failure or because of insufficient braking power for the distances involved.
6. Although, on the whole, drivers of large trucks are less likely to be found in violation than drivers of cars, this is not the case in multi-vehicle crashes. In the latter case the truck operator is more likely to be found in violation than is the driver of the car.

7. Trucks in crashes are more likely to be reported as having vehicle defects than is true for cars.
8. Generally, small trucks (two-axle trucks 24,000 pounds GVW and under) appear much like cars on the basis of accident report information, while the heavier two-axle trucks (over 24,000 pounds GVW) appear more like the three-axle and tractor-trailer trucks.

Recommendations based on analyses include the following:

1. The fact that the small two-axle trucks appear much like cars on the basis of crash information tends to support the licensing classification system proposed by the American Association of Motor Vehicle Administrators. However, the different characteristics of the larger truck crashes confirm the need for special licensing for operators of these larger vehicles.
2. If future research shows that the higher rate of vehicle defects reported for trucks in crashes is indeed a sign of more mechanical failure instead of a difference in reporting, this raises questions concerning the need for more frequent and perhaps more intense vehicle inspection for large trucks. The heavy use made of such vehicles combined with their potentially greater hazard on the highway provide a basis for requiring more stringent standards, including different inspection standards.

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INTRODUCTION

Under the federal standard for driver licensing programs, there is a requirement that drivers be examined for ability to operate the class(es) of vehicle(s) for which they are being licensed (National Highway Traffic Safety Administration, 1974). This requirement is based on the assumption that the skills required to operate a passenger car are appreciably different from those required to operate a motorcycle or a large truck. The states have followed the lead of the federal government, and, by the spring of 1974, 37 states and the District of Columbia had some special procedures for licensing motorcycle operators (Nathan and Waller, 1974). In the fall of 1974, a poll of the 50 states and the District of Columbia revealed that, of 49 jurisdictions responding, 22 had some special procedures for licensing operators of large trucks and an additional ten had legislation proposed or pending to provide for such a system. Seventeen had neither special procedures for licensing truck operators nor related proposed legislation (survey conducted under Governor's Highway Safety Program).

While it is apparent even to the casual observer that operating a large truck requires special skills, there have been relatively few carefully controlled studies to determine just what the differences are. One of the major impediments to such investigations has been the lack of accident information concerning truck characteristics and in particular the weight of the truck. Many accident report forms do not differentiate between pickup trucks and larger trucks nor do they usually provide specific information on vehicle weight.

Classified systems of licensing generally were not intended to require operators of pickup trucks to show special qualifications different from those required of operators of passenger cars. Rather, the intention was that special licensing procedures would be reserved for licensing operators of much larger vehicles. The American Association of Motor Vehicle Administrators (AAMVA) has developed a plan for defining classes of vehicles for licensing purposes. Their scheme provides for the following classes:

"CLASS "C":

Any single vehicle not in excess of 24,000 pounds GVW (Gross Vehicle Weight), or any such vehicles towing a vehicle not in excess of 10,000 pounds GVW; except buses and motorcycles.

CLASS "B":

Any single vehicle weighing over 24,000 pounds GVW, or any such vehicles towing a vehicle not in excess of 10,000 pounds GVW, and any bus, and all vehicles under Class "C", except motorcycles.

CLASS "A":

Any vehicles or combination of vehicles, including all vehicles under Class "B" and "C", except motorcycles.

CLASS "M":

Motorcycles

*Assign unusual vehicles to the most appropriate class and restrict or endorse for driver's license classification.

*Accept certificates of competency by an employer having an approved driver training program in lieu of the road test for Class "A" and "B" (AAMVA Workshop, 1970).

Thus, the AAMVA recommended cutoff for vehicle weight is 24,000 pounds GVW, with additional focus on the weight of any towed vehicle. Examination of accident report forms show that most vehicles described as "trucks" would not meet this weight criterion. The corresponding special licensing procedures are thus concerned with only a small portion of the total truck operators.

To establish valid procedures for licensing operators of large trucks, it would be useful to have better information on the types of accidents that are characteristic of these larger vehicles. To accomplish this it must be possible to identify which crash-involved trucks fall into the higher weight categories. This study analyzes truck accidents reported in North Carolina in 1973 to determine the circumstances surrounding these crashes. Trucks were grouped according to size and

weight and, wherever possible, comparisons were made with collisions involving vehicles that would not require a special license under the recommended classified licensing system. Also investigated was the relationship between driver injury and vehicle type for various accident categories.

The Appendix shows a copy of the accident report form that provided the data for this study.

METHOD

Accident data were collected on truck and car crashes based on North Carolina accident report forms for 1973. The file contained information on 5653 tractor-trailer trucks and three-axle trucks (hereafter referred to as "large trucks"), 29,076 two-axle trucks, and 218,730 other vehicles that would not require special licensing procedures under the system proposed by the AAMVA. These other vehicles included two-door and four-door sedans, two-door and four-door sedans plus house trailer, passenger cars and trailers, station wagons (passenger car), station wagons (truck), and taxi cabs. For purposes of this study, these vehicles were all classified as "cars."

In addition to the data on the reportable accidents used by the Department of Motor Vehicles, this study contains information on accidents occurring on private property and crashes consisting of less than \$200 total damage and no personal injury.

The assumption was made that the three-axle trucks and the tractor-trailer trucks would fall above 24,000 pounds GVW, and no attempt was made to further classify these vehicles. A weight analysis of accident-involved large trucks in North Carolina proved this to be a valid assumption. However, it was recognized that most of the two-axle trucks would have a GVW less than or equal to 24,000 pounds, the cutoff point proposed by AAMVA. Therefore weight information was obtained for the two-axle trucks with North Carolina license plates by linking the license plate number from the accident file to the vehicle registration file. The registration file does not include the actual GVW but rather the weight for which the vehicle has been registered. Since it is fairly costly to register vehicles in the upper weight ranges (\$241 a year for 24,000 pounds and \$801 a year for 80,000 pounds), and since there are random on-road checks conducted to insure that vehicles are not carrying more weight per axle than is legally permitted, it is assumed that owners would not tend to register their vehicles for more than the vehicle can legally carry. Likewise, since large trucks are so expensive to own and operate, it is assumed that owners would tend to use them to the extent of their capacity, and hence would register them for the maximum weight that they could transport. Thus the assumption is being made that the GVW and the registered weight are generally not greatly disparate, and for purposes of this study the registered weight is used as a proxy measure of the GVW.

Of the 29,076 two-axle trucks in crashes, 3318 or 11.4 percent had out-of-state license plates. Of the remaining 25,758, a total of 15,798 or 61.3 percent were successfully linked to usable weight information on the registration file. Of these only 5.4 percent (855) were registered for more than 24,000 pounds GVW. To obtain weights required linking license plate numbers to the title file which was then linked to the registration file. The latter contains over five million records. Furthermore, the available copies of the title and registration files were made at a particular point in time during the 1973 calendar year. Since changes can be made in the registrations and titles at any time during the year, it is not surprising that there was a fairly high attrition in linking the correct vehicle to the correct registered weight. Data analysis, however, showed that the trucks that were not successfully linked did not differ greatly in accident characteristics from the trucks with obtained weights.

Large trucks (three-axle trucks and tractor trailers), intermediate trucks (two-axle trucks over 24,000 pounds GVW), and small trucks (two-axle trucks of 24,000 pounds GVW or less) were compared with cars on the basis of vehicle-oriented accident data and data from single vehicle crashes. Analyses were also carried out on truck-car collisions for each category of trucks, and these findings were compared with data from a four percent sample of car-car crashes (N = 2781). Finally, 404 crashes involving a large truck (three-axle or tractor trailer) and more than one other vehicle and/or pedestrian were examined, using photocopies of the original accident report forms, to determine the circumstances surrounding these crashes. Similar information was obtained for 394 randomly selected car crashes involving more than two vehicles and/or pedestrians. All of the findings are based solely on vehicles involved in crashes. There was no information on the amount or type of exposure accumulated by these vehicles, and the results must be interpreted with this limitation in mind.

RESULTS

Accident Characteristics

Accident type.

On the report form the accident type describes what was the first in a series of harmful events. Table 1 describes the accident type as generated on the accident report form. However, for the remainder of this report the accident type is based on a description of the final configuration of the accident event (see Table 2).

Approximately one out of every four large trucks in crashes was involved in what was initially a single vehicle accident. However, in about one-fourth of these crashes the vehicle initiating the crash proceeded to be involved in a multi-vehicle crash. For example, if a truck or car driver ran off the shoulder, lost control of his vehicle when returning to the pavement, and ran into another vehicle, the crash would be classified as a multi-vehicle accident in this study. Both the percentage of crashes involving a single vehicle and the percentage of single vehicle crashes that turned into multi-vehicle crashes are higher for the larger trucks than for any other category of vehicle analyzed (see Table 1).

Frequently occurring multi-vehicle accident types for all four vehicle categories were "rear-end collision stopping or slowing," "turning" (especially turning left from the same roadway), "sideswipe," and "collision at an angle." In most of these collision types either small trucks or cars have comparatively the highest percentages. For the category "sideswipe," however, the large trucks show the highest proportion (see Table 1).

Almost four percent (3.7 percent) of intermediate trucks and more than two percent of the large and small trucks were reported to have had a rollover during the accident as compared with 1.7 percent for cars. Almost all of the rollovers occurred during single vehicle crashes (see Table 3).

Vehicle maneuver and point of contact.

Vehicle maneuvers at the time of the accident can help describe the accident types more clearly (see Table 4). Although most vehicles were going straight prior to the crash (especially prior to single

Table 1. Accident type by vehicle class.

Vehicle class Accident Type	Large Trucks in	Intermediate Trucks in	Small Trucks in	Cars in
Ran off road - right	12.6	8.7	7.8	9.1
Ran off road - left	6.1	4.2	3.4	5.2
Ran off road - straight	0.4	0.7	0.3	0.5
Overtake	1.5	2.3	0.5	0.2
Other non-collision in road	1.6	0.8	0.5	0.2
Collision with fixed object	2.1	0.6	0.4	0.4
Collision with other object	1.6	1.2	0.5	0.2
Collision with pedestrian	0.4	0.7	1.0	0.9
Collision with parked car	4.2	4.8	5.3	6.1
Collision with train	0.4	0.2	0.2	0.1
Collision with bicycle	0.1	0.1	0.4	0.4
Collision with animal	0.9	0.2	0.9	0.7
Collision of 2 motor vehicles,				
Rear end stopping or slowing	18.8	16.8	16.9	19.6
Rear end turning	3.0	4.4	3.4	3.1
Left turn from same road	7.2	9.4	10.7	9.2
Left turn cross traffic	3.7	4.2	6.4	7.0
Right turn from same road	3.3	4.0	2.3	2.0
Right turn cross traffic	1.4	1.4	1.8	1.8
Head on collision	1.4	1.9	2.4	1.9
Sideswipe	12.9	11.8	10.2	7.8
Collision at angle	10.0	12.9	16.8	16.6
Collision while backing	3.6	5.1	4.7	3.0
Not stated	2.8	3.5	3.3	4.0
N	5653	855	14943	218730

Table 2. Crash type by vehicle class.

Vehicle Class Accident Type	Large Trucks in	Intermediate Trucks in	Small Trucks in	Cars in
Single vehicle crashes	19.4 (1097)	14.4 (123)	10.0 (1493)	13.0 (28520)
Other accidents*	80.5 (4556)	85.6 (732)	90.0 (13450)	87.0 (190210)
N	5653	855	14943	218730

*In the "other accident" category the single vehicle accidents that turned into multi-vehicle accidents and the "not stated accident-type" were included along with the multi-vehicle accidents, bicycle accidents, train accidents, animal accidents and pedestrian accidents.

Table 3. Proportion of rollover crashes by crash type and vehicle class.

Vehicle class:	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type:	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Rollover:												
Yes	9.9	0.4	2.2	22.0	0.7	3.7	18.4	0.3	2.1	12.4	0.1	1.7
No	90.1	99.6	97.8	78.0	99.3	96.3	81.6	99.7	97.9	87.6	99.9	98.3
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 4. Vehicle maneuver by crash type and vehicle class.

Vehicle Class:	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type:	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Vehicle maneuver:												
Stopped in lane	0.4	3.3	2.7	0.0	5.2	4.4	0.3	6.8	6.1	0.1	9.0	7.8
Parked in/out of lane	0.0	3.1	2.4	0.0	2.7	2.3	0.0	4.0	3.6	0.0	4.6	4.0
Going straight ahead	79.4	54.8	59.5	82.9	50.1	54.9	89.8	51.2	55.1	90.3	51.0	56.2
Changing lanes/merging	0.9	3.7	3.2	1.6	3.7	3.4	0.8	2.4	2.3	0.7	2.0	1.8
Passing	2.0	5.4	4.8	3.3	3.0	3.0	1.5	2.8	2.7	2.1	2.6	2.5
Making right turn	4.4	5.3	5.1	0.8	5.7	5.0	1.3	3.2	3.0	1.6	3.3	3.1
Making left turn	3.5	7.1	6.4	1.6	10.9	9.6	2.3	12.5	11.5	2.0	11.0	9.8
Backing	0.7	4.3	3.6	1.6	5.6	5.0	0.5	4.4	4.0	0.4	2.0	1.8
Slowing or stopping	6.8	7.2	7.2	8.1	6.2	6.4	1.7	5.2	4.9	1.5	6.1	5.5
Other*	1.4	2.1	1.9	0.0	2.6	2.2	1.4	3.5	3.3	1.1	3.3	3.0
Not stated	0.6	3.7	3.1	0.0	4.2	3.6	0.3	4.0	3.6	0.2	5.0	4.4
N	1097	4556	5633	123	732	855	1493	13450	14943	28520	190210	218730

*U-turn, parking or leaving parked position, starting in roadway and other

vehicle crashes) quite a number of large trucks were slowing down, while small trucks and cars were already stopped in the lane of travel. Another frequent accident-related maneuver was "turning." For the large trucks there was little difference between right turns and left turns, but for all other vehicle categories the left turn accounted for a higher proportion of the crashes.

In two vehicle accidents the combination of both vehicles going straight ahead prior to the crash is encountered most often. Another combination with a high accident frequency was found where one vehicle was making a left turn and the other vehicle was heading straight. In large truck-car crashes the car was more likely to be making the left turn (see Tables 5, 6, 7 and 8). In car-car crashes the situation where one car was stopped in the lane of traffic and another car was heading straight ahead resulted in a relatively high number of accidents.

The point of contact information for the two vehicle accidents in Table 9 indicates that most trucks and cars were hit in the front. In large truck-car crashes, however, the car is also very likely to be hit in the rear or left side. These findings might be indicative of the failure of large trucks to brake in time to avoid an accident.

Tire impressions and distance travelled after impact.

For all vehicle types, single vehicle crashes were more likely to be associated with the presence of tire impressions and with longer tire impressions (see Table 10). Large trucks were also characterized by more and longer tire impressions. Similar relationships were found for the distance travelled after impact (see Table 11).

Accident Environment

Time of accident.

Both truck and car crashes are approximately uniformly distributed among the 12 months of the year (see Table 12). The distribution among the days of the week, however, is distinctly different for trucks and cars, with larger trucks involved during weekdays to a greater extent. For small trucks and cars, weekend crashes (Saturday and Sunday) account for 20.5 percent and 30.9 percent, respectively. Corresponding figures for intermediate trucks and large trucks are 7.2 percent and 12.4 percent, respectively (see Table 13).

Table 5. Vehicle maneuvers in large truck-car crashes.

Large Trucks	Stopped in Lane	Parked In/Out of Lane	Going Straight	Changing Lanes or Merging	Passing	Right Turn	Left Turn	Backing	Slowing/ Stopping	Other	Not Stated	
Cars:												
Stopped in lane	0.2	0.0	4.8	0.2	0.0	0.8	1.2	2.8	2.2	0.1	0.0	12.3
Parked in/out of lane	0.0	0.0	1.7	0.1	0.0	0.6	0.3	0.6	0.1	0.2	0.0	3.7
Going straight	1.7	2.4	24.1	3.8	1.4	3.0	4.5	1.7	1.4	2.0	0.1	46.1
Changing lanes/ merging	0.0	0.1	2.5	0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.0	3.0
Passing	0.1	0.1	3.2	0.3	0.4	0.4	1.4	0.0	0.0	0.1	0.0	6.2
Right turn	0.1	0.1	2.8	0.0	0.1	1.7	0.1	0.0	0.1	0.0	0.0	5.1
Left turn	0.0	0.0	7.1	0.1	2.4	0.1	1.0	0.1	0.3	0.1	0.0	11.2
Backing	0.0	0.1	0.6	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.0
Slowing/ stopping	0.3	0.0	3.5	0.1	0.2	0.1	0.3	0.3	1.5	0.0	0.0	6.1
Other	0.0	0.1	2.1	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.0	2.7
Not stated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	2.6
	2.5	3.0	52.5	4.9	4.8	6.8	8.9	5.7	5.6	2.6	2.7	N=2776

Table 6. Vehicle maneuvers in intermediate truck-car crashes.

Truck:	Stopped in Lane	Parked In/Out of Lane	Going Straight Ahead	Changing Lanes/ Merging	Passing	Right Turn	Left Turn	Backing	Slowing/ Stopping	Other	Not Stated	
Car:												
Stopped in lane	0.6	0.0	5.8	0.2	0.0	0.6	0.0	4.3	0.8	0.4	0.0	12.8
Parked in/out of lane	0.2	0.0	2.9	0.0	0.0	1.0	0.0	0.8	0.0	0.4	0.0	5.4
Going straight	1.4	1.6	20.3	2.5	0.6	2.9	6.8	1.9	1.9	2.9	0.0	42.8
Changing lanes/ merging	0.4	0.0	2.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Passing	0.0	0.2	1.2	0.6	0.6	0.8	5.2	0.0	0.0	0.0	0.0	8.7
Right turn	0.6	0.0	3.1	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	4.3
Left turn	0.4	0.4	6.2	0.0	1.0	0.6	0.6	0.0	0.4	0.0	0.0	9.7
Backing	0.0	0.2	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Slowing or stopping	0.0	0.2	1.7	0.0	0.0	0.2	0.0	0.2	1.4	0.0	0.0	3.9
Other	0.0	0.0	2.7	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	3.1
Not stated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.2
	3.7	2.7	47.1	3.7	2.3	7.2	12.6	7.2	4.5	3.7	5.2	N=484

Table 7. Vehicle maneuvers in small truck-car crashes.

Truck:	Stopped in Lane	Parked In/Out of Lane	Going Straight Ahead	Changing Lanes or Merging	Passing	Right Turn	Left Turn	Backing	Slowing/ Stopping	Other	Not Stated	
Car:												
Stopped in lane	0.1	0.0	4.2	0.1	0.1	0.3	0.3	1.6	1.2	0.1	0.0	7.9
Parked in/out of lane	0.0	0.0	1.9	0.1	0.0	0.1	0.1	0.9	0.1	0.2	0.0	3.3
Going straight ahead	3.8	2.6	24.8	2.0	0.5	2.4	8.7	2.2	2.0	3.4	0.1	52.5
Changing lanes or merging	0.1	0.0	1.7	0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.0	2.3
Passing	0.1	0.1	0.8	0.1	0.3	0.2	3.5	0.0	0.0	0.0	0.0	5.3
Right turn	0.3	0.1	2.8	0.1	0.2	0.4	0.2	0.1	0.1	0.1	0.0	4.2
Left turn	0.2	0.1	8.2	0.0	1.3	0.2	0.6	0.1	0.2	0.0	0.0	10.8
Backing	0.3	0.3	1.2	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	2.0
Slowing or stopping	0.7	0.1	2.7	0.1	0.0	0.1	0.2	0.1	1.2	0.0	0.0	5.3
Other	0.1	0.1	2.4	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	3.0
Not stated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	3.3
	5.8	3.5	50.8	2.7	2.4	3.6	13.9	5.2	4.8	4.0	3.4	N=9618

Table 8. Vehicle maneuvers in car-car crashes.

Car 1:	Stopped in Lane	Parked In/Out of Lane	Going Straight Ahead	Changing Lanes or Merging	Passing	Right Turn	Left Turn	Backing	Slowing/ Stopping	Other	Not Stated	
Car 2:												
Stopped in lane	0.1	0.0	3.6	0.1	0.1	0.2	0.3	0.4	0.9	0.0	0.0	5.7
Parked in/out of lane	0.0	0.1	3.3	0.0	0.0	0.0	0.0	0.6	0.1	0.5	0.0	4.7
Going straight	6.3	2.2	25.3	2.2	0.4	3.0	9.6	1.3	3.2	2.5	0.1	56.1
Changing lanes or merging	0.0	0.0	1.1	0.3	0.1	0.0	0.1	0.0	0.1	0.0	0.0	1.7
Passing	0.1	0.0	0.7	0.0	0.1	0.0	1.5	0.0	0.1	0.0	0.0	2.6
Right turn	0.3	0.0	1.6	0.0	0.1	0.2	0.3	0.0	0.1	0.1	0.0	2.8
Left turn	0.4	0.1	7.6	0.1	0.8	0.3	0.8	0.1	0.2	0.2	0.0	10.6
Backing	0.2	0.6	0.8	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.9
Slowing or stopping	1.5	0.1	2.0	0.0	0.0	0.1	0.1	0.0	1.8	0.0	0.0	5.6
Other	0.1	0.1	2.5	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.0	3.4
Not stated	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	4.8
	9.1	2.9	48.4	2.9	1.6	4.2	12.9	2.8	6.7	3.6	4.8	N=2781

Table 9. Initial point of contact in two-vehicle accidents.

	Large Truck-Car		Intermediate Truck-Car		Small Truck-Car		Car 1-Car 2	
Front + front corners	44.9 (51.2)*	32.7 (34.2)	40.3 (45.1)	39.7 (42.5)	47.4 (50.7)	44.8 (46.9)	42.8 (45.3)	49.5 (53.2)
Right side	12.1 (13.8)	14.1 (14.8)	14.3 (16.0)	13.0 (13.9)	11.6 (12.4)	14.9 (15.6)	12.2 (12.9)	12.4 (13.4)
Rear + rear corners	14.2 (16.1)	23.3 (24.4)	18.2 (20.4)	17.8 (19.0)	18.4 (19.7)	17.7 (18.6)	23.4 (24.7)	15.0 (16.1)
Left side	15.3 (17.4)	23.2 (24.3)	15.9 (17.8)	21.1 (22.6)	15.8 (16.8)	17.4 (18.2)	15.7 (16.6)	15.8 (17.0)
Other	1.2 (1.4)	2.2 (2.3)	0.6 (0.7)	1.9 (2.0)	0.3 (0.3)	0.6 (0.6)	0.5 (0.5)	0.3 (0.3)
Not stated	12.2	4.5	10.7	6.6	6.5	4.6	5.4	7.0
N	2776		484		9618		2781	

*(percent of vehicles' initial point of contact with the not stated category excluded)

Table 10. Tire impressions by crash type and vehicle class.

Vehicle class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Tire impressions in feet												
0	42.4	74.5	68.2	31.7	79.4	72.5	38.6	76.7	72.9	35.2	77.4	71.9
1- 20	3.7	5.9	5.5	4.9	6.8	6.5	4.8	9.2	8.8	4.1	8.7	8.1
21- 60	11.2	7.9	8.6	18.7	8.3	9.8	14.3	9.9	10.3	13.2	9.2	9.7
61-100	9.3	4.5	5.4	12.2	2.6	4.0	12.9	2.7	3.7	12.5	2.8	4.1
101-200	17.3	5.4	7.7	18.7	2.2	4.6	15.4	1.3	2.7	19.3	1.5	3.8
201+	5.6	0.5	1.5	4.9	0.1	0.8	5.9	0.1	0.7	5.3	0.2	0.8
Unknown	10.5	1.4	3.1	8.9	0.5	1.8	8.1	0.1	0.9	10.5	0.2	1.6
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 11. Distance traveled after impact by crash type by vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Distance in Feet												
0	39.7	48.1	46.4	37.4	53.6	51.2	37.7	51.2	49.9	34.8	52.3	50.1
1-20	14.9	16.9	16.5	23.6	21.2	21.5	18.6	27.7	26.8	18.4	28.3	27.0
21-60	19.4	12.6	13.9	26.8	12.2	14.3	23.0	12.9	13.9	23.8	12.3	13.8
61-100	11.5	7.1	8.0	3.3	6.8	6.3	9.4	4.1	4.6	9.9	3.5	4.4
101-200	9.5	8.2	8.5	4.9	3.5	3.7	7.8	2.8	3.3	8.5	2.4	3.2
201+	5.1	7.0	6.6	4.1	2.7	2.9	3.5	1.2	1.4	4.5	1.1	1.5
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 12. Month of accident by crash type and vehicle class.

Vehicle Class	Large Trucks			Intermediate Trucks			Small Trucks			Cars		
	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Month												
January	8.3	7.1	7.3	6.5	7.0	6.9	7.0	7.8	7.7	7.9	8.5	8.4
February	8.0	7.2	7.4	8.9	6.5	6.9	6.5	7.1	7.1	6.6	7.3	7.2
March	10.7	8.5	8.9	7.3	8.5	8.3	8.2	8.7	8.6	9.3	8.7	8.8
April	6.2	7.7	7.5	8.1	8.1	8.1	7.7	7.9	7.9	8.2	7.8	7.8
May	8.3	8.5	8.5	9.8	9.7	9.7	8.2	8.4	8.4	8.5	8.3	8.3
June	8.5	8.5	8.5	8.1	9.7	9.5	8.6	8.5	8.5	8.7	8.5	8.5
July	9.1	8.0	8.2	11.4	9.0	9.4	9.7	8.0	8.2	8.5	8.0	8.1
August	9.0	10.0	9.8	5.7	9.6	9.0	9.0	8.6	8.7	8.7	8.6	8.6
September	8.1	8.8	8.6	5.7	6.7	6.5	9.2	7.9	8.0	8.2	8.3	8.3
October	7.8	9.4	9.1	10.6	9.7	9.8	9.9	9.7	9.7	8.6	8.9	8.9
November	7.8	8.6	8.4	8.9	9.6	9.5	8.4	9.1	9.1	8.1	8.5	8.5
December	8.1	7.7	7.8	8.9	6.0	6.4	7.5	8.2	8.2	8.6	8.5	8.5
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 13. Day of accident by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Day of Week												
Monday	18.9	17.3	17.6	18.7	21.6	21.2	12.8	15.9	15.6	11.4	13.6	13.3
Tuesday	17.4	16.6	16.8	15.4	18.2	17.8	12.8	15.1	14.9	9.4	12.0	11.6
Wednesday	16.0	16.7	16.6	18.7	14.6	15.2	13.7	14.7	14.6	10.5	12.7	12.4
Thursday	17.0	17.9	17.8	19.5	18.4	18.6	12.8	15.1	14.9	11.5	13.3	13.1
Friday	16.6	19.4	18.9	17.9	20.3	20.0	17.8	19.7	19.5	15.3	19.2	18.7
Saturday	8.6	7.2	7.5	7.3	6.3	6.4	17.4	13.3	13.7	21.5	17.2	17.8
Sunday	5.5	4.8	4.9	2.4	0.5	0.8	12.7	6.2	6.8	20.3	12.0	13.1
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

The hours of the day were divided into periods commonly associated with different types of driving (e.g., commuting to work 6-9 a.m.). For each of the four vehicle categories, most accidents occurred between 9:00 a.m. and 4:00 p.m. (see Table 14). On a per-hour basis, the 4:00 p.m. to 6:00 p.m. period showed the highest percentages for the small truck and car categories, while for the heavier trucks little difference was found in the rates for the periods 9:00 a.m. to 4:00 p.m. and 4:00 p.m. to 6:00 p.m. These findings, however, have to be interpreted while keeping in mind the lack of exposure data. For all vehicle types relatively high proportions of single vehicle accidents occurred at night on unlighted streets (see Tables 14 and 15).

Weather.

In most instances, weather conditions were described as clear or cloudy. However, a relatively high percentage of trucks and cars in single vehicle crashes were involved during rainy weather. This finding was especially noticeable for large trucks (see Table 16). When road conditions were considered, as would be expected, similar relationships were found for wet pavement (see Table 17).

Road type.

In relation to other vehicle types, relatively more crashes involving large trucks occurred on interstate, U.S., or N.C. highways and in open country. The other vehicle categories showed higher proportions for city streets and were somewhat more likely to be involved in business or residential areas (see Tables 18 and 19). For all vehicle types, single vehicle crashes are over-represented on interstate, North Carolina, and rural roads. The differences in road type and locality account for much of the difference in speeds and speed limits at the scene of the accident, as indicated in Tables 20 and 21. Speed is determined by the officer's judgment of the vehicle speed just prior to the onset of the accident sequence.

Road feature.

For all vehicle types, the road feature most frequently associated with crashes was "intersection" (32.6 percent to 39.9 percent of the cases). As might be expected, for all vehicle types the proportion of intersection crashes was lower for single vehicle accidents but still relatively high for large trucks (see Table 22). However, the proportion for other types of crashes at intersections was relatively low for large trucks. In single vehicle accidents, the larger trucks were somewhat more likely to have trouble at intersections, at underpasses or bridges, and at the end or beginning of a divided highway.

Table 14. Hour of accident by crash type and vehicle type.

Vehicle Class Crash Type	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
12:00 PM- 5:59 AM	16.2	7.4	9.1	6.5	2.0	2.7	13.1	2.6	3.7	22.0	4.4	6.7
6:00 AM- 8:59 AM	15.4	14.2	14.4	17.1	15.7	15.9	8.8	14.2	13.7	8.5	11.1	10.7
9:00 AM- 3:59 PM	38.9	48.2	46.4	48.8	54.0	53.2	33.6	46.2	44.9	23.7	38.0	36.1
4:00 PM- 5:59 PM	11.5	13.3	12.9	13.0	17.8	17.1	14.5	18.7	18.3	10.7	19.7	18.5
6:00 PM- 7:59 PM	6.7	6.6	6.7	8.1	4.8	5.3	11.1	8.9	9.1	10.1	11.4	11.2
8:00 PM-11:59 PM	10.8	8.7	9.1	6.5	4.0	4.3	18.1	7.7	8.8	23.6	13.2	14.6
Not Stated	0.4	1.5	1.3	0.0	1.8	1.5	0.8	1.6	1.5	1.5	2.3	2.2
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 15. Light condition by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Light Condition												
Daylight	65.8	76.0	74.0	81.3	87.0	86.2	61.2	79.6	77.8	45.4	69.7	66.6
Dusk	2.3	1.6	1.7	1.6	1.1	1.2	2.5	2.4	2.4	2.4	3.1	3.0
Dawn	2.5	1.5	1.7	1.6	1.1	1.2	1.5	1.1	1.1	1.7	0.8	0.9
Dark (street light)	3.3	3.7	3.6	2.4	2.2	2.2	5.4	5.4	5.4	11.5	11.6	11.6
Dark (no street light)	25.4	13.3	15.7	13.0	4.0	5.3	28.9	7.5	9.7	38.5	9.7	13.4
Not Stated	0.7	3.9	3.3	0.0	4.6	4.0	0.4	4.0	3.6	0.4	5.0	4.4
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 16. Weather conditions by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Weather												
Clear	55.2	65.6	63.6	65.0	68.6	68.1	66.4	65.8	65.9	59.4	63.4	62.9
Cloudy	16.6	16.2	16.3	20.3	15.2	15.9	14.8	16.3	16.2	15.4	16.1	16.0
Rainy	22.1	10.9	13.1	10.6	9.6	9.7	14.7	10.7	11.1	20.0	12.4	13.4
Snowy	2.7	1.2	1.5	0.0	0.8	0.7	1.6	1.3	1.4	2.0	1.4	1.5
Fog	2.3	1.9	2.0	3.3	1.0	1.3	2.1	1.3	1.4	2.2	0.9	1.1
Sleet/Hail	0.1	0.2	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.2	0.2
Not Stated	1.0	3.9	3.3	0.8	4.9	4.3	0.3	4.4	4.0	0.7	5.5	4.9
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 17. Pavement condition by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Condition												
Dry	65.2	78.4	75.8	80.5	80.1	80.1	76.0	76.6	76.5	68.5	73.7	73.0
Wet	28.4	14.8	17.5	17.1	12.6	13.2	19.1	15.4	15.7	25.8	17.2	18.4
Oily	0.1	0.1	0.1	0.8	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Muddy	0.2	0.1	0.1	0.0	0.1	0.1	0.5	0.2	0.2	0.3	0.1	0.1
Snowy	1.8	1.3	1.4	0.8	0.8	0.8	1.5	1.6	1.6	1.8	1.5	1.6
Icy	3.5	1.5	1.9	0.8	1.6	1.5	2.5	2.2	2.2	3.1	2.2	2.3
Not Stated	0.8	3.7	3.2	0.0	4.8	4.1	0.3	4.0	3.6	0.3	5.1	4.5
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 18. Highway class by vehicle class and crash type.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Highway												
Interstate	19.0	11.9	13.3	7.3	2.6	3.3	2.9	1.6	1.8	4.6	2.0	2.3
U.S.	34.6	36.8	36.4	33.3	27.0	28.0	15.9	19.6	19.2	16.7	16.8	16.8
N.C.	17.4	13.4	14.2	17.1	15.9	16.0	15.9	12.7	13.0	14.9	9.9	10.6
Rural Paved	14.2	9.6	10.5	28.5	12.2	14.5	41.4	19.9	21.1	38.4	13.5	16.8
Rural Unpaved	1.3	0.3	0.5	4.1	0.5	1.1	7.5	1.9	2.4	4.0	1.0	1.4
City Streets	12.9	24.2	22.0	9.8	37.2	33.2	15.5	41.0	38.5	21.1	51.4	47.5
Private Property	0.5	3.6	3.0	0.0	4.2	3.6	0.3	3.8	3.5	0.1	4.9	4.3
Not Stated	0.2	0.2	0.2	0.0	0.4	0.4	0.5	0.4	0.5	0.3	0.4	0.2
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 19. Locality by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Crash Type												
Locality												
Business	12.7	25.0	22.6	8.9	32.5	29.1	6.6	29.8	27.5	7.3	33.5	30.1
Residential	7.7	11.5	10.8	8.1	14.1	13.2	16.5	23.5	22.8	21.7	28.8	27.9
School	0.2	0.6	0.6	0.8	0.6	0.6	0.4	0.8	0.8	0.6	1.1	1.1
Open Country	78.9	59.3	63.1	82.1	48.6	53.5	76.1	42.0	45.4	70.3	31.6	36.7
Not Stated	0.5	3.6	3.0	0.0	4.2	3.6	0.3	3.8	3.5	0.1	4.9	4.3
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 20. Estimated speed prior to impact by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Speed in mph												
0	1.3	10.3	8.6	0.0	13.2	11.3	0.7	14.4	13.0	0.8	18.2	16.0
1-15	9.5	25.2	22.2	7.3	32.5	28.9	4.4	31.8	29.1	2.7	27.8	24.5
16-25	10.1	9.3	9.5	10.6	11.9	11.7	8.6	14.3	13.7	5.5	14.1	13.0
26-35	14.1	14.4	14.4	13.8	14.8	14.6	16.4	15.3	15.4	13.2	14.8	14.6
36-45	29.6	19.8	21.7	41.5	16.1	19.8	24.0	11.0	12.3	18.2	8.9	10.1
46-55	21.4	11.5	13.4	15.4	6.3	7.6	25.8	6.1	8.1	27.9	6.3	9.1
56-65	10.4	4.5	5.7	9.8	1.1	2.3	11.9	1.0	2.1	17.1	1.9	3.9
66-75	1.1	0.4	0.5	0.8	0.0	0.1	3.0	0.1	0.4	7.2	0.3	1.3
Over 75	0.3	0.0	0.0	0.0	0.0	0.0	1.1	0.2	0.3	3.9	0.2	0.7
Not Stated	2.2	4.5	4.0	0.8	4.1	3.6	4.1	5.8	5.6	3.5	7.4	6.9
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 21. Speed limit at scene of accident by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Speed Limit												
Under 20	0.4	0.2	0.3	0.0	0.4	0.4	0.1	0.3	0.2	0.2	0.3	0.3
20-25	2.4	5.9	5.2	2.4	9.1	8.2	2.7	8.9	8.4	1.6	10.1	9.1
30-35	12.2	18.7	17.4	6.5	26.2	23.3	17.2	34.1	32.4	21.5	40.9	38.3
40-45	33.3	20.4	22.9	37.4	18.2	20.9	10.5	15.0	14.6	8.7	16.3	15.4
50-55	28.5	27.9	27.9	39.0	27.3	29.0	58.4	28.8	31.7	52.9	19.6	24.0
60-65	17.6	20.1	19.7	11.4	12.9	12.8	9.3	7.9	8.0	11.7	6.6	7.3
70-75	4.0	2.2	2.6	2.4	0.3	0.6	0.3	0.2	0.2	1.3	0.3	0.4
Not Stated	1.7	4.5	4.0	0.8	5.6	4.9	1.5	4.8	4.4	0.9	5.9	5.2
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 22. Road feature by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Road Feature												
Underpass or Bridge	8.4	3.5	4.4	5.7	2.2	2.7	4.5	1.3	1.6	4.0	1.2	1.6
Driveway	5.2	15.2	13.2	3.3	20.3	17.9	5.4	20.6	19.1	5.9	17.3	15.9
Alley Intersection	0.2	0.3	0.3	0.0	0.8	0.7	0.1	0.5	0.4	0.3	0.5	0.5
Intersection	20.9	35.4	32.6	17.1	39.5	36.3	14.1	41.2	38.5	14.8	43.7	39.9
Median Cross (non int.)	2.6	3.2	3.1	0.8	2.3	2.1	2.0	2.3	2.3	2.0	2.7	2.6
End/Beginning of a Divided Highway	1.4	0.9	1.0	0.0	0.3	0.2	0.5	0.4	0.4	0.6	0.4	0.4
Other	55.3	35.9	39.7	72.4	29.5	35.7	68.5	28.0	32.1	68.1	27.9	33.1
Not Stated	6.0	5.6	5.7	0.8	5.1	4.4	4.9	5.7	5.6	4.4	6.3	6.1
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Road surface.

For all vehicle types, most crashes occurred on coarse or smooth asphalt, although concrete is also mentioned relatively often for large trucks (see Table 23). Road defects are associated with a relatively small proportion of crashes for all vehicle types. The highest percentages among the defect categories were soft shoulder and road under construction for the larger trucks and loose material for cars (see Table 24).

Traffic control.

For all vehicles, the majority of both single vehicle and other crashes occurred where there was no traffic control present but more so for single vehicle crashes (see Table 25).

Vehicle Defects

In about 75 percent of the cases or more, no vehicle defect is noted by the investigating officer. For all vehicle types except cars, brake failure was the most frequently reported vehicle defect. Brake failure was reported in 4.4 percent of crashes involving large trucks, 6.2 percent of crashes involving intermediate trucks, and 1.9 percent of small trucks, compared with 1.1 percent for cars. In all cases it was somewhat more commonly reported for single vehicle crashes. For all vehicle types, tire defects were considerably more characteristic of single vehicle crashes. They also appeared somewhat more prominent in accident-involved cars than in accident-involved trucks (see Table 26).

Information on vehicle defects was also obtained from the analyses of 798 accidents (404 large truck accidents and 394 car accidents) involving more than two vehicles and/or pedestrians. According to the narratives on these accident reports, 35.9 percent of the large trucks "failed to stop" compared to 22.1 percent of the cars in similar crashes (only one car was selected from each such crash for purposes of comparison). In the case of the large trucks, the failure to stop appeared to be more often related to improper functioning of the brakes, either because of a defect in the brake system or because of insufficient braking power (see Table 27). In many cases the failure to stop was associated with the vehicle following another vehicle too closely.

In regard to vehicle defects, it should be emphasized that the information reported here is taken from the accident report form completed by the investigating officer. The officer must often rely on

Table 23. Road surface by crash type by vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Road Surface												
Concrete	17.5	15.6	16.0	10.6	8.3	8.7	5.0	5.3	5.2	5.9	5.6	5.6
Smooth Asphalt	60.1	61.0	60.8	57.7	61.5	60.9	52.0	61.5	60.5	55.6	62.2	61.3
Course Asphalt	19.4	18.5	18.7	26.0	24.0	24.3	33.8	26.2	27.0	32.6	25.2	26.2
Gravel, Dirt or Sand	2.1	0.6	1.0	4.8	1.1	1.6	8.7	2.7	3.3	5.2	1.6	2.1
Other	0.2	0.3	0.3	0.8	0.6	0.6	0.1	0.3	0.3	0.3	0.3	0.3
Not Stated	0.7	3.8	3.2	0.0	4.5	3.9	0.5	4.0	3.7	0.3	5.1	4.5
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 24. Road defect by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Defect												
Loose Material	1.4	1.0	1.1	1.6	1.1	1.2	2.0	1.6	1.7	2.7	1.5	1.6
Holes, Deep Ruts	0.5	0.4	0.4	0.0	0.4	0.4	0.9	0.5	0.6	0.8	0.4	0.4
Low Shoulders	2.7	0.7	1.1	2.4	0.1	0.5	2.4	0.3	0.5	2.1	0.3	0.6
Soft Shoulders	4.6	0.8	1.5	5.7	1.0	1.6	2.8	0.4	0.7	2.2	0.3	0.6
Other Defects	1.7	0.4	0.7	1.6	0.7	0.8	0.5	0.7	0.6	0.9	0.5	0.6
Road Under Construction	2.7	2.5	2.5	2.4	2.6	2.6	1.3	1.3	1.3	1.0	1.0	1.0
No Defects	85.4	90.3	89.4	86.2	89.6	89.1	89.4	91.1	90.9	90.1	91.0	90.8
Not Stated	1.0	3.8	3.3	0.0	4.5	3.9	0.7	4.0	3.7	0.3	5.1	4.5
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 25. Traffic control by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Traffic Control:												
Stop sign	7.2	10.5	9.9	8.9	14.4	13.6	5.4	16.7	15.6	5.7	17.7	16.1
Stop/go signal	4.5	13.9	12.1	2.4	14.2	12.5	1.5	12.6	11.5	1.3	15.1	13.3
Yield sign	1.1	0.9	1.0	0.0	1.9	1.6	0.2	1.2	1.1	0.3	1.4	1.3
Other device or officer	5.3	4.3	4.4	1.6	2.4	2.4	2.5	2.1	2.2	2.8	1.7	1.8
No control	80.4	65.7	68.5	85.4	61.5	64.9	89.1	61.9	64.7	88.5	57.5	61.5
Not stated	1.5	4.6	4.1	1.6	5.6	5.0	1.3	5.4	5.0	1.4	6.6	5.9
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 26. Vehicle defects by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Defects:	16.1	6.1	8.0	17.9	9.7	10.8	15.1	3.7	5.0	12.1	2.7	3.9
Brakes	6.8	3.8	4.4	6.5	6.2	6.2	4.4	1.6	1.9	1.9	1.0	1.1
Headlights	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1
Rear Lights	0.1	0.6	0.5	0.0	1.4	1.2	0.1	0.8	0.7	0.0	0.2	0.2
Steering	2.4	0.1	0.5	2.4	0.3	0.6	2.0	0.1	0.3	1.0	0.1	0.2
Tires	4.1	0.3	1.0	4.9	0.6	1.2	6.1	0.6	1.2	8.1	1.0	1.9
Other	2.6	0.2	1.5	4.1	1.2	1.6	2.4	0.6	0.8	1.0	0.3	0.4
No Defect	66.0	78.4	76.0	71.5	73.9	73.6	68.1	79.5	78.3	69.6	76.9	75.9
Unknown	18.0	15.4	15.9	10.6	16.5	15.7	16.9	16.7	16.7	18.2	23.5	20.2
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 27. Proportion of crashes in which vehicle "failed to stop" for large truck accidents and for car accidents involving more than two vehicles and/or pedestrians.

	Large Truck Accidents, Large Truck		Car Accidents, Randomly Selected Car	
	%	N	%	N
Cause: Brakes	6.9	(28)	1.0	(4)
Following too close	7.9	(32)	6.9	(27)
Speed	4.7	(19)	2.3	(9)
Unknown reason for fail- ing to reduce speed	14.1	(57)	9.1	(36)
Other	2.2	(9)	2.8	(11)
Total "failed to stop":	35.9	(145)	22.1	(87)
N		404 accidents		394 accidents

the information given to him by the persons involved. It is possible that truck drivers may be more likely to report a vehicle defect, e.g., brake failure, rather than indicate that the problem was attributable to their own negligence, since the latter approach may quickly lead to loss of their driving privileges and thus their means of livelihood. Also, the police officer might be more alert to a mechanical failure when investigating accident-involved trucks.

Driver Characteristics

Driver age.

Compared to car drivers, relatively fewer truck drivers fell into the young or older age groups (see Table 28). This finding was most dramatic for the larger trucks where the driver is more likely to be operating the vehicle as an occupation rather than as a means of transportation.

Driver sex.

In 96.6 percent of the accidents involving large trucks and intermediate trucks and in 90.2 percent of the accidents involving small trucks, the driver was male. For cars it was 61.0 percent.

Occupancy.

For both trucks and cars the driver was usually the only occupant of the vehicle at the time of the crash. However, this was more likely to be the case for trucks than for cars and for single vehicle crashes as compared with other crashes (see Table 29).

Belt usage.

Table 30 shows belt usage. It can be seen that for all vehicle types belt usage is not a frequently observed practice. However, it does appear that the operators of the large trucks are somewhat more likely to be using the restraint system than operators of the other vehicles. Federal regulations state that all trucks and truck tractors under DOT regulations and manufactured on or after January 1, 1965 must be equipped with seat belts and that if such an assembly is installed at the driver's seat, the driver must properly restrain himself with the available belts (Federal Motor Carrier Safety Regulations, p. 392.16 and p. 393.93).

Table 28. Age of driver by crash type by vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Age												
0-25 years	24.0	21.3	21.8	47.2	30.4	32.9	35.6	24.8	25.7	60.5	39.4	42.2
<15	0.4	0.1	0.1	0.0	0.0	0.0	0.2	0.2	0.2	0.4	0.2	0.3
16	0.1	0.1	0.1	0.8	0.3	0.4	4.6	1.9	2.1	7.8	4.1	4.6
17	0.1	0.2	0.2	0.0	1.0	0.8	4.0	2.1	2.3	7.2	4.4	4.8
18	1.0	1.0	1.0	4.1	2.3	2.6	4.0	2.6	2.7	8.5	4.8	5.3
19	1.3	1.5	1.4	6.5	4.5	4.8	4.3	2.7	2.8	7.9	4.5	4.9
20	2.4	2.1	2.2	3.3	3.7	3.7	3.2	2.3	2.4	6.7	4.2	4.5
21-25	18.7	16.3	16.8	32.5	18.6	20.6	15.3	13.0	13.2	22.0	17.2	17.8
26-55 years	69.9	69.0	69.1	47.2	56.6	55.2	51.4	54.0	53.7	31.1	42.1	40.5
26-30	19.0	17.0	17.4	13.0	15.7	15.3	14.1	12.0	12.2	10.9	11.5	11.4
31-35	14.7	14.0	14.1	9.8	11.5	11.2	9.2	9.2	9.2	6.4	7.8	7.6
36-40	11.4	12.6	12.4	8.9	8.3	8.4	8.7	8.4	8.4	4.5	6.5	6.2
41-45	11.9	10.2	10.5	3.3	6.6	6.1	6.8	8.2	8.1	3.6	5.9	5.6
46-50	8.7	9.1	9.0	8.1	7.5	7.6	6.8	8.4	8.2	3.3	5.5	5.2
51-55	4.2	6.1	5.7	4.1	7.0	6.6	5.3	7.8	7.6	2.4	4.9	4.5
56+	4.5	5.4	5.1	4.0	9.7	8.8	8.6	16.1	15.5	4.1	11.5	10.6
56-60	3.1	3.5	3.4	1.6	5.6	5.0	4.4	6.2	6.1	1.6	3.9	3.6
61-65	1.1	1.2	1.2	0.8	2.7	2.5	1.9	5.0	4.7	1.1	3.1	2.9
66-70	0.2	0.5	0.4	1.6	0.7	0.8	1.5	2.7	2.6	0.7	2.2	2.0
71-75	0.1	0.1	0.1	0.0	0.3	0.2	0.4	1.3	1.2	0.4	1.3	1.2
over 75	0.0	0.1	0.0	0.0	0.4	0.3	0.4	0.9	0.9	0.3	1.0	0.9
Not Stated	1.7	4.4	3.9	1.6	3.3	3.0	4.4	5.1	5.0	4.2	7.0	6.6
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 29. Number of occupants by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Occupants:												
0	1.2	6.5	5.5	1.6	6.7	6.0	2.7	7.4	6.9	2.9	9.7	8.8
1	84.1	80.9	81.5	75.6	73.6	73.9	65.9	67.4	67.3	58.9	54.6	55.2
2	12.3	9.5	10.0	20.3	15.8	16.5	21.4	16.7	17.2	22.6	20.1	20.4
3	1.1	1.3	1.3	2.4	3.0	2.9	6.0	5.3	5.4	8.1	7.2	7.3
4	0.4	0.2	0.2	0.0	0.3	0.2	2.1	1.3	1.4	4.0	3.8	3.8
Over 4	0.1	0.1	0.1	0.0	0.0	0.0	1.3	0.8	0.8	2.5	2.6	2.6
Not Stated	0.8	1.5	1.4	0.0	0.5	0.5	0.6	1.0	1.0	1.0	1.9	1.8
N	1097	4556	5652	123	732	855	1493	13450	14943	28520	190210	218730

Table 30. Belt usage of driver by crash type by vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Belt Usage												
None	68.3 (77.4)*	66.2 (79.9)	66.6 (79.4)	89.4 (94.0)	82.9 (91.8)	83.9 (92.2)	85.4 (93.1)	80.5 (92.3)	81.0 (92.4)	77.0 (88.1)	67.5 (85.4)	68.7 (85.8)
Lap belt	19.7 (22.3)	16.2 (19.6)	16.9 (20.1)	5.7 (6.0)	7.4 (8.2)	7.1 (7.8)	6.1 (6.6)	6.5 (7.5)	6.5 (7.4)	9.1 (10.4)	10.5 (13.2)	10.3 (12.8)
Shoulder and lap or shoulder only	0.3 (0.3)	0.4 (0.5)	0.4 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.3 (0.3)	0.2 (0.2)	0.2 (0.2)	1.3 (1.5)	1.0 (1.3)	1.0 (1.3)
Not stated	11.8	17.1	16.1	4.9	9.7	9.0	8.2	12.9	12.4	12.6	21.0	19.9
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

* Percentage of drivers with "not stated" category omitted.

The figures in Table 30 are considerably lower than those generally reported for usage in the driving population at large (about 20 to 30 percent). The discrepancy is in keeping, however, with the finding that drivers in crashes are less likely to be using belts than drivers in general (Campbell, 1969).

Licensure.

Of the drivers in large trucks, 25 percent had an out-of-state license. An additional 65.3 percent had a North Carolina chauffeur's license, while 8.2 percent held only a North Carolina operator's license. From the available data it was not possible to determine whether the remaining 1.5 percent represented unlicensed drivers or merely drivers for whom the investigating officer did not provide license information. Thus, for large trucks, if the out-of-state licenses are omitted, 87.1 percent of the remaining drivers had chauffeurs' licenses, 10.9 percent had operators' licenses, and 2 percent were not clearly identifiable.

In the case of the two-axle trucks, 11.4 percent of the operators were in vehicles with out-of-state license plates. Of the remaining 25,758, 61.3 percent were successfully linked to the vehicle registration file to determine vehicle weight. Almost half (48.4 percent) of the drivers of intermediate trucks and 13.8 percent of the drivers of the small trucks had a North Carolina chauffeur's license. In 1973, when these crashes occurred, North Carolina law required a chauffeur's license for operating vehicles over 26,000 pounds GVW. Under this provision the operators of the smaller trucks (under 24,000 pounds) would not need a special license. Furthermore, many of the larger trucks would also not require a chauffeur's license because the law exempted persons operating their own vehicles. Thus a driver could legally operate his own large dump truck or logging truck with only an operator's license.

Driver condition.

Table 31 shows the reported sobriety of the driver. For all vehicle types, drinking was markedly more characteristic of single vehicle crashes than other crashes. Compared to the drivers of the large trucks, the car drivers were more likely to have been drinking. Based on the investigating officer's report, approximately one out of every four car drivers involved in a single vehicle crash had been drinking prior to the crash. In 11.3 percent of the cases the police officer described the driving ability of the person as being impaired by alcohol. For drivers of small trucks the reported percentages of alcohol usage were very similar. For the operators of intermediate

Table 31. Sobriety of driver by crash type by vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Sobriety												
Sober	90.5	91.1	91.0	88.6	89.5	89.4	65.5	86.4	84.3	62.0	82.9	80.1
Drinking; Ability												
Impaired	1.5	0.4	0.6	5.7	0.7	1.4	12.5	2.0	3.1	11.3	2.2	3.4
Drinking; Unable												
to Determine												
Impairment	2.3	0.2	0.6	0.8	0.4	0.5	11.1	1.8	2.7	14.7	2.5	4.1
Not Stated	5.7	8.3	7.8	4.9	9.4	8.8	11.0	9.7	9.9	12.0	12.5	12.4
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

trucks in single vehicle crashes, 6.5 percent were reported to have been drinking with 5.7 percent being considered impaired. For the large trucks the comparable figures are 3.8 percent and 1.5 percent, respectively.

Table 32 provides information on whether a chemical test was administered to the driver. For cars, small trucks, and intermediate trucks the proportion of drivers given a chemical test is about the same as or lower than the proportion of drivers judged to be impaired by alcohol. For operators of large trucks, however, chemical tests were reportedly administered to a higher proportion of drivers that were judged to be impaired by alcohol, suggesting that the drunk driving laws may be somewhat more likely to be enforced in the case of these drivers.

Although operators of large trucks often drive for long periods of time, when a crash occurs they are not especially likely to be reported fatigued or asleep (see Table 33).

Violations

On the accident report form the investigating officer indicates the kind of violation(s), if any, committed by the driver. When a violation is indicated, it does not necessarily mean that the driver was cited for the violation, and of course he would not be convicted unless he was cited, and subsequently found guilty in court. Because the data on "violation indicated" carry no special legal ramifications, they appear to provide a fairly sensitive measure, in comparison to citations or convictions, of the extent to which drivers may have been committing errors at the time the crash occurred.

Table 34 shows the violation indicated for the driver. When more than one violation was reported, the first violation was taken. Except for the large trucks, "safe movement violations" account for the largest proportion of violations, but they are much less prominent in single vehicle crashes. The next most frequently reported violation is "speeding." When all crashes are considered, large trucks have the highest proportion of speeding violations (12.4 percent), but in single vehicle crashes cars were reported to be speeding in 36.5 percent of the cases, as opposed to 20.6 percent for large trucks.

Although in single vehicle crashes trucks are less likely to be in violation, this is not the case in other crashes. Table 35 shows violations for operators in two-vehicle crashes, including large truck-car crashes, intermediate truck-car crashes, small truck-car crashes, and

Table 32. Chemical test administered by crash type by vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks			Cars in		
	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Test:												
Yes	2.4	0.5	0.8	3.3	0.8	1.2	7.8	1.7	2.3	7.1	1.7	2.4
No	92.0	88.5	89.2	91.1	86.6	87.2	86.3	85.0	85.1	86.8	82.5	83.1
Not Stated	5.7	11.0	10.0	5.7	12.6	11.6	5.9	13.3	12.6	6.0	15.7	14.5
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 33. Physical condition of driver by crash type by vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Condition:												
Ill	0.4	0.1	0.2	0.8	0.7	0.7	0.7	0.4	0.4	0.7	0.3	0.4
Fatigue	1.2	0.2	0.4	0.0	0.4	0.4	1.6	0.2	0.4	2.0	0.3	0.5
Asleep	1.4	0.3	0.5	2.4	0.0	0.4	1.7	0.1	0.3	2.9	0.1	0.5
Other Physical	0.3	0.2	0.2	1.6	0.3	0.5	3.1	0.7	1.0	3.1	0.8	1.1
Impairment												
Restriction Not	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Complied With												
Normal	87.2	89.1	88.7	86.2	88.4	88.1	76.0	86.2	85.2	72.4	83.1	81.7
Not Stated	9.5	10.0	9.9	8.9	10.2	10.0	16.9	12.2	12.7	18.7	15.4	15.8
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 34. Violation indicated by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Violation												
Speeding Below 65	18.9	10.0	11.7	15.4	6.7	8.0	20.1	6.1	7.5	24.6	6.7	9.0
Speeding Over 65	1.7	0.5	0.7	1.6	0.0	0.2	6.1	0.1	0.8	11.9	0.5	2.0
Yield Violation	0.0	3.4	2.8	0.0	3.8	3.3	0.2	6.8	6.2	0.1	6.3	5.5
Left of Center	2.6	3.4	3.2	4.9	3.0	3.3	8.0	3.5	4.0	8.3	3.0	3.6
Passing Violation*	0.1	2.5	2.0	0.8	1.0	0.9	0.3	1.3	1.2	0.4	1.3	1.2
Disregard Sign or Signal*	1.4	1.8	1.8	3.3	2.1	2.2	1.8	3.1	2.9	1.7	3.4	3.2
Safe Movement Violation	3.2	13.5	11.5	4.1	14.9	13.3	2.7	13.3	12.2	3.0	10.9	9.8
Following too Close	0.9	5.6	4.7	2.4	6.0	5.5	0.5	4.0	3.6	0.2	3.9	3.4
Improper Turn	0.5	2.0	1.7	0.8	2.3	2.1	0.0	1.8	1.6	0.2	1.5	1.4
Improper Parking	0.0	0.7	0.5	0.0	1.0	0.8	0.1	0.4	0.4	0.0	0.3	0.3
Improper Brakes or Lights	1.0	1.0	1.0	0.8	2.5	2.2	0.7	0.6	0.6	0.4	0.3	0.3
Other Improper Driving*	5.3	3.3	3.6	8.1	3.7	4.5	10.5	3.7	4.4	10.9	3.0	4.1
No Violation Stated	64.4	52.4	54.7	57.7	53.0	53.7	49.0	55.2	54.6	38.4	58.8	56.1
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

* Passing on curve, hill, passing a school bus and improper overtake.

* Stop sign, stop signal and other traffic signals.

* Improper or no signal, reckless driving, racing, DUI and other improper driving.

Table 35. Violations indicated in two-vehicle crashes.

Violation	Large Truck--Car		Intermediate Truck--Car		Small Truck--Car		Car--Car	
Speeding below 65	9.1	4.3	5.4	5.0	6.1	6.5	6.1	8.7
Speeding over 65	0.5	1.3	0.0	0.4	0.1	0.5	0.4	0.5
Yield violation	4.3	5.3	4.5	6.4	7.4	6.7	7.4	6.1
Left of center	3.4	4.0	3.3	4.1	3.6	4.1	2.8	3.1
Passing violation	2.4	2.8	0.8	4.3	1.1	2.9	0.8	1.4
Disregard sign(al)	2.4	2.4	2.2	2.4	3.4	3.4	4.6	2.8
Safe movement viol.	17.0	8.9	17.4	8.5	15.0	11.5	12.6	10.7
Following too close	5.0	1.5	4.8	2.1	4.1	2.7	3.0	5.5
Improper turn	2.6	1.3	2.3	0.4	2.2	1.5	2.3	1.4
Improper parking	0.6	0.4	0.8	0.0	0.4	0.4	0.5	0.4
Improper equipment	0.8	0.3	2.1	0.0	0.6	0.4	0.4	0.3
Other improper driving	3.4	3.5	4.5	1.4	3.7	2.7	3.1	3.4
No violation stated	48.5	64.1	51.9	64.9	52.3	56.6	56.0	55.7
N	2776		484		9618		2781	

car-car crashes. In the two-vehicle crashes involving a large truck and a car, 48.5 percent of the truck drivers had no violation indicated, compared to 64.1 percent of the car drivers in the same crashes.

Analyses were also conducted of crashes involving more than two vehicles and/or pedestrians. Large trucks involved with more than one other vehicle or pedestrian were found to be in violation in 48.5 percent of the cases in contrast to only 35.5 percent of the randomly selected cars in this type of crash (see Table 36).

Driver Injury and Accident Severity

In single vehicle crashes the proportion of drivers sustaining a fatal injury does not differ greatly between large trucks and cars, indicating either comparable protection by the vehicle for both truck drivers and car drivers in serious single vehicle crashes or relatively more serious single vehicle crashes for trucks. At the other end of the injury scale, however, the percentage of single vehicle crashes involving property damage only, was highest for large trucks and intermediate trucks (see Table 37). For these two types of vehicles the amount of damage was likely to be either very high or very low in comparison to cars and small trucks. For all vehicle categories, dollar damage was likewise higher in single vehicle crashes (see Table 38).

In two-vehicle collisions the driver's injury differs greatly according to the type of vehicles involved. When a car collides with a truck of any size, the driver of the car is usually more seriously injured than the driver of the truck, as indicated in Table 39. Figures 1, 2 and 3 show the same information graphically. Note the changing scale among the figures. The data show that the car striking or being struck by a large truck is by far the worst off, compared to any vehicle type in any other accident type, including single vehicle crashes. In these car-truck crashes, the car driver is seven times more likely to be fatally injured than the truck driver and about five times more likely to be seriously injured. Compared to driver risk in car-car crashes, the relative risk for the car driver in a car-truck crash is much greater.

The accident severity indicated by the most serious injury sustained by any person involved in the crash is also highest for the two-vehicle accidents involving a large truck (see Table 40). For crashes involving more than two vehicles, the highest accident severity is again associated with collisions involving a large truck (see Table 41). However, in the analysis of crashes involving more than two vehicles, it was found that

Table 36. Violations indicated for large truck crashes and for car crashes involving more than two vehicles and/or pedestrians.

Large Truck Crashes, Large Truck			Car Crashes, Randomly Selected Car		
	%	N		%	N
Violation:					
Failed to reduce speed	10.9	(44)		5.6	(22)
Following	9.4	(38)		6.8	(27)
Speeding	6.7	(27)		19.8	(78)
Other	21.5	(87)		3.3	(13)
Total	48.5	(196)		35.5	(140)
	404 accidents			394 accidents	

Table 37. Driver injury by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Injury*												
None	70.7	86.4	83.4	67.5	88.2	85.3	59.5	83.2	80.8	59.2	78.0	75.6
C	8.1	3.0	4.0	10.6	2.7	3.9	9.4	4.2	4.7	10.7	6.0	6.6
B	13.0	2.5	4.5	11.4	1.5	2.9	17.5	3.4	4.8	17.4	4.3	6.0
A	5.7	1.4	2.2	8.9	0.8	2.0	10.0	1.5	2.4	8.4	1.7	2.6
Killed	1.3	0.3	0.5	0.0	0.1	0.1	0.6	0.2	0.3	1.2	0.2	0.3
Not Stated	1.2	6.5	5.5	1.6	6.6	5.8	3.0	7.5	7.0	3.0	9.7	8.9
N	1097	4556	5653	123	732	855	1493	13450	14943	28528	190210	218730

* C No visible sign of injury, but complaint of pain, momentary unconsciousness.

B Non-incapacitating-injury other than "Killed" or "A injury evident at scene.

A Incapacitating injury.

Table 38. Total dollar damage by crash type and vehicle class.

Vehicle Class	Large Trucks in			Intermediate Trucks in			Small Trucks in			Cars in		
Crash Type	Single	Other	Total	Single	Other	Total	Single	Other	Total	Single	Other	Total
Damage (\$)												
None- 99	11.5	49.2	41.9	8.1	50.8	44.7	8.2	29.4	27.3	4.6	16.9	15.3
100- 199	4.2	13.1	11.4	4.9	18.2	16.3	6.9	21.6	20.1	6.2	19.4	17.7
200- 399	9.7	14.8	13.8	17.9	16.7	16.8	22.2	27.2	26.7	24.9	32.3	31.3
400- 599	11.4	6.0	7.0	15.4	5.3	6.7	17.9	10.1	10.9	19.4	14.4	15.1
600- 799	5.1	2.8	3.2	6.5	1.2	2.0	9.8	4.3	4.9	12.1	6.1	6.9
800- 999	3.4	1.6	2.0	6.5	1.6	2.4	10.1	2.5	3.3	10.2	4.2	5.0
1000-1999	15.2	4.6	6.7	21.1	3.3	5.8	16.5	3.8	5.0	16.6	5.4	6.8
2000-4999	17.3	3.9	6.5	13.0	2.2	3.7	7.2	1.0	1.6	5.8	1.2	1.8
5000+	22.3	4.0	7.6	6.5	0.7	1.5	1.1	1.1	0.2	0.2	0.0	0.1
N	1097	4556	5653	123	732	855	1493	13450	14943	28520	190210	218730

Table 39. Driver injury in two-vehicle crashes.

Crash Type	Large Truck-Car		Intermediate Truck-Car		Small Truck-Car		Car-Car	
Injury								
None	89.5	70.7	88.6	71.3	85.4	80.1	82.1	79.8
C	2.3 - (3.8x) -	8.8	1.9 - (4.6x) -	8.7	3.9 - (1.7x) -	6.5	5.8	4.5
B	1.6 - (4.5x) -	7.2	0.8 - (7.5x) -	6.0	2.9 - (1.6x) -	4.5	3.7	4.2
A	0.9 - (5.3x) -	4.8	0.4 - (8.2x) -	3.3	1.3 - (1.8x) -	2.3	1.1	1.3
Killed	0.3 - (7.0x) -	2.1	0.2 - (1.0x) -	0.2	0.1 - (3.0x) -	0.3	0.0	0.1
Not Stated	5.4	6.3	8.1	10.5	6.4	6.4	7.3	10.1
N	2776		484		9618		2781	

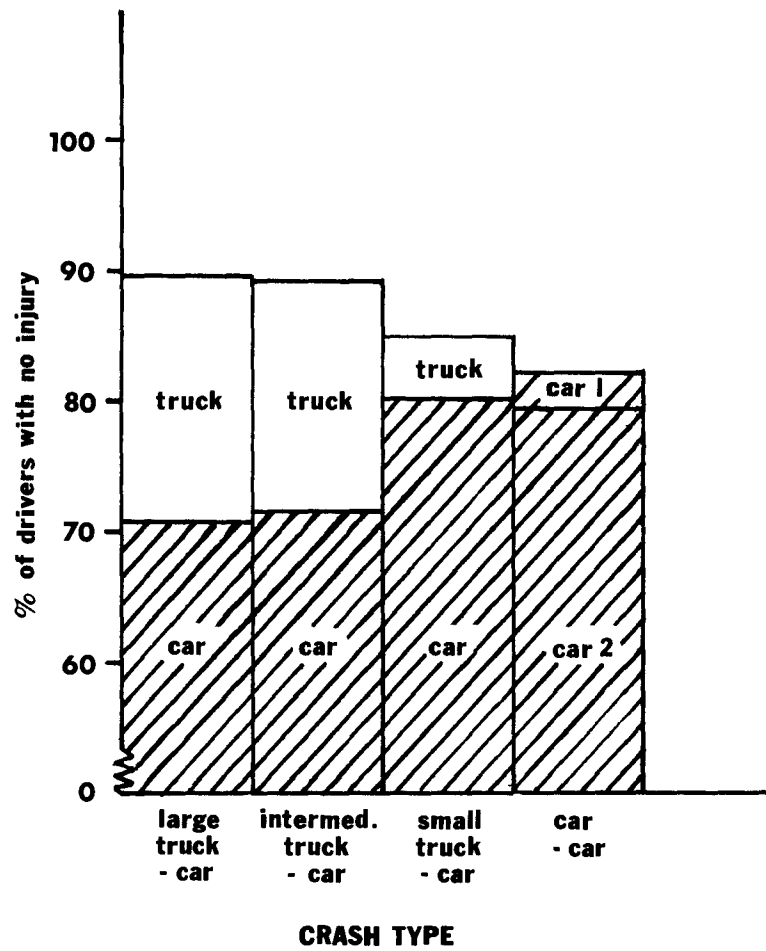


Figure 1. Proportion of drivers incurring no injury in two vehicle crashes.

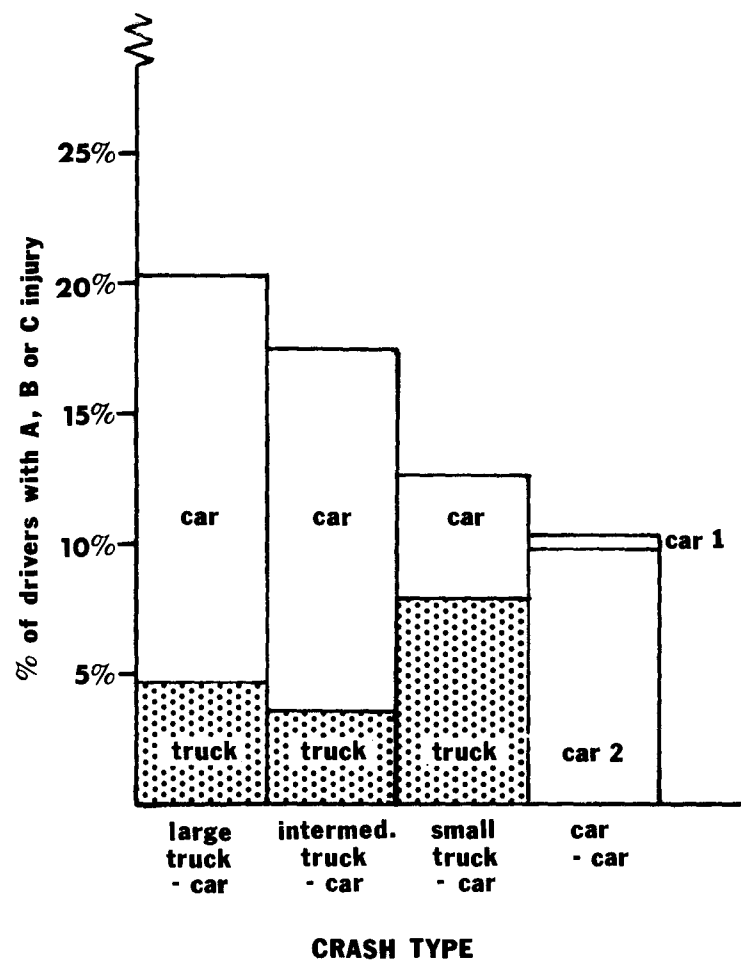


Figure 2. Proportion of drivers incurring an injury (excluding fatal) in two vehicle crashes.

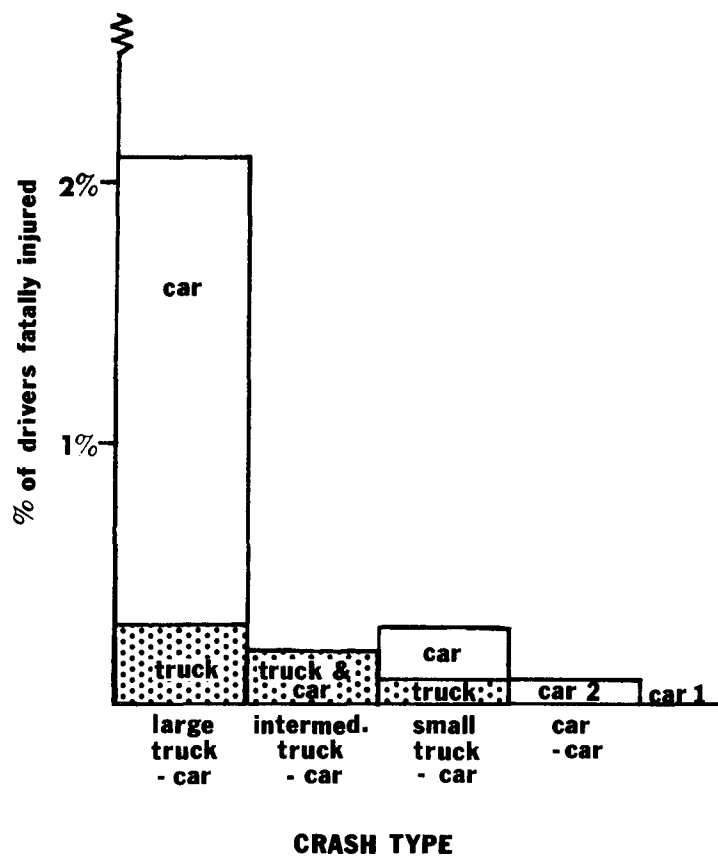


Table 3. Proportion of drivers incurring a fatal injury in two vehicle crashes.

Table 40. Accident severity in two-vehicle crashes.*

Crash Type	Large Truck-Car	Intermediate Truck-Car	Small Truck-Car	Car-Car
Severity				
Property Damage Only	68.2	68.8	74.5	71.2
C	11.1	12.0	10.3	11.8
A + B	15.1	13.2	11.1	11.4
Fatal	2.8	0.4	0.5	0.2
Not Stated	2.7	5.6	3.5	5.4
N	2776	484	9618	2781

* Severity of accident is the most severe injury incurred by any person involved in the accident, including passengers.

Table 41. Accident Severity for large truck crashes and for car crashes involving more than two vehicles and/or pedestrians.

	Large Truck Crashes Large Trucks	Car Crashes Randomly Selected Cars
Property Damage Only	52.7	57.4
C	15.6	19.0
B	14.6	14.7
A	10.9	7.6
Fatal	5.7	1.0
Not Stated	0.5	0.2
	404 Accidents	394 Accidents

large trucks tend to be involved in more complex types of crashes. In over 40 percent of the randomly selected car crashes involving more than one other vehicle, the collision was a chain reaction type. Only 18.8 percent of such crashes involving a large truck could be classified as a simple chain reaction. If it is also true that in two-vehicle crashes trucks were involved in more complex accident types, then the relatively high proportion of fatally injured truck drivers in such crashes might be partially explained by the complexity of the crash.

DISCUSSION AND SUMMARY

The federal highway safety standard covering driver licensing programs requires that states establish a system of driver licensing whereby drivers are tested in relation to the vehicle for which they are being licensed to operate. At the present time about three-fourths of the states have special procedures for licensing motorcycle operators and about two-fifths have special procedures for licensing operators of large trucks.

The requirements for both motorcycle operators and truck drivers vary greatly from state to state. In an effort to provide a standard or guideline for establishing classes of vehicles warranting special licensing procedures, the American Association of Motor Vehicle Administrators conducted a workshop that resulted in the four vehicle classes described in the introduction of this report. Their recommended classes should draw little criticism from the public at large, since, apart from motorcycles, they do not require a special license different from the one required for a passenger car until the gross vehicle weight exceeds 24,000 pounds. Since a standard passenger car weighs in the vicinity of three to five thousand pounds, it would appear only reasonable to require special procedures for licensure to operate a vehicle five times that weight.

Yet there is relatively little solid information available on just how large trucks may pose different types of driving problems. In an attempt to provide better information on which to base procedures for licensing operators of large trucks, an analysis was performed of a year's sample of truck accidents reported in North Carolina. Data were obtained for crashes reported in 1973, including information on the following crash-involved vehicles: (1) 5653 tractor-trailer trucks, and three-axle trucks, referred to as "large trucks"; (2) 29,076 two-axle trucks, and, (3) 218,730 other vehicles classified as "cars." The two-axle trucks with North Carolina license plates were linked to the vehicle registration file to determine GVW for which they were registered. They were then grouped into intermediate trucks (two-axle trucks or more than 24,000 pounds, N = 855) and small trucks (two-axle trucks weighing 24,000 pounds or less, N = 14,943).

In addition to examining the various vehicle types and the crashes in which they were involved, special examination was made of truck-car

collisions for each size category of truck with the findings being compared with a sample of car-car collisions.

The third and last analysis was based on an examination of photocopies of accident reports on accidents involving large trucks (tractor-trailer or three-axle) and more than one other vehicle and/or pedestrian to determine the circumstances surrounding these crashes. Copies were also obtained of accident reports involving cars in crashes with more than one other vehicle or pedestrian, and comparisons were made with the corresponding large truck crashes.

As would be expected, the typical accident-involved truck operator is male between 26 and 55 years of age and was the sole occupant of the vehicle at the time of the crash. The operators of large trucks appear somewhat more likely to be using seat belts compared to drivers of other vehicle types, but belt usage was not high for any group.

As might be expected, a larger proportion of the drivers of large trucks held out-of-state licenses (25 percent). For two-axle trucks 11.4 percent had out-of-state license plates, and these were eliminated before linking accident reports to the vehicle registration file to determine vehicle weight. For cars, 7.7 percent of the drivers held out-of-state licenses. With the out-of-state drivers and vehicles eliminated, 87.1 percent of the drivers of large trucks had chauffeur's licenses, compared to 48.4 percent of the drivers of intermediate trucks, 13.8 percent of the drivers of small trucks, and 5.2 percent of the drivers of cars. At the time of these crashes North Carolina law required a chauffeur's license for operation of a vehicle over 26,000 pounds. Although it is highly likely that many of the large two-axle trucks weighed more than 26,000 pounds GVW, the law exempted drivers operating their own vehicles. Thus a driver could operate any large vehicle over 26,000 pounds (including a tractor-trailer truck) if he owned the vehicle and was operating it for his own purposes.

Alcohol was not as prominent in the crashes of large trucks as it was for cars and small trucks. However, when the investigating officer suspected that the driver had been drinking, a chemical test was more likely to be administered to the operator of the large truck than to the operator of the other types of vehicles. On the basis of the accident report, other physical conditions (e.g., ill, sleep) did not appear to be a major factor in crashes for any of the vehicle categories.

Large trucks were more likely to be involved in single vehicle crashes. About one out of four large trucks in crashes was involved in what began as a single vehicle crash. However, in about one-fourth of these cases, the single vehicle accident turned into a multi-vehicle

crash. This occurred much more frequently as vehicle size increased, representing 6.5 percent of all crash-involved trucks compared to only 2.3 percent of all crash-involved cars. These differences might suggest greater difficulty in recovering control of the larger vehicles.

Trucks appeared somewhat more likely to be involved in sideswipe accidents. There were no systematic differences among vehicle types in rear-end collisions, but cars and small trucks appeared somewhat more likely to be involved in left turn crashes and collisions at an angle. For all vehicle types, rollovers were much more likely to occur in single vehicle crashes.

As would be expected from exposure characteristics, for all vehicles, going straight ahead was the maneuver associated with the majority of their crashes. Slowing down and stopped in the lane of travel were associated with a sizable number of crashes. Larger trucks were slightly more likely to be slowing down, while small trucks and cars were somewhat more likely to be stopped in the travel lane. Turning was also associated with a large number of crashes. For the large trucks there was little difference between left turns and right turns, while for the other vehicle types left turns consistently accounted for a higher proportion of the crashes. This difference suggests that right turns may pose special problems for operators of large trucks. The available information does not indicate whether the problem is one of visibility (indicating a need for better mirroring), or whether it is related to the fact that a right turn for a large truck requires in many cases that the truck move into the left lane of traffic on the street being entered, or whether the problem lies elsewhere. For all vehicle types, turning maneuvers are more often associated with multi-vehicle crashes than with single vehicle crashes, but in the case of large trucks the differences are smaller.

Tire impressions and distances travelled after impact are more likely to be present and are longer in the case of single vehicle crashes and large truck crashes.

The distribution of crashes throughout the months of the year is similar for trucks and cars, but differences do occur for day of week, with car crashes showing higher proportions on weekends. Differences were also present for the time of day, with large trucks showing higher proportions of crashes in the early hours of the morning and a lower proportion in the late afternoon and early evening. Intermediate trucks also showed a lower proportion during the evening. Of the four vehicle types, cars were much more likely to have their crashes occur during darkness on a lighted street.

Although all vehicle categories showed most crashes occurring during clear or cloudy weather, cars and large trucks had somewhat higher proportions during rainy weather.

Trucks were more likely to have their crashes occur on interstate and U.S. highways, while cars and small trucks had more of their crashes on city streets. These differences are again reflected in the crash locality and speed. Unfortunately, exposure data for trucks and cars were not available for these comparisons.

For all truck types, brake failure was the most frequently reported vehicle defect. It was most prominent in the case of intermediate trucks. Indeed, this vehicle class showed the highest proportion with defects, suggesting that these trucks may present special needs. It may be that large trucks (tractor-trailer and three-axle) are more likely than the intermediate trucks to be involved in interstate commerce (indeed, we found a higher proportion of these drivers holding out-of-state licenses) and subject to the U.S. Department of Transportation regulations. In any event, it is of some importance that both classes of large trucks showed considerably higher proportions of vehicle defects associated with crashes. Although for all vehicle classes defects are more likely to be associated with single vehicle crashes, in the case of the larger two truck types the proportion of other crashes involving defects is fairly high, representing a hazard to the rest of the motoring public.

Analyses of crashes involving more than two vehicles and/or pedestrians showed that large trucks failed to stop more often than cars in similar situations. This failure to stop appeared to be frequently associated with brake functioning.

Drivers of large trucks are less likely to be found in violation in single vehicle crashes compared with drivers of the other vehicle types. However, the same finding does not hold for other accidents. In the large truck-car crashes, the operator of the truck was much more likely to be found in violation. This was also true for crashes involving an intermediate truck. The drivers of the small trucks appeared more like the car drivers. The analyses of crashes involving more than two vehicles and/or pedestrians also showed the operators of large trucks more likely to be in violation.

In single vehicle crashes, drivers of large trucks were as likely to be fatally injured as operators of cars. However, they were also more likely to survive with no injury, suggesting that single vehicle crashes involving a large truck are likely to be either very serious or relatively minor. Examination was also made of two-vehicle crashes

involving trucks and cars. As would be expected, when two vehicles of different masses collide, the driver of the smaller vehicle fares worse. The large truck-car crash represents the greater disparity in vehicle mass, and it is here that there is the greatest disparity in driver injury. In these crashes, the operator of the car was seven times more likely to be killed. If a car collides with another car, the car driver's risk of fatal injury is only a small fraction of that in a car-truck collision. Overall accident severity, reflected by the highest injury category sustained by any person in the accident, is considerably higher for crashes involving larger trucks.

Generally small trucks (two axle trucks under 24,000 pounds) appear much like cars on the basis of the accident report information. The large two-axle trucks appear more like the three-axle and tractor-trailer trucks. Thus the findings of this study tend to support the classified system of licensing proposed by the AAMVA. The higher proportion of drivers of large trucks found to be in violation in two vehicle crashes, and the greater risk of serious injury for the operator of a car hit by a truck constitute a basis for serious consideration of a requirement that operators of these large vehicles demonstrate special competence in order to obtain licensure.

The presence of vehicle defects in a higher proportion of trucks in crashes may indicate a need for stricter maintenance of these large vehicles. Large trucks represent a considerable investment, and are therefore probably kept in operation as much of the time as possible. Vehicle inspection programs are geared more toward vehicles in normal use and might therefore not be adequate for heavy duty vehicles in continuous use. There may be a need for consideration of some alternative procedures for ensuring that these large trucks do not present hazards caused by poor vehicle condition.

The findings reported do not take into account driver exposure but rather are based only on what is reported after an accident has occurred. The differences found among vehicle types for accident environment variables are undoubtedly largely a function of exposure variables. However, exposure variables cannot temper the important differences found among vehicle types for vehicle defects, for driver culpability, and for risk of injury to driver in multi-vehicle crashes. These differences underscore the fact that the heavier trucks pose special problems on the highways that have significance for the rest of the driving public. Measures to ensure that in the case of these large vehicles both operators and vehicles are in optimal condition should prove beneficial both to the trucking industry in terms of reduced losses and to the driving public in terms of increased safety.

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APPENDIX

The Accident Report Form

TRAFFIC ACCIDENT REPORT	LOCATION		Date of Accident: 19 Day of Week: Hour: A.M. P.M.		Do not write in this space							
	Accident Occurred In: County: Near City or Town of: Outside City or Town: Miles N E S W of Limits Center		On: Hwy. No. (I., U.S., N.E., R.P., R.U.) If No., or within corporate limits, identify by name									
	Hwy. No., or Adjacent County Line		Hwy. No., City, or Adjacent County Line									
	Toward: (10 Ft. if Intersect.) N E S W		Toward: Hwy. No., City, or Adjacent County Line									
ACCIDENT TYPE	Type of Collision:		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 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	Driver: First Middle Last Name		Driver: First Middle Last Name									
	Address:		Address:									
	City: State: Zip: Is above address same as on Driver's License? Yes No		City: State: Zip: Is above address same as on Driver's License? Yes No									
	Date of Birth: Month Day Year Specify Restriction: Member of Armed Forces Yes No Veh. Year: Make: Type: Lic. Plate No. State: Year: VIN ODOM.		Date of Birth: Month Day Year Specify Restriction: Member of Armed Forces Yes No Veh. Year: Make: Type: Lic. Plate No. State: Year: VIN ODOM.									
VEHICLE NO. 2 or PEDESTRIAN	Driver: First Middle Last Name		Driver: First Middle Last Name									
	Address:		Address:									
	City: State: Zip: Is above address same as on Driver's License? Yes No		City: State: Zip: Is above address same as on Driver's License? Yes No									
	Date of Birth: Month Day Year Specify Restriction: Member of Armed Forces Yes No Veh. Year: Make: Type: Lic. Plate No. State: Year: VIN ODOM.		Date of Birth: Month Day Year Specify Restriction: Member of Armed Forces Yes No Veh. Year: Make: Type: Lic. Plate No. State: Year: VIN ODOM.									
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 D=No injury											
	INJURED NAMES AND ADDRESSES			INJURED NAMES AND ADDRESSES								
	First Name Last			First Name Last								
ADDED BY (Initials)	SEAT	Ini	Res	Race	Age	SEAT	Ini	Res	Race	Age		
	Left Front					Left Front						
	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:						Injured taken to:					
	WIT- Name Address Phone No.						WIT- Name Address Phone No.					
NESSES Name Address Phone No.						NESSES Name Address Phone No.						
Arrests: Name Charge(s) (Crt. No.)						Arrests: Name Charge(s) (Crt. No.)						
Sign Here Officer's Rank and Name Number Department Date of Report						Sign Here Officer's Rank and Name Number Department Date of Report						

[illegible]