MOTORCYCLE HELMETS, HELMET LAWS, AND SAFETY

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MOTORCYCLE HELMETS, HELMET LAWS,

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INTRODUCTION

In 1986 there were 5,023,749 motorcycles registered in the United States. During that same year, 163,983 motorcycle accidents were reported. Many of these accidents caused extensive physical injuries, acute pain, and substantial economic hardships for the riders, their families, and society. The leading cause of deaths and injuries among motorcyclists and passengers resulted from injuries to the head. Data from the Fatal Accident Reporting System (U.S. Department of Transportation, 1984) indicates that from 1982-1984 roughly 50% of all motorcycle fatalities were caused by injuries to the head, neck, or face with the majority of those injuries being to the head.

Background

In 1966, Congress passed the Highway Safety Act which granted to the Secretary of Transportation the authority to institute National Highway Safety Standards (U.S. Department of Transportation, 1980). During that year, the Secretary established a highway safety program that consisted of 13 Highway Safety Program Standards. To induce state compliance with the Highway Safety Program Standards, Congress granted the Secretary of Transportation authority to withhold 10% of federal highway construction funds and all federal highway safety funds from states that would not

implement an approved highway safety program. For states to have an approved program, they had to pass a law mandating motorcyclists and passengers wear approved helmets.

The leverage granted to the Secretary of Transportation by the Highway Act of 1966 proved instrumental in persuading many state legislatures to adopt mandatory motorcycle helmet use laws. By 1975, all but three states--California, Utah, and Illinois--complied with the Federal standards for helmet laws as outlined by the 1966 Act. In 1976 the Secretary of Transportation, under authority of the Highway Act of 1966, began proceedings to withhold funds from the three non-compliant states. After intense Congressional lobbying by groups opposed to mandatory helmet use laws, Congress passed the 1976 Highway Safety Act which withdrew the Secretary of Transportation's authority to withhold Federal highway funds from states that would not comply with Highway Safety Standards. As a result of this change in Federal consumer protection legislation, many states began dismantling motorcycle helmet legislation.

According to the National Highway Transportation and Safety Administration (NHTSA), over one-half of the states either repealed or weakened their helmet use laws by 1980 (U.S. Department of Transportation, 1980). Though there have been numerous attempts to resurrect mandatory helmet use laws, approximately one-half the states still do not have comprehensive helmet laws that protect all riders. Louisiana, an exception to the trend, re-enacted a mandatory

helmet use law in 1982. A two year study following Louisiana's re-enactment showed that motorcycle fatalities dropped by 40 deaths the first year, which equated to a 30% reduction in motorcycle fatalities. This decline in deaths occurred even though motorcycle registrations increased 5.9% during that year. Stated in the summary of the U.S. Department of Transportation Final Report (McSwain and Willey, 1984): "Statistically significant decreases in the incidence and severity of injuries to the head are shown [in Louisiana] during the re-enactment period as compared to the helmet repeal period" (p. i).

Nature and Justification of Problem

Mandatory helmet use by motorcyclists and passengers is hotly contested in legal, political, social, medical, and economic arenas. To the opponents of mandatory helmet laws, the debate focuses on two philosophies. First is the challenge to the helmet as a safety device. Some opponents of mandatory helmet use laws insist that helmets do not appreciably reduce injuries, and in some cases aggravate or cause injury. The second issue is the civil rights position which advocates that "only those that ride can decide". The American Motorcyclist Association (AMA), largest of the motorcyclist lobbies, has taken a strong stand against helmet use laws. The AMA stated in their October 1987 position paper that adults should have the right to choose whether or not they wish to wear a helmet. Their position has remained unchanged since the Highway Act of 1966. After

reviewing many sides of the enduring debate the question remains: Do motorcyclists have the right for optional helmet use or does concern for the public interest eclipse a motorcyclist's right to choose whether or not to wear a helmet?

Purpose of Research

Consumers' interest in motorcycle safety and mandatory helmet laws affect not only the motorcyclist but society at large through medical costs, insurance costs, and road safety. Nearly all consumers are affected directly or indirectly by this issue.

The purposes of this report are to 1) review the history of consumer protection legislation requiring motorcyclists to wear helmets; 2) evaluate opposition to helmet use laws; 3) examine the benefits of motorcycle rider education as a means to improve motorcycle safety; and 4) make policy recommendations for motorcycle helmet laws, licensing, education, and training.

Methodology

The methodology of this report represents an attempt to explore the economic consequences to society when some of its members who ride motorcycles choose not wear helmets. Tax payers, public policy makers, and legislators must decide if society can afford to give motorcyclists the right of optional helmet use.

The first stage of the research focused on literature that examined the injury prevention potential of motorcycle

helmets. After the potential to reduce injury was clearly developed, the second step of the research was to determine the economic costs and benefits of helmet use. The evidence that helmet use was effective at reducing injury proved overwhelming. The natural follow on step focused on the approaches used to encourage motorcyclists to wear helmets.

The history of helmet laws were examined in the U.S., Canada, Britain, and Australia. What set the U.S. apart from other countries was the repeal era which resulted in over half the states eliminating their helmet laws in the 1970s. Helmet use following the repeal declined while fatalities and injuries climbed dramatically. This caused an expansion in my search for other means to make motorcycling safer. This search led to motorcycle education and training which began to play an increasingly important role in motorcycle safety.

Motorcyclists, however, have not embraced helmet laws preferring freedom of choice to laws. In areas where helmet use is voluntary, many motorcyclists elect not to wear helmets. Medical costs for nonhelmeted motorcyclists have proven substantially higher than for helmeted motorcyclists. The increased costs to society is staggering. The drain on limited resources created by these excessive injuries opens important social and economic questions. This research was an attempt to account for our allocation of limited resources and to help others make better informed choices on motorcycle helmet laws and motorcycle safety training.

Definition of Terms

The following definitions are applied to selected terms and phrases in this report:

Department of Transportation (DOT) - The federal agency responsible for the administration of traffic safety programs.

Motorcycle- A motor vehicle with a seat or saddle, and normally has two, but can have three wheels. The major differences between motorcycles and other motor vehicles are: (1) riders are exposed to the elements; (2) motorcycles do not have occupant restraining system; and (3) the two-wheeled versions require balance.

Motorcycle Safety Foundation (MSF) - A national, private, nonprofit organization whose goal is the reduction of motorcycle accidents and injuries. MSF is sponsored by motorcycle manufacturers.

National Highway Traffic Safety Administration (NHTSA) - A branch of the U.S. Department of Transportation, dealing specifically with safety problems.

REVIEW OF LITERATURE

History of Helmet Use

The importance of motorcycle helmets as a consumer safety issue grew dramatically in the United States as motorcycle sales surged in the 1960s. In 1956, motorcycle registrations were just under 500,000, but with the explosive growth of light weight, inexpensive Japanese motorcycles, registrations exceeded 2,000,000, in 1966 (U.S. Department of Transportation, 1980). In Europe, consumers showed interest in motorcycles much earlier than Americans. Europeans were attracted to motorcycles by their utility, fuel economy, and low operating costs. In addition to the excellent fuel economy of motorcycles (approximately 70 miles per gallon), the manufacturing of a motorcycle requires only one-tenth the glass, steel, and plastic consumed in the manufacturing of an automobile (Newman, 1982, p. 1). During those early years of motorcycle development, Europe was also the hub of motorcycle manufacturing as all but one major manufacturer, Harley Davidson, were located in Europe.

Because of the popularity of motorcycles in Europe, it is not surprising that the very first public health and consumer concerns of motorcycle safety emerged in Europe

concurrently with the growth of the motorcycle industry. In 1941, the British Army made helmet use mandatory for all soldiers when involved in motorcycle riding activities (Cairns, 1941). This provided the first statistically significant population of helmeted motorcyclists from which safety comparisons between helmeted and nonhelmeted riders could be drawn. British surgeon, Dr. Hugh Cairns, took advantage of this phenomena to conduct the first research aimed at determining the effects of helmet use in motorcycle accidents.

Cairns and Holburn (1943) investigated 106 reported motorcycle accidents in Britain from 1941 to 1943. In their study, they reported that helmet use by motorcyclists reduced severity of injuries in motorcycle accidents. Through their accident analysis, they determined that helmet use by motorcyclists correlated with a 25% reduction in head trauma and a 50% reduction in hospital treated injuries when compared to nonhelmeted motorcyclists. Latter, British researchers (Lewin and Kennedy, 1956) published results of their motorcycle crash helmet study. They concluded that helmet use in motorcycle accidents contributed to a 40% reduction in injuries for helmeted motorcyclist when compared to nonhelmeted accident victims. The results of these studies and the growing concern for public safety thrust the idea of mandatory helmet use laws into various public forums around the world.

Helmet Use Laws

Following the British helmet use studies, the state government of Victoria, Australia, in an effort to improve public safety, introduced the first mandatory helmet use law on January 1, 1961. In anticipation of the legislation, Foldvary and Lane (1964) conducted a four year helmet use study in Victoria beginning two years before the law and concluding two years after the helmet law enactment. These studies provided the first documented evidence of the effect of mandatory helmet use laws. The most important results of the Foldvary and Lane study showed that compliance with the Victoria helmet law was above 99% and motorcycle fatalities were down over 30%.

In the United States, the NHTSA carefully reviewed the Australian study and used the findings as evidence in Congressional hearings on helmet law legislation. In the NHTSA Technical Note (Johnson, Buchanan, and Levy, 1976) a case was made for helmet use citing the original helmet use study in Victoria (Foldvary and Lane, 1964, pp. 7-14):

> 1. The legislation was successful, i.e., compliance was near 100 percent;
>
> 2. Fatalities [in Victoria] for 1961 and 1962 were reduced by half, and after study of many other factors, the reduction appears attributable to helmet use; and
>
> 3. The risk of fatality to an accident involved helmet user is one-third that of an accident involved nonuser. (Johnson, Buchanan, and Levy, 1976, p. 2).

The findings of the Foldvary and Lane study (1964), which were in agreement with all helmet use studies to date in the U.S., contributed to Congressional passage of the Highway Safety Act of 1966. In state after state, motorcycle helmet laws correlated with about a 30% reduction in deaths and severe injuries (U.S. Department of Transportation, 1980). This trend, however, was reversed with Congressional passage of the 1976 Highway Safety Act which withdrew the Secretary of Transportation's authority to withhold Federal funds from states not in compliance with the Highway Safety Program. As states no longer had a financial incentive to comply with the Federal Highway Safety Program, many began dismantling their helmet law legislation. This marked the beginning of the helmet law repeal era. Within three years, 27 states eliminated or modified their helmet use laws. As of September 1979, 10 states had no helmet law requirement, 22 states required helmets for all motorcycle riders (includes District of Columbia and Puerto Rico) and 20 states had helmet use laws that applied to riders 18 years old and younger. (U.S. Department of Transportation, 1980). The effects of helmet laws and repeals on fatalities can be observed in Figure 1.

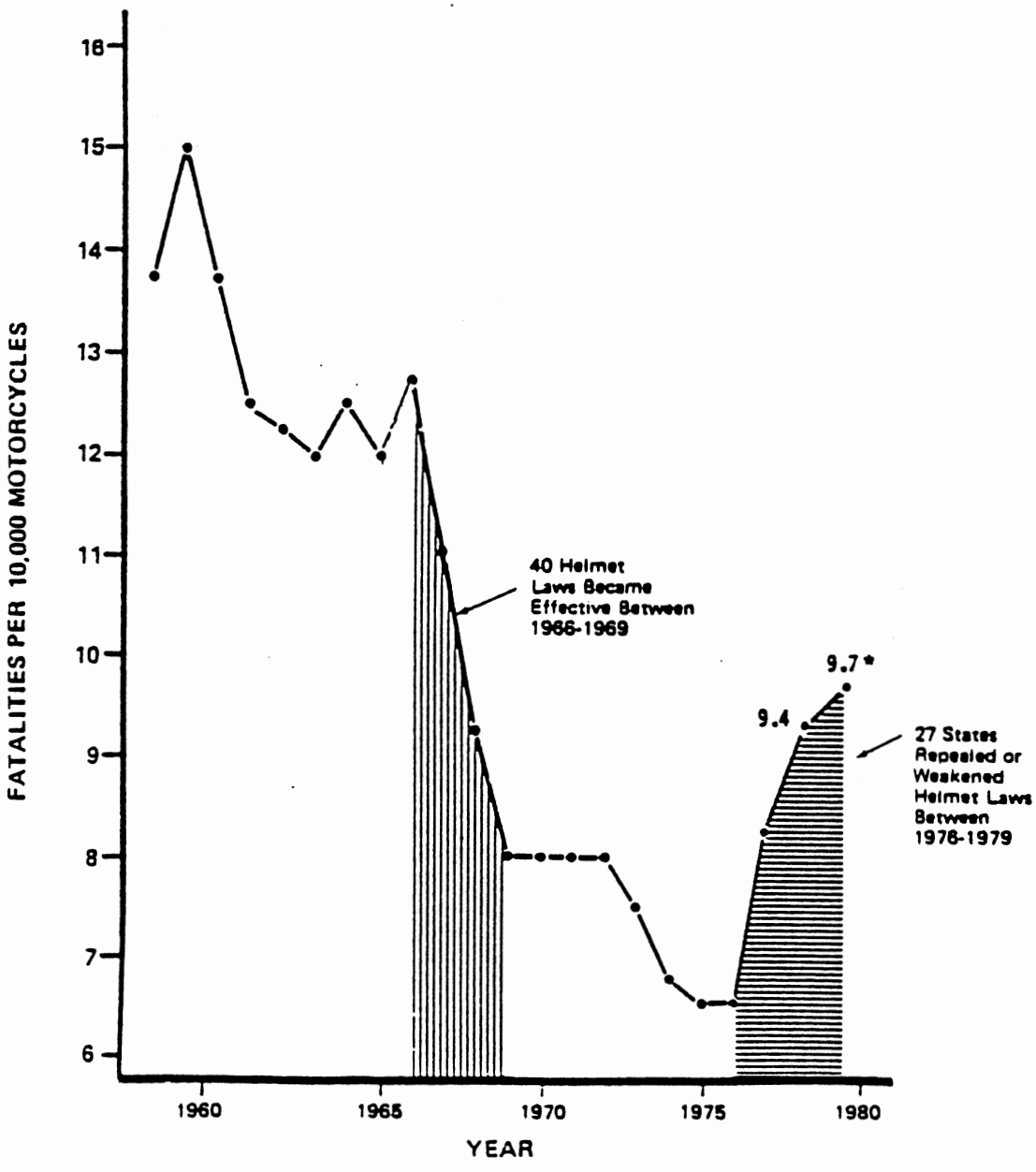

Figure 1. Graph of Fatalities

(U.S. Department of Transportation, 1980)

Economic Impact of Helmet Use

Numerous studies have explored the social and economic costs associated with the repeal of the motorcycle helmet laws. Hartunian, Smart, Willemain, and Zador (1983) used a two step approach to apply an economic cost to helmet law repeal. First, computations were made to determine the number of excess fatalities attributed to the repeal or modification of helmet laws for 28 states. Then the direct and indirect economic cost to society that resulted from the fatalities were calculated. Factors considered in the direct economic costs were derived from medical, legal, and funeral expenses of the deceased. The direct costs were then added to the indirect costs that were estimated by analyzing the foregone earnings and the value of homemakers' services of the excess fatalities. The sum of the direct and indirect costs represents the amount of goods and services that the society could have allocated to targets other than the fatalities in question. A serious limitation in this research was the exclusion of costs which resulted in the increased frequency of nonfatal injuries due to helmet law repeals. Hartunian et al. (1983) acknowledged that limitation by stating "our cost figures therefore represent a lower bound on the economic consequences of helmet-law repeal" (p. 93).

Hartunian et al. estimated that in 1980, there were 516 fatalities that resulted from the repeal of helmet use laws. The direct and indirect costs to society for those 516

fatalities, in 1980 dollars, was approximately 176.6 million. What separates this study from others is that the indirect costs were derived by using age and sex demographics of fatalities as factors in the estimate. According to the California study (Hurt, Quellet, and Thom, 1981) the age group from 17 through 26 are involved in more than half of the motorcycle accidents in California. This data appears generalizable to the other 49 states. The lost wages and long term costs for motorcycle injuries, disabilities, and fatalities create a tremendous economic burden on the society. The younger the victim, the higher the cost to society. Legislators and consumers must be cognizant of the economic consequences of motorcycle helmet use legislation, particularly as it applies to our young riders.

In a case study of consumer protection of motorcycle helmet laws, Dardis and Lefkowitz (1987) examined the losses to society in 1981 from the states that repealed or failed to enact helmet laws. The first step of their research efforts was compiling statistics on the estimated number of excess fatalities based on each states' helmet laws. Second, they estimated the economic cost of increased injuries and disabilities that occurred as a result of the rider not wearing a helmet. An economic value was then applied to helmet use effectiveness that served as a basis for a cost benefit analysis of helmet laws. Dardis and Lefkowitz (1987) stated "that every dollar of benefit due to motorcycle helmet laws costs from five to 18 cents" (p. 214).

Consequently, they concluded that helmet laws are cost effective in preventing serious injury.

What is a Helmet?

Helmets are protective head gear designed to protect the wearer in an accident. A helmet protects the wearer in two ways. First, the outer shell prevents piercing of the skull and distributes the force of a blow or impact over a large area. Second, the inner shell absorbs shock by slowly collapsing under impact. This energy absorbing inner shell is crushed or destroyed as it consumes energy from impact. As a result, the energy absorbed by the liner and shell is not available to injure the wearer's head. For a helmet to be effective, it must remain securely on the wearer's head. Retention systems are designed to keep a helmet securely fastened to a motorcyclist's head during an accident. Department of Transportation (DOT) standards require helmet retention straps as well as the helmet itself to pass rigorous testing. All helmets sold in the United States after 1980 must pass DOT testing and be so annotated with a DOT sticker on the back of the helmet.

Today there are three types of helmets available to consumers: the full face, the full (also known as the three-quarter), and the partial. The full face helmet covers the jaw and portions of the face and is recognized as offering the most protection to the rider (Hurt et al., 1981). These helmets were originally designed for racing but improvements in shell material and interior ventilation

have made them increasingly popular with motorcycle consumers over the past several years (Motorcycle Safety Foundation, 1986).

The second best helmet for protection is the full helmet that looks similar to a jet pilot helmet. The full helmet covers from the base of the head, forward over the ears, and up around the forehead. These helmets do not provide face or chin protection but are considered equal to the full facial helmet in protecting the head (Hurt et al., 1981). These full helmets appear to comprise the majority of helmets sold to and used by motorcyclists today. If protection were the sole criteria of consumer helmet purchases, consumption of full helmets would give way to full facial helmets.

The third type of helmet is called a partial coverage or "pudding bowl". The partial helmet offers coverage over the top of the head but generally does not extend down over the ear. This leaves the entire face, chin, and lower portions of the back of the head exposed. Partial helmets are recognized as the least effective of the three helmets based entirely upon the reduced amount of coverage. The degree of protection offered by a helmet is proportional to the amount of coverage they offer the rider. A helmet cannot protect an area of the head, neck, or face that is not covered (Hurt et al., 1981). Since such a high percentage of injuries to motorcyclists are to the head and face, the more a helmet protects these areas, the better for

a rider. The drawing below (Figure 2) shows the relevant coverage for each of the three helmets.

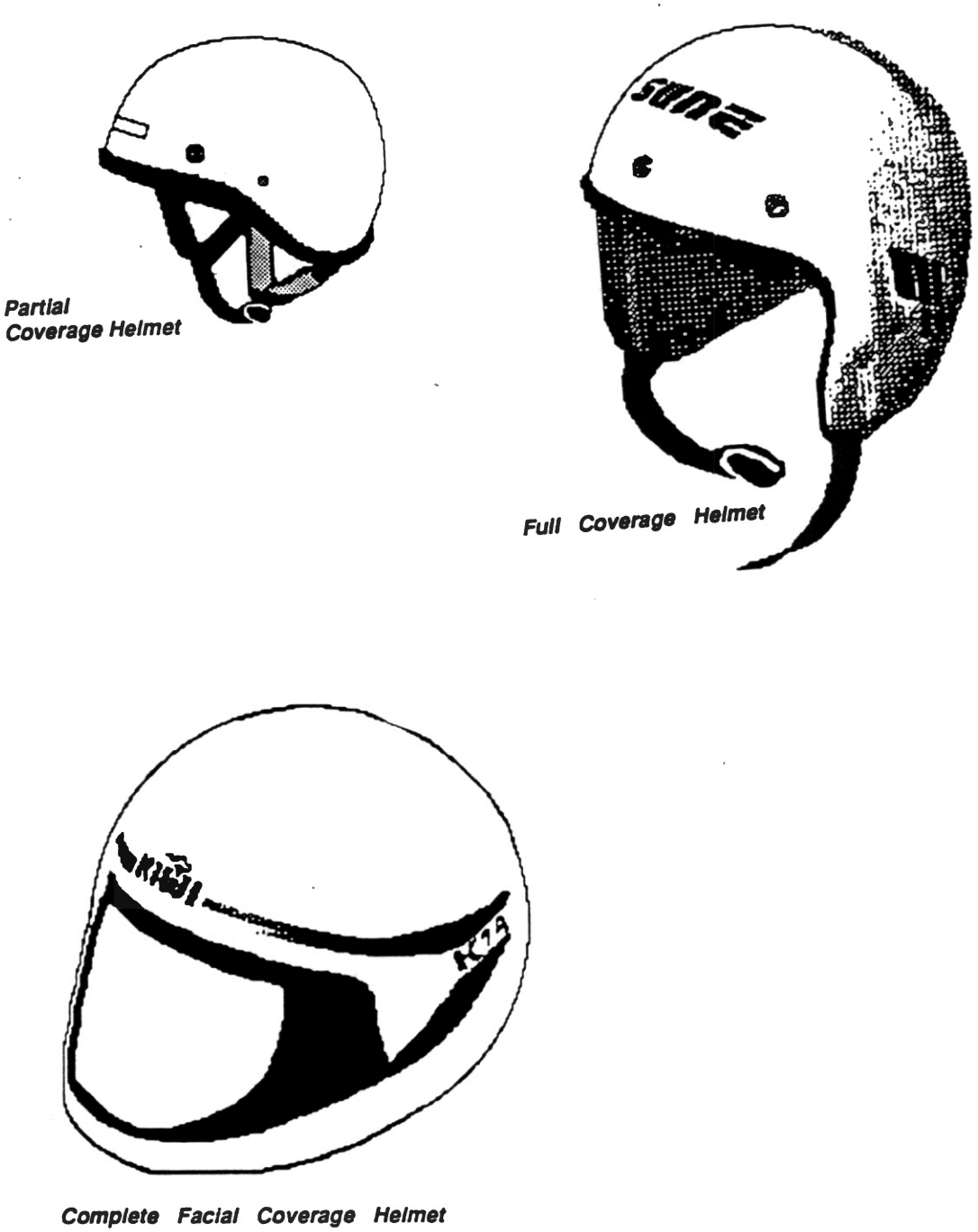

Figure 2. Motorcycle Helmets

Why Not Wear a Helmet?

The most persuasive argument for why an individual motorcyclist would choose not to wear a helmet voluntarily is because riders underestimate the risk and have no expectation of an accident (Allegrante, 1979). Those who intend not to wear a helmet are generally not as informed of the risks as their contemporaries who intend to wear helmets. Motorcyclists who do not believe in the probability of accident see little need for the probabalistic insurance that a helmet offers. If the individual is involved in an accident, there is no guarantee a helmet will save the wearer's life or prevent serious injury. Consequently, some motorcyclists who are aware of the higher injury risk of not wearing a helmet rationalize away the positive aspects of helmet use.

Opposition to Helmets and Helmet Laws

Those who oppose mandatory motorcycle helmet-use laws have challenged legislation on two primary issues. First, the integrity of a helmet itself has been challenged as a safety device. Second, the motorcyclist's have challenged helmet-use laws as a civil rights issue. Many motorcyclists do not agree that the government has a right to force them to protect themselves with mandatory helmet use laws.

The helmet itself is challenged as a safety device on four major issues.

1. Helmets diminish hearing ability, thereby preventing the wearer from recognizing sounds in traffic.

2. Helmets impede a wearer's vision by restricting the rider's field of view, especially the peripheral vision to the sides.

3. Helmets are heavy, which contributes to rider fatigue and performance that can lead to accidents.

4. Helmets cause neck injuries.

Each of these four challenges to the motorcycle helmet as an effective safety device were refuted in a wide variety of studies. Listed below are the results of several of the most relevant studies and their conclusions on helmet use.

1. Helmets do not interfere with a motorcyclist's ability to hear. Helmets do attenuate sound. Since helmets attenuate traffic noises, engine noise and wind by the same degree, the signal to noise ratio among different sounds will not change. Any sound that is loud enough to be heard over the engine noise and the wind without a helmet, will have the same signal to noise ratio with a helmet (Henderson, 1975).

2. Helmets do not obstruct a riders critical field of view. In Hurt et. al (1981) analysis of 900 motorcycle accidents, 90% of the motorcycle hazards were encountered from the front. The DOT standard requires that helmets have no visual restriction to the wearer from straight ahead to 105 degrees on either side. This straight ahead line is called the midsagittal plane. According to Hurt et. al "Considering the extremely low incidence of hazards in the peripheral field denies the

need for wide eye space in safety helmets: there is no need for lateral visual space greater than the current standard of 105 degrees from midsagittal plane."(p.89).

3. Rider fatigue from helmet use does not appear to contribute to motorcycle accidents. First, the average motorcycle helmet weighed just under three pounds (Richardson, 1974). Since 1974, new materials such as Kevlar (Motorcycle Safety Foundation, 1986), have lightened motorcycle helmets further. In Hurt et al. (1981), 50% of the accidents occurred within six minutes from the start of the trip and over 90% occurred in less than one hour from the start of the trip. With most accidents occurring so early into a trip, fatigue does not appear to be a causal factor in most motorcycle accidents.

4. Helmets do not cause neck injuries. According to the NHTSA, neck injuries occur in less than two percent of all motorcycle crashes. In addition, every study reviewed by the NHTSA during 30 years of helmet law debates shows no evidence that helmet use contributes to neck injuries (Johnson, Buchanan, and Levy, 1976).

As a civil rights issue, mandatory helmet use has been opposed by some motorcyclists, particularly by organized groups such as the American Motorcycle Association (AMA) and A Brotherhood Against Totalitarian Enactment (ABATE). Those opposed to mandatory helmet use laws believe such laws are an assault on their personal freedom. Specifically, they

believe that the basic freedoms guaranteed in the Constitution entitle them to make helmet use a personal decision. In their opinion, helmet laws are civil rights issues not public health issues.

Those opposed to helmet use laws have been soundly defeated in the legal arena. According to Baker (1980) the highest courts in 25 states have upheld helmet laws as Constitutional. In 1972, the United States Supreme Court upheld the opinion of the Massachusetts Supreme Court which in their legal opinion supporting helmet laws stated:

> While we agree with plaintiff that the act's only realistic purpose is the prevention of head injuries incurred in motorcycle mishaps, we cannot agree that the consequences of such injuries are limited to the individual who sustains the injury. The public has an interest in minimizing the resources directly involved. From the moment of the injury, society picks the person up off the highway; delivers him to a municipal hospital and municipal doctors; provides him with unemployment compensation if, after recovery, he cannot replace his lost job, and, if the injury causes permanent disability, may assume the responsibility for his and his family's subsistence. We do not understand a state of mind that permits plaintiff to think that only he himself is concerned. (Simon v. Sargent, 1972).

The Constitutionality of mandatory helmet use laws was upheld. However, legal defeat did not diminish the

enthusiasm of advocates against helmet use laws. Lobby groups from the AMA and ABATE shifted their tactics and challenged helmet laws in the federal and state legislative arenas. There the advocates and lobbyists of helmet use choice were more successful. The advocates believe that our social fabric is strengthened by individuals who choose high risk activities (American Motorcycle Association, 1987). Many motorcyclists believe that other activities (Perkins, 1981) such as rock climbing and rodeo riding are not covered by consumer protection legislation mandating helmet use; consequently, these motorcyclists feel entitled to the same rights. In addition, 50.8% of motorcycle accidents are caused by automobile drivers, which is an infringement on motorcyclists' rights (Hurt et al. 1981). Motorcyclists do not believe that they have the legal and economic responsibility to protect drivers that run into them.

According to Perkins (1981) "For every law and regulation there is a judgement to be made both by public officials and by the consuming public as to what constitutes a reasonable risk as compared to associated positive and negative consequences" (p. 294). Perkins, in his advocacy of motorcyclists' rights, believes that 27 state legislatures have concluded that helmet laws have negative consequences for society as evidenced by their votes to repeal helmet laws. When the Secretary of Transportation could no longer coerce states with financial penalties, state legislatures were financially free to make decisions

in the perceived interests of their constituents. Perkins, in defense of helmet choice, makes no effort to compute the social, economic, and public health costs that result from rock climbers and rodeo contestants who choose not to wear a helmet. Without the costs, an objective comparison is difficult. Cursory estimates, based on the small percentage of the population that participates in rodeos and rock climbing, would indicate a small cost when compared to the death rate and cost to society for nonhelmeted motorcycle accident victims.

Training, Education, and Licensing

The purposes of motorcycle helmets and helmet laws are to reduce the severity of injury and the chance of fatality in any given motorcycle accident. The goal of motorcycle education and training is to reduce motorcycle accidents and injuries through accident prevention. The purpose of licensing is to sanction those riders with the necessary education and training to ride on our streets and highways. The public interest in this approach focuses on reducing motorcycle casualties before the rider is dependent upon his or her last critical line of defense against injury--protective clothing and a helmet.

Until recently, motorcycle riders were often self taught. Another source of training was the motorcycle dealer who often provided the customer enough training to get the motorcycle and rider off the premises. The majority of motorcycle training and education in the United States

was accomplished by one motorcycle rider teaching another. Hurt, Quellet, and Thom (1981) reported in their study that 92% of the riders involved in accidents were in the category. In my own experience, I was self taught and received occasional instruction from fellow motorcyclists. Each of us was guilty of passing on and reinforcing the same misinformation we were taught. As an example, I was totally misinformed about the utility and risk of use of the front brake and consequently never used it. Six years later, during my first motorcycle safety course, I learned that the front brake accomplished the majority of the braking load and reduced stopping time and distance by up to 70% over rear wheel only braking. The following is a quote from the Hurt, Quellet, and Thom's (1981) report: "Imagine one motorcyclist rider learning anything valuable from another rider who has no appreciation of head and eye protection and no understanding of the vital performance of the front brake in collision avoidance." Fortunately, this era of nonprofessional instruction is slowly giving way to professional instruction.

Motorcycle safety training is a comprehensive approach that attempts to reduce the probability of accidents through academic and skill training while simultaneously teaching motorcyclists how to protect themselves in the event an accident does occur. The Motorcycle Safety Foundation (MSF) was founded in 1973 with the primary goal of making motorcycle riding safer. The MSF's goal of reducing

motorcycle accidents and injuries is being accomplished through rider education, licensing improvements, public information campaigns, and research and development programs.

The MSF, for all practical purposes, is our national resource for motorcycle safety. Their pioneering effort in development of the Motorcycle Rider Course (MRC) was designed to educate and train novice motorcyclists who are so vulnerable to accidents. Statistics show that 25% of novice riders become involved in accidents within the first six months of riding (Hurt, Quellet, and Thom, 1981). The MRC was first introduced in 1976 and was offered at various colleges, military installations, and a few secondary schools around the country. Today, the revised course is the basis for nearly all formalized motorcycle training in the United States.

The MSF is a national, non-profit organization sponsored by the five leading motorcycle manufacturers: Honda, Yamaha, Kawasaki, Suzuki, and Bavarian Motor Works. No doubt safer motorcycling results in positive economic consequences for the motorcycle manufacturers. However, investing in safety through a foundation gives some measure of independence to the program. Many of the independent academic studies on motorcycle safety were sponsored by the MSF. For consumers, this appears to be a responsible approach by motorcycle manufacturers to a recognized safety problem.

According to the Motorcycle Safety Foundation (MSF), substituting motorcycle training for helmet laws conflicts with their goal of making motorcycling safer. However, many opponents of helmet laws argue in favor of that position. The MSF, as a matter of policy, takes every opportunity to support voluntary helmet use in the absence of laws. In fact, all MSF supported courses and rider activities require motorcyclists to wear a Department of Transportation approved helmet, safety goggles, and appropriate riding apparel for participation. The recurring theme of professional motorcycle educators and instructors supports the consensus that: training and education reduce the number of motorcycle accidents; however, when a motorcyclist is involved in an accident, a helmet will significantly reduce injuries.

The academic aspect of motorcycle rider training is designed to provide an understanding of road and traffic hazards before the rider is confronted with them. As an example, the major cause of motorcycle collisions with other vehicles is the result of the driver not seeing the motorcyclist (Hurt et al. 1981). A major effort by the MSF has been made to teach motorcyclist how to be conspicuous on the road. This theme is taught in all their courses and is part of nearly every piece of their safety literature. The MSF highly recommends riders wear brightly colored clothing and keep their head lamps on day and night.

The training aspects of motorcycle riding provide the motorcyclist with the physical riding skills to stop, start, turn and negotiate different road surfaces. The minimum physical skills to operate a motorcycle require more strength, more coordination, and a better sense of balance than driving an automobile. As an example, the routine tasks of starting or stopping a motorcycle requires simultaneous use of both hands and both feet while maintaining one's balance. Any hesitation or complication during these starting or stopping maneuvers could divert the rider's attention from the road and traffic environment.

In 1979, a study was conducted in California (Collins, 1979) on the effects of motorcycle safety education in accident prevention. The motorcycle safety education course used in the study was presented by the Metropolitan Adult Education Program (MAEP) located in San Jose. The conclusions of the study showed that motorcycle riders who had completed a safety education course had an annual accident rate of 1 per 100 registrations. This is significantly lower than both the national rate of 3.43 accidents per 100 registration and the California rate of 3.92 accidents per 100 registrations. A total of 100 respondents out of 352 MAEP graduates of the course were randomly selected to participate. A limitation of the study was that the National and California control groups were based on motorcycle registration data while the course group were known to be actively riding motorcyclists. In

addition, all of the 100 respondents involved had previous motorcycle experience before the course and many were enrolled in the course as an alternative to paying traffic fines. Of this group of 100 respondents, an astounding 48 reported some type of motorcycle accident before enrolling in the course.

Professional instruction is gaining momentum in many states as a requisite for motorcycle licensing. Results of the Collins (1979) study and a populist view that education and training improve performance, have led many to believe that properly trained motorcyclists have less chance of becoming involved in an accident. According to the MSF (Motorcycle Safety Foundation, 1988) 30 states now have legislatively funded motorcycle safety programs.

In an effort to validate motorcycle safety programs the DOT funded the New York Department of Motor Vehicles to study crash reduction effectiveness of various motorcycle operator training and licensing programs and materials. According to Buchanan (1987):

> "Investigators randomly assigned over 26,000 motorcycle license applicants to one of four groups: 1) standard New York State program [control group which consists of a simple test for a motorcycle license], 2) revised program including new knowledge and skill test, 3) revised program with a three hour training program, and 4) revised program with a 20 hour training program. The investigators examined accident records for these

applicants in five exposure periods (3, 6, 12, 18, and 24 months) after initial application for a motorcycle operator's permit. The results of this study showed no significant differences between motorcycle accident rates among any of the groups including the control group.

In 1980, the MSF funded a study at the University of Illinois (Mortimer and O'Rourke, 1980) to evaluate the effectiveness of motorcycle rider course in affecting safety of operation of motorcycles. The results of the study did not show any direct benefits of motorcycle rider course on the accident rate. In fact, the trend in that study showed that those involved in the motorcycle rider course had a slightly higher accident rate. However, the severity of accidents in terms of motorcycle damage and cost to treat injuries per million miles for the course graduates was 59% of the cost for the non trained control group. Investigators in the project have conjectured that the lower level of injuries could be attributable to the courses emphasis on protective clothing and helmets. Illinois has no helmet use laws and motorcycle rider course graduates tend to have a higher use of helmets and protective equipment.

A different trend in motorcycle safety has been realized by the United States Air Force (USAF), which has combined mandatory helmet use with mandatory motorcycle education. In 1969, the USAF experienced 10.5 fatalities per 10,000 motorcycle registrations compared to the national

average of 8.2 fatalities per 10,000 motorcycle registrations (Wilkes, 1988). In 1969, all USAF personnel fell under the state and local laws for licensing, training and helmet use. During the helmet law repeal era of the 1970s, the USAF did not relax helmet use requirements on their installations. In an effort to reduce the number of motorcycle accidents and injuries, the USAF initiated a program in 1976 that required motorcyclists to enroll in an MSF sponsored Motorcycle Rider Course (MRC) prior to operating a motorcycle on a USAF base. The MRC course requirement was a four hour safety lecture. However, most USAF installations offered an additional four hours for riders to practice their skills under the guidance of professional instructors.

In 1986, the Department of Defense (DOD) took motorcycle safety one step further by requiring military personnel to wear helmets at all times when motorcycling on and off military installations. Factors bearing on the decision were concern for the health and welfare of military personnel, responsibility to the nation for defense, and concern for tax payers who must pay not only for military training but the medical care and disability costs should military personnel be injured.

In addition to mandatory helmet use, the USAF continues to invest in motorcycle training. The USAF has close to 500 MSF certified instructors that volunteer their services on bases throughout the world. In 1987, the USAF sponsored 92

Rider Education Programs that reached over 10,000 personnel (Wilkes, 1988). Courses such as the Experienced Rider Course and a Riding and Street Skills are offered to riders that have already completed the basic MRC. The purpose of these advanced courses are to hone the skills of experienced riders and perhaps more importantly, keep their attitudes positively focused on safety. The results of the USAF's comprehensive approach of rider education and mandatory helmet use can be observed in Figure 3.

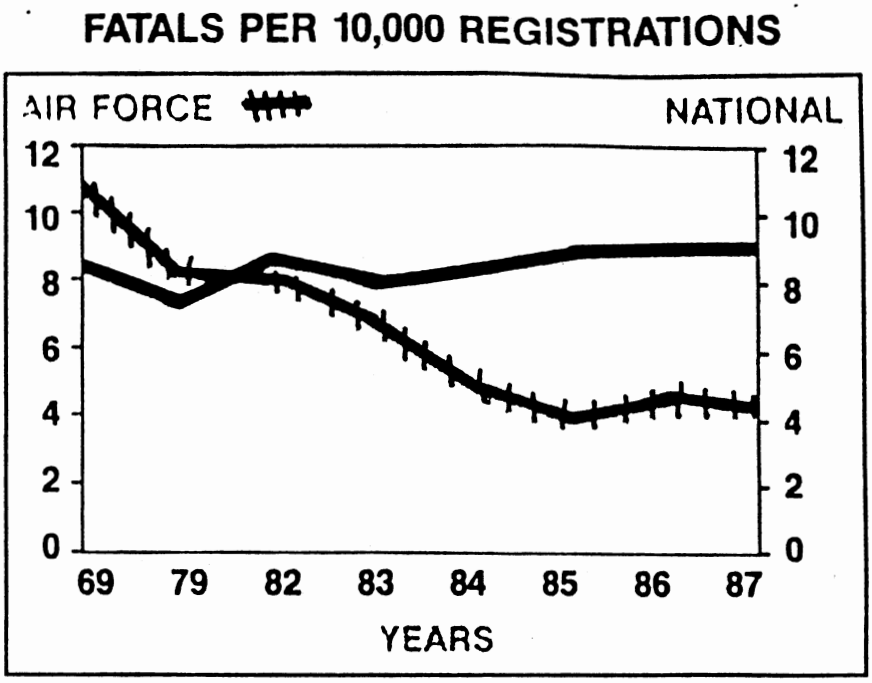

Figure 3. U.S. Air Force Fatalities

Despite the overwhelming evidence that motorcycles are potentially dangerous and complicated to operate, 13 states will legally license children under the age of 16 to operate motorcycles on their streets and highways. Of those 13 states, six will license 14-year-olds and seven states will license 15-year-olds. One additional state will issue a license for 14-16-year-olds for motor driven cycles but specifically excludes motorcycles (MSF, 1987). In Hurt, Quellet, and Thom's (1981) analysis of 3600 motorcycle accidents, the average age of a motorcycle accident victim is 22.9 years. The age group of 17 through 26 are involved in 62.6% of motorcycle accidents (p 114). There has, however, been improvement in motorcycle safety training and licensing procedures for young riders in a variety of states. California, for example, now requires completion of a motorcycle safety course for riders under 18 before a motorcycle license is granted.

CONCLUSION

Summary

Riding a motorcycle is inherently more dangerous than driving an automobile. Motorcycles offer no protective compartment and no restraint system for operators or passengers. A motorcycle rider is nine times more apt to be injured or killed in a traffic accident than is the occupant of other types of motor vehicles (U.S. Department of Transportation, 1984).

Motorcycle helmets have proven to reduce injuries and fatalities in motorcycle accidents. Motorcycle helmet use laws have resulted in helmet usage rates approaching 100% in states with helmet use legislation. In states without motorcycle helmet use laws, helmet use rates vary from 40% to 60% among motorcyclists.

Statistics from numerous studies have shown that approximately 30% of motorcycle deaths and serious injuries could be eliminated with mandatory helmet use laws. The cost of mandatory helmet use laws is borne by the motorcyclists who must purchase, maintain, and wear a helmet.

The costs to society for optional helmet use are the increase in the serious injuries and fatalities to motorcyclists that are inevitable from such a policy. Over

90% of injured motorcyclists do not have adequate medical insurance nor the resources to cover the costs should the rider be injured. Even those motorcyclists with adequate insurance can effect higher insurance premiums for all consumers. As a result, there is an unjustified economic burden placed on society by a small minority of motorcyclists.

There is no doubt that motorcycle rider training improves knowledge level and skills of students. The MSF is the major innovator of motorcycle safety programs. The safety programs revolve around the central theme that improved rider performance and knowledge translates into accident reductions.

Most studies support the hypothesis that motorcycle training significantly reduces accidents. There were, however, some studies that did not. One of the studies that did not show a benefit from motorcycle training was done by Mortimer and O'Rouke (1980). The conclusions in this study were based on demographics that may not be generalizable to the average motorcycle population. As an example, one of the groups receiving the rider education was made up of all college students at the University of Illinois. Another group received motorcycle training at off-campus sites. Both groups were compared with a control group consisting of off-campus participants. The findings showed that off-campus motorcyclist had similar accident statistics but there was little evidence to prove that motorcycle safety classes made

any difference. This author believes that the demographic uniqueness of the test groups and control group reduced the validity of the study. These findings conflict with helmet choice advocates who are convinced that motorcycle safety training is more effective at reducing injuries than helmet laws.

Mandatory education combined with mandatory helmet laws appear to be the best approach to motorcycle safety. The USAF experience which combines the two has been remarkably successful. The success of the USAF in motorcycle safety may not be generalizable to our broader society due to the unique social and legal factors of military service. However, the USAF success and similar successes of other military services provide a useful basis for a hypotheses supporting a combined approach of motorcycle rider training and mandatory helmet use as a means to improve motorcycle safety.

Motorcycle education and training, unlike automobile driver education, has no broad based support in high school curriculums. If young riders are to be instructed in motorcycle safety, either the schools or licensing bureaus of the states must assume responsibility for training. Thirty states now support some form of motorcycle safety programs. Most of these states have begun their efforts within the last several years. Future statistics will provide us with some indicators of the success of various state programs.

Recommendations

Mandatory helmet laws appear to be the best way to protect motorcycle operators and passengers. Helmet laws aimed only at riders below the age of 18 not only miss a large percentage of riders, but induce young riders to disregard the helmet laws that discriminate by age.

The Motorcycle Rider Course of the MSF or some similar course should be a requirement for licensing in all fifty states. A national standard for training and licensing would be particularly effective in reaching a large percentage of the motorcycle population.

Motorcycle operators should be required to carry medical insurance commensurate with the risk of the activity. If legislators can not pass mandatory helmet laws, then perhaps there could be economic incentives by insurance companies for helmet use.

In 1980, Mueller concluded that "Nation wide, at least 61 million in direct medical costs could be saved annually if all motorcyclists were to use helmets" (p. 586). With medical costs increasing faster than the cost of living in recent years, the savings might be relatively more in 1988 dollars.

The evidence appears to support the conclusion that helmet laws are effective in encouraging helmet use among motorcyclists. The combination of motorcycle education and training combined with mandatory helmet laws appears to offer the greatest opportunity to prevent unnecessary

medical expenditures and indirect costs to society. The pain and suffering avoided but attributable to helmet laws may not be quantifiable, but represent serious social and humanitarian concerns. The lost opportunity to invest our economic and human resources that are wasted for lack of helmet laws may be the greatest tragedy of all.

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