Statement of
Motor Truck Manufacturers Division,
Motor Vehicle Manufacturers Association
of The United States, Inc.
on

"Key Issues In Heavy Truck Safety"

Submitted at the
Motor Vehicle Safety Seminar

Sponsored by the
National Motor Vehicle Safety Advisory Council

July 12, 1976
FAA Building, 800 Independence Avenue, S.W.
Washington, D.C.

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MVMA'S ANALYSIS AND VIEWPOINTS ON KEY ISSUES IN HEAVY TRUCK SAFETY

Contents

Contents

Appendices

SUMMARY & RECOMMENDATIONS

Summary

Expressing its continuing commitment to heavy truck safety, MVMA pledges full support to the National Motor Vehicle Safety Advisory Council in its efforts to improve knowledge and understanding of the key safety issues involved. MVMA cites its considerable investment in truck safety research and analysis and underscores the industry's concern and its commitment to further study and evaluate accident causation and other safety issues. This includes the need to focus on all three elements of highway traffic safety: the vehicle, the driver and the highway itself.

Before making recommendations to the Advisory Council, the Association addresses several hypotheses and recommendations advanced by Mr. Gustafson for the seminar agenda. While some of the statements and proposals appear valid and others less so, virtually all of them suffer from a lack of well-defined and reliable data.

In this regard, MVMA suggests a coordinated heavy truck safety research and information gathering program involving government, industry, the academic and scientific communities. Subjects to be explored include: the development of better accident involvement reporting and evaluating procedures that segregate large from small truck data; development and maintenance of in-depth large truck accident studies, including the collection of better exposure information, data on the effects of speed differentials, and data on the effects of various vehicle designs; studies and analyses on methods for improving police reporting and collection techniques on large truck accident involvements; the development of more effective motor truck inspection procedures; and, the development of comprehensive training, registration and licensing procedures for truck drivers.

A prepromulgation exchange of information between government, industry, the public and researchers is suggested as a means to assure that proposed truck safety standards are necessary, that they meet statutory goals, and are the best of all alternatives. The proposals also should be supported by adequate analysis of the costs and consequences before being finalized. The analysis should include the feasibility for design and production of a particular system necessary to meet standards and assurance that the system is cost-effective.

When unproven safety standards are proposed and when a new technology is involved, MVMA emphasizes the importance of adequate development, field testing, and manufacturing lead time. In this

regard, the Association suggests the use of General Service Administration vehicles in a program of planned research and testing of the proposed requirement so DOT and the manufacturers can evaluate the effect of implementing a new standard before it is proposed, and assure that the cost of implementation--to the manufacturer, truck user and public--is accurately identified and will not be disproportionate to the results to be achieved.

The Association calls for a solid and creative relationship between Federal and state governments, and industry, for a freer exchange of information on real world needs for safety enhancement on the highways.

Recommendations

Initiation of a coordinated heavy truck safety research and information gathering program involving government, industry, the academic and scientific communities to investigate:

- The development of better accident involvement, reporting and evaluating procedures that segregate large from small truck data;

- Development and maintenance of in-depth large truck accident studies including the collection of better exposure information, data on the effects of speed differentials, and data on the effects of various vehicle designs;

- Studies and analyses on methods for improving police reporting and collection techniques on large truck accident involvements;

- The development of more effective motor truck inspection procedures;

- The development of comprehensive registration and licensing procedures for truck drivers.

A pre-rulemaking exchange of information between government, industry, the public and researchers to assure that:

- Proposed rules are necessary

- Proposed rules meet statutory goals

- Proposed rules are the best of all alternatives.

Use of General Service Administration vehicles in a planned research and testing program to:

- Evaluate the effect of implementing a new unproven standard involving new technology
- Give manufacturers an opportunity to evaluate reliability of the standard in day-to-day operation
- Enable manufacturers to gain in-service experience and leeway for training mechanics who must service and repair the new equipment
- Assure that the cost of implementation will not be disproportionate to the results achieved.

June 29, 1976

MVMA's ANALYSIS AND VIEWPOINTS ON KEY ISSUES IN HEAVY TRUCK SAFETY

I - INTRODUCTION

We commend the National Motor Vehicle Safety Advisory Council for initiating this symposium, and in particular the Chairman of today's session, Mr. Gustafson. It is our hope that the presentations will shed light on the key issues of heavy truck safety. We pledge our support and full participation and cooperation in your efforts to develop more knowledge and better information and understanding of the issues involved in heavy truck safety.

Many hypotheses on truck safety which will be discussed at this seminar today have been advanced for the purpose of drawing public attention to the safety performance of trucks. As with all forms of transportation, safety is a serious consideration. What is at issue, however, is the nature of proposed countermeasures to safety related problems and whether these responses will be cost effective and constructive in terms of the real world in which motor trucks are utilized in the nation's economy.

We recognize that the information regarding heavy tractor-trailer combinations is far from definitive and because of this there is need for caution in interpreting the analysis of available accident statistical information. Our information and analysis of available data fails to establish heavy trucks as grossly disproportionate contributors to the incidence of death and injury in motor vehicle transportation. As in all societal systems, however, there is room for improvement.

Our Association -- the Motor Vehicle Manufacturers Association -- is dedicated to working for a better understanding of the role motor trucks and buses play in our daily life and the critically important contributions they make to our nation's economy. The Association sponsors basic research concerning their use and over the years has supported efforts aimed at developing the bases for safer, more reliable, more effective motor truck transportation.

Our motor vehicle research program, conducted largely through grants and contracts, has been directed toward a better definition of the traffic safety problem, and better understanding of those factors which cause accidents and injuries on the highway. The objective has been to expand information and knowledge bearing on traffic safety problems so that effective countermeasures can be developed. (Appendix A)

The Association has sponsored research conducted at the University of Michigan's Highway Safety Research Institute, Calspan Corporation, University of North Carolina's Highway Safety Research Center, University of Southern California, Wayne State University, Southwest Research Institute, Stanford Research Institute, Stevens Institute of Technology, and Purdue University. Today, the program consists of seven categories: human tolerance, occupant dynamics, tires, lighting, driver vision, braking and handling for trucks, and collision data gathering and analysis.

MVMA's current motor truck research program is in two parts: (1) the Truck Braking and Handling Projects, and (2) the Truck Accident Causation and Investigation effort.

A - MVMA'S TRUCK BRAKING AND HANDLING PROGRAM

In mid-1971 MVMA initiated a motor truck braking and handling program at the University of Michigan's Highway Safety Research Institute. This comprehensive research project, costing more than $1 million, will help define vehicle handling characteristics. Hopefully these will be useful in developing handling specifications for the future that will be technically sound, cost effective, and not unduly design-restrictive. The objective of this program is to develop a computer-based mathematical model for predicting the straight line and directional response of trucks and tractor trailers under various braking and handling situations. (Appendix B)

The intent of this program is to produce a sophisticated engineering aid that will be available to reduce the mechanics of truck design to mathematical terms. This, hopefully, will enable design engineers to predict the performance of motor trucks yet to be built. It will also provide a uniform basis for performance analysis and estimation which will be useful to both the truck manufacturing industry and those in Government who have the responsibility for establishing vehicle safety standards.

B - MVMA'S TRUCK ACCIDENT RESEARCH PROGRAM

The second major research effort is the truck accident investigation and accident data collection program. The purpose of this program is to determine the modes and types of accidents in which trucks are involved so that they can be designed to prevent accidents and minimize injuries -- both to their occupants and those of other vehicles.

The Association, over a period of many years, has sponsored the Collision Data Bank at the University of Michigan's Highway Safety Research Institute. This includes files on large truck accidents from various parts of the country. It has also supported the establishment and maintenance of collision data files at Calspan covering the eight western counties of New York State. In addition to passenger car data, these files describe accidents in which at least one of the vehicles involved was a large truck. These police-reported accident data (10,000 reports) are augmented by Calspan investigations of some 2,700 tractor-trailer combinations involved in accidents.

More recently, MVMA in conjunction with NHTSA and the California State Highway Patrol funded a heavy truck and bus accident study by the University of Southern California. This is a census sample of all heavy trucks (over 10,000 lbs. GVW) involved in accidents occurring in two well defined areas -- Los Angeles and Sacramento. The data sample is of major significance because of its unique sampling, exposure and involvement rate information.

At the request of MVMA, another recent study was undertaken by the Highway Safety Research Institute of the characteristics of large truck accidents as reported in its Texas accident data file.

The occurrence of large truck accidents is relatively infrequent so that very large data samples are required to obtain meaningful statistics. The Texas data file contains reports of about 50,000 large truck accident involvements, (10 percent), of a total of one-half million accidents. The Texas truck accident data represents the largest police-reported data bank anywhere in the world. The data bank files are constructed to permit an examination of five percent samples for rapid evaluation of the large volume of data.

Although these comments are focused upon safety of the operation of motor trucks, the interest of MVMA in truck safety is but one part of our total interest in the safety of the use of 134 million motor vehicles -- including 25 million trucks -- on the nation's 3.8 million miles of highway, streets, and roads.

We will not go into detail here on the positions taken and advocated on safety, nor on the safety services we have provided or financed. Suffice it to say that MVMA advocates a balanced approach toward identifying and proposing appropriate and effective measures to improve the safety qualities of the highway and its environment. These include emergency medical services; a high level of competence and performance for all drivers; and an adequate level of controllability and crashworthiness in the motor vehicle.

MVMA has recently completed a four-part research program on the management of state safety programs, on the evaluation of these programs, on the application of safety technology on the highways, and on the human factors research needs.

The truck manufacturing industry is confident that by a cooperative effort with those who use its products and with those in government who regulate them, a productive effort can be mounted aimed at reducing truck accident involvement. But first, we need more knowledge and a better identification of the problems. A truly cooperative effort can contribute significantly in improving truck safety for the driver, the driver of other vehicles and the pedestrian.

II - GENERAL OVERVIEW OF TRUCK SAFETY HYPOTHESES AND ISSUES

In announcing the agenda for this morning's session, Mr. Gustafson asked that we address our remarks to the data, conclusions and recommendations in his letter to the Advisory Council dated January 28 of this year. In reviewing that letter and the references cited, we find 21 hypotheses concerning the accident involvement of tractor-trailer combinations.

In order to evaluate and comment constructively on these hypotheses, MVMA asked two major independent research organizations to review, evaluate and critique them against available research findings, the literature and new truck accident data from the State of Texas and two defined areas in California. Southwest Research Institute and Calspan Corporation were adked to undertake this assignment.

Following is a summary of the hypotheses:

1. One percent of all registered vehicles are tractor/trailer or other combinations. This one percent is involved in 2.6 percent of all accidents and 7.3 percent of all fatal accidents.

2. The better safety performance of smaller trucks (pickups, vans, etc.), which constitute about 96 percent of the total number of trucks, completely obscures the safety performance of combination trucks.

3. Comparatively little information has been developed on the unique safety performance of truck combinations.

4. With the energy crisis, have come two distinct movements: More smaller, economical cars and larger heavier trucks on the roads. With this increasingly adverse vehicle mix, the safety problems cannot get better.

5. Trucks are more likely to be reported as having safety defects than cars. The Department of Transportation's Bureau of Motor Carrier Safety inspects about 30,000 trucks each year, and has listed the most numerous safety violations as follows (in descending order): 1) lighting, 2) brakes, 3) tires, 4) exhaust, and 5) safety appliances.

6. In car/tractor/trailer crashes, the truck driver is more likely to be at fault.

7. The tractor/trailer is more likely to collide into the rear of a car, rather than vice-versa, in rear end crashes. Sixty-three percent of truck collisions with other vehicles involved the truck's braking ability. Tractor/trailers also have greater propensity to "jackknife", turnover and otherwise lose control than passenger cars.

8. Trucking is the most costly, in terms of lives, of all the freight modes, four times more costly than railroads, which are the next most costly.

9. Trucks are more likely to kill other highway users: two-thirds of the people killed in crashes involving trucks are other highway users.

10. For each truck occupant fatality in crashes involving trucks, there are 30 to 40 other highway users killed.

11a. Some studies have shown that fatal collisions of cars with tractor/trailers resulted in occupant deaths in the cars 10 times as high as in trucks.

b. Other studies have shown that a tractor/trailer accident is three times more likely to result in a fatality than a passenger car accident.

12. Passenger cars account for 82 percent of all accidents and 70 percent of all fatals while tractor/trailers account for 2-4 percent of all accidents but 7-8 percent of all fatals.

13. Trucks are twice as likely to be involved in a crash per mile driven than cars.

14. About half of all fatal accidents involving trucks are single-vehicle incidents, usually driving off the road into immovable objects.

15. The crashworthiness of tractors has decreased since the hood and extra distance between the driver and the front bumper are now gone.

16. Larger trucks are more likely to be involved in single vehicle crashes than smaller trucks or passenger cars.

17. If the truck hits another vehicle, the driver's chances of surviving are excellent, since the other, usually smaller vehicle, acts as an energy attenuating device. But if the truck goes off the road in a single vehicle incident, the driver's chances of surviving are not much better than if he were in a car.

18. Trucks are inherently more unsafe because they are driven many more miles than other vehicles.

19. Speed differentials lead to increased risk of crash.

20. Other vehicles underride trucks in about 10 percent of car-truck crashes.

21. Deaths/injuries per ton mile is an acceptable comparison criteria by mode of transportation.

Specifically, both contractors were given the following four tasks:

1. <u>Review and Analyze Interpretation of Available Literature</u>:

Review and analyze the listed hypotheses that have raised a number of questions about the role of tractor-trailer combinations and traffic accidents. Make a determination of the accuracy of the statements and verify the validity of the references cited.

2. Accident Data Statistical Analysis:

Analyze current available collision data involving trucks and evaluate the 21 hypotheses listed above on the basis of that data. Tractor-trailer accident data from California, Texas and Calspan will be utilized in this analysis.

3. Data Bias Identification:

Examine existing collision data files involving tractor-trailer combinations and identify biases and/or limitations that are inherent or implied.

4. Assessment and Report:

Undertake an assessment of the findings and prepare a final narrative and tabulated report. Qualified comparisons will be made, where possible, and the extent of the problems will be identified.

Independent Evaluations Summary of Findings

The independent contractors -- Calspan and Southwest Research Institute -- have submitted their final reports on their evaluation and critique of the various hypotheses on heavy truck safety which were advanced by Mr. Gustafson for discussion purposes. These reports are attached as Appendix C and Appendix D so that the Advisory Council can have the benefit of these in-depth reviews. The findings of the two reports are summarized in four basic categories, as one of the contractors had grouped the 21 hypotheses for analysis purposes. A summary of the findings is presented here in the same four groupings -- (1) accident characteristics, (2) fatalities, (3) accident rates, and (4) miscellaneous.

A - ACCIDENT CHARACTERISTICS

Hypothesis: "About half of all fatal accidents involving trucks are single-vehicle incidents, usually driving off the road into immovable objects."

1. Calspan Comments

Calspan determined that a more appropriate estimate for large trucks in single-vehicle, fatal accidents would be about 20 percent instead of 50 percent on the basis of North Carolina, Maryland and Texas large truck accident data. Furthermore, they found that when all truck accidents, not limited to fatalities, were examined in Texas and North Carolina, approximately 27 percent and from 19 to 28 percent, respectively, were found to be single-vehicle accidents, again short of the 50 percent stated.

Calspan further found that the data supported the view that most single vehicle truck accidents, particularly fatal ones, involve either running off the road or hitting a fixed object.

2. Southwest Research Institute Comments

SwRI found that 50 to 70 percent of fatal accidents involving large trucks over 10,000 lbs. GVW were single-vehicle accidents, whereas for tractor-trailers 10 to 30 percent were single vehicle accidents. The 50 percent was from North Carolina data; the 70 percent was from an analysis of the Texas Large Truck File. The tractor-trailer information came from Maryland and the Texas Fatal File.

SwRI further found from the Texas tractor-trailer data that about 50 percent of the fatal accidents included driving off the road but only 20 percent included hitting a fixed object.

3. MVMA Comments

Although Calspan and SwRI reached different conclusions about the involvement rate of single large trucks in fatal accidents, an examination of their respective conclusions indicates that tractor-trailers, the type of vehicle at which these discussions are generally directed, are involved in single-vehicle, fatal accidents less than the stated 50 percent. In fact the information indicates it is in the range of 10 to 30 percent, which is significantly less than that which would be implied in the Gustafson report.

The point that most of these types of accidents involve running off the road is not disputed, but there is an indication that they do not strike immovable objects most of the time in contrast to the statement made in the Gustafson report.

Tractor-trailer drivers, it can be concluded, even though they are in large vehicles which articulate and a portion of which are the cab-over-engine type, do not incur more injuries than do drivers of other large trucks or in single-vehicle, fatal accidents based on limited data.

Hypothesis: "The tractor-trailer is more likely to collide into the rear of a car, rather than vice-versa, in rear end crashes. Baker's study showed that 63 percent of truck collisions with other vehicles involved the truck's braking ability. Tractor-trailers also have a greater propensity to "jackknife", turnover and otherwise lose control than passenger cars."

1. Calspan Comments

Calspan found that there is little reason to accept the statement that in rear end accidents involving cars and tractor-trailers the truck is more likely to be the striking vehicle for they found there was little demonstrated difference in the data available. The data indicated that the striking vehicle was a truck in 46.8 to 61.5 percent of the incidents, and, therefore, there was roughly an even chance that the striking ehicle was a truck, not a "more likely" chance that it was a truck.

Calspan found misleading the statement that "63 percent of truck collisions" involved the truck's brakes. Rather, the Baker study indicated the referenced incidents were accidents in which braking may have been a factor and there was no confirmation that braking in fact was a factor. Further, the study did not indicate which vehicle was at fault or if improved braking would have prevented the accident. Lastly, there was no comparision with other types of vehicles, such as passenger cars, to determine if other types had a higher braking involvement rate than tractor-trailers.

In respect to jackknifing and loss of control relative to passenger cars, Calspan found that tractor-trailers roll over more often than cars and jackknifing is a problem for articulated trucks, but cautioned that loss of control or jackknifing should not be viewed in all cases as the event that precipitated the accident. In fact two studies they evaluated indicated that between one-third and two-thirds of the jackknifings occurred after impact.

2. Southwest Research Institute Comments

SwRI concluded from examining data not limited to tractor-trailer data that trucks more frequently strike vehicles in the rear end rather than get struck by other vehicles in multi-vehicle crashes and that the ratio was approximately two to one.

In respect to the truck's braking capability they determined that truck braking played a prominent role, but there was no evidence that 63 percent of crashes are traceable to poor brakes.

SwRI concluded in respect to jackknifing and roll over that trucks are more unstable than cars and thus tend to have a greater propensity to jackknife and roll over. The institute then poses this "philosophical question": "Is the trade-off between the large truck as a means of distributing merchandise and supplies more cost effective than some other (as yet undefined) method of distribution."

3. MVMA Comments

Tractor-trailers are by definition large articulated vehicles. SwRI, however, identifies an important issue that these vehicles play a key role in our economic system. These vehicles need to be large; they need to be articulated. One could well imagine the number of vehicles it would require to replace large trucks with small pickups. The extra labor and energy cost would be high, and an increased number of vehicles would be exposed in the traffic stream. Furthermore, the articulation is necessary to allow the trucks to enter into and maneuver around loading areas. To compare the control dynamics of tractor-trailers with passenger cars is inappropriate since they do not serve the same function in society.

In regard to the other point, that trucks are more likely to be the striking vehicles in rear end multi-vehicle accidents, it should be noted that Calspan and SwRI came up with two different conclusions. Calspan indicates that there is an even chance that the striking vehicle is a car or a truck. SwRI concludes that the truck is more often the striking vehicle. These differing conclusions only serve to point out that truck accident data is limited; conclusions from it can be varied and should be viewed with caution.

The last item, that brakes are involved in 63 percent of truck collisions, is misleading. One might reasonably expect that brakes are involved in most truck collisions as every

driver's instinctive reaction when faced with an imminent collision is generally to apply the brakes. Calspan and SwRI, however, have appropriately pointed that the Baker study only indicated that in 63 percent of truck collisions braking may have been a factor. It was not identified that in 63 percent of the incidents braking was a factor or that the brakes were poor. Furthermore, the study did not indicate the vehicle at fault or whether improved brakes would have prevented the accident or even reduced its severity. One could conclude that braking plays an important role in accidents and accident avoidance, but the information does not support the assertion that brakes are a causative factor in the majority of truck collisions.

Hypothesis: "In car-tractor-trailer crashes, the truck driver is more likely to be at fault."

1. Calspan Comments

Calspan found no data pertaining to fault in accidents involving tractor-trailers and cars. It did, however, examine North Carolina data and a study done by Perchonok on data pertaining to large trucks.

In North Carolina the large truck drivers were more often reported to have committed a violation, but it was noted that in single vehicle accidents cars had a higher violation rate versus trucks by an approximate two to one margin.

In the Perchonok study it was determined in 57 car-truck accidents studied in-depth that the truck drivers were culpable in only 42 percent of the accidents investigated. There is no statistically significant difference between car and truck driver culpability.

Calspan concluded by stating that its findings were mixed and that they could not conclude "at this time that truck drivers are more likely to be at fault."

2. Southwest Research Institute Comments

SwRI reviewed data from North Carolina, Texas and California. It concluded from the data that the truck driver was more likely to be listed for a violation by the investigating officer than the car driver in the car-truck crashes.

As did Calspan, however, SwRI found that in single-vehicle accidents there were data indicating that truck drivers were less likely to be in violation than car drivers.

3. MVMA Comments

Calspan and SwRI both agree that available data indicate that truck drivers in car-truck accidents are more often the drivers cited with the violation.

The offsetting information that this is not the general case in single-vehicle accidents raises some questions. Why would truck drivers be at fault more often in car-truck accidents and statistically less than car drivers in single-vehicle accidents? Are truck drivers actually more careful drivers, as indicated by the single-vehicle accident data, but draw more citations in multi-vehicle accidents because of the greater difficulty in performing avoidance maneuvers with a large truck than with a car? Are investigating officers sympathetic to the car drivers and, consequently, issue more citations to truck drivers?

The above questions, and the limited data with the conflicting trend information clearly indicate a need for more research in this area.

Hypothesis: "Other vehicles underride trucks in about 10 percent of car-truck crashes."

1. Calspan Comments

Calspan reviewed studies of Maryland and Utah data and another study made by Scott and O'Day of HSRI. It concluded that the data supported the 10 percent underride figure. Calspan cautioned, however, that the data were not sufficient to allow complete generalization of the hypothesis.

2. Southwest Research Institute Comments

SwRI reviewed studies or data on accidents in Maryland, Texas, Michigan, Denver, Los Angeles and data in the BMCS file. It concluded that 10 percent was too high for underride and that 5-6 percent was more representative.

SwRI also determined that the "frequency of car-into-truck rear end fatal collisions is on the order of one per million population per year."

3. MVMA Comments

The studies by Calspan and SwRI indicate that underride occurs in from 5-10 percent of multi-vehicle accidents involving trucks, but it was cautioned that the data are too limited to support a generalization from the information.

Most interestingly, and certainly a significant indicator of the minimal nature of the underride type of accidents, was the finding by SwRI that only one per million population

per year is involved in a fatal rear end underride accident. This statistic should point the way to an appropriate cost/ benefit study of the potential effectiveness of underride protection versus the substantial economic impact of such manufacturing requirements.

B - FATALITIES

Hypothesis: "Trucks are more likely to kill other highway users: two-thirds of the people killed in crashes involving trucks are other highway users."

1. Calspan Comments

Studies of accidents involving trucks can be used to determine the number of non-truck occupants killed in truck accidents. If two-thirds of the fatalities are in non-trucks, then one-third are in trucks: hence the ratio of occupant deaths in non-trucks compared with trucks would be two to one. It should be noted that in BMCS studies, pedestrians are included, and result in the following ratios:

1975 BMCS	3:1
Ernst & Ernst (tractor-trailer combinations)	3:1
Ernst & Ernst (All Trucks)	2:1

2. Southwest Research Institute Comments

The available data indicate that 60% to 85% of the people killed in car-large truck crashes are the occupants of the car.

Green (Texas)	91.1%
Loman & Waller	94.2%
Robertson & Baker	82.8%

SwRI concludes that this is a conservative statement and could be restated as follows: "Over 80% of the people killed in large truck-car collisions are occupants of the car."

3. MVMA Comments

Truck-car collisions cause a disproportionate share of the fatalities to occur in the passenger car for two reasons. First, because there is a large difference in weights between the car and the truck, the passenger car occupants suffer more from the collision. Secondly, since passenger cars are intended to carry people while trucks are intended to carry goods, there are likely to be more people exposed to injury in the passenger car than in the truck. Neither of these conditions can be changed by safety-related regulatory rulemaking. One would expect in time, however, that this condition will improve as the highways become more populated with later model cars that have had the benefit of recent safety improvements in crashworthiness, braking, etc. But it emphasizes the need of efforts to avoid collisions through driver improvement, improved braking and handling, and improvements in the highway environment.

Hypothesis: "For each truck occupant fatality in crashes involving trucks, there are 30 to 40 other highway users killed."

1. Calspan Comments

A number of investigators who have studied truck accidents have reported values which can be used to test the validity of this statement. In a few cases, data was available which permits the number of occupants of the vehicle to be taken into account when the ratios are calculated.

The studies reported the following ratios:

		adjusted for occupants
Baker	16:1	9:1
Ernst & Ernst	24:1	16:1
Lohman & Waller	7:1	
Scott & O'Day (Turnpike)	21:1	
Scott & O'Day (BMCS)	34:1	
Scott & O'Day (Texas)	21:1	
Scott & O'Day (Turnpike, trucks only)	10:1	
Scott & O'Day (Texas, secondary roads)	8:1	
Herzog	16:1	

2. Southwest Research Institute Comments

Texas accident data indicate that for each truck occupant fatality in crashes involving tractor-trailers, there were approximately 36 other highway users killed. This data supports the hypothesis.

3. MVMA Comments

The arithmetic average of the non-adjusted ratios is 17:1. This is substantially below the "30-40" reported in the hypothesis above. If the ratios are adjusted for the number of occupants in the respective vehicles, that ratio would be even lower.

Truck-car accidents cause a disproportionate share of fatalities in the passenger car for two reasons: (1) because there is a difference in weights between the car and the truck, the passenger car occupants suffer more from the collision; and (2) since passenger cars are intended to carry people while trucks are intended to carry goods, there are likely to be more people exposed to injury in the passenger car than in the truck.

Hypothesis: "Some studies have shown that fatal collisions of cars with tractor-trailers resulted in occupant deaths in the cars 10 times a high as in trucks. Other studies have shown that a tractor-trailer accident is three times more likely to result in a fatality than a passenger car accident."

1. Calspan Comments

The consensus is that the ratio is likely to be near ten to one after correcting for the greater number of occupants in cars. The uncorrected ratios tended to cluster near twenty to one.

Accident Facts (1975) gives the following figures. Passenger cars constituted 82.0 percent of all accident vehicles and 70.4 percent of all vehicles in fatal accidents; all truck-trailer combinations taken together constituted 7.3 percent of all accident vehicles and 2.6 per cent of all vehicles in fatal accidents. These figures are quite close to those in the hypothesis and lead to a ratio of 3 to 1 ($7.3/2.6 \div 70.4/82.0 = 3.27$). Thus it seems that these statements are based on the same data, reflect the same view, and are valid representations of those data.

2. Southwest Research Institute Comments

The Maryland report showed that in 101 collisions between tractor-trailers and cars or station wagons, 56% of the car occupants died while only 6.0% of the tractor-trailer occupants were fatalities. Thus the occupant death rate in the cars was 9.3 times as high as in the tractor-trailers. The North Carolina study

reports car drivers are seven times more likely to be fatally injured than truck drivers in large truck-car accidents. Data from Accident Facts reported for passenger cars a rate of 1.98 fatal involvements per 1,000 accident involvements while for truck tractor and semi-trailer and other truck combinations, the fatal involvement rate was 6.27. Thus the ratio between trucks and passenger cars is 3.17.

3. MVMA Comments

Our comments on pages 22 and 24 apply here and we reiterate that the consequences of the weight differences serve to emphasize the importance of countermeasures aimed at avoiding such accidents, particularly through better driver training and improvements in the highway environment.

Hypothesis: "...passenger cars account for 82 percent of all accidents and 70 percent of all fatals while tractor-trailers account for 2-4 percent of all accidents but 7-8 percent of all fatals."

1. Calspan Comments

Accident Facts (1975) gives the following figures. Passenger cars constitute 82.0 percent of all accident vehicles and 70.4 percent of all vehicles in fatal accidents; all truck-trailer combinations taken together constituted 7.3 percent of all accident vehicles and 2.6 percent of all vehicles in fatal accidents. These figures are quite close to those in the hypothesis and lead to the ratio of 3 to 1.

2. Southwest Research Institute Comments

The data supports the 3 to 1 hypothesis as stated. The same data can be utilized to find involvement rates based on the miles traveled. For combination trucks, the accident involvement rate is 14.0 vehicles in accidents per million miles of travel. This is compared to rates of 15.5 for non-combination trucks and 20.3 for passenger cars. Similarly for combination trucks, the fatal accident involvement rate is 8.8 vehicles in fatal accidents per million miles of travel. This is compared to 3.3 for non-combination trucks and 4.0 for passenger cars. Thus the accident involvement rate for passenger cars is 1.5 times higher than for combination trucks, but the fatal rate for trucks is twice that of cars. In either approach, large trucks are over-represented in fatal accidents.

3. MVMA Comments

Although the statistics are apparently accurate, the data used to support hypotheses concerning over-involvement of heavy trucks in fatal accidents frequently require caution in their use. For example, the National Safety Council when referring to its tabulated data states: "Percentage figures are based on numbers of vehicles and do not reflect miles traveled or place of travel, both of which affect accident experience."

The North Carolina data shows, for example, that 50 percent of the large truck accidents occurred where the posted speed limit was at least 50 mph while 32 percent of the passenger car accidents occurred in such zones. This not surprising result comes from the fact that trucks are used to move goods on major roads where any accident is more likely to produce severe injury. These cautions and the limited availability of data serve to emphasize the need for heavy truck accident reporting and analysis to identify those characteristics causing fatalities and serious injuries that can be modified by improved design of the vehicle, the highway, driver training, or other means.

Hypothesis: "...if the truck hits another vehicle, the driver's chances of surviving are excellent -- since the other, usually smaller vehicle acts as an energy attenuating device -- at the expense of the other driver. But if the truck goes off the road in a single vehicle incident, the driver's chances of surviving are not much better than if he were in a car."

1. Calspan Comments

This hypothesis notes that in car-truck accidents, the truck drivers have the greater survival rate; it also states that in single vehicle accidents, drivers of trucks and cars have almost equal survival rates. The literature supported both views. The statement goes on to say that the difference exists because in multi-vehicle accidents, the car acts as an energy attenuating device. This view is not supported empirically.

2. Southwest Research Institute Comments

If a large truck collides with a car, 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. In single vehicle crashes, it is reported that the proportion of drivers sustaining a fatal injury does not differ greatly between trucks and cars.

3. MVMA Comments

The data on single vehicle accidents show that occupant injuries are less severe in heavy trucks than in passenger cars. The North Carolina data shows that in single vehicle

crashes 79 percent of the heavy truck drivers will suffer no visible injury while only 70 percent of the passenger car drivers will be as well off.

C - ACCIDENT RATES

Hypothesis: "One percent of all registered vehicles are tractor/trailer or other combinations. This one percent is involved in 2.6 percent of all accidents and 7.3 percent of all fatal accidents. (1975 Motor Truck Facts, and Accident Facts, 1975)."

1. Calspan Comments

Using the broadest data sources Calspan obtained the same figures as appear above. It should be noted, however, that these figures fail to take into account the proportionately greater amount of exposure of tractor/trailers,and differences in the nature of the environment in which they travel.

2. Southwest Research Institute Comments

Based on 1974 data the above statement is generally correct. The percentage figures are based on numbers of vehicles not numbers of accidents. Also, such numbers do not adequately reflect exposure-to-risk so some caution must be utilized in concluding an over-involvement in accidents for large trucks. If it were possible to determine driving exposure of large trucks so that involvement rate per unit of miles driven, or per unit of hours on the road, etc., could be calculated then more accurate and meaningful comparisons could be made.

3. MVMA Comments

MVMA concurs with the Calspan and SwRI comments, in accepting these statistics; they are not considered to be meaningful, however, nor conclusive since exposure and environment are not considered.

Hypothesis: "Trucks are twice as likely to be involved in a crash per mile than cars: (Campbell, Scott, and Tolkin, 1976.)"

1. Calspan Comments

No report studied supported this hypothesis. The ratio of truck to car accident rates ranged from 0.28 to 1.69. The arithmetic average of these ratios equaled one.

In summary, previous findings concur with the higher fatality rate for accidents involving trucks. However, that trucks have a higher probability of an accident (i.e., accident involvment frequency divided by the number of registered trucks) must be tempered by the accident rate data (using miles driven) which fail to show different accident rates for trucks versus cars.

2. Southwest Research Institute Comments

Toll road data indicate large trucks are more likely to be involved in slightly more crashes per mile driven than cars for U.S. interstate roads; but not twice as likely. The USC study indicate over-involvement in accidents by large trucks in the California area, but the hypothesis cannot be effectively evaluated until car exposure rates are available for comparison.

3. MVMA Comments

The above hypothesis is not supported by available data.

Hypothesis: "Larger trucks are more likely to be involved in single vehicle crashes than smaller trucks or passenger cars."

1. Calspan Comments

The source for the above hypothesis was specified as Lohman and Waller. Their comparison was done in terms of accidents, not rates. Scott and O'Day looked at rates of involvement for single vehicle accidents on turnpikes for large trucks and cars. This study, then, showed that in two out of three states, trucks had lower single vehicle accident rates on turnpikes than did cars.

2. Southwest Research Institute Comments

The above hypothesis is correct. Involvement in single vehicle accidents include approximately 20%-23% of large trucks, 10%-15% of small trucks and 13% of passenger cars.

3. MVMA Comments

The researchers' comments suggest that this hypothesis is a generalization to be taken at face value only with careful reservations. As Calspan points out this comparison was done in terms of accident involvement, not rates.

Hypothesis: "Speed differentials lead to increased risk of crash."

1. Calspan Comments

Calspan assumes the basis for this hypothesis is data reported by Solomon (1964). Solomon studied rear end accidents, which he took to include same direction sideswipes, and compared the distribution of relative travel speeds between the two vehicles involved to a distribution of some measure of relative speed between vehicle pairs in "normal traffic". He included only accidents involving two passenger cars.

He showed that greater speed differentials between vehicles occurred more frequently in these rear end accidents than in normal traffic.

He also showed accident involvement rates increased as individual travel speeds departed from average travel speeds. This was particularly evident for vehicles well under the average travel speed. On the basis of such findings he concludes: "Thus, the greater the variation in speed of any vehicle from the average speed of all traffic, the greater its chance of being involved in an accident."

The greatest difficulty with this conclusion is that it does not include Solomon's findings comparing the speed of accident and non-accident drivers. His curves show that