FEATURE ARTICLES

Myths and Misconceptions in Traffic Safety

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Because of the rather provocative nature of this topic, perhaps I should preface my remarks with a few points of clarification. This may help prevent some misunderstanding from developing as I cover subjects that are somewhat controversial.

My purpose in presenting this material is to stimulate you and others to take a new, fresh look at the traffic safety problem. Of immediate concern is the identification of those countermeasure areas where the payoff is greatest in terms of injury and death reduction. Certain judgments have been made as to where the highest probabilities for early payoff appear to be and it is suggested that we should make our initial major thrusts in these directions. Because these directions may be somewhat different from those taken in the past, this in no way detracts from the vital contributions made to traffic safety by the many private and public organizations engaged in safety work during the past years. We need to build on the past and take that which has been good and move ahead with it toward even greater successes.

I shall be suggesting that a large portion of our effort should be concentrated on <u>research</u> activity. This ranges from simple action research aimed at solving an immediate problem to long-range conceptual research designed to explore some of the broader problems in the field. Our approaches to the phenomena of interest here must become more rational and scientific. This is true now and it will be even more so in the future. We need good information on which to build sound prevention efforts. Good, solid research programs are essential. As I describe my research thinking to you, it is important to keep several things in mind: Because I am suggesting that we should be seeking new truths by engaging in research activity, it should not be inferred that I am condemning as worthless all work that has gone on before. I am suggesting that we take a hard look at existing programs and activities in the traffic safety field. This does not necessarily mean we should <u>reject</u> all existing programs and activities. We should question them with <u>the objective of building</u> on them in a positive direction—not destroying those that have value. At the same time, when it is clearly evident that a traditional approach is not paying off, we should be willing to let go of it and not fight to preserve unprofitable programs simply because they are familiar and comfortable. Of course, research takes time and we cannot afford the luxury of resting complacently on the sidelines until we have scientific evidence that a particular course of action

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is best. We must meet our immediate needs by injecting into the system action programs based on their intuitive or face validity. But, at the same time, we must use caution not to become so emotionally involved with perpetuating intuitively based countermeasures that we exclude or resist new approaches based on more objective reality. These important points will be reinforced as I proceed.

Traffic accidents have been with us for around 50 years or so. They now produce approximately 53,000 deaths per year, contribute to more than 10,000 injuries each day, involve approximately 10 billion dollars in losses each year, and as a cause of accidental death, lead all others in the United States. Since traffic accidents have been with us for so long, you might logically ask why more progress has not been made toward countering these problems with workable solutions. A major difficulty has been the nature of the concepts and methods which commonly serve as the basis for most prevention efforts. Approaches to the phenomena of interest here are rapidly becoming more rational and scientific. Nevertheless, the field still includes the only substantial, remaining categories of human morbidity and mortality still viewed by most laymen and professionals alike in essentially prescientific terms. There is a general inclination for safety practitioners to adopt timeworn solutions contaminated by traditionalists bent on perpetuating the myths and unsupported shibboleths prevalent in the field today. Unfortunately, these approaches tend not only to produce unsatisfactory results, they also serve to inhibit research progress in areas where the acceptance of erroneous information has produced a rather complacent posture. Let's examine a few of these myths and misconceptions and at the same time discuss some accident philosophy.

MYTH NO. 1. "ACCIDENT PREVENTION"

A good place to start is with the concept of "accident prevention," that is, reduction of crashes. The term "accident" is seldom used to describe unexpected injuries due to biological agents such as viruses and bacteria. Rather, it is usually used to describe unexpected physical and chemical injuries to the body and other structures. The notion of an accident addresses itself to one part of the problem but not to all of the problem. It has a long history and close relationship to notions of personal vulnerability and invulnerability and is reminiscent of the supernatural and prescientific. The notion of an accident is descriptive, not etiologic, that is, causally definitive. The old concept of an "accident" gives no indication of causes or results. Although the term is retained in common with customary usage and folklore, it is neither medically nor scientifically appropriate for most purposes and is gradually being replaced by descriptions of the injuries themselves and the physical and chemical agents whose release is responsible for their occurrence. Most of the behavioral science literature in the overall field is highly inbred and concerned almost exclusively with studies and programs centered on the use of the descriptive notion of "accident." The problem can be addressed by approaches which are more comprehensive, useful, and appropriate. The problem is not, a priori, "to prevent accidents," per se. Instead, we should concentrate on the forces which produce the injuries to animate and inanimate structures, the ways these can be avoided, the susceptibilities of the structures involved, and the amelioration of the various forms of damage once these occur. The fundamental problem in the prevention of physical and chemical injuries is the prevention of abnormal energy exchanges. This can be achieved either by interference at various early stages in the sequences which lead up to them, or by directly preventing their occurrence.

Now, please don't misinterpret my remarks. I am not saying that preventing accidents is "out." I am suggesting that the end results of injury and death are influenced by many factors in addition to those that determine the likelihood of crash and that the problem can be more comprehensively, systematically, and usefully approached than by only emphasizing crash prevention. "Accident prevention" as a term does not cover everything that must be done, such as upgrading the crash design of vehicles and highways and making certain that emergency services are improved. "Accident prevention" simply is not considered as being fully descriptive of the problem.

MYTH NO. 2. "THE SOCIAL DRINKER"

Approximately one-half of crashes fatal to vehicle occupants, one-third or more of those fatal to adult pedestrians, and one-fifth of crashes in which vehicle occupants are injured non-fatally result at least in part from the prior use of alcoholic beverages. An assumption is often made that the typical "social drinker" contributes to the bulk of this problem. There is increasing evidence, however, that the "solid citizen" normal driver who limits his drinking to social occasions is not involved in most of the arrests for drunk driving. This is supported, in part, by a study involving an admittedly rather small sample of 150 drivers arrested for drunk driving who were compared with a control group of 150 "average" drivers in terms of number of prior arrests. The group of drivers arrested for drunk driving had experienced a total of 971 prior arrests, while the control group experienced only 65. Thus it appears that the person arrested for drunk driving may be a basically unstable, deviant kind of person who is different from those in the normal "social drinking" population. The major parts of the picture of drinking drivers involved in accidents appear to be the deviant group of drinkers, alcoholics, etc.; in addition, the teen-agers and young adult males; and finally, the social drinkers, with evidence indicating that the latter group does not constitute the bulk of the problem as is often assumed.

The problem is not, as often assumed, based on the number of drinks consumed but rather with the actual concentration of alcohol in the blood and brain tissue. Consequently, the literature and the law are based on alcohol concentrations in the blood, brain, and occasionally other tissues, usually expressed either as "percent by weight," "milligram percent," or as "grams per liter." The medical literature uses the milligram percent designation while the nonmedical writers and most laws in the United States use the "percent by weight" designation.

Three concentrations, 0.05, 0.10, and 0.15 percent by weight, have particular significance because of their use in the recommendations of groups of experts and in legal definitions. Although generalizations concerning the blood alcohol concentrations that result from the ingestion of specific amounts of given alcoholic beverages are difficult to make because of the number of conditions which must be specified (e.g., preconditional tolerance to alcohol, amount of food consumed, type of food, elapsed time since food intake, etc.), a concrete example may place these three concentrations in perspective for you. Specifically on the work of Coldwell and others in the Canadian Report on Impaired Driving Tests, the three blood alcohol concentrations of 0.05, 0.10, and 0.15 percent by weight would probably result if a 155 pound man, drinking between one and two hours after an average meal, were to consume at least 5, 7½, or 10 ounces, respectively, of U.S. "80 proof" liquor. It must be remembered, however, that these quantities pertain to a very specific set of conditions and that under other conditions—for example, when no food or adjuvants are taken—the same concentrations may be reached with considerably smaller amounts.

The problem of the drinking driver includes such behavioral components as (1) cultural patterns in recreation, business, courtship, and entertainment; (2) public attitudes; (3) economic and social forces that favor drinking; and (4) the emotional needs of the individual that favor his use of alcohol. Further, since the chronic alcoholic is now known to be disproportionately represented in drinking-driving accidents, the behavioral factors of this common disease are also important.

MYTH NO. 3. "THE NUT BEHIND THE WHEEL"

The widespread belief that accidents are largely—even exclusively—a problem of human behavior has been endorsed by behavioral scientistis, manufacturers of motor vehicles, safety educators, and many officials who regard "enforcement" as the key to motor vehicle accident prevention. While some of this emphasis may be appropriate to problems in the field, it represents an overly narrow point of view. In fact, preoccupation with this aspect delayed for decades the recognition of the preventive possibilities of other components of the causal complex. Further, many accidents involve causal sequences which have little or nothing to do with the behavioral characteristics of those involved. It is also important to distinguish between behavioral characteristics of individuals contributing to their own injuries and those of the victims of the actions of others.

In compiling accident data it has become almost traditional to use a classification system which dichotomizes accidents due to human behavior and those in which human behavior apparently played no part. Thus an accident attributed to "driver error" (the "nut behind the wheel") is regarded as clearly due to human behavior, whereas an accident resulting from the failure of a mechanism, such as the tire of an automobile, the steering linkage, or the braking system, is classified as having no human cause. Such a scheme is misleading for several reasons. First, it implies that enough is known about accident causation to permit accurate attribution to human or nonhuman factors. In the present state of our knowledge such an implication is not warranted. Secondly, what we do know about accident causation leads to the conclusion that even the most obvious case of "driver error" may involve a nonhuman environmental situation in which "error" was greatly favored if not, indeed, made inevitable. Similarly, even an accident that seems due to a mechanical failure involves the human element of failure to inspect the device adequately or to design fail-safe features into the system, just as an accident due to hurricane or other so-called acts of God involves the behavioral element of the victims who fail to predict the occurrence of damaging winds or to remove or otherwise protect themselves from the effects. Even when the magnitude of the human element in a certain kind of accident can be accurately assessed, it is important to note that its sheer magnitude does not inevitably make it the most appropriate target for preventive measures. The amputations suffered by punch press operators in industry during the late nineteenth century, for example, could be clearly attributed to the "human error" of placing the fingers or hands between the dies of the press, but the most effective countermeasure proved not to be a program to change human behavior—that is, to make the worker "more careful"—but rather the installation of machine guards which made the human error noninjurious to the person involved.

The human is, of course, part of the problem. However, excessive concentration on human failure as the primary causal factor in accidents to the exclusion of environment modification considerations has several serious pitfalls:

(1) It ignores vehicle failures as accident contributors.

(2) It ignores human engineering considerations—that is, the design of equipment and environments to meet man's physiological and psychological characteristics and limitations.

(3) It ignores highway causes of crashes—that is, where defects in the highway were the primary contributors. Examples include accidents resulting from poorly designed curves, poorly controlled intersections, broken-down vehicles, animals and other objects on the road, fog, slippery spots, and poor traffic signs.

(4) It ignores packaging considerations—that is, designing the surroundings in which the human is placed so as to provide maximum body protection. Within the car, the maximum protection available to the occupant can be achieved only by so packaging him that he decelerates primarily with the car rather than in the so-called second collision, either within its structures or when thrown against the pavement or other hard outside surface. Ideally, this packaging should be accomplished by designing the vehicle so that all occupants are automatically kept in place without any cooperation on their part.

(5) It ignores highway crash design considerations—that is, designing the highway and its surroundings (bridges, signposts, etc.) to minimize the severity of crash occurrences. This can be accomplished by decreasing the rate of transfer of the mechanical energy which must be exchanged in a crash situation. For example, signposts can be designed to collapse on impact and bridge abutments can be shielded to deflect vehicles in order to prevent abrupt decelerations.

(6) Finally, it ignores post-crash considerations—actions taken after the crash to increase the success of emergency care. This response involves prompt use of communications and transportation facilities. The quality and rapidity of emergency services greatly determine the end result in many serious accidents. The present slowness and inadequacy of emergency medical care, transportation, and other factors commonly lead to completely unnecessary death, disability, and prolonged medical care.

MYTH NO. 4. "PEDESTRIAN CONTROL"

The pedestrian control and driver education myths relate to the assumption that the actions of pedestrians and drivers are the major problem and that education, police action, and the control of pedestrian and vehicular traffic flow, if applied rigorously, are sufficient to prevent these accidents. While such measures most certainly aid in the prevention of some types of accidents, there has yet to be reported any scientifically controlled investigation demonstrating the extent to which this is the case. Available evidence suggests that more attention needs to be paid to the sources of the problem and that mixed strategies of less narrow emphasis are required.

One major myth in this area is the safety practitioner's attempt to manipulate human behavior through the use of safety posters. If we accept as evidence of a safety poster's success the degree to which it motivates an individual to change his behavior from "safe" to "unsafe," then most safety posters now in use are simply no good! On the other hand, if we are only interested in publicizing the fact that there is someone around with enough concern for safety to put up a few posters, then perhaps the fact that there are posters around allows us to conclude intuitively that someone is interested in doing something. However, if we simply sent the posters out to supervisors with a note to "please post" perhaps even this hypothesis might prove negative if in fact the supervisor chose to "post the poster" as a conservative, waste-prevention alternative to throwing it away!

A rather extensive study of the effectiveness of safety posters was conducted in Great Britain under the sponsorship of the British Iron and Steel Institute. In this study, posters of various design were placed in departments engaged in the same operations in five steel mills. A sixth steel mill served as a control, with no posters being used. The criterion of poster success was whether or not the behavior of workers actually changed in a positive direction as a result of the posters' use. In addition, the length of time during which this improvement was sustained was also noted in each case. The standard measurement technique of work or activity sampling was used as an indicator of behavior change, accompanied by a control chart indication of the significance of the shift in behavior relative to chance expectations. The study findings revealed that most safety posters do not produce a significant change in behavior. In particular, posters with a general message, such as "Always Be Careful," "Speed Kills," "Drive Carefully, the Life You Save May be Your Own," and "Safety Pays With Happy Days," are meaningless. The only poster that produced a significant change in behavior, and this change was only marginal, was one containing a very specific message about how to overcome a specific safety problem which existed in close proximity to where the poster was placed. It was also interesting to note that the posters which did produce a behavior change were apparently effective in sustaining this change for up to six months after the poster was first presented.

Some studies of safety poster effectiveness have used as a criterion the ability of the viewer to remember the poster's contents. Unfortunately, there is no evidence that the viewer acts upon what he remembers. In fact, his behavior may be subconsciously motivated by something he doesn't remember at all. It is also possible that the viewer will remember some aspect of the poster but forget the intended major point. For example, one of the most popular safety posters in history was one published in Great Britain containing a photograph of a beautiful nude girl. This poster had world-wide distribution, has gone through several printings, and requests for copies are still coming in. I can remember rather vividly the picture of the beautiful girl, but I'll be darned if I can recall the safety message that went with it.

Some pedestrians are injured through no fault of their own. Such injuries may be due to the mechanical failure of vehicles, or the failure of their operators to control them properly. Measures directed at pedestrians would not prevent such accidents. One solution might be to install barriers along highways in locations where the chief purpose is to prevent vehicles and their occupants from crashing off the road.

Children constitute a group heavily represented in pedestrian accidents. It is not yet known whether this representation is disproportionate to their numbers in the pedestrian population at risk. Research findings do suggest that lack of parental supervision and family stability are of major importance in childhood injury experience. One preventive measure might be the training of young children in how to stay alive in an environment interlaced with moving traffic. This is particularly important in our highly mobile society where there is constant movement from rural areas with low traffic density to urban areas where the traffic density is relatively high. The child may be killed or seriously injured as a result of following a particular behavior pattern which involved little or no danger in the country, but became hazardous in an urban environment.

Elderly pedestrians are involved in accidents disproportionately to their number in the population at large. This, together with their lowered injury thresholds and poorer clinical courses, accounts for their high death rates. The situation is, in many respects, the reverse of that in children. With increasing age, people are less able to handle the hazards present in their environments. No doubt contributory also is the isolation and poor and often hazardous accommodations in which many of the elderly live, largely because of economic and other social factors beyond their control. Actions which might be taken to reduce the accidents of the elderly include providing adequate medical care so that the mental and physical states which reduce their ability to live safely can be prevented or contained, making their environments less hazardous and more negotiable, and designing means to attenuate the forces of falls when these occur. Another problem is that fatal diseases often follow injuries among older persons. This is due to the lowered physical resistance to disease often encountered by older persons in an injury state.

Drinking pedestrians are involved in accidents more often than expected from their numbers in the population at risk. This disproportion begins in the very low blood alcohol range produced by one or two drinks, and increases progressively with higher concentrations. Many reports show that about one-third of fatally injured pedestrians have been drinking substantially. This aspect of the pedestrian accident problem is largely ignored in pedestrian safety programs based chiefly on the assumption that the actions of pedestrians can be manipulated—a rather dubious notion in the case of those who have been drinking. The effectiveness of pedestrian education programs is also questionable in cases where accidents are caused by outside forces generally beyond their control, such as drunk drivers and out-of-control cars and trucks.

MYTH NO. 5. "DRIVER EDUCATION"

While the case for driver education may be intuitively supported by strong "common sense" argument, the effectiveness of driver education programs as presently constituted has not been scientifically established. Perhaps this is due to a lack of sufficient study. Although some studies have indicated that the accident rates of trained drivers are more favorable than those of the untrained, subsequent research has revealed that the difference in rates may be due, at least to some extent, to a selective bias introduced by the preselection of those who receive such training. For example, an investigation by Rainey, Conger, and Walsmith has found that those who voluntarily enrolled for such training were significantly different in their psychological characteristics. In addition, social differences might be anticipated. Those registering for driver education courses may do so because, unlike those who do not register, they do not already drive and have less opportunity to do so once they receive their licenses. It also may be that those who volunteer have a predisposition toward developing better driving habits which would have produced favorable subsequent driving performance even though they had not completed the course. Until differences of this type have been thoroughly investigated, it will not be possible to determine, despite its seeming reasonableness, the extent to which "driver education" influences the accident experience of those who receive it. This point, which is widely overlooked by nonresearch workers concerned with highway safety, illustrates the need for caution in the interpretation of gross differences in accident rates.

MYTH NO. 6. "THE SILVER BULLET"

The silver bullet concept implies that there exists a single "magic solution" to the accident problem and that when we find it, all of our problems will be solved. An unfortunate corollary to this concept is that, unless a particular countermeasure solves all aspects of a problem, it is often rejected by the program decision-maker in his quest for the perfect "silver bullet." There are, of course, multiple factors involved in any accident causal sequence and these factors normally require multiple solutions. The fundamental problem in the prevention of physical and chemical injuries is the prevention of abnormal energy exchanges. This can be achieved either by interference at various early stages in the sequence leading up to them, or by directly ameliorating the injurious energy exchanges themselves. Prevention programs must be based on combinations of approaches designed to interfere at many points in the sequences of events which culminate in injury. Further, since the immediate and long-term results of injuries can often be improved by appropriate medical care, balanced programs must also include post- as well as pre-injury measures, including long-term rehabilitation. The specifics of accident countermeasures depend on the level in the causal sequence at which they are directed and on the specific problems involved. Although the varieties of abnormal energy exchanges are relatively few (i. e., mechanical, thermal, electrical, ionizing radiation, and chemical) there are many ways in which they can be initiated. Countermeasures are therefore similarly numerous and varied. A general principle in injury prevention is that the greater the amount of energy available for potential damage, the earlier in the causal sequence must prevention be directed.

Two major problems in developing a prevention effort are the lack of data on particular causes and the difficulty of cross-classifying data that do exist. Data are faulty on particular cause information existing at various stages in the causal sequence. For example, there is growing evidence that mechanical failures frequently contribute to accidents. Most of these are obscure and never documented, and therefore are assumed by many not to occur. One reason for this lack of complete causal information is the rather limited problem perception capability of the typical contemporary accident investigator. Most traffic accident reports used for prevention purposes are prepared by law enforcement officials who are primarily concerned with documenting evidence for legal purposes. The investigator most often concentrates on identifying law violations instead of injury causal factors. He is also very rarely equipped to identify more than the most obvious mechanical malfunctions or physical inadequacies of the vehicle. The problem of gathering good information is further compounded by an accident report form which contains a block labeled "primary cause" or, perhaps even worse, a large block listing several causes, one of which is to be checked as the "primary cause" by the investigator. Under these conditions, both the quality and quantity of the information collected during an accident investigation is severely limited. It may be possible to identify proximate and distal causal factors in a particular accident by going back in time or space from the point of impact. However, to identify one of these factors as the primary cause is a very difficult if not impossible task. As an example, if we examine the details of an automobile accident in a temporal sequence leading up to the point of impact, we might discover the following chain of events:

A man gets up in the morning after oversleeping due to his failure to set the alarm. He has a terrible hangover from the previous night's drinking—a sensation he has experienced with increasing frequency during the past year. He completes the usual morning preparations, proceeds down the stairs, steps on his son's roller skate and falls to the floor. Receiving only a slight bruise as a result of the fall, he picks himself up and walks as best he can toward the kitchen. His wife greets him with a growl and a few sharp words. As she comes into focus, he notices that she looks horrible with her hair tied up in curlers and no makeup. He sits down at the table, only to be greeted by a cup of cold coffee and two overdone fried eggs. He mumbles a few words indicating displeasure, then stomps out of the house in obvious anger. It is a cold, cloudy day. It has been snowing and the road is covered with ice. He manages without mishap to reach his car parked in the driveway. The brakes on his car are faulty and his tires are worn slick. He has a seat belt, but usually doesn't wear it and today is no exception. He starts the car, pulls out of the driveway, and proceeds down the road at high speed. When he attempts to turn a corner, centrifugal force takes over, his automobile skids off the road and crashes head-on into a tree. The driver is impaled on the steering column, thrown forward with his head penetrating the windshield, and is killed before the energy forces generated at the point of impact have dissipated.

What was the cause of this accident? The man's fight with his wife? His previous night's drinking? The bald tires? The icy road? Chances are that, if there was no immediate evidence of alcohol, the police investigator would identify the primary cause as "driving at excessive speed for conditions" or simply "speed in excess of legal limit." What about the recommended prevention methods? Should we caution other drivers to "be careful" or advise them to "slow down and live?" Should we warn drivers not to fight with their wives before driving? Should we recommend a redesign of the car interior, including the steering column and windshield, so that the forces developed in the "second collision" are distributed over time and space to avoid reaching the threshold of the body's energy absorbing capacity? Perhaps we should remove the tree!

It is evident from this description that accidents have multiple causes and that multiple remedial actions are necessary in our prevention efforts. It also should be evident that accident investigators should receive the best possible training so that their causal factor perception capability will be improved. Perhaps a group of specialists consisting of individuals with skills in certain aspects of the man-vehicle-roadway-environment system should be called in for a more comprehensive, systematic investigation of future vehicle accidents.

The one-way classifications under which most accident data are assembled prevents the cross-classification of the information for purposes of conducting comparative analyses of causal factor data. Often the cause data are placed in nonhomogeneous groupings, further complicating the causal comparison task. In applying countermeasures, we are apparently dealing in small percentages, if not fractions of one percent, in determining the proportion of total causes affected by a single countermeasure. Furthermore, almost no countermeasures have been scientifically evaluated as to efficacy and cost/benefit ratios. Needless to say, safety practitioners who attempt to oversimplify the accident problem and its solutions have little chance of ever achieving real success.

MYTH NO. 7. "RANK ORDER OF CAUSES"

The most common and universal fallacy in the field is one which is so ingrained that it is seldom explictly recognized. It involves the assumption that the priority rank of countermeasures, in terms of their ability to influence the end result of concern, must parallel the ranking, in order of their relative contributions, of causes influencing those end results. In other words, we rank the relative importance of countermeasures according to the relative contribution of causes. In its most common form, the assumption states that because drivers cause most accidents, most prevention programs correspondingly must be concerned with drivers. If we accept the 88-10-2 ratio suggested by H. W. Heinrich, that is, the general but unproven viewpoint prevalent in the safety field that 88 percent of all accidents are caused by human failure, 10 percent by mechanical failure, and 2 percent by "acts of God," this fallacy leads to the conclusion that 88 percent of our prevention effort should be directed at the human, 10 percent toward preventing mechanical failures, and the other 2 percent should perhaps be forgotten since they are beyond our control. In the real world, there is no basis for making this assumption, especially since in numerous areas of the field it leads to demonstrated misleading and false conclusions. For example, if applied to the widespread thermal and electrical injuries associated with early house wiring systems, it would have led to concentrating on attempts to influence human behavior rather than the development of the fuse. With respect to motorcycle accidents, where we know that compelling the use of appropriate helmets reduces death and injuries about 65 percent, it would have us concentrate on the far less productive manipulation of motorcycle drivers. In the case of occupant protection in automobiles, which we know has great potential, this fallacy held back for many years the application of such information, since it supported the false assumption that the driver was the primary problem and therefore should be the center of countermeasure activity.

Finally, under causes versus effects, the interactions of countermeasures are not accounted for in a rank order assignement in relation to causes. The total effect of the simultaneous application of countermeasures is often different from that expected from the individual efforts applied separately. We should thus evaluate the cost-effectiveness of various sets of countermeasures applied in combination, since there is no way of assessing the value of various trade-offs among countermeasures on an a priori basis. We need to recognize that payoffs are where you find them. We should be flexible in selecting countermeasures which produce payoffs and not attempt to examine the problem with a preconceived fixed notion of what will work. The ultimate criterion in choosing between different allocations of highway safety resources is the payoff each provides for a given expenditure of manpower and capital. One example of a recent exploration of the payoff problem is a study conducted by the U. S. Public Health Service in support of its internal Planning-Programming Budget System (PPBS). An 11-member Public Health Service committee looked at nine safety programs and attempted to come up with an answer to the basic question: What are the relative payoffs for various traffic safety programs? Or stated another way, given x number of dollars, where should they be spent in order to obtain the maximum return in reducing death and injuries resulting from motor vehicle accidents? The PHS findings, stated as a simple estimate of the expenditure needed to save one life in nine highway safety program areas, were as follows:

(1)	Increased use of seat belts—	$ 87
(2)	Developing and encouraging the use of other restraint systems for children and adults—	$ 100
(3)	Reducing the exposure of pedestrians to injury—	$ 600
(4)	Reducing accident and injury characteristics of the total driving environment—	$ 2,340
(5)	Increasing the use of helmets and protective eye shields by motorcycle riders—	$ 3,000
(6)	Improving driving performance and behavior by decreasing driving exposure while under the influence of alcohol—	$ 5,300
(7)	Improving driver licensing—	$13,800
(8)	Improving emergency medical services—	$45,000
(9)	Improving driver performance and behavior by upgrading driving skills, knowledge, and attitude (the general program area of driver education)—	$88,000

This represents a beginning in weighing the relative merits of many longstanding "apparent" highway safety programs.

MYTH NO. 8. "THE ADEQUACY OF INFORMATION"

Another problem in the safety field is over-reliance on "popular opinion" or "common knowledge" as justification for assuming a particular position or accepting as fact a particular conclusion. The assumption is that if x number of people say it is so, or it appears on page 86 of a particular text book or on page 27 of a certain journal, then it must be so. Unfortunately, in the traffic safety field, most sources, studies, and statistics are highly questionable. The literature is largely parochial, fragmented, and divergent. The methodology of accident research is in a relatively primitive state. We need to improve the content and accuracy of raw data. Often the investigator's training is either too narrow to encompass certain significant variables or is inadequate for the proper analysis and interpretation of the data. (I presented a previous paper on this subject entitled "Removing the Blind Spot in Safety Education Teacher Preparation.") And finally, countermeasures are frequently adopted without adequate evidence of their effectiveness or provision for their continuous evaluation after adoption. For example, such measures as motor vehicle inspection, speed laws, vehicle operator licensing requirements, and public information programs are often adopted on the basis of "common sense," with little attempt being made to assess either the magnitude of the specific accident toll they are intended to reduce or their effectiveness in accomplishing such reduction.

There is a great need to increase the reliability of statistics. Popular opinion and so-called generally accepted principles are usually of unknown validity unless proved otherwise. This myth has been referred to as the "fifty million Frenchmen can't be wrong" logical fallacy. Evidence presented in support of positions taken in the field is often derived from poorly prepared accident reports, based on extrapolations beyond the limits of available data, developed from armchair guesswork, or accumulated by some other similarly ineffective process.

An area in which considerable information is readily available is the increasing public discovery that there is little scientific evidence that the many exhortations and programs so long directed at manipulating human behavior as a means of preventing crashes themselves are to any substantial degree effective. For example, although the evidence is overwhelming that about half of our fatal crashes are initiated at least in part by the prior use of alcohol, no one has yet bothered to do the research necessary to find out whether any of the programs directed at reducing its contribution are in any way effective. This is not to say that some of these various measures do not work, or work well, but rather that the research that would enable us to say which are effective, to what extent, under what circumstances, and at what relative costs, is almost completely lacking.

This is a situation we can no longer tolerate. Unsupported assertions, however long repeated and widely believed, are a poor substitute for facts, as the medical, scientific, and engineering professions discovered generations ago. Unfortunately, however, we cannot stand still while the research that should have been done long ago is begun. In addition to ensuring that the complex range of necessary scientific study with respect to all phases and components of the highway safety problem is undertaken, completed, and applied, we must proceed energetically as a nation to do the things that are most reasonable at our present stage of substantially imperfect knowledge. In doing so, we must be acutely aware of a great hazard in this necessary course of action. This is the very real risk that we will so freeze our present ideas and approaches that future progress will be impaired. This is not only a problem in connection with standards for vehicles, it is also very serious in licensing, education, enforcement, highway engineering, traffic control, and emergency medical care. This is not to argue that we should avoid the necessary forceful action by government, industry, and other important groups that must cooperate effectively to solve this problem. Rather, it is to point out that we must build into our approaches ample provision for rapid and flexible change as new knowledge and technological innovations become available. Unless we do this, our success will fall far short of our capacity to reduce traffic injuries both in the near future and for the longer pull. We are faced with a complex but not insoluble problem. It has many facets that need attention. In dealing with a particular issue, we must not exclude attention to the others. Nor can we long afford the present luxury of poorly balanced, uncoordinated efforts of substantially unknown efficacy.

Finally, there is a need for the use of new data sources, that is, other data sources than the traditional ones. Some examples of new sources that might assist us in traffic safety include:

(1) Weather Bureau data. For example, there are a half dozen excellent weather stations in and around New York City. Data relating to temperature and road conditions are available constantly and could be conveyed to the driver, especially during transitional weather condition periods.

(2) The people who have the best information on detailed characteristics of each vehicle (for example, horsepower, type of brakes, type of differential, power steering, power braking, kinds of tires supplied on original equipment, color, and optional safety equipment) are the manufacturers. This information could be identified by serial number, year, make, body style, etc., and could be cross-classified according to component failure characteristics on a temporal basis.

(3) Medical, occupational, and existing social data are not being fully utilized.

(4) Finally, little use has been made of available data from the U. S. Census.

Research of quality has been building up piece-by-piece now for almost a half century, but we need to know a great deal more and do a great deal more before we can expect a significant reduction in traffic injuries and deaths. My remarks should not be interpreted as an indictment of all research on safety topics that has been done in the past. I am suggesting that we take from the past that which has been good and build on it. In the pursuit of this task, we are now clearly in a state of accelerating transition. Unfortunately, behavioral scientists, engineers, and others in coming to this field for the first time still often merely translate the traditional wisdom and its terms into their own scientific framework and jargon, build on the result, and assume they have contributed something. Hopefully this will be less likely to occur in the future because of the accelerating transition in concepts and research now taking place. This transition is part of the increasing awareness of the relationships between man and his environment, or human ecology, especially of man's relationships with certain potentially or actually hazardous physical and chemical attributes of the environment.

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