

QUADRIPLÉGIA AND OTHER MOTOR VEHICLE INJURIES:
SOME IMPLICATIONS AND CHOICES FOR MOTOR VEHICLE MANUFACTURERS

William Haddon, Jr., M.D.

President

Insurance Institute for Highway Safety

Watergate 600, Washington, D.C. 20037

Presented at the Automotive News World Congress, Detroit, Michigan,
July 25, 1978.

Simply stated, the gut issue underlying the so-called motor vehicle "safety" problem is the number of Americans that end up dead, or mangled yet alive, after motor vehicle crashes. Despite gains, the picture remains grim.

In illustration, motor vehicle crashes produce more new quadriplegics and paraplegics each year in the United States than all other causes combined.¹ Speaking only of the 70% of such individuals injured as vehicle occupants, in 1974 alone these new cases of spinal cord-damaged people -- mostly young, mostly male -- totalled some 3,700, of whom about half went on to long-term survival.^{1,2}

Stated differently, each year sees the addition of some 1,800 mostly young people to the tens of thousands of earlier motor vehicle drivers and passengers already in wheelchairs and neurological wards as the result of crashes -- crashes in which inadequately-managed crash forces permanently disconnected their brains from large sections of the rest of their bodies. The process goes on year after year, and is the principal reason we are seeing more and more young people in wheelchairs.

Many other grim illustrations could be cited. For example:

- Improperly managed forces reaching and scarring the brain in motor vehicle crashes are a leading cause of epilepsy in the United States.
- Major damage to the face in motor vehicle crashes is by far the leading cause of non-cosmetic plastic surgery.
- On average, of every 1,000 boys reaching the age of 15 in the United States, 6 die as the result of motor vehicle crashes before age 25^{3,4} and some 600 are injured.⁵
- By a wide margin, injuries in motor vehicle crashes are the leading cause of death for American teenagers.⁶

- According to the National Health Survey, the most scientifically-reliable source of such data, an average of almost 13,000 people are injured* by motor vehicles in the United States each day; more than four and one-half million U.S. residents are injured by motor vehicles each year; and about forty-five million each decade -- about a fifth of all of the people in the country!⁵

Small wonder the issue is increasingly a political and not just a medical issue.

Nevertheless, even in the face of such huge amounts of human suffering and tragedy, it is often suggested that the problem is overstated because the risks of death and injury per mile travelled are low and declining. There is, however, a much more important and meaningful measure than such mileage-weighted statistics, namely, the numbers of deaths and injuries expected during the lifetime of each vehicle. It is, after all, the total of injuries and deaths per vehicle during its lifetime (or, alternatively, where lifetimes of different vehicles vary substantially, per year of use) that is the most fundamental and useful measure of the effort and success of the manufacturer in designing and building it to protect human life during its use.

Although the presently available statistics are far from satisfactory, they are more than sufficient to indicate that present vehicle designs leave a huge amount to be desired. On the basis of reasonable estimates, during the lifetime of every 1,000 new vehicles, they will be involved in somewhere

*The National Health Survey injury totals include persons whose injuries caused them to restrict their usual activities for at least a day (including the day of occurrence), who had injuries that were medically attended, or who had both.

between 2,000 and 3,000 crashes; kill, on average, more than three people, and injure more than three hundred.*

Such illustrations do not reflect a situation newly burst upon us. The motor vehicle injury situation in its essentials is already many decades old. It is an American tragedy. It is a situation with many aspects and extensive history. Many needed things have been done, and many others need yet to be done by many people, including by public and private executives and their organizations. (These things that need to be done are by no means exclusively within the motor vehicle manufacturing and selling community; and 96% of the Federal expenditures to reduce the country's damage to people and property associated with vehicle use is targeted on aspects of the problem other than improving the performance of new vehicles before, in, and after crashes.¹⁰)

Nonetheless, there is much evidence that long-practical improvements in motor vehicles would greatly reduce the totals of the maimed and dead, even in many very severe crashes. Despite this, it surely would be an overstatement to suggest that vehicle manufacturers have shown aggressive leadership in providing such life-respecting improvements. In fact, it is already a matter of American history that some manufacturers have fought -- too often successfully, by many means, over a period now of many years -- to delay even minimal improvements in vehicles. It is also a matter of history that, when

*In 1976, there were 138,549,263 registered vehicles⁷, 45,181 motor vehicle deaths⁸ and 4,611,000 injuries⁹. The total number of motor vehicle crashes, excluding property damage-only crashes in which the vehicles were not repaired, was 28,400,000⁸. On the basis of unrepaired damage surveys of passenger cars⁷ it is reasonable to assume that at least an additional 12,000,000 such crashes occur each year. Using the above figures and an assumed vehicle lifetime of 10 years produces the following estimates:

Number of deaths per 1,000 vehicles during their lifetime = 3.26
Number of injuries per 1,000 vehicles during their lifetime = 333
Number of crashes per 1,000 vehicles during their lifetime = 2,049-2,916.

required by Federal minimum performance standards* to make such improvements, manufacturers have often accomplished this in ways that leave their customers and other users of their products essentially no margin of safety above the modest, Federally-required minimums -- in fact, with so little extra that even tiny variations in the Federal compliance tests produce failures.**

In considering this situation in which the American people are so tragically the losers, and having been invited to give my thoughts in a motor vehicle manufacturing context, I would like to suggest thoughtfully for your consideration that over a period of decades, it has been commonplace in the motor vehicle manufacturing community for the so-called safety issue to be misunderstood and misdefined, for things about it to be believed and propagated that are not so, and for actions to be taken that have done and continue to do fundamental damage to the interests of vehicle manufacturers themselves (and of others such as car dealers) -- with the unhappy result that far more people have continued to be hurt than would otherwise be the case.

But there is also evidence that some major companies are shifting in directions which will make their records in the future better than in the

*The National Traffic and Motor Vehicle Safety Act of 1966, Public Law 89-563, September 9, 1966, states that "motor vehicle safety standard means a minimum (emphasis added) standard for motor vehicle performance."

**In illustration, one manufacturer in contesting an "Initial Determination" by the National Highway Traffic Administration that its testing of one of the manufacturer's 1977 vehicles for compliance with the fuel spillage requirements of Federal Motor Vehicle Safety Standard 301 had found it to be in non-compliance, stated, "...It would be improper to find a vehicle out of compliance on the basis of a test conducted at a performance level in excess of the requirement of the standard, no matter how slight ..." (emphasis added). The manufacturer then went on to argue, inter alia, that, "It is clear that the actual barrier speed could have been at least .19 mph over or under the reported test speed of 29.93 mph."¹¹ (emphasis added) The standard requires it to pass a 30 mile per hour rear impact test.

past. In illustration, work is well advanced in some company back rooms on automatic ("passive") crash protection systems (employing air bags) which will give superior protection in frontal crashes, including pole crashes, at speeds greatly in excess of the 30 mile per hour barrier crash-testing speed required in the Federal standard. Moreover, since the real-world crash injury experience of specific makes, models, and series of cars of the coming model years will be routinely determined on the basis of insurance data, and published (and used by insurers, some of whom are developing their own, parallel data) as is now beginning to be accomplished by the Highway Loss Data Institute, there will be increasing incentive for manufacturers to do far better than just meeting the minimum federal standards.

It is also likely that the U.S. Department of Transportation sooner or later will begin crash-testing at least some new vehicles to determine the extent to which their designs and construction actually have been chosen to reduce injurious crash forces. Since the agency's statutory mandate requires it to be concerned generally with reducing crash injuries, and not merely those at and under the quite low test speeds specified in its "minimum" standards, it should be expected to do such crash force-reduction evaluations at considerably higher speeds -- evaluations the results of which would, needless to say, be public property.

It was Hugh De Haven who, in classical scientific and engineering papers published in 1942 and subsequently, first let the cat out of the bag by showing from a quantitative, engineering standpoint (as many others have since) that the human body is so rugged that it can take, with much less injury than it usually sustains, the huge but very transient forces of crash decelerations -- provided that body is properly packaged.* Stated dif-

*See, for example, references (12), (13), (14), (15), (16), and (17).

ferently, you have known scientifically since 1942 that large numbers of those injured in motor vehicle crashes in each of the subsequent years would have been far less damaged, and often not damaged at all, if De Haven's then revolutionary discovery as to how to better preserve life and limb amid the hazards of the transportation environment had been implemented to the maximum practical extent.

I believe that there is considerable evidence that it is just this tragic discrepancy between the scientific knowledge of the great crash forces the body can take and how those forces can be practically managed, on the one hand, and their application in the design, construction, and sale of motor vehicles, on the other, that continues to underlie the bulk of the safety-related public problems with which motor vehicle manufacturers see themselves as confronted. I believe also that these issues will remain and grow for manufacturers, until -- by private initiative, actions of the judicial, legislative, and executive branches of the government, or both -- this lethal discrepancy is eliminated to the benefit of all concerned.

Moreover, similar points can easily be made concerning such parallel issues as flimsy gas tanks, which the public and its institutions are at long last finding out about and which they are also learning need not be that way at all. (Needless to say, it is not only the vehicle that presents lethal discrepancies between what we know how to do and what is being done, as the perpetual relining of our highways with telephone poles and other lethal hazards we would immediately recognize as such if placed along runways for aircraft also so tragically demonstrates.^{18,19,20})

Stated differently, I believe we are already years into an accelerating transition in which the public and its institutions are becoming increasingly aware that many of the maimings and deaths suffered in using highway vehicles

(and, of course, the huge medical and other costs associated with them¹) would not occur if vehicle and highway design reflected both longstanding scientific knowledge and far greater respect for the lives of the American people. In short, I believe Americans are finding out that much of the time, they and their loved ones don't need to die or be maimed just because crashes take place, and they are reflecting this awareness through all three branches of their government, through their press, and in other ways. I suggest that any manufacturers who have not already decided to do so would be well advised to stop fighting this clear interest of Americans in staying alive and unmaimed on the country's roads, and to start providing the real leadership and aggressive competition on this issue, in the best spirit of the free enterprise system, of which they are capable.

I do not know with certainty who actually fabricated that brilliantly-negative slogan, the deception that "Safety doesn't sell," but it is not so. What is so is that "Safety isn't sold," by U.S. and many foreign manufacturers. Buyers have even been strongly discouraged from buying safer cars. In illustration, with respect to air bags, for example, The Wall Street Journal, in a front page investigative report in depth, on November 11, 1976, documented, as its headline put it, how "GM Failed to Push (the) Device: (and) Dealers Discouraged Use ..." ²¹ And, there was widespread dismay among the readers of the Journal's piece at the statement it attributed to a GM spokesman, commenting on a Kansas City physician who had walked away from a violent head-on collision between his air-bag-equipped car and a city transit bus, that the physician was "unusual because he is 'biased' in liking the device. 'Anybody whose life has been saved by the air bag would be biased in favor of it.'" ²¹

Moreover, there is substantial evidence that American purchasers of at least some imported vehicles are especially interested in staying unmaimed and alive. A recent DOT survey found that belt use varied substantially among major car models, and that the highest use was in a number of imported models. This was true not only for users of cars made by Volvo, a company that has for many years emphasized the crash worthiness of its vehicles, but for some inexpensive imports as well.²² It is commonplace that many Americans believe that imported vehicles are generally "safer", and that this is a factor in purchases of such vehicles.* Are these purchases not evidence, then, that "Safety does indeed sell" in these United States? Moreover, is it not likely that the market penetration of the imports will, to the extent to which safety is in fact a factor in their sales, tend not to be reduced until Americans believe the domestic products can do better in protecting them from harm.?

Challenged for evidence to support the "safety doesn't sell" slogan, its proponents usually cite the supposed facts concerning the 1956 Ford. Aside from the questionable relevance of using a product and sales situation almost a quarter of a century obsolete, and aside from the fact that the 1956 Ford was hardly a winner as a car line, consider what Alex Haynes, Director, Advanced Product Study, Ford Motor Company, told a congressional hearing in 1957 as to the actual facts.

The problem today is how to encourage the public to purchase and use seat belts. To some degree, we can evaluate our success in gaining public acceptance of seat belts by examining Ford Motor Co. sales. We announced the introduction of seat belts as dealer-installed accessories on July 12, 1955, and since the introduction of our 1956 models,

*In illustration, reporting at length (in Automotive News, April 17, 1978) on explanations by Bjorn Ahlstrom, President of Volvo of America, for the higher belt use rates in Volvos, Detroit reporter Robert W. Irvin noted that, "Next to quality, Volvo owners say their most important reason for buying a Volvo is safety."

belts have been available on all Ford Motor Co. cars and trucks as factory-installed optional equipment.

Since the 1956 introduction, 160,000 vehicles were purchased with seat belts installed at the factory. In addition over 200,000 belts have been furnished to dealers for their installation.

While our sales figures are considerably higher than originally anticipated, [emphasis added] we are disturbed that the rate of seat belt installation has fallen off in the last few months. Of course, this is due to a reduction in dealer orders for belts, which in turn reflects a decrease in public demand.

It has been disappointing to us that the acceptance of seat belts by many groups interested in highway safety has been slow, and, as you well know, there has been a small vocal minority who have generally opposed seat belts on the basis of misinterpretation of data from a relatively small number of accidents and tests.

In recent months, there have been many articles discussing the pros and cons of seat belts. These have further added to the confusion of the general public, and it is little wonder that there has been a reduction in sales.

It may be of interest to the committee to know that Ford Motor Co. has sold more belts than the rest of industry combined. Perhaps this is due to the fact that, with the exception of Studebaker-Packard Corp., we have been the only manufacturer to install them at the factory. For this reason, our installed price is considerably lower than the prices of our major competitors. Therefore, our experience probably gives a more accurate reflection of public's interest in seat belts than the overall experience of the industry.²³

As Haynes indicated, Ford's belt sales, numbering in the hundreds of thousands over a period of months, and at a time when Americans were far less aware of the crash-protection issue, were "considerably higher than originally anticipated."²³ Clearly, Ford's transient promotion of its safety package was a success -- hardly evidence in any way supporting the tragically lethal dogma that "Safety doesn't sell."

There is, of course, extensive additional evidence pointing to the firm conclusion that the American people have for years been strongly convinced that much more vehicle safety is practical and that manufacturers could, and should, do much more than history shows them to have done.

In illustration, a February 1978 Harris poll found that, "When Americans were asked to rate the importance of nine proposed improvements in the nation's transportation system ... auto safety finished far in front, rated as 'very important by 83%.'" Moreover, the same poll found that Americans by three to one wanted to "spend more money" to improve "auto safety" -- the action with the largest majority of support of all of the many specific proposals the people were asked as to ways "to improve transportation in the United States."²⁴

There is also the evidence of years of judicial decisions. In 1966 and 1968, the landmark Evans and Larsen rule cases were decided. Each involved a plaintiff suing General Motors for damages. In Evans, the U.S. Court of Appeals for the Seventh Circuit decided that the manufacturer had no duty to design his vehicles for the possibility of their being involved in crashes, because the "intended purpose" of an automobile did not include participation in collisions²⁵. But in Larsen, the U.S. Court of Appeals for the Eighth Circuit held the opposite, that an auto manufacturer has a duty to design and construct his product so as to be reasonably fit for its "intended use". The court noted that,

... While automobiles are not made for the purpose of colliding with each other, a frequent and inevitable contingency of normal automobile use will result in collisions and injury-producing impacts. No rational basis exists for limiting recovery to situations where the defect in design or manufacture was the causative factor of the accident, as the accident and the resultant injury, usually caused by the so-called 'second collision' of the passenger with the interior part of the automobile, all are foreseeable The sole function of an automobile is not just to provide a means of transportation, it is to provide a means of safe transportation or as safe²⁶ as is reasonably possible under the present state of the art.

Since then, scores of similar cases -- involving claims that motor vehicle manufacturers had not properly anticipated that many of the vehicles

they make would inevitably crash, and that therefore they should have applied more of their knowledge in the form of practical crash-injury reduction measures -- have reached courts throughout the country. Routinely, the manufacturers have maintained that crash-injury protection was not their responsibility. Nevertheless, by 1978, virtually every court chose in these cases to follow the Larsen Rule -- that the manufacturer could be held liable for not taking reasonable steps to safeguard people in crashes. (In 1977, in a remarkable departure from the customary, the Seventh Circuit Court, the promulgator of the original Evans Rule, reversed itself in favor of Larsen. In doing so, it pointed out that, "... The intended use of a vehicle encompasses the normal incidents of its being driven on the streets and highways, including the potentiality of collisions ..."²⁷)

When many of these cases were decided, widely diverse American juries, themselves a cross-section of Americans, commonly reached the decision after extensive presentation of evidence that the manufacturers involved could have and should have done much more -- in short, that there was a discrepancy between what the manufacturer in each case had done, and what he could, and should, have done, to provide crash protection. This is the same conclusion that several state legislatures reached when, beginning in the early 1960's, they forced strongly resisting auto companies to install belts in some occupant seating positions. Later, the U.S. Senate and the House of Representatives, after long hearings, reached the same conclusion and passed, by unanimous votes, the National Traffic and Motor Vehicle Safety Act of 1966.

As I said earlier, it is not that "Safety doesn't sell"; it is that "Safety isn't sold." What is sold, too often, is misinformation about life-saving technology, even when the technology has proved hugely successful.

Let us consider examples of these problems that relate to the air bag, or "Air Cushion Restraint System," as GM calls it.

As an example of failure to disseminate favorable information, GM in 1972 or 1973 made an enthusiastic, 10½ minute marketing film for its dealers very strongly praising its Air Cushion Restraint System. In emphasizing the practicality of its system, it states for example that, "Naturally years of research and testing have gone into the development of the Air Cushion Restraint System."²⁸ (I note that though the film reached the National Highway Safety Administration's docket, few car dealers or even GM employees apparently ever even learned of its existence, and it is apparently not listed by GM in its film catalogue nor made available for showing.)

In further illustration, by the spring of 1978, air bag-equipped vehicles (1972 Mercurys, 1973 Chevrolets, 1975 Volvos, 1974-76 G.M. Cadillacs, Buicks, Oldsmobiles) -- in an outstandingly successful field trial -- had been driven over 500 million miles on U.S. and Canadian roads*, equivalent to over twenty thousand trips around the earth at the equator, but one can search fruitlessly to find this fact disseminated with any energy by vehicle manufacturers for the information of the American people.

Even more tragic is evidence that decision-makers in vehicle manufacturing companies are operating on and communicating relevantly incorrect information, as the following two examples illustrate.

*By the spring of 1978, according to the National Highway Traffic Safety Administration, the nearly 12,000 air bag-equipped 1972 to 1976-model vehicles placed in use had accumulated some 558,000,000 miles of driving.²⁹

In attempting to hold off requirements that they promote more automatic ("passive") crash protection to purchasers and other users* of their products**, auto industry representatives have stated in many private and public contexts, both in and out of the United States, including in Congressional testimony, that a combination of air bags and lap belts was "only about 10 percent effective in reducing significant injuries."³³ Tragically, that statement is hugely incorrect because the junior GM staff study on which it is based had a fundamental deficiency.

We discovered this research deficiency because we had been puzzled by the large discrepancy between the very favorable results of analyses of air bag injury reductions in the real world (and of their reductions of harmful decelerative forces in the thousands of laboratory tests to date) that had been obtained independently by the U.S. Department of Transportation and ourselves, on the one hand, and those reported by GM, on the other. (In fact, GM had noted that the discrepancy had "somewhat dampened our early enthusiasm."³⁴)

*In a recent study it was found that of 192 people injured as occupants of 147 cars and station wagons, "about half were occupants of vehicles that were no longer owned by the original purchaser, 59 percent did not own the vehicles in which they were injured, 21 percent of the drivers and 74 percent of the passengers apparently were not related to the owner, and 30 percent were less than 21 years of age."^{30,31}

**"It is noteworthy that regardless of the crash speeds at which manufacturers variously design their air bags to deploy, the passive protection they provide is an addition to -- a strengthening of -- the passive protection already present as a baseline because of prior DOT minimum standards and manufacturer's initiatives. Much of this already-present protection -- for example, in the case of crash padding and strong door locks -- functions below the 12 mile per hour speed mentioned in the Hearing, as well as above. It is not as if a passive restraint requirement would start passive crash protection at the air bag deployment speed, leaving the occupants unprotected at lower speeds, but rather that they already have several kinds of passive protection at lower speeds to which the proposed passive restraint requirements would be an additional and substantial improvement."³²

To determine independently if GM's methods and conclusions were sound, we obtained through the cooperation of GM the data its staff had used. When we examined them, we were dismayed to discover that GM's analysis had failed to consider the effects of multiple injuries -- a crucial omission because many of those injured in motor vehicle crashes are injured seriously in several parts of their bodies, and because such multiple, serious injuries (as surgeons and medical research workers concerned with injuries have well known for years) greatly increase the likelihood of death.^{35,36} Consequently, we reanalyzed the GM data considering multiple injuries resulting from crashes of similar type and intensity involving active safety belt-equipped cars, on the one hand, and air bag-equipped cars, on the other. In doing so, we concentrated our analyses on head, neck, chest, abdominal, internal, and lower back injuries -- the types most frequently resulting in death or serious impairment. On this basis, analyzing crashes of all directions and types combined,* we found that the frequency of serious injury was about 40 percent less for the occupants of the air bag-equipped cars, or the same as the 40% fatality reduction estimated by the U.S. Department of Transportation.³³ This was four times the small significant-injury reduction figure stated widely by GM and others based on the Company's deficient study.

*Institute researchers separately compared results of frontal crashes (documented in National Highway Traffic Safety Administration files) of vehicles in which front-seat occupants were using no restraints, those in which they were wearing lap/shoulder belts, and those in which they were automatically restrained by air bags. Both active lap/shoulder belts (when worn) and air bags were found to substantially reduce the severity of injuries to front-seat occupants of the full-size and luxury cars whose frontal crashes were the basis of the study. In the more serious frontal crashes the air bag protected occupants, 83 percent of whom were wearing no belts, experienced greater reductions in the average severity of injuries (64 percent) than occupants of such crashes wearing lap/shoulder belts (55 percent). The study also showed that as the severity of the crashes increased, the role of the restraints became more important.³³

The second example of decision-makers in vehicle manufacturing companies acting on and communicating relevantly incorrect information comes from the attachment of a letter a company executive sent to the President of the United States several months ago. The example in it relates to the intensive attempt of Motorists Information, Inc., an industry group, to increase belt use in Detroit. In the context of lengthy discussion of problems faced by GM and its industry, including a number of those involved in dealing with the federal government, the communication to the President stated, "... Recent research in conjunction with a seat belt use advertising campaign sponsored by Motorists Information Incorporated (MII) indicates that public attitudes toward safety belt use and actual safety belt usage can be favorably affected by well conceived advertising"³⁷ (emphasis added)

Unfortunately, as much as all of us concerned with this field would like to greatly increase belt use, and despite years of extensive research by us and others as to how to accomplish this,* the facts with respect to actual belt use (the measure by which the success of any such effort must be judged to succeed or fail) in Detroit as a result of the Motorists Information, Inc. campaign do not support any such optimism. Regrettably, in fact, they lead to exactly the opposite conclusion.

Fortunately, driver seat belt use in Metropolitan Detroit has long been directly observed, including by the Institute before, during, and after the MII campaign. In addition, the National Highway Traffic Safety Administration and MII made observations in association with the campaign itself. Figure I gives the dismal results, including the results of our April 1978 observations

*By September 1977, the Institute, over a period of years, had spent over \$900,000 in research on its own and others' attempts to increase belt use.^{38, 39-58} Since then, its work on this subject has continued on several fronts, concentrating on attempts to increase the use of child restraints.⁵⁹⁻⁶¹

Driver seat belt use in metropolitan Detroit

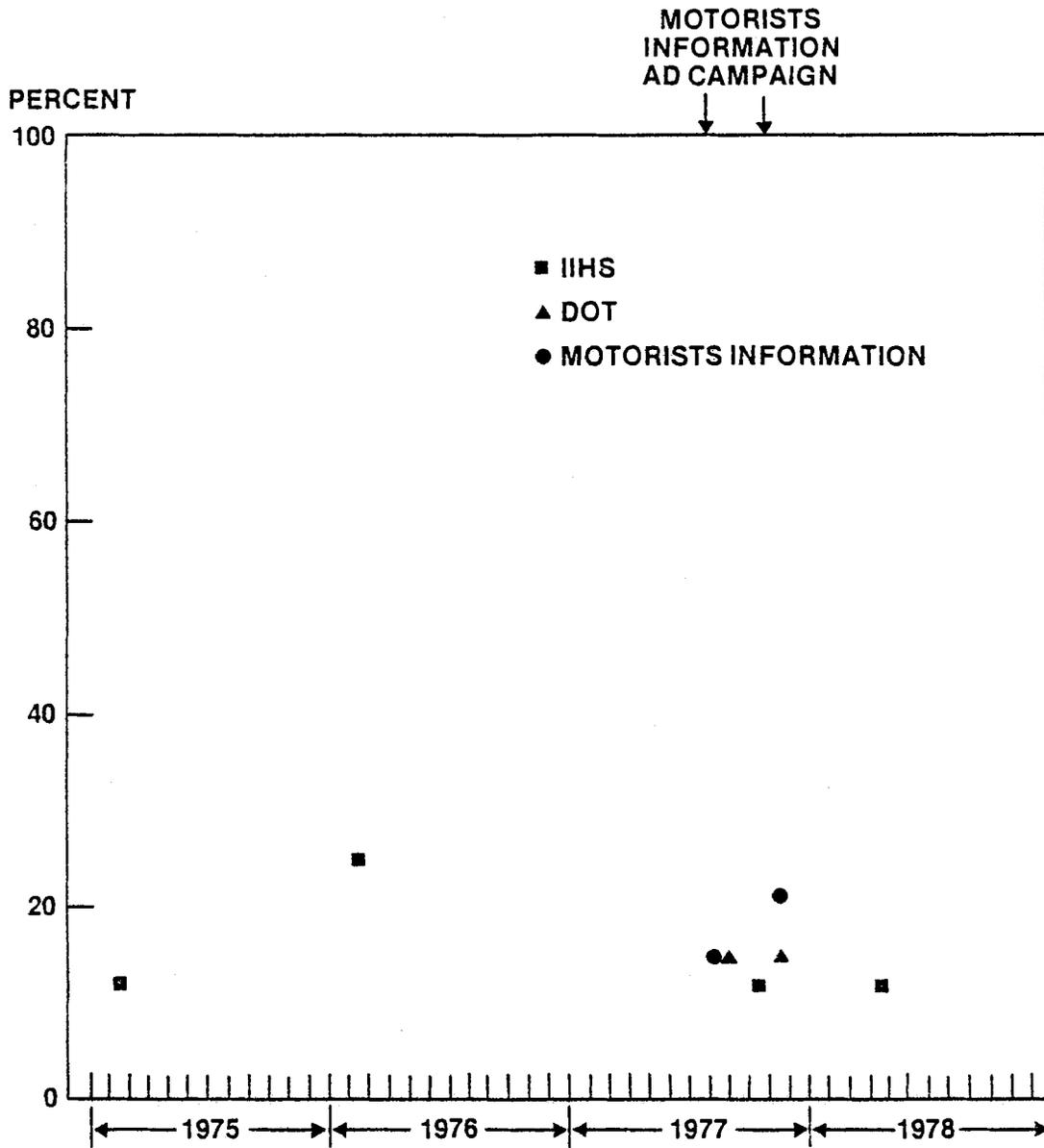


FIGURE I

showing that driver belt use in Detroit this spring was 12%, non-use 88%.

Surely no chief executive, in considering results of a campaign to increase market penetration, return on investment, or any other more customary aspect of his organization's activities, would be optimistic over such results.

No doubt, underlying both of the examples cited, the information communicated had been handed up the organizational ladder without knowledge at its destination that it was erroneous, but this in no way lessens the tragedy of basing programs to reduce injury on misinformation, or of not having the correct answers determined and used.

As I said earlier, it has been commonplace in the motor vehicle manufacturing community for the so-called safety issue to be misunderstood and misdefined, for things about it to be believed and propagated that are not so, and for actions to be taken that have done and continue to do fundamental damage to the interests of vehicle manufacturers and to many people. Surely the time has long since arrived for motor vehicle manufacturers:

- to comment more constructively on government proposals to reduce crash injuries;
- to themselves propose needed Federal Motor Vehicle Safety standards, including the substantial upgrading of the standards from a decade ago that were intended explicitly by the Congress to be relatively easy to meet "initial standards"²⁶;
- to show leadership in developing research safety vehicles of many types -- instead of leaving the job, as at present, to the federal government -- and in explaining objectively to the public the specific injury-reduction goals sought and the means of approach,

- and, as they so well know how to do, to exceed the federal "minimum motor vehicle safety standards" both as free-enterprise competitors and to guarantee far less wastage of life and limb.

In recent months there has been a marked, continuing increase in interest in this general subject on the part of the public. I believe this is far more basic than such items of current interest as flimsy gas tanks and how they got that way, as informative and relevant to the underlying problem as these may be. Members of the general public, and of the media, continually and increasingly mention recalls, the federal Research Safety Vehicles, and the extensive other evidence that even the newest vehicles are far less protective of people in crashes than manufacturers know how to make them. People simply don't understand why this lethal discrepancy is not eliminated by either the manufacturers or, if necessary, by the U.S. Department of Transportation.

Despite three generations of motor vehicle manufacturing, there is not for sale anywhere in the United States or abroad a car, van, truck cab, or tank trailer for hazardous cargoes that is not technologically backward from the standpoint of the protection afforded people in the crashes that inevitably occur. This is true whether the manufacturer is in Stuttgart or Detroit, Dearborn or Yokohama.

However, as I mentioned earlier, there is some evidence that some major companies gradually are shifting in directions which will make their records in the future far better than in the past. Last year, Thomas A. Murphy, GM's president, said to dealers, "It may be that we were late in recognizing the extent of the public's individual and collective dissatisfaction with our combined performance. We were so engrossed -- as we need to be -- in daily competition for business that we may have let ourselves grow out of touch with

the customer's need for satisfaction in a time of heightened expectations and society's concern for environmental improvement and energy conservation."⁶³

Let us all hope that that recognition includes the public's interest in far better protection in crashes, and that great improvements in the ability of new motor vehicles to protect people from harm will soon be evident to the millions of people who are watching and waiting.

REFERENCES

1. Smart, Charles N. and Sanders, Claudia R., "The Costs of Motor Vehicle Related Spinal Cord Injuries. Washington: Insurance Institute for Highway Safety, 1976.
2. Status Report, Vol. 11, No. 20, December 15, 1976, Insurance Institute for Highway Safety.
3. National Highway Traffic Safety Administration. Fatal Accident Reporting System - 1976 Annual Report. Washington: U.S. Department of Transportation, November 1977.
4. U.S. Bureau of the Census. Current Population Reports, Series P-25, No. 721, "Estimates of the Population of the United States, by Age, Sex, and Race: 1970 to 1977." Washington: U.S. Government Printing Office, 1978.
5. National Center for Health Statistics. Vital and Health Statistics, Series 10, No. 119, DHEW Publication No. (PHS) 78-1547. Hyattsville, MD: U.S. Department of Health, Education, and Welfare, November 1977.
6. National Center for Health Statistics. Monthly Vital Statistics Report; Advance Report, Final Mortality Statistics, 1976. DHEW Publication No. (PIH) 78-1120. Hyattsville, MD: U.S. Department of Health, Education, and Welfare, March 30, 1978.
7. Ward's Communications, Inc. Ward's 1978 Automotive Yearbook. Detroit, MI: Ward's Communications, Inc., 1978.
8. National Safety Council. Accident Facts - 1977 Edition. Chicago: National Safety Council, 1977.
9. Cassassa, James II; O'Neill, Brian; Miller, Irwin; and Stone, Sandra. A Survey of Unrepaired Automobile Crash Damage: I. 1968-1972 Models. Washington: Insurance Institute for Highway Safety, September 1973.
10. Status Report, Vol. 13, No. 7, May 31, 1978, Insurance Institute for Highway Safety.
11. Weber, W.L.; Stempel, R.C.; and Martin, D.E. Statement on NHTSA Testing and Chevette Field Performance at the 1977 Chevette Fuel System Public Hearing. Warren, MI: General Motors Corporation, June 16, 1978.
12. De Haven, H., "Mechanical Analysis of Survival in Falls From Heights of Fifty to One Hundred and Fifty Feet", War Medicine, 2, 586-596, 1942.
13. De Haven, H., "Accident Survival--Airplane and Passenger Automobile"; Annual Meeting of the Society of Automotive Engineers, January 1952.

14. De Haven, H., "Crash Study Can Reduce Chances of Injury", Public Safety, 41, No. 6, 8-9, 28, 29, June 1952.
15. Hasbrook, H., "The Historical Development of the Crash-Impact Engineering Point of View", Clinical Orthopaedics, 8, 268-274, 1956.
16. De Haven, H., "Beginnings of Crash Injury Research", Accident Pathology, Proceedings of an International Conference, 8-11, U.S. Government Printing Office, 1968.
17. Haddon, W., Jr., Suchman, E.A., and Klein, D., Accident Research, Methods and Approaches, Chapter 9, 535-612, Harper & Row, 1964.
18. "Changing Lanes", The Changing Challenge, 5, No. 2, 22-30, General Motors, 1978.
19. "Boobytrap!", 16mm. color, sound, 28 minutes, Insurance Institute for Highway Safety and Harvest Films, 1973.
20. Highway Safety Design and Operations--Roadside Hazards, Hearings Before the Special Subcommittee on the Federal-Aid Highway Program of the Committee on Public Works, House of Representatives, Ninetieth Congress, First Session; May, June, July, 1967, U.S. Government Printing Office, 1968.
21. Karr, A.R., "Sage of the Air Bag, Or the Slow Deflation of a Car-Safety Idea, GM Failed to Push Device; Dealers Discouraged Use; Case of a 'Biased' Buyer", The Wall Street Journal, November 11, 1976.
22. Kirschner Associates, Inc. Safety Belt Usage: Survey of the Traffic Population (August, 1976-March, 1977). Prepared for the National Highway Traffic Safety Administration under Contract No. DOT-HS-6-01340. Washington: U.S. Department of Transportation, December 1977.
23. Automobile Seat Belts, Hearings Before a Subcommittee of the Committee on Interstate and Foreign Commerce, House of Representative, Eighty-Fifth Congress, First Session on Crashworthiness of Automotive Seat Belts, April and August, 1957, U.S. Government Printing Office, 1957.
24. "The Continuing Public Mandate To Improve Inter-City Rail Passenger Travel Final Report", Study No. PZ814T, Louis Harris and Associates, Inc., March 1978.
25. Evans v. General Motors Corp., F.2d 822 (7th Cir.), cert. denied, 385 U.S. 836 (1966).
26. Larsen v. General Motors Corp., 391 F.2d 495 (8th Cir. 1968).
27. Huff v. White Motor Corp., 565 F.2d 104 (7th Cir. 1977).
28. "Buick Presents the Air Cushion Restraint System" (The title of the version for Buick dealers.), 16mm., color, sound, 10 1/2 minutes, GM/Photographic, 1973 (or '72).

29. Information from National Highway Traffic Safety Administration, April 1978.
30. Status Report, Vol. 13, No. 5, April 12, 1978, Insurance Institute for Highway Safety.
31. Baker, S.P., and Haddon, W. Jr., "Ownership of Motor Vehicles in Which People are Injured", Insurance Institute for Highway Safety, March 1978, 11pp.
32. Status Report, Vol. 11, No. 16, October 12, 1978, Insurance Institute for Highway Safety.
33. Installation of Passive Restraints in Automobiles, Hearings Before the Subcommittee on Consumer Protection and Finance of the Committee on Interstate and Foreign Commerce, House of Representatives, Ninety-Fifth Congress, First Session on H.R. 1019 and H. Con. Res. 273, September 9 and 12, 1977, U.S. Government Printing Office, 1978.
34. Transcript of Proceedings, Department of Transportation, National Highway Traffic Safety Administration, Public Hearing on FMVSS 209, April 27, 1977, Ace Federal Reporters, Inc., Washington, D.C.
35. Baker, S.P.; O'Neill, B.; Haddon, W. Jr.; and Long, W.B., "The Injury Severity Score: A Method for Describing Patients with Multiple Injuries and Evaluating Emergency Care", The Journal of Trauma, Vol. 14, No. 3, March, 1974, 187-196.
36. Baker, S.P. and O'Neill, B., "The Injury Severity Score: An Update", The Journal of Trauma, Vol. 16, No. 11, 1976, 882-885.
37. Letter, March 22, 1978, from T. A. Murphy, Chairman, General Motors Corporation, to President Jimmy Carter, attachment, Impact of Government Regulations on General Motors, Specific, 4-Auto Safety.
38. Letter, September 23, 1977, from Ben Kelley, Senior Vice President, Insurance Institute for Highway Safety, to Senator Robert O. Griffin, for inclusion in record of September 9, 1977 Hearing (Q.V. 33).
39. Robertson, Leon S. Auto Industry Belt Use Campaign Fails. Washington: Insurance Institute for Highway Safety, August 1977.
40. Robertson, Leon S. Automobile Seat Belt Use in Selected Countries, States and Provinces With and Without Laws Requiring Belt Use. Washington: Insurance Institute for Highway Safety, April 1977.
41. Robertson, Leon S. The Seat Belt Use Law in Ontario, Canada: Effects on Actual Use. Washington: Insurance Institute for Highway Safety, February 1977.
42. Williams, Allan F. and Zador, Paul. "Injuries to Children in Automobiles in Relation to Seating Location and Restraint Use." Accident Analysis and Prevention, Vol. 9, No. 1 (March 1977), pp. 69-76.

43. Williams, Allan F. "Observed Child Restraint Use in Automobiles." American Journal of Diseases of Children, Vol. 130, No. 12 (December 1976), pp. 1311-1317.
44. Robertson, Leon S. "Estimates of Motor Vehicle Seat Belt Effectiveness and Use: Implications for Occupant Crash Protection." American Journal of Public Health, Vol. 66, No. 9 (September 1976), pp. 859-864.
45. Robertson, Leon S. "The Great Seat Belt Campaign Flop: What Now?" Journal of Communication, Vol. 26, No. 4 (Autumn 1976), pp. 41-45.
46. Robertson, Leon S. Automobile Seat Belt Use After the Interlock. Washington: Insurance Institute for Highway Safety, June 1976.
47. Robertson, Leon S. "Safety Belt Use in Automobiles With Starter-Interlock and Buzzer-Light Reminder Systems." American Journal of Public Health, Vol. 65, No. 12 (December 1975), pp. 1319-1325.
48. Snyder, Richard G. and O'Neill, Brian. "Are 1974-1975 Automotive Belt Systems Hazardous to Children?" American Journal of Diseases of Children, Vol. 129 (August 1975), pp. 946-949.
49. Robertson, Leon S. Belt Use in 1975 Cars: Initial Data From One Metropolitan Area. Washington: Insurance Institute for Highway Safety, May 1975.
50. Campbell, B. J.; O'Neill, Brian and Tingley, Beth. "Comparative Injuries to Belted and Unbelted Drivers of Subcompact, Compact, Intermediate, and Standard Cars." Proceedings of the Third International Congress on Automotive Safety, San Francisco, California, July 15-17, 1974, pp. 12-1--12-9. Washington: Department of Transportation, 1975.
51. Foldvary, L. A. and Lane, J. C. "The Effectiveness of Compulsory Wearing of Seat Belts in Casualty Reduction." Accident Analysis and Prevention, Vol. 6, No. 1 (September 1974), pp. 59-81.
52. Robertson, Leon S. and Haddon, William, Jr. "The Buzzer-Light Reminder System and Safety Belt Use." American Journal of Public Health, Vol. 64, No. 8 (August 1974), pp. 814-815.
53. Council, Forrest M. and Hunter, William W. Seat Belt Usage and Benefits in North Carolina Accidents. Chapel Hill: Highway Safety Research Center, University of North Carolina, July 1974.
54. Robertson, Leon S. "Factors Associated With Safety Belt Use in 1974 Starter-Interlock Equipped Cars." Journal of Health and Social Behavior, Vol. 16 (June 1975), pp. 173-177.
55. Robertson, Leon S.; Kelley, Albert Benjamin; O'Neill, Brian; Wixom, Charles W.; Haddon, William, Jr. and Eiswirth, Richard S. "A Controlled Study of the Effect of Television Messages on Safety Belt Use." American Journal of Public Health, Vol. 64, No. 11 (November 1974), pp. 1071-1080.

56. Foldvary, L. A. and Lane, J. C. "Seat Belts for Victoria." The Medical Journal of Australia, Vol. 1, No. 20 (May 13, 1972), pp. 1054-1055.
57. Robertson, Leon S.; O'Neill, Brian and Wixom, Charles W. "Factors Associated With Observed Safety Belt Use." Journal of Health and Social Behavior, Vol. 13, No. 1 (March 1972), pp. 18-24.
58. Levine, Donald M. and Campbell, B. J. Effectiveness of Lap Seat Belts and the Energy Absorbing Steering System in Reduction of Injuries. Chapel Hill: Highway Safety Research Center, University of North Carolina, November 1971. Reprinted in Journal of Safety Research, Vol. 4, No. 3 (September 1972), pp. 106-107.
59. Reisinger, K. R. and Williams, A. F., "Evaluation of Programs Designed to Increase the Protection of Infants in Cars", Pediatrics, in press. (Status Report, Vol. 12, No. 15, October 13, 1977.)
60. Williams, A. F., "Warning: In Cars, Parents May be Hazardous to Their Children's Health; The Hazards of On-Lap Travel", Insurance Institute for Highway Safety, Washington, D.C., April 1978. (Status Report, Vol. 13, No. 5, April 12, 1978.)
61. Williams, A. F., "Evaluation of the Tennessee Child Restraint Law", Insurance Institute for Highway Safety, Washington, D.C., May 1978. (Status Report, Vol. 13, No. 7, May 31, 1978.)
62. Report on the Development of the Initial Federal Motor Vehicle Safety Standards Issued January 31, 1967, U.S. Department of Commerce, National Traffic Safety Agency, Washington, D.C., March 17, 1967.
63. Stuart, R., "Detroit Stunned by Recall Blitz", The New York Times, March 12, 1978, p. 9-F.