SB

666

"An Act relating to motorcycle safety; and providing for an effective date."

COMMITTEE REPORT

3/31/76

HOUSE

Mr. Speaker: Date May 24, 1976

The Committee on JUDICIARY has had CSSB 666 under consideration. A Majority of the members of the Committee

( ) recommends it DO PASS

( ) recommends it DO NOT PASS

( ) recommends it DO PASS WITH ATTACHED AMENDMENT(S)

( ) recommends it BE REPLACED WITH CS FOR _____ AND THAT CS FOR _____ DO PASS

( ) "and" recommends it BE REFERRED TO THE _____ COMMITTEE

( ) reports it back WITHOUT RECOMMENDATION

( ) "other"

Members signing the Majority report:

_____ _____ _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

Members NOT concurring in the Majority report:

_____ recommends:

_____ recommends:

_____ recommends:

_____ recommends:

_____ recommends:

_____ Chairman

1939

Original sponsor: Huber

Offered: 3/26/76
Referred: Rules

IN THE SENATE BY THE STATE AFFAIRS COMMITTEE

CS FOR SENATE BILL NO. 666

IN THE LEGISLATURE OF THE STATE OF ALASKA

NINTH LEGISLATURE - SECOND SESSION

A BILL

For an Act entitled: "An Act relating to motorcycle safety; and providing for an effective date."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. AS 28.35 is amended by adding a new section to read:

Sec. 28.35.270. MOTORCYCLE HELMET. A person who has reached the age of majority as defined by AS 25.20.010 may not be required to wear a helmet while operating a motorcycle if he is the holder of a license which, under regulations adopted under AS 28.15.070(b), is classified singly as a license to operate a motorcycle.

* Sec. 2. This Act takes effect immediately in accordance with AS 01.10.-070(c).

Have sanctioned 3 states

500,000 - highway safety

12⅓ Million highway construction

Called states in for hearings

Cal.; Illinois; Utah

rider; renters; under 19 - Insurance helmets

THE BROTHERS
MC
ALASKA

March 21, 1976

Honorable John Huber
Alaska State Senate
Pouch V, State Capitol Building
Juneau, Alaska 99811

Dear Senator Huber,

I Just recently learned of your sponsership of the bill to repel the mandatory helmet law. I am very much in favor of this bill's passage. I would like to extend my cooperation to you on this bill.

I have been active in petitioning signatures to repel the helmet law, and have sent them to Mr. Daved M. Baldwin, National Chairman, National Committee on Uniform Traffic Laws and Ordinances. So far I have sent in aproximately five hundred (500) signatures.

Please advice me of the action that has been taken on this bill and that will be taken in the future.

Sincerely yours,

Charles R. Lemmons

Charles R. lemmons
P.O. Box 4-2041
Anchorage, Alaska
99509

Reference to NHTSA Technical Note
DOT HS-801 137

A Motorcycle Safety Helmet Study

Safety Helmet Effectiveness [10]

A comparison between head injury sustained by safety helmet users and nonusers in traffic accidents in rural areas of Illinois, on the basis of a standard accident speed for both groups of riders, revealed the following:

1. In general, when helmets were not used, fatal or serious head injury was 3 times greater and head injury of all types was twice as great.
2. Helmets dislodged from the rider's head during the course of an accident did not reduce head injury and helmets damaged by cracking or splitting during impact were only slightly effective in that fatal or serious head injury was reduced by only 20% over non-helmeted riders. As expected, helmets that had not been damaged or ejected proved the most effective.
3. Helmets significantly reduced head injury in all three of the accident speed ranges considered: 60% for speeds up to 30 mph, 52% for speeds between 31-50 mph, and 51% for speeds over 50 mph. However, these differences in helmet effectiveness were not significant and helmets were equally effective in all three speed ranges.
4. Helmets significantly reduced head injury at both seat positions on the motorcycle, 68% for passengers and 52% for operators, but the difference in helmet effectiveness between the two positions was not significant.
5. Helmets significantly reduced head injury in accidents involving either noncollision (by 57%) or collision (by 50%), but the difference in helmet effectiveness between the two types of accidents was not significant.

Reference to NHTSA Technical Note
DOT HS-801 836

Motorcyc .e Safety- The Case for Helmet Use

Motorcycle helmets do not increase incidence of neck injury in accidents.

It has been suggested that helmet use increases the incidence of fatal neck injury in motorcycle crashes (using data from a 1969 statistical analysis of motorcycle accidents in New York).[13] Actually, the incidence of neck injury in motorcycle accidents during 1966 and 1967 involved any type of neck injury, and most of these involved only comp'aints of pain with no visible signs of injury. Studies done recently in Nebraska,[14] California and Canada[15] show that the incidence of neck injury of any type occurs in less than two percent of all motorcycle crashes.

Motorcyclists have been wearing safety helmets for more than 30 years, and during this period a number of studies of injury patterns in motorcycle accident have been made. None support the claim that helmets increase fatal neck injuries. The neck injury issue has been used in opposition to helmet laws as an attempt to exploit a peripheral issue on which there is not a great deal of valid data. Consequently, the problem has been magnified far out of proportion.

In order to provide conclusive evidence which will resolve the issue once and for all, the University of California and the Los Angeles County Medical Examiner's Office, under contract with the NHTSA, are now undertaking in-depth analysis of all fatal motorcycle crashes in Los Angeles County. Post mortem examination of each helmeted and unhelmeted rider will be made to document the incidence of neck injury in each group. The results of these analyses will provide authoritative resolution of the neck injury issue.

Mandatory helmet use laws reduce the number of serious head injuries and fatalities resulting from motorcycle accidents.

It is a logical conclusion that if a mandatory helmet use law is passed, more people will wear helmets, and consequently fewer fatalities and fatal injuries will occur in motorcycle accidents. Researchers have tried to verify this by comparing motorcycle fatalities and head injuries before and after implementation of a mandatory helmet use law. Of particular interest is a Brisbane, Australia report[16] which utilized three groups -- one sample done before implementation of a helmet use law, and two samples done in the two years immediately following. This study found (see Table IV) (a) that a significant increase in helmet use by motorcyclists involved in accidents (as expected) and (b) a significant decrease in head injuries in the post-legislation group.

IV. Summary and Conclusion

In general, motorcycle helmet visual restrictions were smaller along the horizontal plane as compared to the vertical planes. The full coverage helmets produced relatively small reduction in the entire field of view. As expected, the full facial coverage helmets resulted in somewhat larger reductions. The two styles of full facial coverage helmets yielded significantly different fields of view. Goggles produced approximately the same lateral visual field as the most restricted helmet.

With regard to restriction of the total field of view in the horizontal plane, it can be concluded that full coverage helmets (the most common type in use) provide only minor restrictions, less than 3 percent from that of an unhelmeted person. The full facial coverage helmets designed to comply with the lateral vision requirements of the ANSI Z90.1 standard and FMVSS No. 218 provided a restriction in lateral vision only marginally more than the full coverage helmets (7.3 percent). The "worst case" helmet provided a restriction of 21.9 percent from the unhelmeted lateral field.

All helmets tested exceeded the maximum State licensing requirements of 140° total "peripheral" view in the horizontal plane. Also, all helmets were in general compliance (especially visual regulations) with DOT standards. Therefore, helmet selection in terms of acceptable visual field, appears to be a matter of personal preferance among the many available styles.

Reference to NHTSA Technical Note
DOT HS-801 759

Effect of Safety Helmets on Auditory Capability

SUMMARY

Wearing a protective helmet has little to do with whether or not a motorcycle driver will hear a particular sound of interest to him or her. While it is true that safety helmets do attenuate external sounds, the amount of such attenuation is inconsequential, even when coupled with the amount of age-related hearing loss that normally occurs with age. The major determiner of whether a given sound will be heard is the ratio between the intensity of that sound and the intensity of the masking noise generated by the motorcycle (i.e., the signal-to-noise ratio). Safety helmets have an inconsequential effect because they reduce the loudness of both the sound of interest and the motorcycle noise by an equal amount and hence do not alter the signal-to-noise ratio between the two. A helmeted motorcycle rider can hear a sound of interest approximately as well as a person in an automobile with the windows closed.

IDAHO STUDY

SUMMARY OF STUDY FINDINGS

This summary is for the benefit of those who are more interested in survey results than in detailed analysis. All findings are substantiated in the body of the study.

1. There were 7.67 motorcyclists strongly in support of the mandatory helmet law for every 1 strongly opposed to the law.

2. Of motorcyclists who commented on the mandatory helmet law, 77.3% were in favor of the law.

3. Of motorcyclists who wore helmets, 84.7% indicated that the helmet reduced injury and 8.7% voluntarily added that it saved their lives.

4. Neck injuries were very rare in the severity A (incapacitating) injuries.

5. Over half of the respondents were at least twenty years old.

6. Motorcyclists over 35 years old comprised 20.7% of the respondents.

7. A few motorcyclists (2.6%) had less than one month motorcycling experience, but 75.6% had more than one year motorcycling experience.

8. Analysis of medical costs and days lost by severity code indicates that the injury severity codes marked by investigating officers are accurate indications of injury severity.

9. The opinion survey was favorable to motorcycle licensing with written and traffic exams, but not favorable toward off-road driving exams.

10. The opinion survey was favorable toward motorcycle training courses, with reservations on funding and administration.

11. The opinion survey supported the importance of eye protection but was not favorable toward a law requiring full-time eye protection.

12. Annual motorcycle mileage estimates varied greatly with an average somewhere between 3500 and 4500 miles per year.

13. Single motorcycle accidents predominately occurred in rural areas during daylight hours, while motorcycle accidents involving a car or truck occurred mostly in urban areas during daylight hours.

14. There was a marked difference in urban and rural accidents by injury severity type. Over half of the A injury severity accidents occurred in rural areas, while B and C injury severity accidents occurred mostly in urban areas.

15. Automobile driver awareness of and courtesy toward motorcyclists was determined to be the primary single factor in motorcycle collisions.

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file with members 4/5/76

BARRY'S CUSTOM CYCLE

HOUSE OF HARLEY

1204 CHUGACH WAY • ANCHORAGE, ALASKA • 99503 • (907) 272-0423

Mr Terry Gardiner
Box 1092
Ketchikan Alaska 99901
District 1

Dear Terry,

I am writing in reference to Senate Bill #666 "The Motorcycle Helmet Law"

I feel that helmets should not be required for people over 18 years of age. This should be an option.

Please consider this letter as written testimony when the resolution comes for vote before the Committee.

Sincerely,

Beverly Barry
Beverly Barry

NHTSA Technical Note
DOT HS-801 836

MOTORCYCLE SAFETY- THE CASE FOR HELMET USE

Prepared by:

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Traffic Safety Programs
Office of Driver and Pedestrian Programs

February 1976

crash helmets have been the subject of considerable court litigation across the country. With the exception of Michigan and Illinois, the appellate courts in at least 30 state[s] have upheld the constitutionality of such requirements.[19] Further confirmation of their constitutionality is the action of the U.S. Supreme Court in affirming the decision in *Simon v. Sargent*.[20]

Thus the courts have held that requiring a crash helmet and eye-protective devices is a reasonable regulation and within the police power of the state to protect the public health, welfare, and safety. Such requirements do not deny equal protection under the constitution since the equal protection clause does not require that everyone be treated equally but rather permits a reasonable classification and classifying motorcyclists separate from operators in other vehicles is reasonable. The equal protection clause does require equal treatment within each reasonable classification.

A common legal theme in these court decisions is that crash helmets and eye-protective devices *protect other users* of the highway from danger since such protections help prevent the motorcyclist from losing control of his vehicle due to flying rocks or debris, limbs of trees, etc. Also, in rejecting the claims of motorcyclists that such requirements are only for the protection of himself and thus are beyond the power of the government to regulate, the opinion of the court in *Simon v. Sargent* is representative:

> ". . . (W)e cannot agree that the consequences of such injuries are limited to the individual who sustains the injury. . . . From the moment of the injury, society picks up the person 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 continued subsistence. We do not understand a state of mind that permits plaintiff to think that only he himself is concerned."[21]

NHTSA Technical Note

MOTORCYCLE SAFETY -

THE CASE FOR HELMET USE

Penelope Johnson
Lewis Buchanan
Paul Levy

Prepared by:

National Highway Traffic Safety Administration
Traffic Safety Programs
Office of Driver and Pedestrian Programs
February 1976

MOTORCYCLE SAFETY - THE CASE FOR HELMET USE

INTRODUCTION

In line with the National Highway Traffic Safety Administration's mission to save lives on our nation's highways, significant effort has been directed towards better motorcycle equipment, education and licensing. Of these, the most immediate safety benefits are available from increased motorcycle helmet use by all motorcycle riders and passengers.

Currently, forty-seven States, the District of Columbia and Puerto Rico have enacted comprehensive motorcycle helmet usage laws. Utah requires helmet usage on all roads posted above thirty-five miles per hour (35 mph); California and Illinois have no laws. Because of the demonstrated effectiveness of helmet use described in this paper, the Secretary of Transportation initiated sanction action as provided for under the Highway Safety Act against those three States for their failure to conform to Standard No.3. However, recent actions by the Congress of the United States indicate that the Highway Safety Act of 1975 will contain a provision which prohibits the Secretary of Transportation from sanctioning any State because it fails to require helmet use by persons over 18 years of age. This action by the Congress may lead to efforts on the part of many States to repeal existing motorcycle helmet laws.

While those opposing helmet usage laws do so primarily on the basis of concern with the governmental interference with personal liberties, they have also raised issues relating to the validity of the technical data supporting the effectiveness of helmets. The legal, governmental and social issues of safety helmet use are beyond the scope of this report.

HISTORICAL BACKGROUND

In order to show the importance of the motorcycle helmet as an effective safety device, it is necessary to survey the research which has been conducted during the past thirty years. While the motorcycle has been popular in the United States since the eraly 1960's, it has been an intergral part of European and Australian transporation for far longer. Thus, one should look to the British and the Australians, who are responsible for the initial research on helmet effectiveness.

Between 1940 and 1943, Dr. Hugh Cairns conducted in-depth studies of 106 motorcycle accidents to determine if the crash helmets in use in Great Britian were effective in reducing injury[1,2]. After study of the helmets themselves, the type of injury and the severity of injury for each case, Dr. Cairns reported reduced severity of injury through helmet use; one-fourth

the frequency of fractured skulls through helmet use; and a reduction of one-half in hospital treated injuries for helmet users. The report based on these studies formed the precedent for future helmet research, and presented the first discussion of safety helmets as important safety equipment.

The work of Cairns was continued by Lewin and Kennedy, who published a study in 1956 of 555 civilian and 135 army motorcyclists admitted to hospitals.[3] Similar results supporting helmet effectiveness were reported, and criteria of an effective helmet were also presented. In 1957 Chandler and Thompson developed a statistical demonstration of the usefulness of helmets, based on 7,010 motorcyclists injured in 1954 or 1955.[4] In addition to comparing helmet effectiveness in urban and rural areas, the study documents a 30-40 percent reduced chance of head injury if a helmet is worn in a motorcycle accident. These British doctors had taken the first significant steps toward identifying the life saving potential of motorcycle helmets.

On January 1, 1961, a law became effective in the State of Victoria (Australia) making it mandatory for all motorcycle riders to wear safety helmets. A relatively thorough study of the data both two years before and after implementation of the law indicated:[5]

1. The legislation was successful, i.e., compliance was near 100 percent;

2. Fatalities 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 non-user.

Thus, the Australian experience showed that a mandatory helmet use law was enforceable and the resultant helmet use reduced fatalities in motorcycle accidents.

In the United States, safety officials and state legislators watched with concern as fatality totals from motorcycle accidents continued to increase. A Washington State accident summary published in 1967, showed that two-thirds of all Washington motorcycle fatalities in 1965 and 1966 resulted from head injury.[6] In 1966, New York and Michigan adopted helmet use laws. Late that year the United States Department of Health, Education and Welfare published preliminary data suggesting that projected motorcycle fatalities would be reduced by 40 percent if all motorcyclists used helmets.[7] This and other evidence was evaluated, and led the NHTSA to include a motorcycle safety standard as one of the initial thirteen Highway Safety Programs Standards

The number of serious, including fatal, head injuries is reduced when motorcycle riders are wearing helmets.

Two recent American studies have explored helmet use in relation to injury severity in motorcycle accidents. The first was conducted by staff from the School of Medicine of the University of California at Davis, and reviewed the injury and accident reports of 1,273 persons injured in Sacramento, California in 1970.[9] Table II, taken from the study, concerns 626 male drivers and shows helmet use, injury severity and injury severity rates. (Serious injuries include those resulting in death, hospitalization, most nontrivial medically diagnosed fractures in any anatomic location except digits, or continuous medical care beyond two visits to a physician.) Comparison of non-helmeted driver data to that of helmeted drivers shows that:

1. Non-helmeted drivers were injured twice as often as helmeted drivers;

2. Serious injury occurred nearly three times as often to non-helmeted drivers; and

3. Statistically significant decreases in all head injury rates were detected when helmets were worn by the driver.

TABLE II
SERIOUS AND NON-SERIOUS HEAD INJURY RATES FOR INJURED MALE DRIVERS ACCORDING TO HELMET USE SACRAMENTO COUNTY, CALIFORNIA, 1970

Helmet Use	Total Injured Drivers	Drivers with Serious Head Injury	Serious Head Injury Rate (%)	Drivers with Non-Serious Head Injury	Non-Serious Head Injury Rate (%)
Yes	218	33	15.14*	20	9.17*
No	408	93	22.80*	53	12.99**

* Difference in proportions significant, p = .016
** Difference in proportions non-significant, p = .136

Note that a difference in serious head injury rates as large as those shown in the table could have occurred by chance less than two times in one hundred.

Safety Helmet Effectiveness [10]

A comparison between head injury sustained by safety helmet users and nonusers in traffic accidents in rural areas of Illinois, on the basis of a standard accident speed for both groups of riders, revealed the following:

1. In general, when helmets were not used, fatal or serious head injury was 3 times greater and head injury of all types was twice as great.
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5. Helmets significantly reduced head injury in accidents involving either noncollision (by 57%) or collision (by 50%), but the difference in helmet effectiveness between the two types of accidents was not significant.

The second American study was carried out by the NHTSA, and was published in 1974.[10] Information was gathered from police records of 5,608 traffic and non-traffic motorcycle accidents which occurred in Michigan (May, June, July, 1971, June, July, August, 1972) and Illinois (November 1971 - October, 1973). After the Illinois data was corrected for overrepresentation of rural accidents, analysis and comparisons were made. Table III (taken from Appendix C of the report) shows the standardized head injury rates for users and nonusers for Illinois and Michigan. The ratio of nonusers to users (bottom line of Table III) makes a very important point -- that accident involved riders without helmets have three times as many fatal and serious injuries as helmet users in both States (3.0 for Michigan and 2.9 for Illinois). The ratios for moderate injury are also similar, (2.2 for Michigan, 2.0 for Illinois) indicating twice as many helmet nonusers suffering moderate injuries as helmet users. Again we have convincing evidence that if an accident occurs, a rider's chance of fatal, serious or moderate injury will be greatly reduced if he is wearing a helmet.

TABLE III

Standardized Percentage of Head Injury Rates for Motorcycle Riders in Michigan and Illinois

	Fatal or Serious		Moderate		Minor/ Indet		Total % Injured		Total Riders	
	M	I	M	I	M	I	M	I	M	I
Users	5.3	7.0	4.4	6.4	3.1	3.2	12.8	16.6	3820	438
Non Users	15.8	20.0	9.5	12.5	5.9	3.8	31.2	36.3	286	927
Ratios	3.0	2.9	2.2	2.0	1.9	1.2	2.4	2.2	-	-

Motorcycle helmets do not dangerously restrict or interfere with safe operation of a motorcycle.

Those who oppose laws requiring the use of safety helmets have claimed that helmets are dangerous because they restrict a motorcyclist's ability to see and hear potential hazards. However, these claims are not supported by any type of research or statistical documentation.

The NHTSA has completed initial studies of each of these problems.[11,12] In the first study on vision, four popular helmets were tested to determine the degree to which each limited motorcyclists vision. The field of view of 19 experienced motorcyclists was measured using each of the four helmets

(two full facial coverage, and two full coverage). Each person's field of view was also treated without a helmet.

The results of the study show that full coverage helmets, representing almost 95 percent of current helmet sales, restrict a motorcyclist's field of view in the horizontal plane (peripheral vision) by less than 3 percent. The study also found that the helmet which provided the smallest field of view (a full facial coverage helmet intended for motorsport competition) restricted the riders' horizontal field of view less that 22 percent. All of the helmets provided a horizontal field of view of more than 130°, well above the 140° used by State driver licensing agencies for screening out drivers with possible vision problems that would warrant some type of restricted driving privilege.

With regard to hearing, helmets do reduce a person's ability to hear, but in actual practice the reduction in auditory capacity for the motorcyclist is inconsequential. The primary reason for this is that the noise generated by the motorcycle and the noise produced at high speed by the wind are so great that any sound loud enough to penetrate this noise is loud enough to be heard inside the helmet.

To understand why this is true, it is necessary to examine the phenomenon of hearing. Whether or not a given sound will be heard by a driver is dependent upon three factors: (1) the auditory capability of the driver, (2) the intensity and frequency of the sound of interest, and (3) the intensity and frequency of the environmental noise that might "mask" or hide the desired sound. A given sound will be heard by a driver if it is loud enough when it reaches his ear to be above his hearing threshold, and if it is not "masked" or hidden by other sounds or noise present at the same time. Motorcycles create average levels of ambient noise ranging from 85 to 98 db(A) for on-street or dual purpose machines. For a rider to hear any other sound in the presence of this high noise level, the sound must be as loud or louder than the motorcycle itself, i.e., it must have a signal-to-noise ratio of approximately 1 to 1. The greater the signal-to-noise ratio, (e.g., the more intense the sound of interest relative to the ambient noise) the greater the attention getting properties of the signal and the higher the probability that it will be heard. Helmets reduce the loudness of both the sound of interest and the motorcycle noise by an equal amount, and therefore do not alter the signal-to-noise ratio between the two sounds, Consequently, as long as the rider can hear the motorcycle itself while wearing a helmet, he or she can also hear any other sound with a favorable signal-to-noise ratio at least as well as a driver who does not wear a helmet.

Motorcycle helmets do not increase incidence of neck injury in accidents.

It has been suggested that helmet use increases the incidence of fatal neck injury in motorcycle crashes (using data from a 1969 statistical analysis

of motorcycle accidents in New York).[13] Actually, the incidence of neck injury in motorcycle accidents during 1966 and 1967 involved any type of neck injury, and most of these involved only complaints of pain with no visible signs of injury. Studies done recently in Nebraska,[14] California and Canada[15] show that the incidence of neck injury of any type occurs in less than two percent of all motorcycle crashes.

Motorcyclists have been wearing safety helmets for more than 30 years, and during this period a number of studies of injury patterns in motorcycle accident have been made. None support the claim that helmets increase fatal neck injuries. The neck injury issue has been used in opposition to helmet laws as an attempt to exploit a peripheral issue on which there is not a great deal of valid data. Consequently, the problem has been magnified far out of proportion.

In order to provide conclusive evidence which will resolve the issue once and for all, the University of California and the Los Angeles County Medical Examiner's Office, under contract with the NHTSA, are now undertaking in-depth analysis of all fatal motorcycle crashes in Los Angeles County. Post mortem examination of each helmeted and unhelmeted rider will be made to document the incidence of neck injury in each group. The results of these analyses will provide authoritative resolution of the neck injury issue.

Mandatory helmet use laws reduce the number of serious head injuries and fatalities resulting from motorcycle accidents.

It is a logical conclusion that if a mandatory helmet use law is passed, more people will wear helmets, and consequently fewer fatalities and fatal injuries will occur in motorcycle accidents. Researchers have tried to verify this by comparing motorcycle fatalities and head injuries before and after implementation of a mandatory helmet use law. Of particular interest is a Brisbane, Australia report[16] which utilized three groups -- one sample done before implementation of a helmet use law, and two samples done in the two years immediately following. This study found (see Table IV) (a) that a significant increase in helmet use by motorcyclists involved in accidents (as expected) and (b) a significant decrease in head injuries in the post-legislation group.

TABLE IV: HELMET USE AND HEAD INJURY BEFORE AND AFTER MANDATORY HELMET USE LEGISLATION

	Pre-Legislation	Post-Legislation	
	Group 1	Group 2	Group 3
No. of Persons	151	38	65
No. of Helmets Used	25	34	63
Rate of Wear	16.6%	81.1%	96.9%
Major Head Injury	44	6	13
% of Group Total	29.1%	15.7%	20.0%
Minor Head Injury	58	11	23
% of Group Total	38.4%	28.9%	35.4%

Other studies of fatalities and head injuries before and after helmet law implementation (Victoria, Australia (1964), New York State (1969) and Washington State (1969)) drew similar conclusions; further, the national motorcycle fatality rate decline since 1967 is also an impressive indicator.

CONCLUSION

There is no question that there is still some lack of carefully designed studies of motorcycle accidents, and that there remain questions to be answered in the field of motorcycle safety. States have only recently started to maintain accurate records of the unique characteristics associated with the motorcycle accidents and injuries. Because of this shortage of specialized data, it remains a difficult task to conduct studies of a rigorous nature that will precisely define the benefits of helmet use.

We can, however, look back over the past 30 years of motorcycle accident research, and using the data and insights thus acquired, develop meaningful programs to reduce fatalities and injuries resulting from motorcycle accidents. From such studies and experience, NHTSA has promoted efforts in education and licensing to enable motorcycle riders to better handle the problems characteristic to motorcycle use. However, to reduce fatalities and serious injuries, it is absolutely essential to address the leading cause, which of course, is head injury. From the data presented here, we can conclude with high confidence that motorcycle helmet use greatly decreases the likelihood of fatal and serious injury if an accident does occur; also, it is clear that the helmet is a truly effective, necessary piece of safety equipment. It is therefore important that helmet usage be included along with improved motorcycle education and licensing procedures as a major part of all highway safety programs. Through uniformly high rates of helmet use, whatever the means of achieving such rates, we should be able to greatly reduce the number of motorcycle deaths recorded in the U.S. in years to come.

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NHTSA Technical Report

DOT HS-801 758

FIELD OF VIEW WITH AND WITHOUT MOTORCYCLE HELMETS

Prepared by:

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Research and Development
Safety Research Laboratory

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15. Supplementary Notes

16. Abstract

The total field of view for 19 experienced motorcyclists at 10 angular positions was obtained by moving a target along a circular perimeter and recording the angle at which it was first perceived. All subjects were tested with no helmet, two full coverage helmet models, two full facial coverage helmet models, and goggles.

Along the horizontal plane, visual restriction was less than 3 percent with full coverage helmets as compared to no helmet. The full facial coverage helmets produced 7.3 percent and 21.9 percent lateral field reduction. The helmet with the large restriction was a "worst case" helmet representing a small percentage of helmet sales and typically used in off-street situations. Lateral vision with goggles was approximately equivalent to that achieved by the most restrictive helmet.

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TABLE OF CONTENTS

I. Introduction

The effectiveness of motorcycle safety helmets in preventing or reducing the severity of head injury in motorcycle crashes has been well documented. Under authority of the Highway Safety Act of 1966, the Department of Transportation published a Motorcycle Safety Standard for State highway safety programs which required that each motorcycle operator and passenger wear an approved safety helmet. Currently 47 States, the District of Columbia, and Puerto Rico meet the requirement. However, the laws implementing this requirement have been opposed by a vocal minority of motorcyclists. One of the allegations made is that motorcycle safety helmets are hazardous because they restrict the lateral vision of cyclists.

Since no previously published studies have measured the fields of view of helmeted and unhelmeted motorcyclists, the work described in this report was initiated to develop such data. The limited time period allowed to complete this study suggested a simple manually controlled test device. Therefore, the total field of view at ten angular positions was obtained by moving a target along a circular perimeter and recording the angle at which it was first perceived. A total of 19 motorcyclists participated with each using four different styles of helmets. A less detailed test was performed along the horizontal plane using safety glasses and goggles.

II. Test Methods

This section includes discussions of the procedures, apparatus, and subjects utilized during this test program. Most pieces of apparatus mentioned in Procedures are described in detail under Apparatus.

A. Procedures

The primary objective was to evaluate the field of view for helmeted and unhelmeted riders. Total field of view was measured with the head in a fixed forward position and the eyes free to move towards the target. The maximum visual angle was observed along five reference planes. One reference plane was the typical horizontal or lateral plane. (Occasionally, this total lateral field of view is referred to as peripheral field, but the word peripheral is only applicable for a fixed eye position test.)

A target point slowly moving from out of the visual field to the point of perception determined each data point. Three such readings produced an average value along each of the ten test angles (see Figure 1). It should be noted that measuring the location of a target leaving the field of view would produce a different absolute number. However, in the present study, relative comparisons with and without helmets are more important than absolute values.

Positioning the subject at the center of the perimeter test device significantly influenced the exact target position when it entered the visual field. A string stretched across the diameter of the bow and placed a few inches above the subject's head served as a center marker. Vertical alignment with respect to the horizontal plane was accomplished by adjusting the height of the chair on which the subject sat. The large eight (8) foot diameter bow (see Figure 2) allowed for slight subject misalignment without seriously affecting the recorded angle.

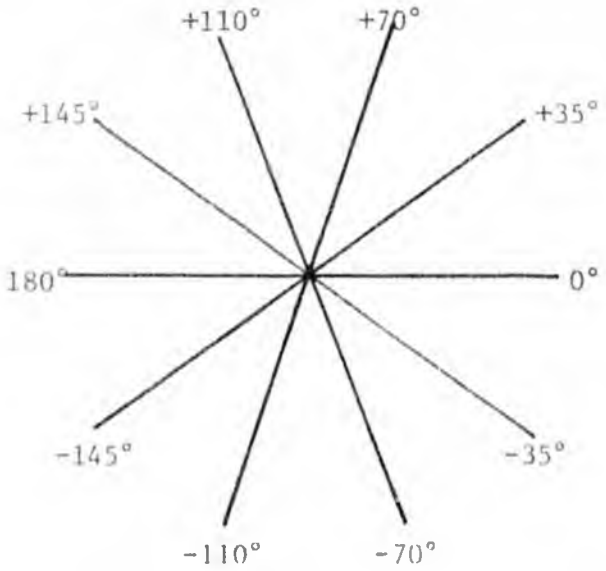


FIGURE 1 Angles Along Which Field of View was Measured

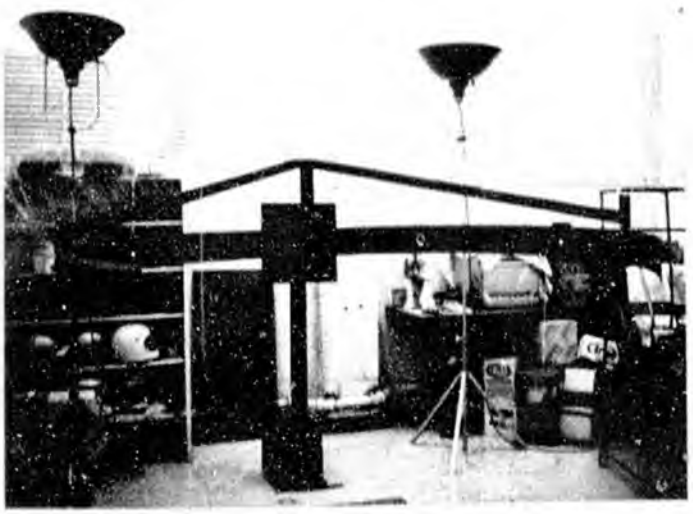


FIGURE 2 Perimeter Device for Measuring Visual Angles

A chin support kept the subjects from making large movements from the fixed forward position, but many individuals tilted their heads slightly towards the target. Helmet position on the head varied between individuals, and some helmet readjustment occurred during the testing. Therefore, any particular reading might be expected to be largely different from the average value. But this situation is realistic compared to the variance one would find between different riders during in-use conditions.

Three other tests were performed on each subject. The first test determined the maximum head turning (rotation in the horizontal plane) with and without helmets. With the subject facing forward, a light 3/16 inch aluminum tube was taped to each helmet. When the subject turned his head, while both hands were on handle bars provided, the "pointer" indicated angular displacement on the perimeter bow. The no helmet condition was approximated by repeating the above test using a light weight hockey helmet.

The second additional experiment measured visual field with safety glasses and goggles. This test was limited to the results obtained along the horizontal plane. The final evaluation was a simple helmet positioning check. The vertical distance between the subjects' eyes (centerline) and the helmet brim above was measured.

The helmets used in the study are depicted in Figure 3. They were selected to represent both the "worst case" of field of view restriction with a helmet and the typical cases. The helmets were of two designs, commonly referred to as full coverage and full facial coverage. The major distinction is that the full coverage helmets do not provide crash protection from direct impacts in the facial area. From qualitative observation it

Arthur Fulmer
Model AF-4

Buco
Enduro Model

Shoei
Model S-20

Bell
Star Model

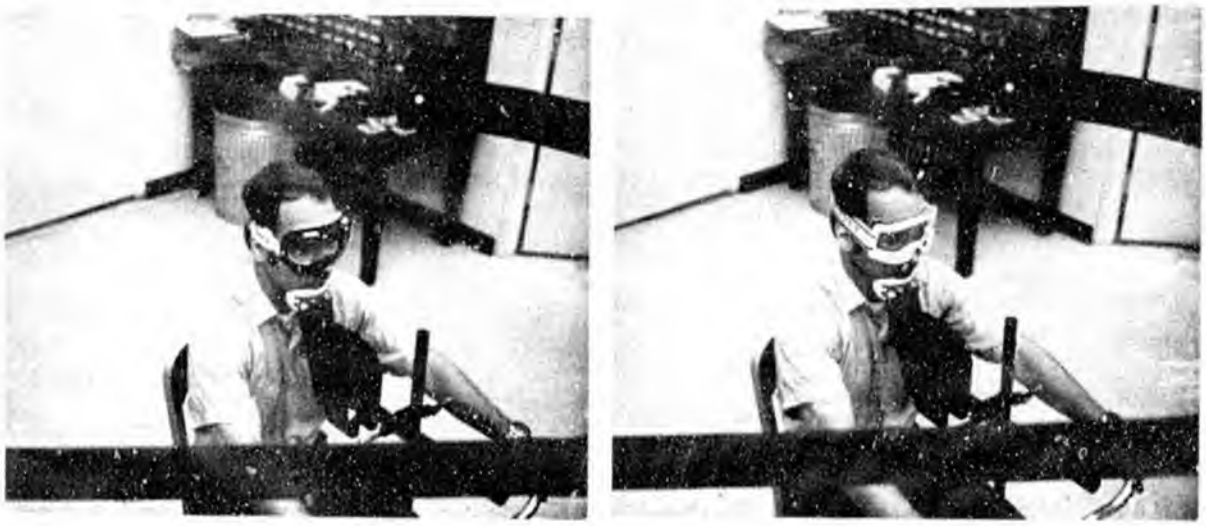
FIGURE 3 - Four Helmet Models as Worn During Visual Field Testing

can be discerned that the full facial coverage helmet creates a substantially reduced field of view as compared to an unhelmeted rider. However, it should be noted that this configuration of helmet was originally designed to provide maximum protection under motor-sport racing conditions and is not typically used by motorcyclists riding on public roads. The Safety Helmet Council of America estimates that less than 6 percent of the helmet sales are of this configuration. All helmets were purchased from commercial cycle shops and are manufactured by large helmet companies.

The safety glasses were made by Foster Grant and Studio Craft. These are displayed in Figure 4. The Foster Grant glasses were constructed with thin wire frames, and the Studio Craft had heavy plastic frames. Scott and Salice represented two of the many styles of goggles. Scott had a flat shield, while Salice had a bubble shield. Both types of goggles are shown in Figure 5.

B. Apparatus

The four (4) foot radius perimeter device is shown in Figure 2. This structure was fabricated from welded rolled aluminum sections. It extends 127° from the center of rotation. Because of the large moment on the rotating support piece, there was a slight (1 inch) sag at the extreme edge of the bow. This was compensated by slightly tilting the entire structure backwards. One (1) degree increments were marked on the outside surface of the bow (away from the subject). Both chordal and circumferential measurements were used to double check the angular locations.



Salice Scott

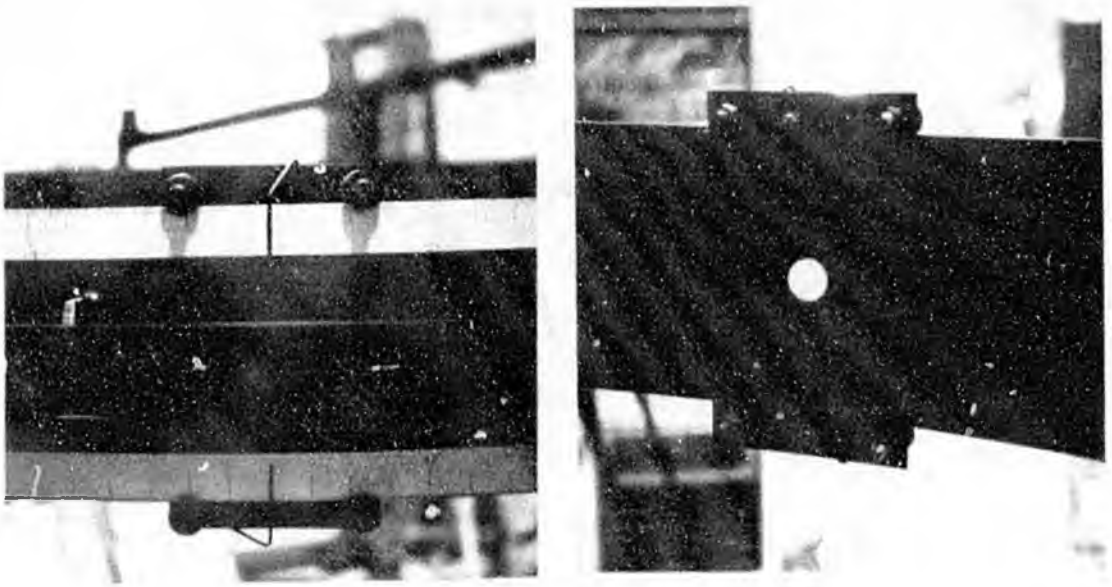
FIGURE 4 -Goggles as Worn During Visual Field Testing

FIGURE 5 - Safety Glasses Tested: Studio-Craft (on left) and Foster Grant

Two trolleys supported by four nylon rollers each moved around the track with markers pointing to the angle indicators. A black 18-inch flexible rod was attached to one wheel of each trolley. This permitted moving the trolley into the subjects view without having any hands near the target area. This device is displayed in Figure 6.

The seat structure provided for adjustable subject height and chin support. After original positioning, the subject could move slightly in the seat and still return to the same location within the perimeter device. Figure 7 shows the chin support during a test condition with no helmet. The chin rest caused some interference with the full facial coverage helmets. The lower portion of these full facial coverage helmets had to be lifted up to place the subjects' chin in the chin support. The helmet was then returned to its normal position. Several checks validated that the final helmet placement on the head was approximately equivalent to the original position. No interference existed with the full coverage helmets. Typical helmet and chin support positioning may be observed in Figure 3. It should be noted that there is minimal interference in the full facial coverage helmets.

The target that the subjects observed entering their field of view was a white dot on the black trolley. The 0.81 inch diameter dot subtended a one (1) degree visual angle to the subjects' eyes. Indirect lighting (provided by four photo flood lamps) produced a bright non-glare room illumination. Light incident on the white dot was measured as approximately 100-foot candles.



(a) side away from subject (b) side toward subject

FIGURE 6 Trolley With Visual Target and Angle Indicator

FIGURE 7 Chin Support and Cuide Device

C. Subjects

A total of 19 subjects (18 male and one female) completed the test series. All participants were experienced motorcyclists. It was felt that this group of people could better position (to normal comfort levels) the helmets and not suffer fatigue during the one and one-half hour test. Subjects ages ranged from 20 to 55 with median age of 31. Fifty percent of the participants normally wore eye glasses. Many did not use their glasses during the test because the temple (side) portion of the frames blocked a particular perimeter target position. It was felt that vision rather than eye glasses style was to be tested, so when interference occurred the subjects removed their glasses. Many near-sighted individuals commented that they could easily perceive (though not see with great acuity) the target when it was out of the range of normally corrected vision.

III. Results and Discussions

A. Helmets

At each test angle, with respect to the horizontal plane, three trial readings were recorded. Typically, the subject and helmet positions remained fixed so that the readings were within a few degrees of each other. The data were gathered for all subjects at each angle. Table 1 shows the mean and standard deviation obtained from all individual data.

The standard deviations were rather large for both helmeted and unhelmeted conditions at each test angle. Several simple explanations were obvious from the nature of the test. First, there are physiological and anatomical differences between subjects that affect both normal field of view and position within the helmet. Second, exact placement of the helmet on the head and precise positioning of the head in the perimeter were difficult to obtain repeatably. Third, slight and unconscious head and shoulder movements from side-to-side were impossible to control.

However, there was a concept that was overlooked in the experimental design that now appears to be a major factor. While the chin rest provided positive downward and side-to-side head guidance, the jaws were not clamped down. Table 1 clearly indicates a larger scatter in the data for above the horizontal plane readings as compared to below. Thus, if a subject subconsciously opened his jaw when looking up towards a target, then an artifically larger visual field would be recorded. This phenominon could occur with both helmeted and unhelmeted subjects.

Angular Plane	Arthur Fulmer		Bell		Buco		Shoei		No Helmet	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
0°	113.6*	6.4	92.1	5.7	116.1	5.20	107.1	4.8	116.2	7.8
+35	80.3	12.7	70.1	12.3	83.9	11.0	77.1	9.5	85.7	9.9
+70°	46.8	11.6	37.6	8.2	56.3	12.5	47.2	10.9	64.3	11.5
+110°	49.3	14.1	38.9	8.2	54.8	11.5	46.4	9.1	66.5	11.0
+145°	85.1	11.3	69.6	11.3	83.9	12.7	77.0	9.3	88.5	11.9
-35°	107.0	8.1	70.4	10.0	107.7	6.1	89.5	8.4	111.1	7.8
-70°	81.7	6.1	39.4	8.1	81.5	6.2	51.4	9.9	84.0	6.0
-110°	81.8	7.8	41.5	6.8	79.9	7.0	53.4	6.9	83.7	6.5
-145°	104.8	10.0	67.9	9.4	107.4	9.0	90.6	6.7	110.5	7.4
180°	112.5	7.2	89.5	6.8	115.6	7.3	108.2	7.0	116.5	7.8

TABLE 1 Mean and Standard Deviation Data for All Angular Planes

*All measurements are in degrees

Considering the large number of variables that are very difficult to fully control, the statistical aspects of the data seem adequate for the intended purpose of an initial determination and identification of field of view values with and without helmets.

Figures 8 through 12 graphically illustrate the average field of view for each helmet and the no helmet condition. Note that the field is displayed as the subject observes it (i.e. 0° is to the right). Figure 13 is a composite of the three helmeted and the unhelmeted test results. One of the full coverage helmets is omitted because it is essentially the same as the other.

As noted in the introduction, a primary purpose of this work was to develop data on the degree to which the lateral vision (i.e., the field of view in the horizontal plane) is reduced by the use of safety helmets. Helmets representing the "worst case" and the typical case of lateral field reduction were used.

Table 2 displays the total visual field along the horizontal plane for each of the helmets tested as well as the unhelmeted condition. From this table it can be determined that the two full coverage helmets (Arthur Fulmer and Buco) had relatively little effect on lateral vision; both reduced the field less than 3 percent. The Shoei helmet, a full facial coverage helmet designed to meet FMVSS No. 218, reduced the total visual field along the horizontal plane by only 7.3 percent. The Bell Star* full facial helmet was selected as the "worst case" helmet in terms of reduction in the field of view along the horizontal plane. The Bell Star helmet reduced lateral vision by 21.9 percent. However, as noted previously, this configuration of helmet accounts for less than 6 percent

*Bell also markets another full facial coverage helmet, the Star 120, which provides a field of view similar to the Shoei helmet.

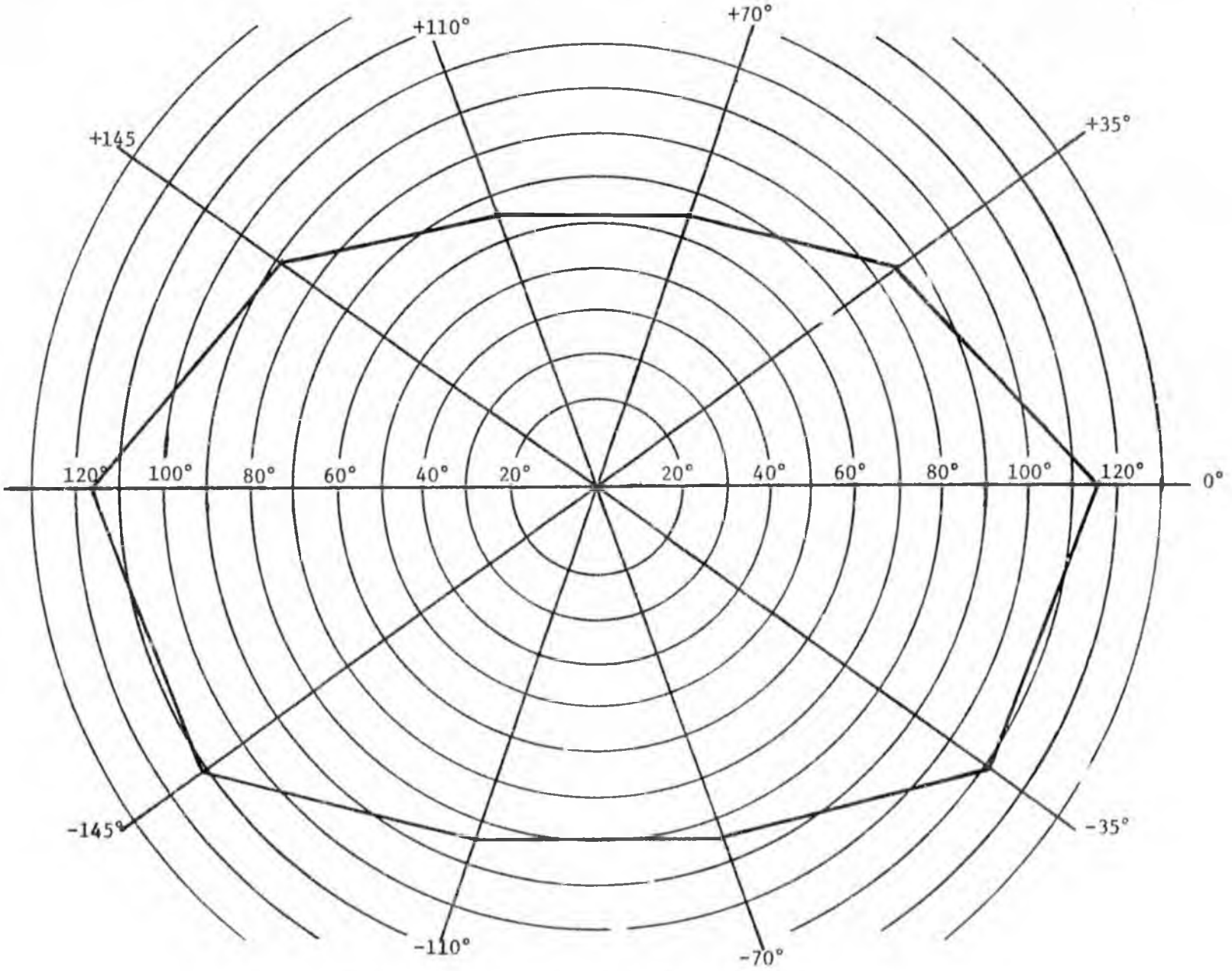


FIGURE 8 -Average Visual ield With No Helmet

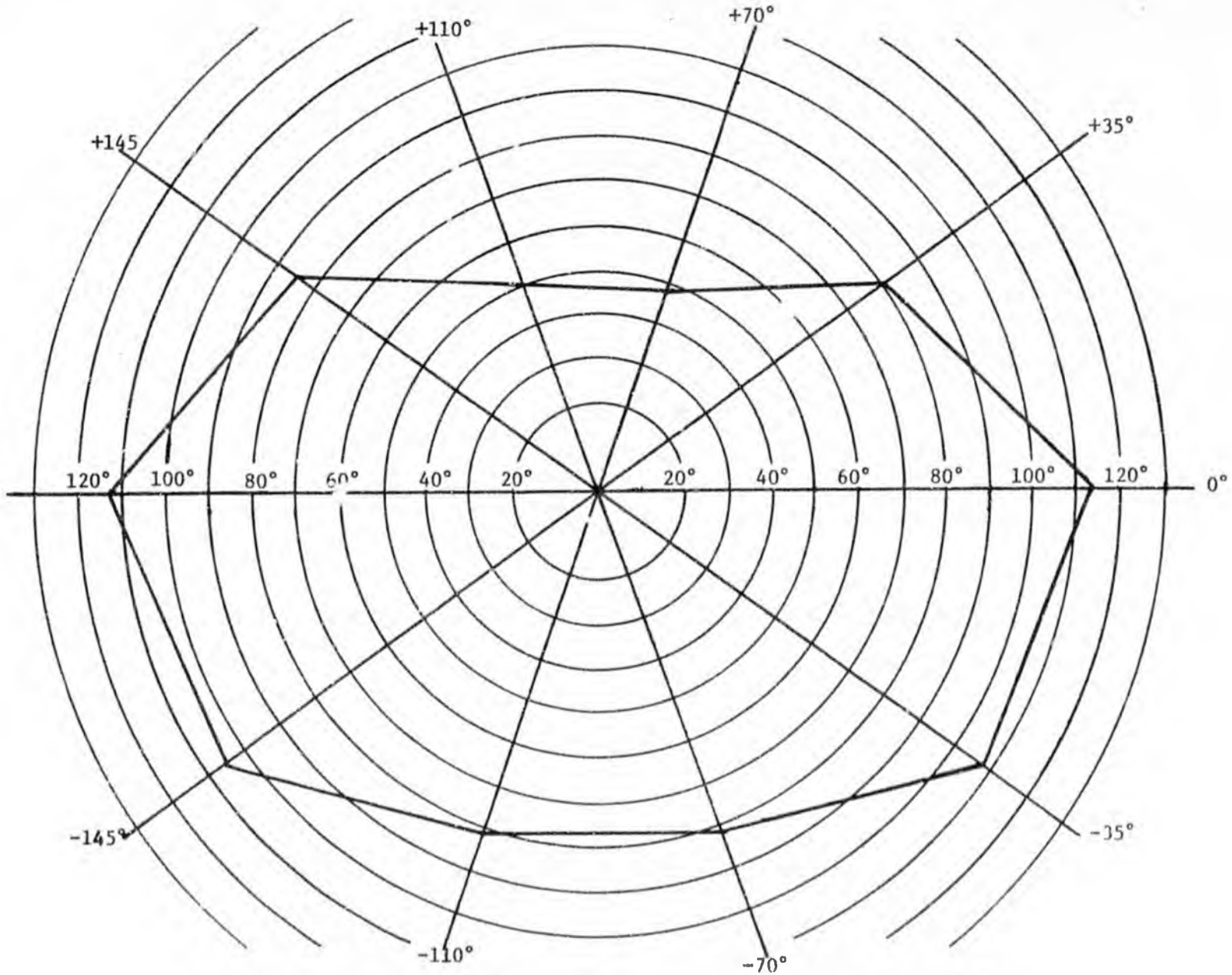


FIGURE 9 - Average Visual Field with Arthur Fulmer Model AF-40 Helmet

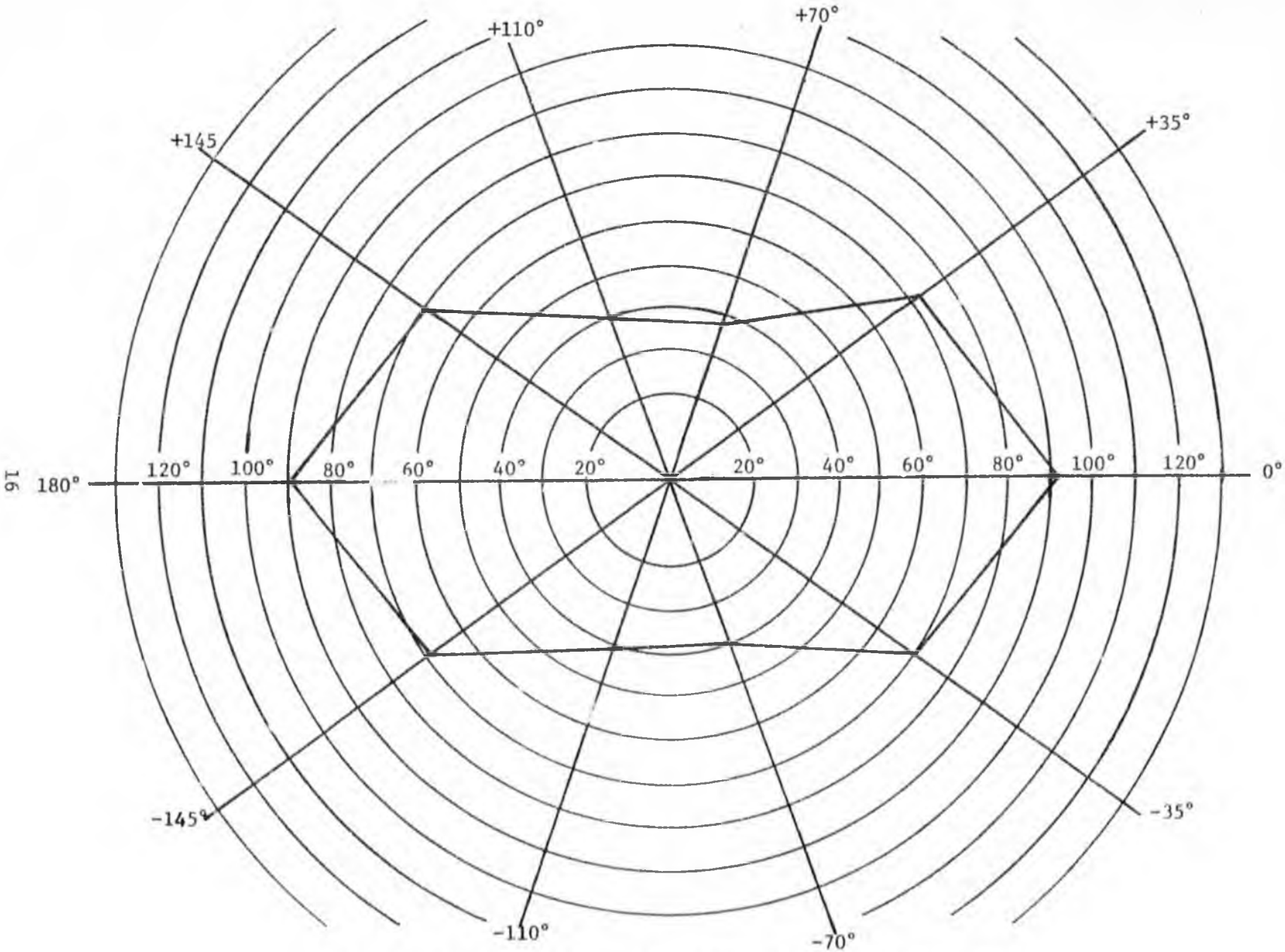


FIGURE 10 - Average Visual Field With Bell Star Model Helmet

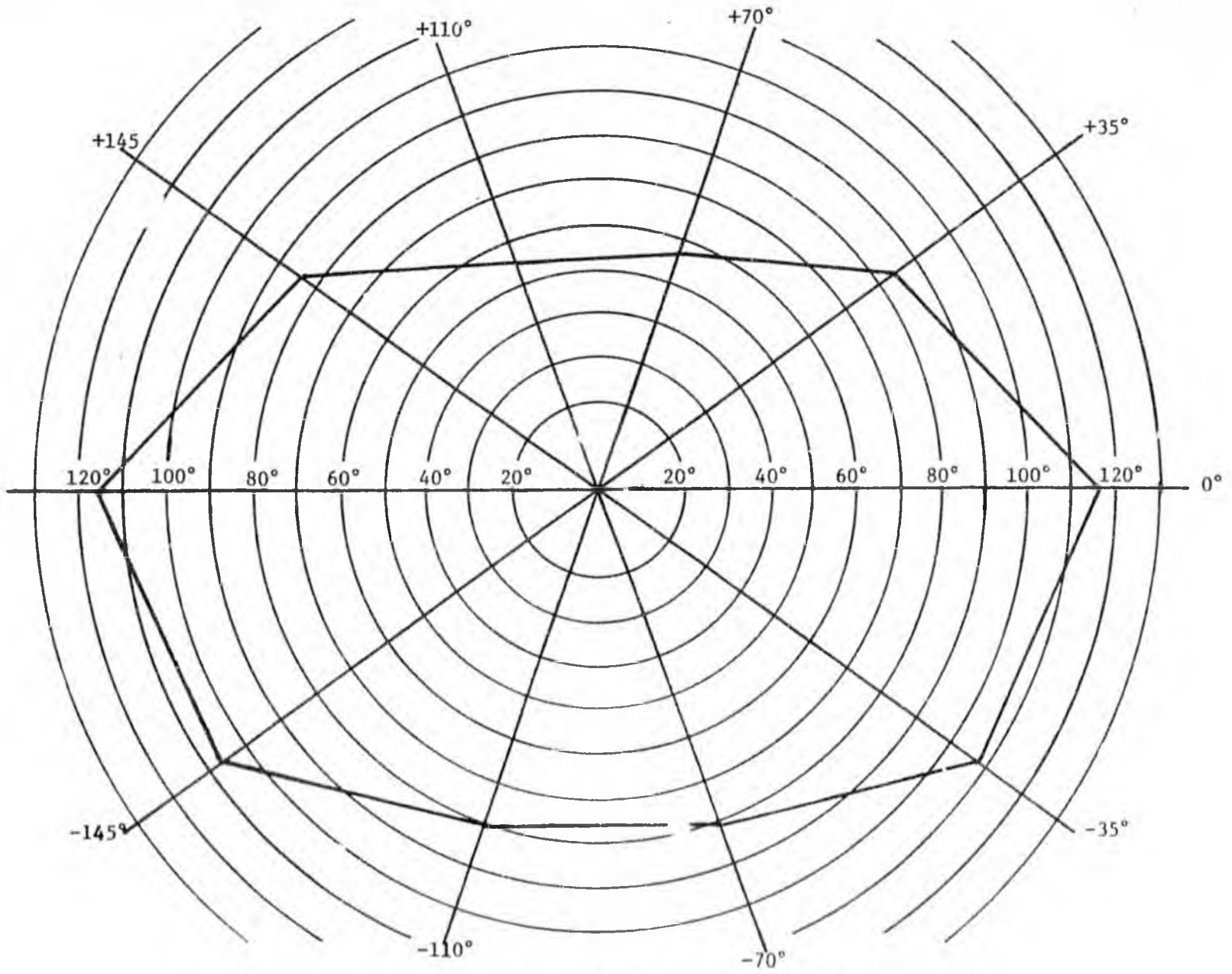


FIGURE 11 - Average Visual Field With Buco Enduro Model Helmet

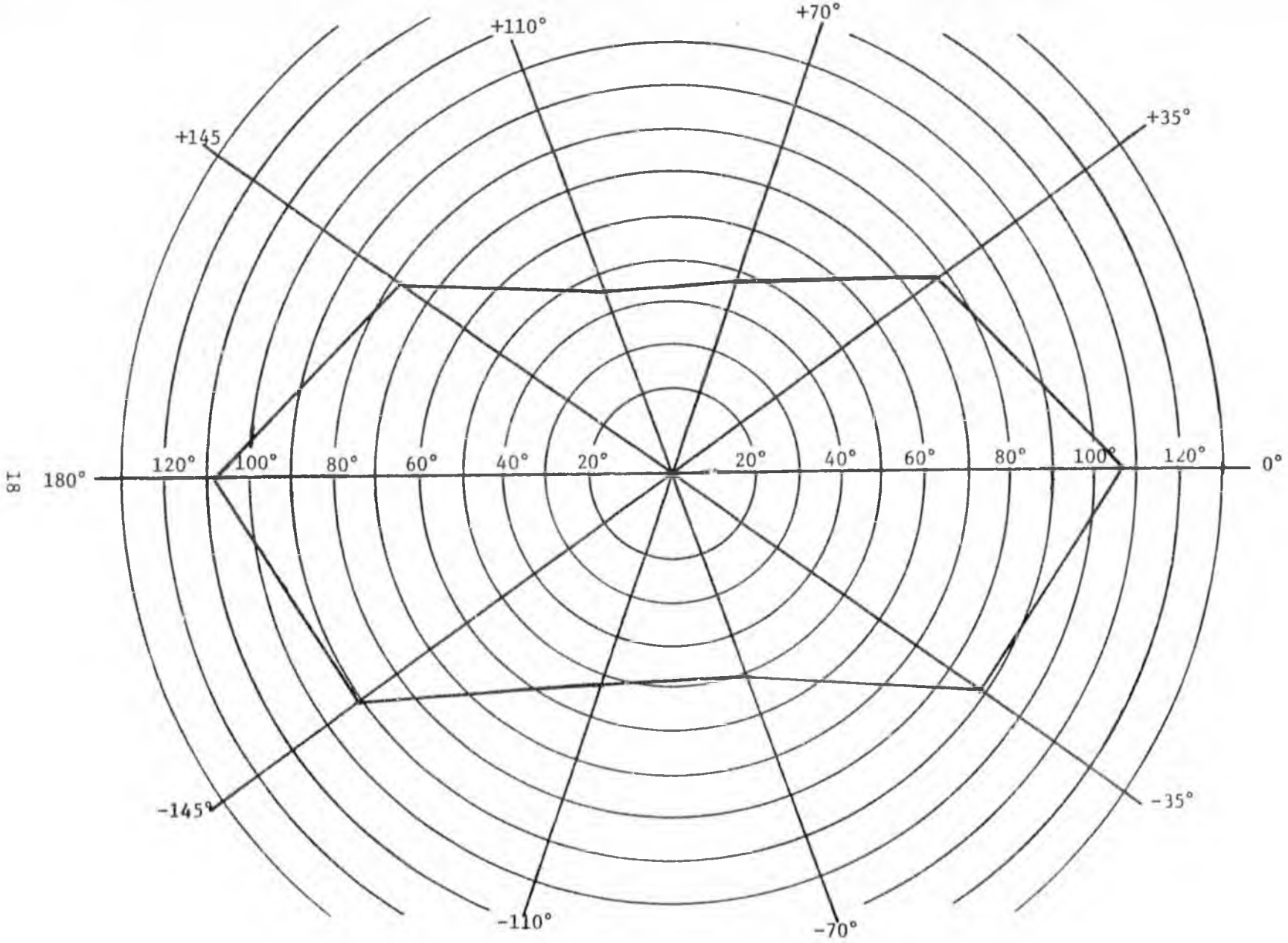


FIGURE 12- Average Visual Field With Shoei Model S-20 Helmet

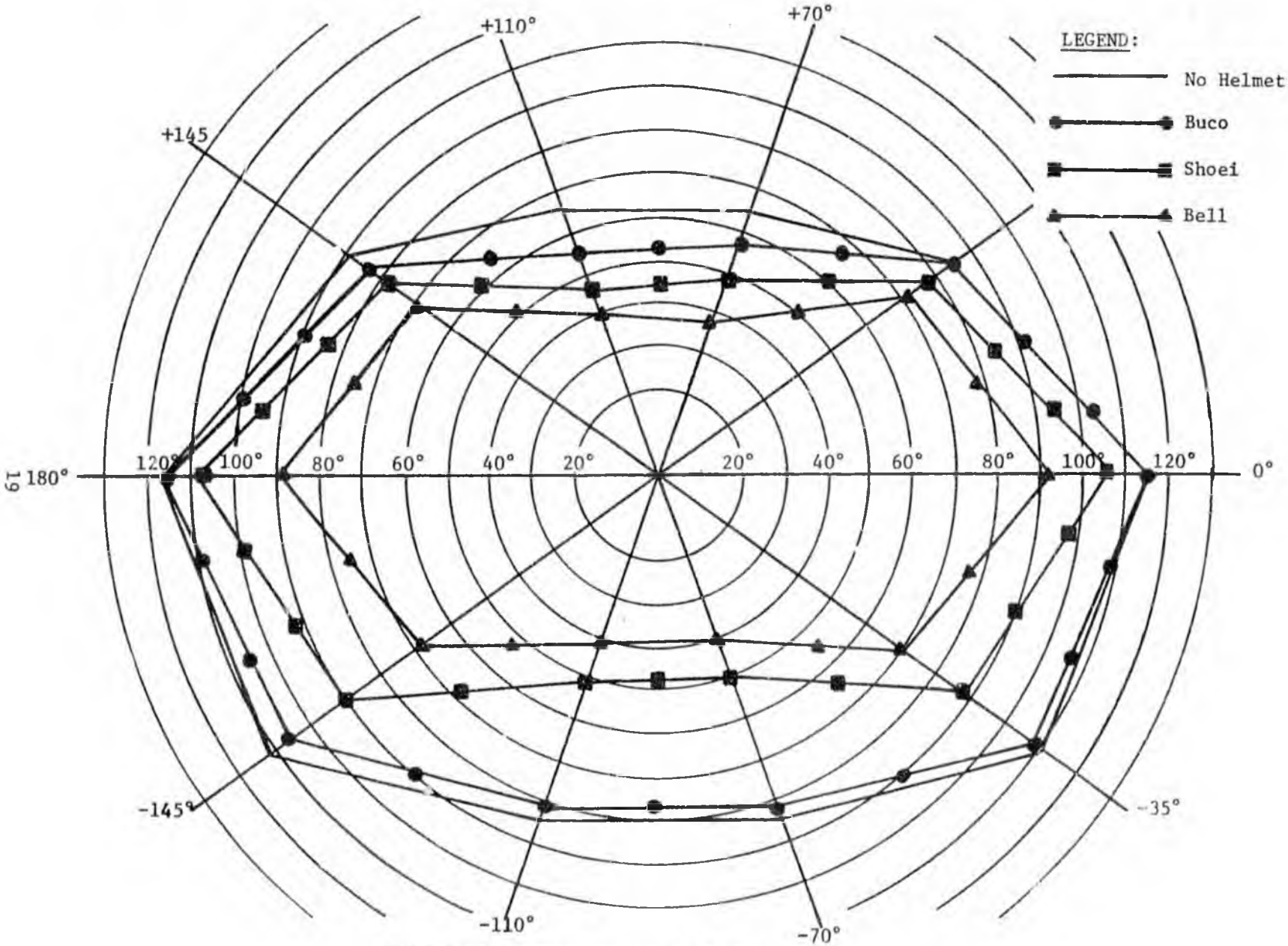


FIGURE 13 Composite Visual Field

of current helmet sales and many of these are used exclusively for off-road motorsport activities rather than for on-street motorcycle riding.

	Arthur Fulmer	Bell	Buco	Shoei	No Helmet
Mean	226.2°	181.7°	231.7°	215.8°	232.7°
Standard Dev.	12.9°	10.6°	11.3°	9.0°	14.0°
Percent Reduction from no helmet value	2.8%	21.9%	0.4%	7.3%	-

TABLE 2 Total Visual Field Along the Horizontal Plane

As can be observed from Figures 8 - 13, the full facial coverage helmets (Bell and Shoei) reduced the total visual field along the vertical planes significantly from the unhelmet or full coverage helmet conditions. Full facial coverage helmets also accounted for a significant reduction in the total field of view area (i.e., the envelop depicted by the bold lines in Figures 8 - 13). In the extreme comparison between the "worst case" helmet, the Bell Star, and the no helmet condition, the total visual area was lessened by 55 percent.

Two facts must be made clear at this point. First, along the horizontal plane all helmets provide more than a 180° field of view. This exceeds the maximum 140° total "peripheral" vision required for any State licensing test. Second, choice in helmet purchasing is the decision of the individual mototcyclist. The full coverage helmets met DOT regulations (FMVSS No. 218) and had relatively small effects on the visual field. If additional protection is desired, then a full facial coverage helmet may be the rider's choice.

B. Goggles and Safety Glasses

Goggles and safety glasses were evaluated only along the horizontal plane. The total field was 184.2° for the Salice goggles and 186.1° for the Scott g les. These values were very similar to those of the Bell Star helmet. everal participants complained about the distortion in the Salice goggles due to the double curvature of the bubble shaped plastic shield.

The safety glasses evaluation proved to be meaningless. Two conditions existed --either the temple piece interfered or it did not. If the side piece did not obstruct viewing the target, then normal bareheaded vision was being tested. Therefore, the only safety glasses data which is meaningful is that about 50% of the wide framed Studio Craft glasses interfered with lateral vision. The thin framed Foster Grant glasses did not obstruct vision.

One interesting extraneous result appeared when testing with Foster Grant glasses. Because this test was essentially the same as the initial bareheaded test, the two were compared. The glasses test was the final procedure of an hour and a half test program. Despite the generally tired eye conditions of most subjects, the average total horizontal field increased from 232.6° to 237.5°. This small, but consistent (13 to 19 subjects) improvement appears to be a psychological, as well as physiological function of a learning process.

C. Additional Tests

Two tests related to vision (but not measured with the perimeter device) were also performed on all subjects. The first study dealt

with reduced head turning with motorcycle helmets. Table 3 displays the findings of this study. The results with a light-weight hockey helmet were clearly larger than with the motorcycle helmets. Each subject provided data for four comparisons between no helmet (as simulated with a hockey helmet) and motorcycle helmet conditions. Therefore a total of 76 (4 x 19) comparisons could be made. Surprisingly, 86% of the individual analyses showed higher angular rotation for the hockey helmet condition. The restriction of head turning is small, but highly consistent. There appears to be no anatomical obstruction, so the effect is probably psychological in nature.

	Hockey Helmet	Arthur Fulmer	Bell	Buco	Shoei
Total Angle	195.8°	188.4°	188.6°	187.4°	184.4°

TABLE 3 Head Turning (Side-to-Side)

Data was collected on the typical positioning (presumably the most comfortable) that each subject chose. Measurements were made of the approximate distance between the center of the participant's eye and the helmet brim above. In order of increasing distance, the helmets were as follows: Bell (1.22), Arthur Fulmer (1.38), Shoei (1.51), and Buco (1.84). The standard deviations were large, so it is difficult to specify a typical comfortable helmet placement index.

IV. Summary and Conclusion

In general, motorcycle helmet visual restrictions were smaller along the horizontal plane as compared to the vertical planes. The full coverage helmets produced relatively small reduction in the entire field of view. As expected, the full facial coverage helmets resulted in somewhat larger reductions. The two styles of full facial coverage helmets yielded significantly different fields of view. Goggles produced approximately the same lateral visual field as the most restricted helmet.

With regard to restriction of the total field of view in the horizontal plane, it can be concluded that full coverage helmets (the most common type in use) provide only minor restrictions, less than 3 percent from that of an unhelmeted person. The full facial coverage helmets designed to comply with the lateral vision requirements of the ANSI Z90.1 standard and FMVSS No. 218 provided a restriction in lateral vision only marginally more than the full coverage helmets (7.3 percent). The "worst case" helmet provided a restriction of 21.9 percent from the unhelmeted lateral field.

All helmets tested exceeded the maximum State licensing requirements of 140° total "peripheral" view in the horizontal plane. Also, all helmets were in general compliance (especially visual regulations) with DOT standards. Therefore, helmet selection in terms of acceptable visual field, appears to be a matter of personal preferance among the many available styles.

NHTSA Technical Note

DOT HS-801 759

EFFECT OF SAFETY HELMETS ON AUDITORY CAPABILITY

Prepared by:

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Research and Development
Office of Driver and Pedestrian Research

September 1975

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EFFECT OF SAFETY HELMETS ON AUDITORY CAPABILITY

Robert L. Henderson

U.S. DEPARTMENT OF TRANSPORTATION
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EFFECT OF SAFETY HELMETS ON AUDITORY CAPABILITY

ROBERT L. HENDERSON

INTRODUCTION

One of the arguments advanced by opponents of safety helmets and laws mandating their use is that such helmets reduce auditory capability to a level unsafe for driving. There is no scientific data supporting this view. There is, however, scientific data showing clearly that the reduction in auditory capability resulting from wearing a protective helmet is inconsequential in the driving situation. The primary reason for this is that the noise generated by the motorcycle itself (and at higher speeds, by wind) is so great that any sound loud enough to penetrate this noise is loud enough to be heard inside a helmet.

To understand why this is true, it is necessary to examine the phenomenon of "hearing." Whether or not a given sound will be heard by a driver is dependent upon three factors:

1. The auditory capability of the driver; i.e., his sensitivity to sound stimuli at each frequency within the auditory range (20-10,000 Hz for the average adult).
2. The intensity and frequency composition of the sound at the ear of the driver.
3. The intensity and frequency composition of any ambient noise that might "mask" or hide the desired sound, also measured at the ear of the driver.

A given sound will be heard by a driver if it is loud enough, when it

reaches his ear to be above his threshold (minimum sensitivity), and if it is not"masked" or hidden by other sounds (noise) present at the same time. Motorcycles create average levels of ambient noise ranging from 85 to 98 db(A) for on-street or dual purpose vehicles to as much as 110 db(A) for racing machines (Harrison, 1974). For a rider to hear any other sound in the presence of this high noise level, the sound must be as loud as or louder than the motorcycle itself; i.e., have a signal-to-noise ratio of approximately 1:1. If these conditions hold, the sound can theoretically be "heard" by an attending driver. The greater the signal-to-noise ratio; e.g., the more intense the sound of interest relative to the ambient noise, the greater the "attention-getting" properties of the signal and the higher the probability that it will be heard. In the paragraphs that follow, it will be shown that wearing a protective helmet reduces the loudness of both sounds of interest and motorcycle noise an equal amount and hence does not alter the signal-to-noise ratio between the two. Consequently, as long as the rider can hear the motorcycle itself while wearing a protective helmet, he or she can also hear any other sound with a favorable signal-to-noise ratio at least as well as a driver who does not wear a protective helmet.

BASIC HUMAN AUDITORY CAPABILITY

The theoretical sensitivity of the human auditory mechanism to sound stimuli of various frequencies is shown in Figure 1 (after Kryter, 1970). Maximum sensitivity occurs between 1000 and 3000 Hz, decreasing at both higher and lower frequencies. This sensitivity distribution would rarely be found in an individual driver, since the progressive loss in hearing sensitivity due

to the aging process will have begun by the time an individual is old enough to be licensed. Since the aging process does significantly affect auditory capability, it must be considered in our analysis. In the absence of quantitative data concerning the age distribution of motorcycle drivers, an arbitrary assumption was made that relatively few motorcycle drivers would be found older than 55, with the vast majority of drivers considerably younger. By selecting an age range between 46-55, for which good auditory sensitivity data was available, it was felt that the analysis would involve the "worst case" situation with regard to driver age. In other words this group would represent the motorcyclists who could hear least well; those with the greatest loss of auditory sensitivity. The top curve in Figure 1 illustrates the effects of aging on the auditory threshold of a group of 367 males between 46 and 55 years of age (from Kryter, page 118). It can be seen from this figure that the age-related hearing loss is restricted to the higher frequencies, commencing around 600 Hz for this group, and increasing rapidly with increasing frequency.

DIRECT EFFECT OF HELMETS ON AUDITORY THRESHOLD

Wearing a protective helmet has exactly the same effect on auditory threshold as hearing loss due to aging; e.g., the auditory threshold is raised, in this case by an amount equal to the sound attenuation provided by the helmet. An indication of the magnitude of this attenuation or "helmet loss" is presented in Figure 2. This figure shows the average difference between the intensity of sounds measured inside a number of different helmets at the ear of the wearer, and the intensity of the same sounds measured outside

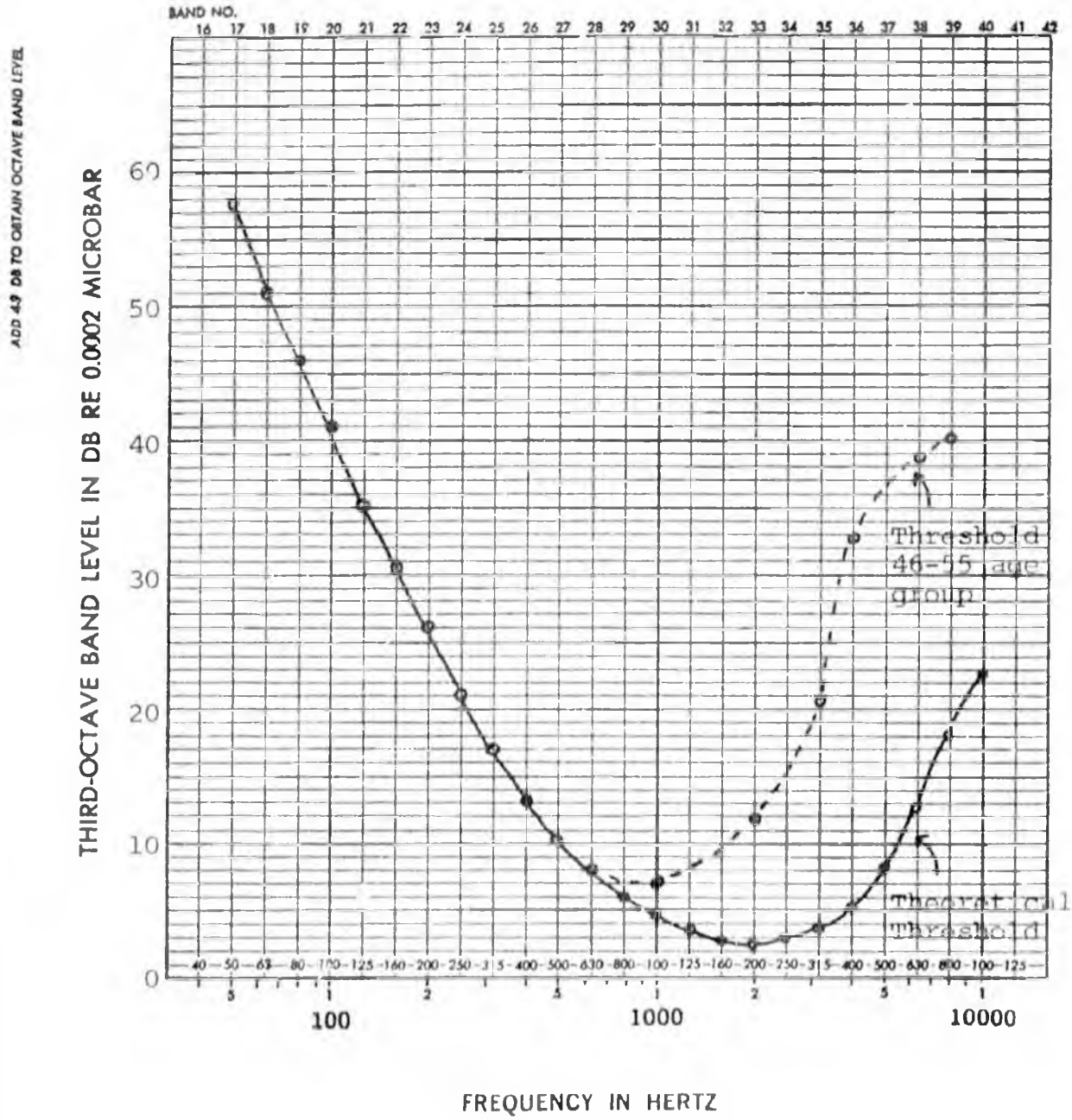

Figure 1. Human Auditory Sensitivity to Sounds of Different Frequencies

the helmet (Henderson and Burg, 1974).* In general, there is very little consistent effect at lower frequencies; but at frequencies above 800 Hz, the attenuation effect increases rapidly. For comparison, the sound attenuation of an automobile (with doors and windows closed) is also shown in Figure 2. It is clearly evident that an automobile body attenuates sounds significantly more than a protective helmet at all frequencies. Thus, the hearing impairment attributable to a protective helmet is very minor compared to the impairment provided by the soundproofed construction of modern automobiles.

For all practical purposes, any attenuation that does occur is the equivalent of raising the auditory threshold of the wearer by an equal amount since in both cases, the intensity of the sound must be increased for it to be heard. The effect of helmet attenuation on auditory threshold is shown in Figure 3, where the theoretical threshold values have been raised at each frequency by an amount equal to the attenuation of the helmet at this frequency. For comparison purposes, the auditory threshold for the 46-55 age group is also shown. It is obvious that the amount of "hearing loss" that can be attributed to wearing a safety helmet is approximately the same as the amount of hearing loss that normally occurs to 46-55 year-old males. Thus, those who claim that helmets reduce hearing to an unsafe level would also have to claim that drivers 46-55 years of age or above are also unsafe when compared to a young driver with no hearing loss.

*The observed increase in intensity inside the helmet at certain frequencies could be due to errors in measurement; however, the consistency with which such increases are found suggest that they are the result of the helmet "trapping" certain frequencies and actually increasing their intensity at the driver's ear relative to their intensity under "free field" conditions.

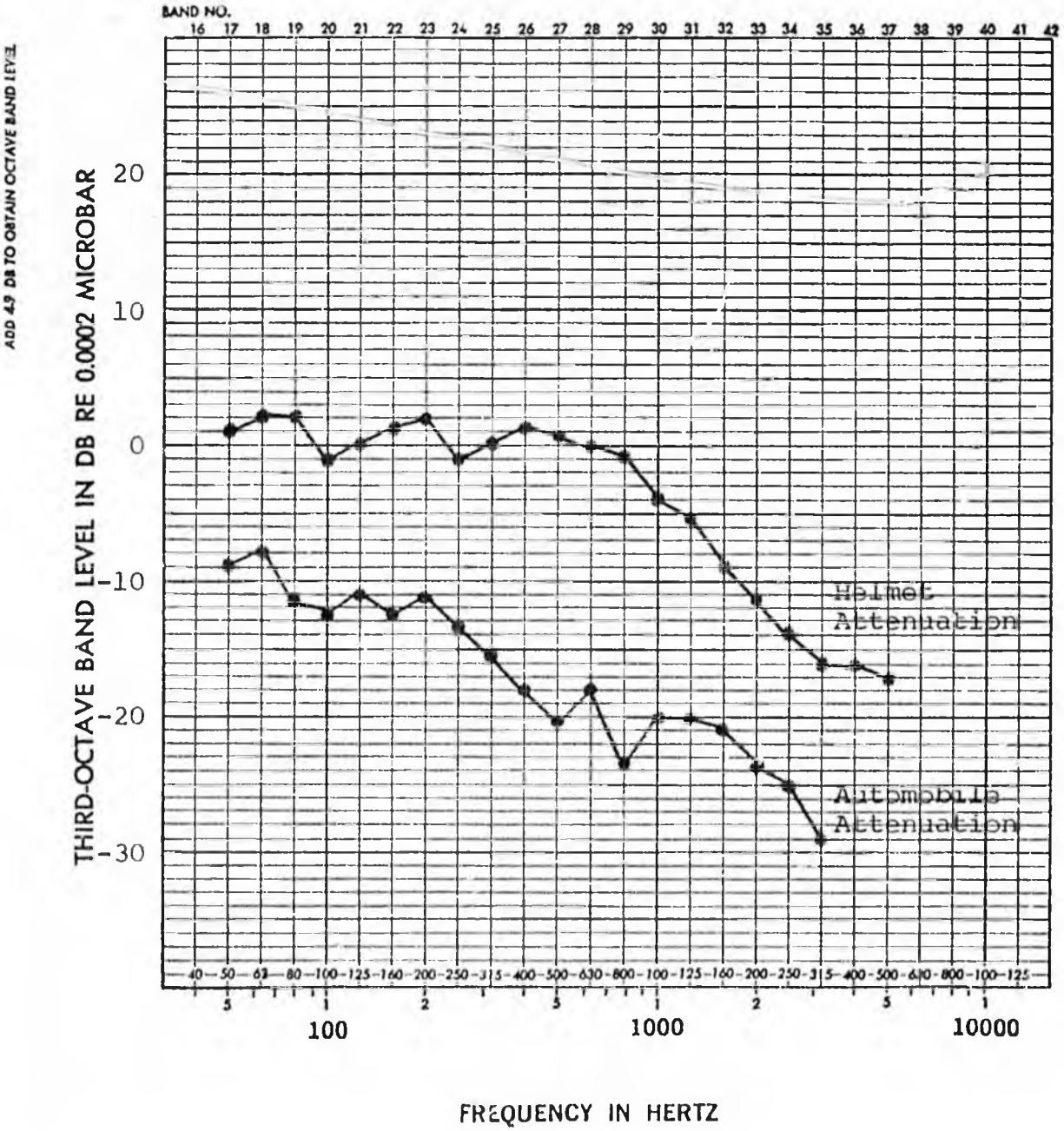

Figure 2. Comparison of Average Sound Attenuation Characteristics of Automobiles (Windows Up) and Protective Helmets

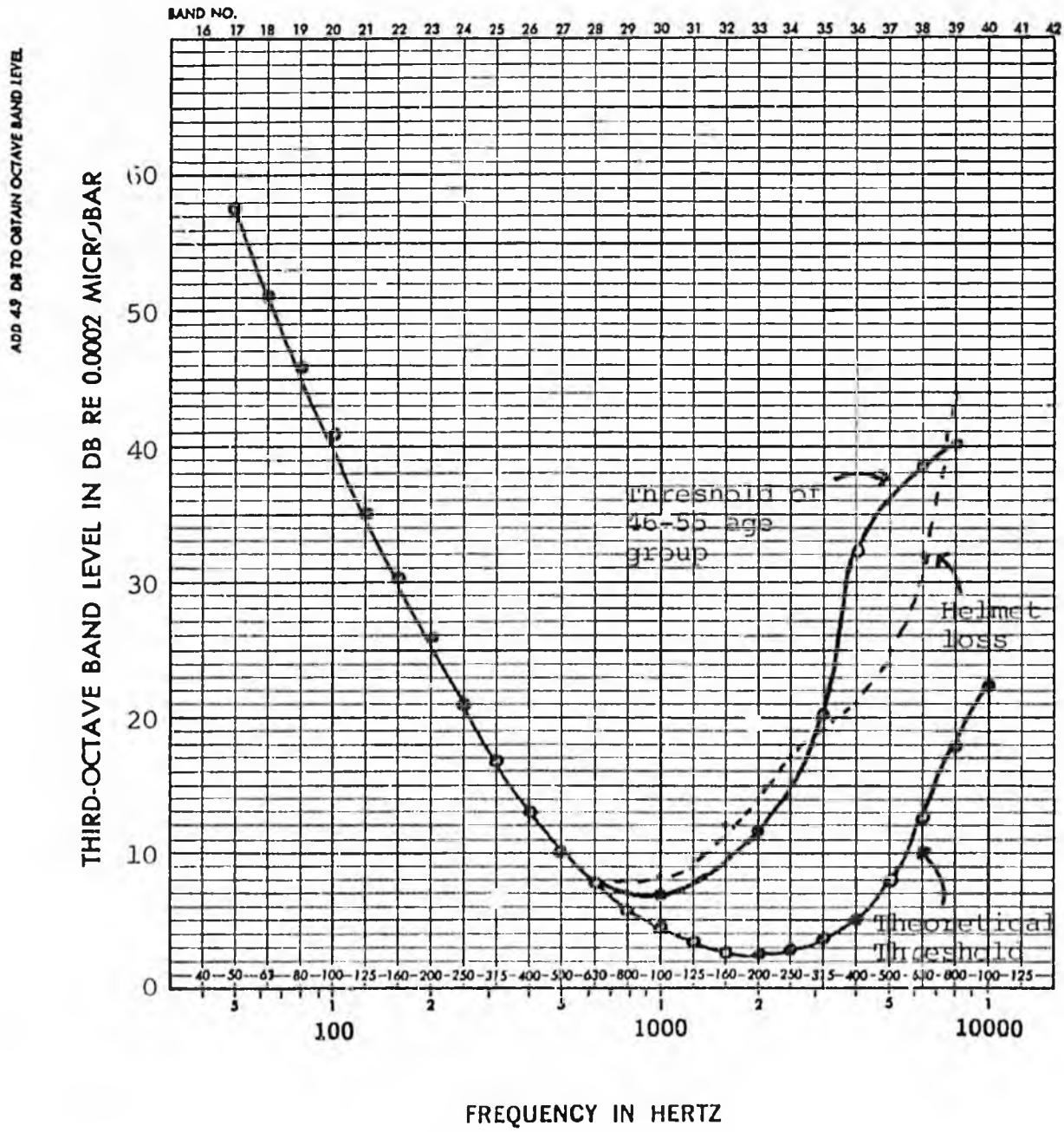

Figure 3. Comparison of Age-Related Hearing Loss (ages 46-55) and Temporary Hearing Loss from Wearing Protective Helmet

In practice, "helmet loss" must be added to any permanent hearing loss a person may have to determine his true auditory threshold. In figure 4, the auditory threshold for 46-55 age group is shown with, and without, helmets. The hatched area between the two curves represents the additional loss due to wearing a helmet. Assuming a "quiet" environment without interfering noise, sounds whose intensity fall within the hatched area could not be heard by the driver wearing a helmet, but could be heard by a driver without a helmet.

EFFECT OF AMBIENT NOISE ON AUDITORY PERFORMANCE

The assumption of a "quiet" environment, however, is not valid for a motorcycle driver. Figure 5 presents the sound pressure level at various frequencies that is generated by a motorcycle under operational conditions that vary from idle (stationary) to 50 miles per hour (Henderson & Burg, 1974). For comparison, auditory threshold data previously discussed is also presented.

The significance of the ambient noise generated by the motorcycle is that, through what is known as "masking," it affects auditory performance in much the same way as hearing loss. Masking occurs when one sound hides or obscures another sound. Both masking and hearing loss effectively shift the auditory threshold upward, but do not influence the detection of sounds above the new threshold. For example, a person who suffers a 20 db hearing loss at a given frequency (whether due to aging, or wearing a helmet, or some combination of those) cannot hear a tone of that frequency until it is 20 db louder than a tone that can just be heard by an individual with no hearing loss. However, in the presence of 20 db of masking noise at

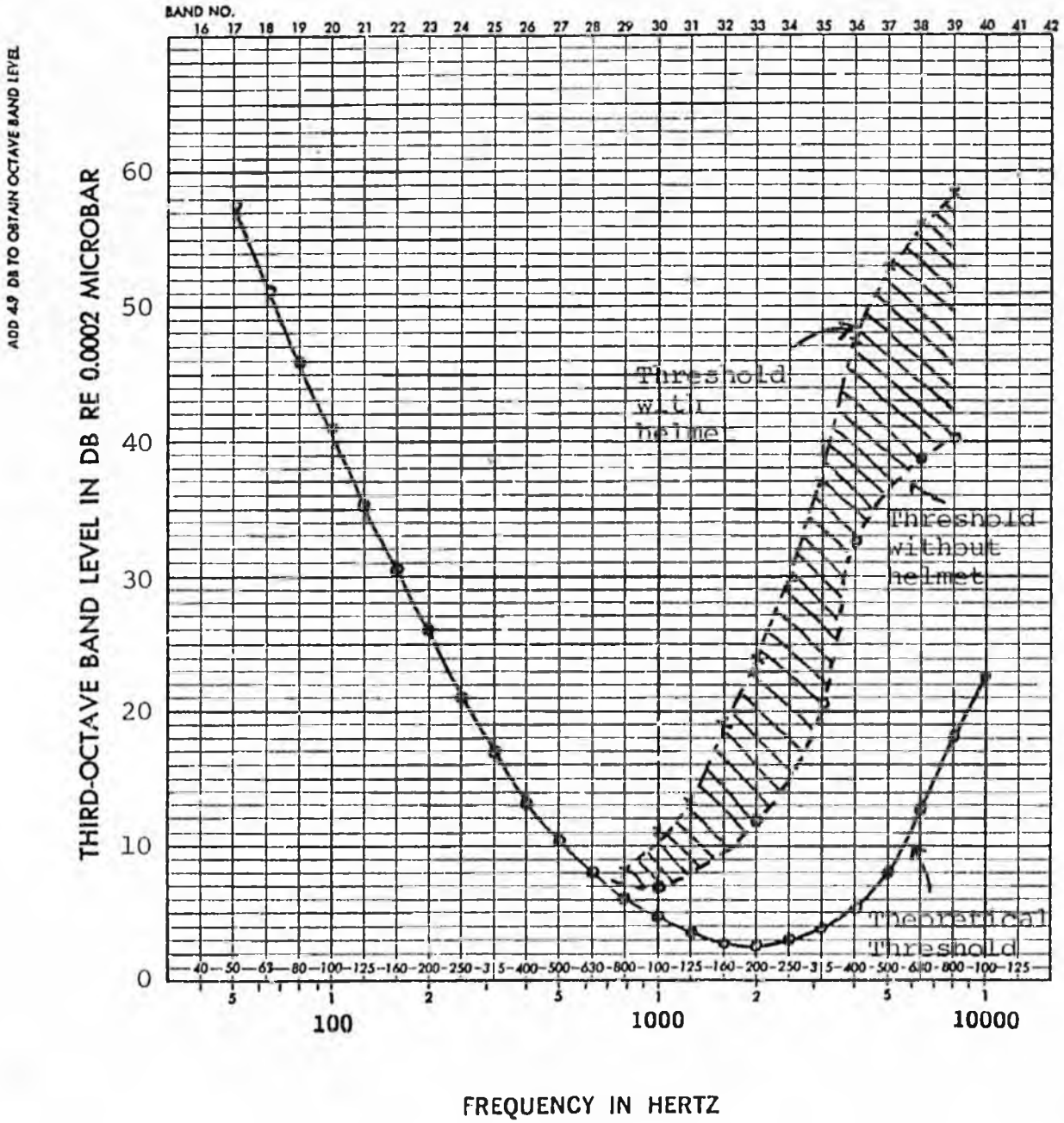

Figure 4. Auditory Threshold for 46-55 Age Group With and Without Protective Helmets

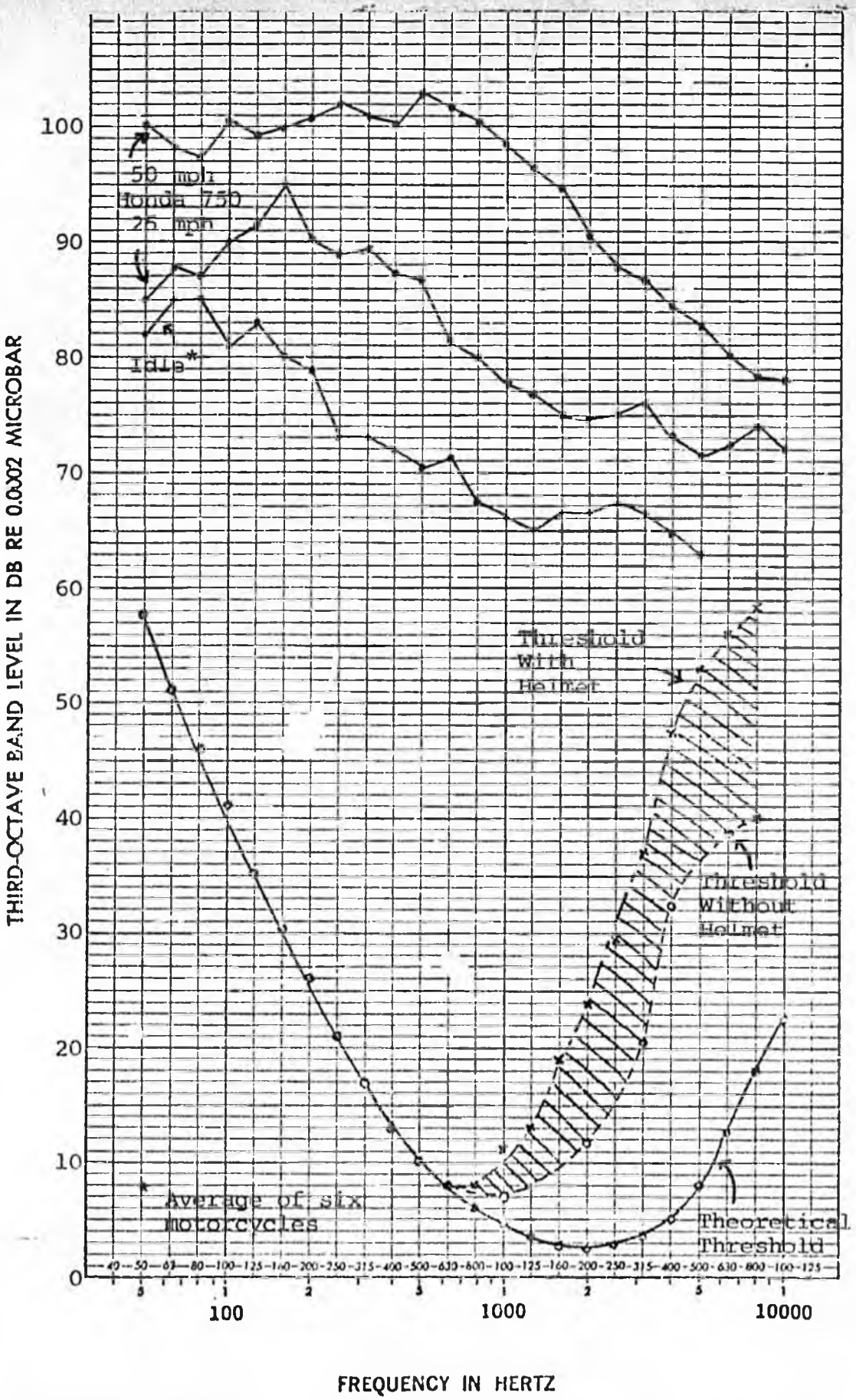

Figure 5. Comparison of Motorcycle Noise at Various Speeds and Auditory Threshold of 46-55 Age Group With and Without Protective Helmets

that particular frequency, both individuals would have basically the same auditory capability; i.e., both would have the same probability of detecting a sound whose signal-to-noise ratio is approximately 1 or above.

The ambient noise level associated with motorcycle operation can be seen from Figure 5 to be very high. If it is necessary for any sound to be as loud as or louder than the motorcycle noise in order to be heard, it is clear from figure 5 that it will be well above the auditory threshold for the helmeted driver, and hence the loss associated with wearing the helmet is completely inconsequential.

Figures 6 and 7 present examples of typical sounds of potential interest to motorcycle drivers. Figure 6 illustrates the sound pressure level of an automobile horn at a distance of 50 feet. While the horn is above threshold even for the helmeted driver in the 46–55 age group, the masking provided by the motorcycle would prevent the rider from hearing the horn at speeds of 25 mph or above. In Figure 7, the sound pressure level of an emergency vehicle siren at a distance of 50 feet is shown. Again, the siren is above the threshold for the helmeted motorcycle driver and could be heard at speeds above 25 mph, but not at 50 mph. In both instances illustrated, and with reference to any other sound of potential interest to a motorcycle rider, the critical factor in determining whether or not the sound will be heard is the amount of masking noise generated by the motorcycle, not whether the driver wears a helmet.

A similar situation is found in automobiles. Although the masking noise generated by the vehicle is much lower than found with motorcycles, the

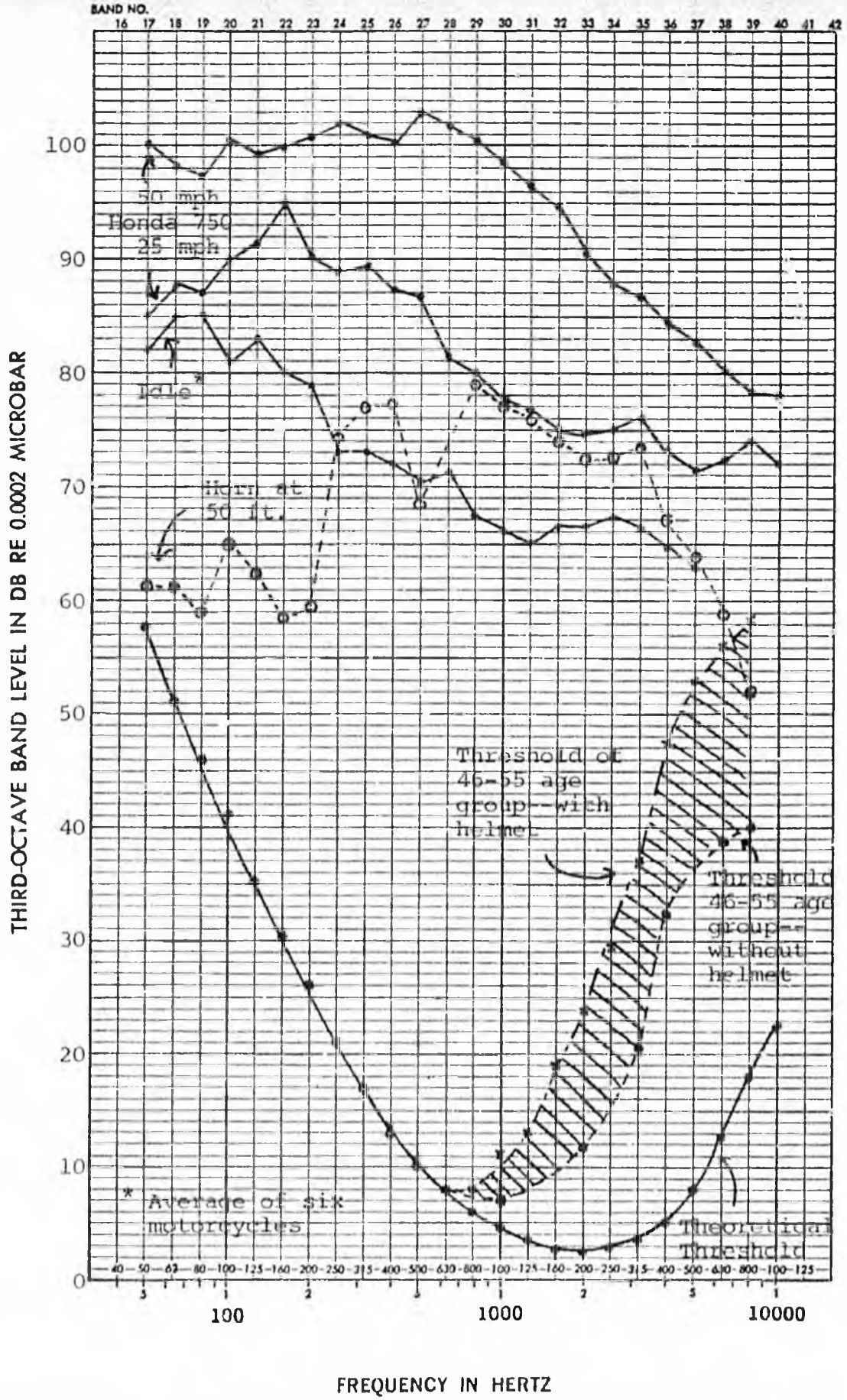

Figure 6. Illustration of the Masking of an Automobile Horn by Motorcycle Noise

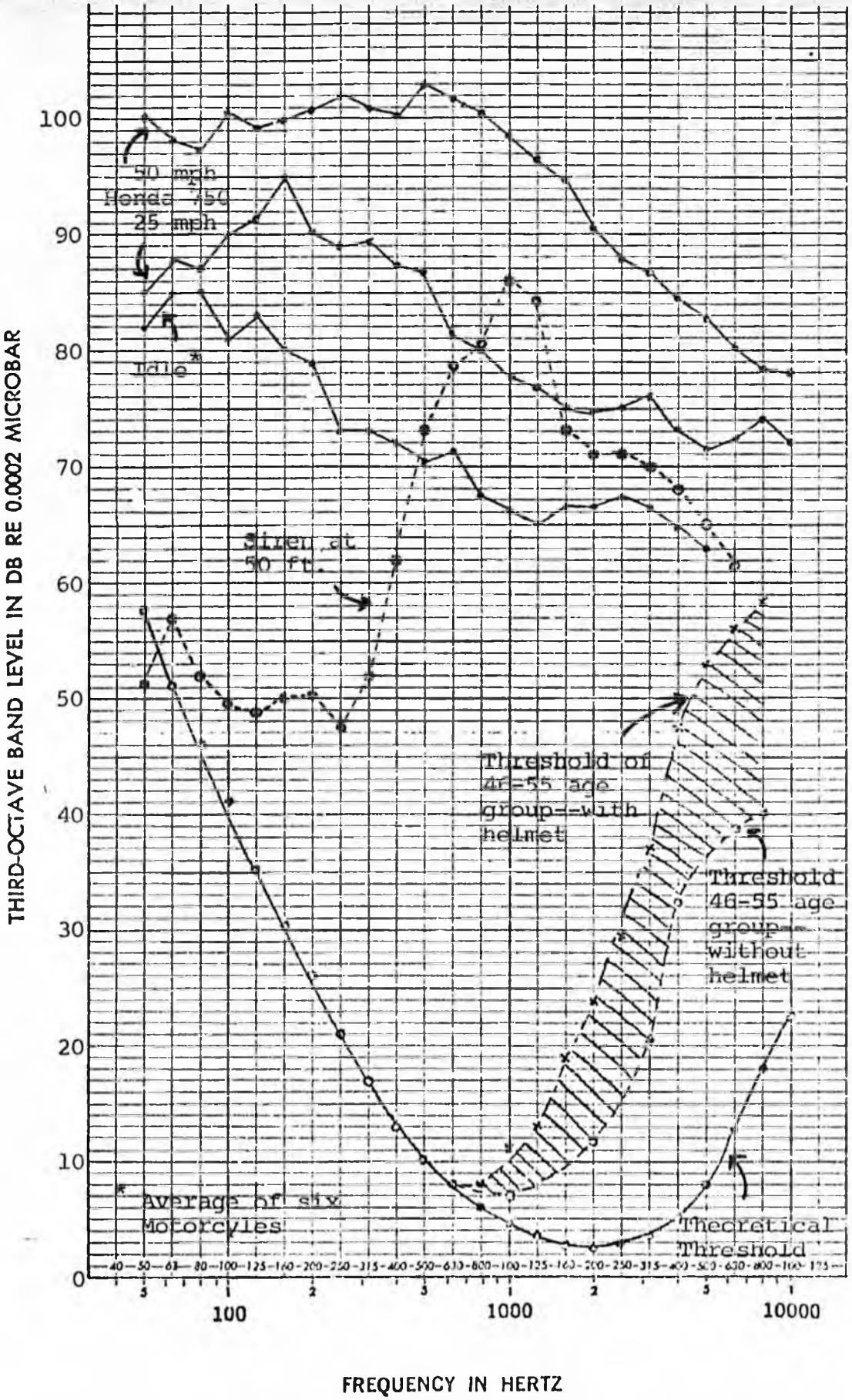

Figure 7. Illustration of the Masking of an Emergency Vehicle Siren by Motorcycle Noise

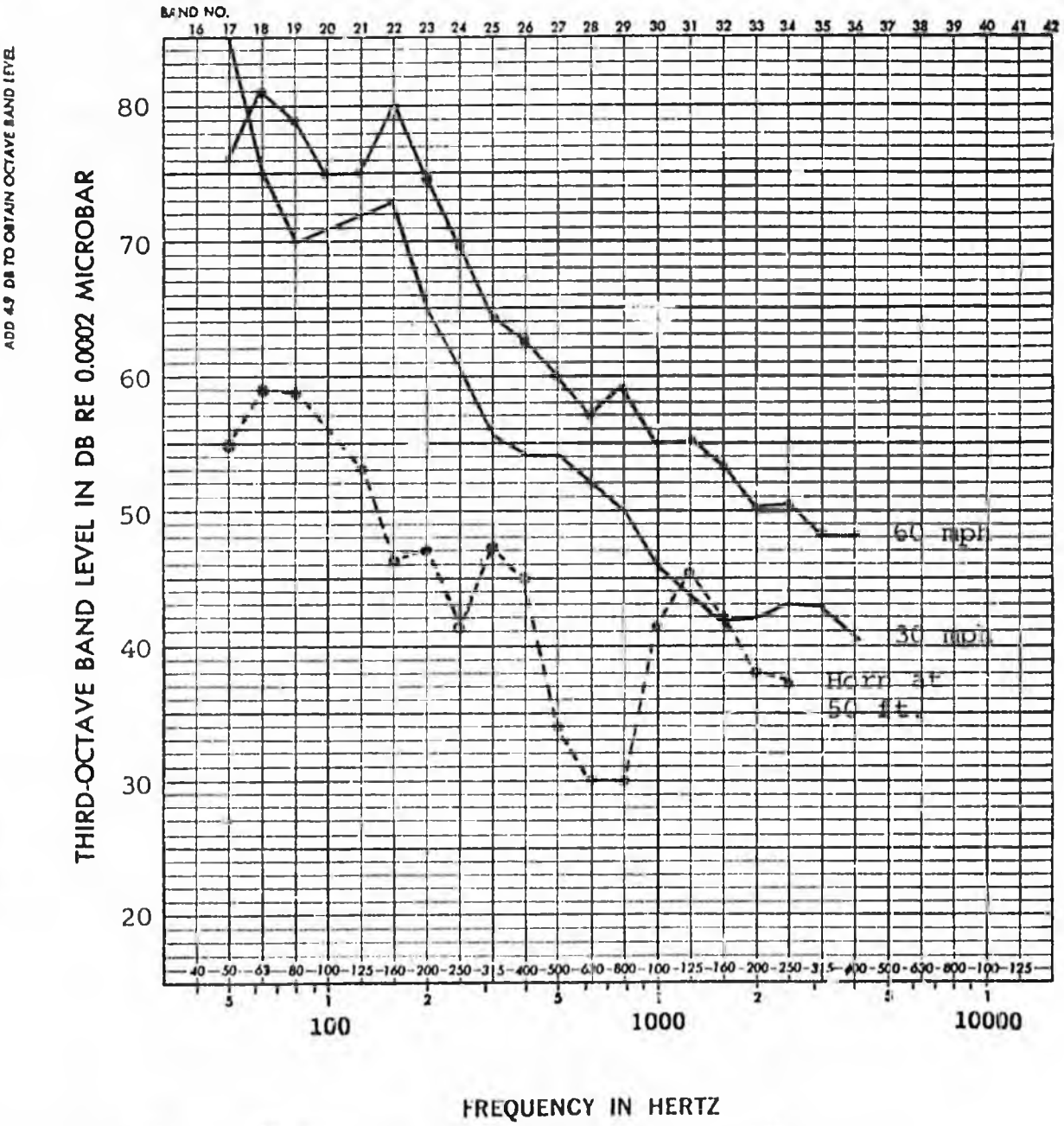

Figure 8. Horn audibility inside a passenger car

attenuation of external sounds is much greater due to the soundproofing of the body. The net result is that the ratio between the loudness of external sounds and interior noise level is very comparable to that found with motorcycles. This is illustrated in Figure 8, where the sound pressure levels of an automobile horn 50 feet away is compared with the interior noise level at 30 and 60 miles per hour (all measurements made at the ear of the driver, with all windows closed). It is clear that, as shown earlier for motorcycle drivers, an automobile horn at 50 feet has marginal warning value to the driver of an automobile at vehicle speeds of 30 miles per hour, and essentially no warning value at 60 miles per hour.

SUMMARY

Wearing a protective helmet has little to do with whether or not a motorcycle driver will hear a particular sound of interest to him or her. While it is true that safety helmets do attenuate external sounds, the amount of such attenuation is inconsequential, even when coupled with the amount of age-related hearing loss that normally occurs with age. The major determiner of whether a given sound will be heard is the ratio between the intensity of that sound and the intensity of the masking noise generated by the motorcycle (i.e., the signal-to-noise ratio). Safety helmets have an inconsequential effect because they reduce the loudness of both the sound of interest and the motorcycle noise by an equal amount and hence do not alter the signal-to-noise ratio between the two. A helmeted motorcycle rider can hear a sound of interest approximately as well as a person in an automobile with the windows closed.

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SB666

STATE MOTORCYCLE EQUIPMENT REQUIREMENTS

OCT. 75

MOTORCYCLE INDUSTRY COUNCIL, INC.

This information is provided by the Motorcycle Industry Council Government Relations office. As State Assemblies continue to pass and/or amend motorcycle equipment requirements, subsequent charts with current dates will be issued. Phone, telex, or write to the Motorcycle Industry Council offices listed below for additional information concerning motorcycle equipment requirements or for additional copies of this chart.

STATE	SAFETY HELMET	EYE PROTECTION	REARVIEW MIRRORS	BRAKES	HANDLEBAR HEIGHT	PASSENGER SEAT	PASSENGER FOOTRESTS	PASSENGER HANDHOLD	SAFETY BARS	PROTECTIVE CLOTHING	TURN SIGNALS	SPEEDO-METERS	HEADLIGHT DAYTIME USE	ANNUAL INSPECTION
Alabama	●		●-3	●-6		●								
Alaska	●-1	●	●-4	●-7	●-11									
Arizona	●	●	●-3	●-6	●-11	●	●	●						
Arkansas	●	●	●-3	●-6		●	●	●	●				●	●
California			●-3	●-7	●-12	●	●				●			
Colorado	●-1	●	●-3	●-6		●	●							●
Connecticut	●	●	●-3	●-6	●-11	●								
Delaware	●-1	●	●-3	●-6	●-11	●	●							●
Dist. of Col.	●	●	●-3	●-7	●-11	●	●	●						●
Florida	●	●	●-3	●-7	●-11	●	●						●	●
Georgia	●	●	●-5	●-6	●-11	●	●			●-14			●	●
Hawaii	●-1	●	●	●-6	●-11	●	●							●
Idaho	●			●-6		●	●							●
Illinois		●	●	●-6	●-11	●	●	●					●	
Indiana	●	●	●	●-7	●-11	●	●						●	●
Iowa	●	●	●	●-6	●-11	●	●							
Kansas	●	●	●	●-6	●-11	●	●				●			●
Kentucky	●	●	●	●-6		●	●							●
Louisiana	●	●	●	●-7	●-11	●	●				●			●
Maine	●		●	●-6	●-11	●	●						●	●
Maryland	●-1	●	●	●-6	●-11	●	●							
Massachusetts	●	●	●	●-6	●-11	●	●							●
Michigan	●	●-2	●	●-7	●-11	●								
Minnesota	●	●	●	●-6	●-12	●	●						●	
Mississippi	●		●	●-6	●-8	●								●
Missouri	●		●	●-6	●-11									●
Montana	●		●	●-7		●	●						●	
Nebraska	●		●	●-6	●-10	●	●							●
Nevada	●	●	●	●-7	●-11	●	●				●			
New Hampshire	●	●	●	●-6	●-11	●	●							●
New Jersey	●-1	●	●	●-6	●-11	●	●	●						●
New Mexico	●-1	●	●	●-6	●-11	●	●							●
New York	●-1	●	●	●-7	●-11	●	●	●					●	●
No. Carolina	●		●	●-6		●	●						●	●
No. Dakota	●-1		●	●-7	●-11	●	●					●-17		
Ohio	●	●	●	●-6	●-11	●	●							
Oklahoma	●	●	●-4	●-7	●-9	●	●					●-18		●
Oregon	●		●-3	●-6	●-12	●-18	●-16						●	
Pennsylvania	●	●		●-7	●-11	●	●	●						●
Rhode Island	●	●	●-3	●-6	●-11	●	●	●						
So. Carolina	●-1	●	●-3	●-6	●-11	●	●						●	●
So. Dakota	●	●	●-3	●-7	●-11	●	●							●
Tennessee	●	●	●-3	●-6		●	●		●-13					
Texas	●-1		●-3	●-6	●-11	●								
Utah	●-2	●-2	●-3	●-7	●-12	●	●							●
Vermont	●-1	●	●-3	●-6	●-11	●	●							●
Virginia	●	●	●-3	●-6	●-11	●	●							
Washington	●	●	●-5	●-7	●-11	●	●						●	
W. Virginia	●-1	●	●-3	●-6	●-11	●	●							
Wisconsin	●	●	●-3	●-6	●-11	●	●						●	●
Wyoming	●	●	●-3	●-7	●-11	●	●				●-15		●	●

- ● Requirement in law
- ●-1 Helmet reflectorization required
- ●-2 Required where speeds exceed 35 mph
- ●-3 One mirror required
- ●-4 Left and right mirrors required
- ●-5 Left side mirror required
- ●-6 Required on one wheel
- ●-7 Required on both wheels
- ●-8 10" above fasten point
- ●-9 12" above fasten point
- ●-10 15" above fasten point
- ●-11 15" above seat
- ●-12 Handgrips below shoulder height
- ●-13 Required for over 750cc if operator is under 21
- ●-14 Footwear
- ●-15 Required on newer models
- ●-16 Effective 7/1/76
- ●-17 Speedometer, odometer
- ●-18 Regulates speed limit for vehicle

Although this chart represents information from the most authoritative sources available as of the date shown above, the Motorcycle Industry Council is not responsible for accuracy or completeness.

MOTORCYCLE INDUSTRY COUNCIL, INC.

Other motorcyclists objected to helmet use legislation on the ground that they regarded it as an unconstitutional infringement upon personal liberties. This position received very limited support from the courts. In People v. Fries, 42 Ill.2d 446, 250 N.E.2d 149 (1969), the Illinois Supreme Court ruled that the helmet use law of that State was unconstitutional.

The Illinois decision is contrary to the overwhelming weight of authority on the constitutionality of helmet use laws. The constitutionality of State (20) and municipal (6) helmet use laws has been considered by the supreme courts or their equivalents in 26 States. 25 of the courts upheld the helmet use laws. Only the Illinois court went the other direction. Its ruling thus departed from the 7 favorable rulings that preceded it and was not followed in any of the 18 favorable rulings that followed it.

The Federal courts are in strong accord with the majority State court position on this question. In the leading case, Simon v. Sargent, 409 U.S. 1020, 93 S. Ct. 463, 34 L.Ed.2d 312 (1972), aff'g 346 F. Supp. 277 (1972), the United States Supreme Court affirmed a decision by the Federal District Court for Massachusetts upholding the helmet use law of that State. Prior to that decision, the Supreme Court had denied certiorari in three other cases and dismissed an appeal for want of a substantial Federal question in a fifth case.

Do State Governments have the right to tell a person to wear a safety helmet since only that person would be affected if they incurred a head injury?

° Headgear legislation stems from the police power of a State. The police power includes the power to enact laws within constitutional limits to promote the public safety and health. It is one of the least limitable of governmental powers, and a proper exercise thereof may involve limitation of the use and enjoyment of private property without violation of the due process clause of the Constitution.

The public streets, roads, and highways of a State are the property of all the people of a State, and a State has plenary power over the regulation of the use of such, for the safety and best interests of the public. The Supreme Court has recognized and given sanction to the State exercise of its police power over use of the public way for more than 40 years:

> "Motor vehicles are dangerous machines, and, even when skillfully and carefully operated, their use is attended by serious dangers to persons and property. In the public interest the State may make and enforce regulations reasonably calculated to promote care on the part of all . . . who use its highways."
>
> Hess v. Pawloski, 274 U.S. 352, at 356 (1927).

Protection of a motorcyclist and his passenger while on the public roads then is within the legitimate concern of the State and not an area reserved to the individual. Legislation requiring the use of protective headgear by both cyclist and passenger is reasonably related to the end envisioned of reducing deaths and injuries to cyclists and passengers and others upon the public roads. Therefore, State headgear legislation is a valid exercise of the police power by a State.

The unprotected motorist presents a potential traffic hazard to the public at large. Unlike the operator of an enclosed motor vehicle a cyclist without a helmet is unprotected against falling objects such as tree branches. He is also unprotected against flying stones or gravel from the wheels of other moving vehicles. If struck in the head, an unprotected cyclist could be so affected as to lose control of the vehicle and be the cause of death or injury to himself and other users of the highway. Everhardt v. City of New Orleans, supra; State ex rel. Colvin v. Lombardi, 241 A 2d 625 (S. Ct. R. I. 1968).

that appellant chose to drive his car with defective tires. The defect was not latent, but rather the tires were visibly worn, if not bald. Trooper McVitty immediately noticed this when he examined the car after the accident. If McVitty could make this observation, so could appellant. He was not unfamiliar with cars; rather, by his own admission, he had practically built the car himself, and he was taking a course in automobile mechanics. The jury could therefore reasonably infer that appellant could spot a worn tire and would realize that it was dangerous. Further, if appellant had put the tires on his car and taken it to be inspected, as required by law, he would have been told that the tires were not safe for highway use. Thus, it seems clear not only that appellant operated his car with defective tires, but that he did know or should have known of the dangers involved. Finally, appellant chose to drive the car on a wet, slippery highway. The decreased traction due to the tires' worn condition could only be exacerbated by the slickness of the road. However, appellant did not reduce his speed to compensate for this but instead drove at a high rate of speed. Considering all of these circumstances, we have concluded that the evidence was sufficient for the jury to find that appellant acted in "disregard of human life or (with) an indifference to (the) consequences." If the appellant had been required to use his car because of some emergency, or if he had taken some precautionary measures, our decision might be different, but that is not the case.

-2-

In deciding whether appellant's conduct was the cause of Ashbrook's death, the standard to be used is not the familiar proximate cause requirement that the conduct must be the direct cause of the death. *See generally, Commonwealth v. Root, supra.* Here, an eyewitness watched practically the whole sequence of events. As has been mentioned, appellant's car was travelling down the highway when the rear began to fishtail, and shortly thereafter it went into a spin, crossed the median, and crashed into Ashbrook's car. It is the fishtailing that is significant, for from this the jury could reasonably infer that the tires lost their grip on the road due to slipping. This was the very danger inherent in the use of worn tires, on a wet highway, at high speed. We therefore conclude that appellant's actions were the direct cause of Ashbrook's death.

The judgment of sentence is affirmed. *(Decided September 22, 1975. Reported November 15, 1975.)*

SCR 59

MOTORCYCLE EQUIPMENT OFFENSES

STATE v. BEEMAN
541 P.2d 409 (Ariz. Ct. App.)

THERE IS A VALID STATE INTEREST IN REQUIRING ALL MOTORCYCLISTS TO WEAR HELMETS, AND THEREFORE THE ARIZONA STATUTE PROHIBITING THE DRIVING OF A MOTORCYCLE WITHOUT A HELMET IS A VALID CONSTITUTIONAL EXTENSION OF THE STATE'S POLICE POWER.

OGG, Presiding Judge.

Defendant/appellant Harold Beeman was found guilty on December 31, 1974, of driving a motorcycle without a helmet in violation of Sec. 28-964A, Arizona Revised Statutes, Laws 1973. The pertinent part of this statute reads in part:

"A. The operator and passenger of a motorcycle or motor-driven cycle shall at all times, while operating or riding on such motorcycle or motor-driven cycle, wear a protective helmet on his head in an appropriate manner safely secured. The operator and passenger of a motorcycle or motor-driven cycle shall also wear protective glasses, goggles or a transparent face shield of a type approved by the director unless the motorcycle or the motor driven cycle is equipped with a protective windshield. The provisions of this subsection shall not apply to electrically powered three wheeled vehicle or three wheeled vehicles on which the operator and passenger ride within an enclosed cab."

The defendant contends on appeal that Sec. 28-964A is unconstitutional in that it violates the due process clause of the 5th and 14th Amendments of the United States Constitution insofar as it is not a valid exercise of the state's police power. Our court has already ruled on this matter in *State v. Also*, 11 Ariz.App. 227, 463 P.2d 122 (1969). In upholding the constitutionality of the forerunner of the current statute which is essentially identical, Judge Krucker, speaking for the court, stated:

"(4) We do not believe that the purposes of the Act, whether it be solely directed at the individual's well-being or viewed as coincident with potential threats against public safety, places this regulation on a par with those which the decisions invalidating the statutes have suggested are similar."

. . . . . .

"Public highways just cannot be said to provide a place where anyone's encounter with danger can be tolerated. The ramifications are too broad."

We hold, therefore, that the statute in question is a constitutional exercise of the police power in the area of highway safety."

Since *Also*, the United States Supreme Court has affirmed a Massachusetts District Court decision which upheld the constitutionality of a Massachusetts statute requiring motorcyclists to wear helmets. (Sic) See *Simon v. Sargent*, 346 F.Supp. 277 (1972), affirmed 409 U.S. 1020, 93 S.Ct. 463, 34 L.Ed.2d 312 (1974). The wording of the Massachusetts statute is essentially the same as ARS Sec. 28-964A.

The defendant's position in *Simon* is identical to that of defendant Beeman in the present case: that is, he argued that the state's police power does not extend to overcoming the right of an individual to incur risks that involve only himself. In dealing with this argument the District Court observed:

"In view of the evidence warranting a finding that motorcyclists are especially prone to serious head injuries, see Statistical Division, National Safety Council, 1974 Motorcycle Facts, 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 continued subsistence. We do not understand a state of mind that permits plaintiff to think that only he himself is concerned."

We agree with this observation. Any accident on the public highway puts into motion the wheels of a number of different state and local agencies at a substantial cost to the taxpayers. Furthermore, the helmet prevents a motorcyclist from being injured or his attention diverted by stones or debris thrown up from the roadside, thereby causing the cyclist to lose control and threaten the safety of both motorists and pedestrians in close proximity. In light of these facts we feel that there is valid state interest in requiring all motorcyclists to wear helmets, and therefore, ARS Sec. 28-964A is a valid constitutional extension of the state's police power.

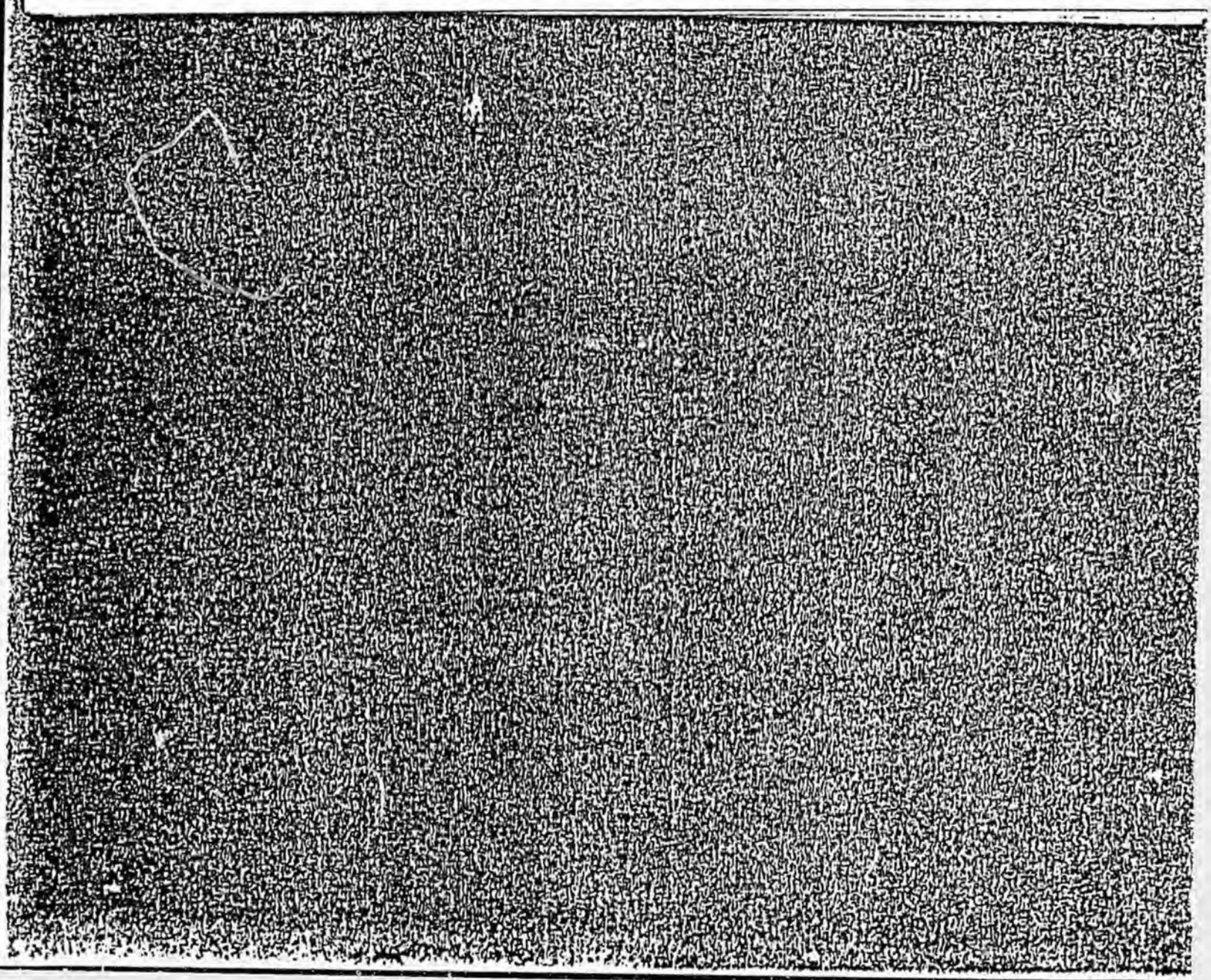
The judgment and sentence of the trial court are affirmed. *(Decided October 21, 1975. Reported November 21, 1975.)*

(National Traffic Law News December, 1975)

HISTORICAL BACKGROUND

In order to show the importance of the motorcycle helmet as an effective safety device, it is necessary to survey the research which has been conducted during the past thirty years. While the motorcycle has been popular in the United States since the early 1960's, it has been an intergral part of European and Australian transporation for far longer. Thus, one should look to the British and the Australians, who are responsible for the initial research on helmet effectiveness.

Between 1940 and 1943, Dr. Hugh Cairns conducted in-depth studies of 106 motorcycle accidents to determine if the crash helmets in use in Great Britian were effective in reducing injury[1,2]. After study of the helmets themselves, the type of injury and the severity of injury for each case, Dr. Cairns reported reduced severity of injury through helmet use; one-fourth.



the frequency of fractured skulls through helmet use; and a reduction of one-half in hospital treated injuries for helmet users. The report based on these studies formed the precedent for future helmet research, and presented the first discussion of safety helmets as important safety equipment.

The work of Cairns was continued by Lewin and Kennedy, who published a study in 1956 of 555 civilian and 135 army motorcyclists admitted to hospitals.[3] Similar results supporting helmet effectiveness were reported, and criteria of an effective helmet were also presented. In 1957 Chandler and Thompson developed a statistical demonstration of the usefulness of helmets, based on 7,010 motorcyclists injured in 1954 or 1955.[4] In addition to comparing helmet effectiveness in urban and rural areas, the study documents a 30-40 percent reduced chance of head injury if a helmet is worn in a motorcycle accident. These British doctors had taken the first significant steps toward identifying the life saving potential of motorcycle helmets.

On January 1, 1961, a law became effective in the State of Victoria (Australia) making it mandatory for all motorcycle riders to wear safety helmets. A relatively thorough study of the data both two years before and after implementation of the law indicated:[5]

1. The legislation was successful, i.e., compliance was near 100 percent;

2. Facalities 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 non-user.

Thus, the Australian experience showed that a mandatory helmet use law was enforceable and the resultant helmet use reduced fatalities in motorcycle accidents.

In the United States, safety officials and state legislators watched with concern as fatality totals from motorcycle accidents continued to increase. A Washington State accident summary published in 1967, showed that two-thirds of all Washington motorcycle fatalities in 1965 and 1966 resulted from head injury.[6] In 1966, New York and Michigan adopted helmet use laws. Late that year the United States Department of Health, Education and Welfare published preliminary data suggesting that projected motorcycle fatalities would be reduced by 40 percent if all motorcyclists used helmets.[7] This and other evidence was evaluated, and led the NHTSA to include a motorcycle safety standard as one of the initial thirteen Highway Safety Programs Standards — 1967.

operation of a motorcycle.

Those who oppose laws requiring the use of safety helmets have claimed that helmets are dangerous because they restrict a motorcyclist's ability to see and hear potential hazards. However, these claims are not supported by any type of research or statistical documentation.

The NHTSA has completed initial studies of each of these problems.[11,12] In the first study on vision, four popular helmets were tested to determine the degree to which each limited motorcyclists vision. The field of view of 19 experienced motorcyclists was measured using each of the four helmets

(CONT. on next page)

(two full facial coverage, and two full coverage). Each person's field of view was also treated without a helmet.

VISION

The results of the study show that full coverage helmets, representing almost 95 percent of current helmet sales, restrict a motorcyclist's field of view in the horizontal plane (peripheral vision) by less than 3 percent. The study also found that the helmet which provided the smallest field of view (a full facial coverage helmet intended for motorsport competition) restricted the riders' horizontal field of view less that 22 percent. All of the helmets provided a horizontal field of view of more than 180°, well above the 140° used by State driver licensing agencies for screening out drivers with possible vision problems that would warrant some type of restricted driving privilege.

With regard to hearing, helmets do reduce a person's ability to hear, but in actual practice the reduction in auditory capacity for the motorcyclist is inconsequential. The primary reason for this is that the noise generated by the motorcycle and the noise produced at high speed by the wind are so great that any sound loud enough to penetrate this noise is loud enough to be heard inside the helmet.

HEARING

To understand why this is true, it is necessary to examine the phenomenon of hearing. Whether or not a given sound will be heard by a driver is dependent upon three factors: (1) the auditory capability of the driver, (2) the intensity and frequency of the sound of interest, and (3) the intensity and frequency of the environmental noise that might "mask" or hide the desired sound. A given sound will be heard by a driver if it is loud enough when it reaches his ear to be above his hearing threshold, and if it is not "masked" or hidden by other sounds or noise present at the same time. Motorcycles create average levels of ambient noise ranging from 85 to 98 db(A) for on-street or dual purpose machines. For a rider to hear any other sound in the presence of this high noise level, the sound must be as loud or louder than the motorcycle itself, i.e., it must have a signal-to-noise ratio of approximately 1 to 1. The greater the signal-to-noise ratio, (e.g., the more intense the sound of interest relative to the ambient noise) the greater the attention getting properties of the signal and the higher the probability that it will be heard. Helmets reduce the loudness of both the sound of interest and the motorcycle noise by an equal amount, and therefore do not alter the signal-to-noise ratio between the two sounds. Consequently, as long as the rider can hear the motorcycle itself while wearing a helmet, he or she can also hear any other sound with a favorable signal-to-noise ratio at least as well as a driver who does not wear a helmet.

Motorcycle helmets do not increase incidence of neck injury in accidents.

It has been suggested that helmet use increases the incidence of fatal neck injury in motorcycle crashes (using data from a 1969 statistical analysis

of motorcycle accidents in New York).[13] Actually, the incidence of neck injury in motorcycle accidents during 1966 and 1967 involved any type of neck injury, and most of these involved only complaints of pain with no visible signs of injury. Studies done recently in Nebraska,[14] California and Canada[15] show that the incidence of neck injury of any type occurs in less than two percent of all motorcycle crashes.

Motorcyclists have been wearing safety helmets for more than 30 years, and during this period a number of studies of injury patterns in motorcycle accident have been made. None support the claim that helmets increase fatal neck injuries. The neck injury issue has been used in opposition to helmet laws as an attempt to exploit a peripheral issue on which there is not a great deal of valid data. Consequently, the problem has been magnified far out of proportion.

In order to provide conclusive evidence which will resolve the issue once and for all, the University of California and the Los Angeles County Medical Examiner's Office, under contract with the NHTSA, are now undertaking in-depth analysis of all fatal motorcycle crashes in Los Angeles County. Post mortem examination of each helmeted and unhelmeted rider will be made to document the incidence of neck injury in each group. The results of these analyses will provide authoritative resolution of the neck injury issue.

Mandatory helmet use laws reduce the number of serious head injuries and fatalities resulting from motorcycle accidents.

It is a logical conclusion that if a mandatory helmet use law is passed, more people will wear helmets, and consequently fewer fatalities and fatal injuries will occur in motorcycle accidents. Researchers have tried to verify this by comparing motorcycle fatalities and head injuries before and after implementation of a mandatory helmet use law. Of particular interest is a Brisbane, Australia report[16] which utilized three groups -- one sample done before implementation of a helmet use law, and two samples done in the two years immediately following. This study found (see Table IV) (a) that a significant increase in helmet use by motorcyclists involved in accidents (as expected) and (b) a significant decrease in head injuries in the post-legislation group.

1. Cairns, H., Head injuries in motorcyclists, British Medical Journal, p465-71. October 4, 1941

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3. Lewin, W. and W.F.C. Kennedy, Motorcyclists, crash helmets, and head injuries, British Medical Journal, p1253-9. June 2, 1956

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6. Crancer, A., Motorcycle fatality study, 1965 and 1966 Data, Washington State Department of Motor Vehicles. January, 1967.

7. "Motor Vehicle Injury Prevention Program", Office of the Assistant Secretary for Program Coordination, U.S. Department of Health, Education and Welfare, August, 1966.

8. Accident Facts, 1975 Edition, National Safety Council, p56. 1975

9. Krauss, J.F., et al, Some Factors Associated with Severity of Injuries in Motorcycle Collisions, University of California at Davis. 1973

10. Richardson, H.A., A Motorcycle Safety Helmet Study, DOT-HS-801-137. March 1974

11. Gordon, S. and J. Prince, Technical Report on the Field of View With and Without Motorcycle Helmets, DOT-HS-801-758. September 1975

12. Henderson, R.L., Technical Note on the Effect of Safety Helmets on Auditory Capability, DOT-HS-801-759. September 1975

13. Rodell, M.F. and A. Crancer, Motorcycle Fatality Study, 1967 and 1968 Data, Report No. 002. April 1969

14. A Study of Motorcycle Traffic Accidents in Nebraska, Nebraska Department of Public Roads, Safety Division. January 1975

15. Newman, J.A., The Protective Value of Contemporary Motorcycle Helmets in the Provention of Head Injuries, University of Ottawa. May 1974

16. Jamieson, K.G. and D.S. Kelly, Crash Helmets Reduce Head Injuries, Medical Journal of Australia. October 1973

Motorcycle Helmets:

(Note to Sen. John Huber from Speaker Mike Bradner)*

On Helmets: If the provision was repealed we might also get away from the "space helmet" and get some safety certifying group to "approve" a proper helmet that DOES NOT INTERFERE with peripheral vision.

You will "note" NO MOTORCYCLE POLICEMAN wears a space helmet, but rather a perhaps slightly less convenient (getting off and on) and less comfortable helmet that does allow him to see !

If law enforcement people wish a helmet law they should perhaps first specify a proper helmet that ISN'T A CURE WORSE THAN THE DISEASE !

* at meeting of National Committee on Uniform Traffic Laws and Ordinances; Washington, D.C. (May 1970)

Nat'l. Comm. Uniform Traffic Laws & Ord.
Washington, D.C. / May 19

Federal Aid Highway Act of 1975. The U. S. Senate passed its version S 2711 on December 12, 1975. The House version HR 8235 came out of Public Works Committee on December 15.

It is likely that the two versions will be taken up in late January by a conference committee of members from both houses. The resulting bill then will be taken back to both houses of Congress for what is expected to be a quick final approval.

The Senate passed this measure with a vote of 52 for, and 32 against. 11 abstained.

BOTH BILLS SPECIFICALLY FORBID THE DEPARTMENT OF TRANSPORTATION FROM ANY LONGER REQUIRING THAT STATES ENACT AND ENFORCE MOTOR CYCLE HELMET USE LAWS.

THE HOUSE BILL ALSO TAKES AWAY THE DOT POWER. TO FORCE STATES TO ADOPT MOTOR CYCLE USE LAWS.

In Identical language, both the House and Senate bills would expunge DOT's current helmet use standard by directing that a highway safety program "not include any requirement that a state implement such a program by adopting or enforcing any law, rule, or regulation based on a standard promulgated by the Secretary under this section requiring any motorcycle operator 18 years of age or older or passenger 18 years of age or older to wear a safety helmet when operating or riding a motorcycle on the streets and highways of that state."

To quote Sen. James Abourezk (D-S. Dak):

". . . While I believe that the state and the federal government have the right to protect the safety of people from the acts of someone else, I think it is highly questionable that they have the right to protect an individual from himself. I think it is an invasion and an intrusion upon that person's privacy and his right to decide for himself what he wants to do. I would urge the Senate to adopt this amendment."

There is no evidence showing that requiring use of helmets reduces deaths, injuries or accidents. Studies in several states indicate an increase in fatalities after the requirement was adopted. Helmets have not decreased deaths or injuries.

Motorcycle helmets are heavy and increase the number and severity of neck injuries. In one study, serious neck injuries increased 750%.

Motorcycle helmets cause crashes. They reduce hearing. They reduce side vision to 105 degrees when the minimum desireable is 140 degrees.

Though police officers favor compulsory helmet use laws, many do not wear helments complying with recognized standards. That is, they wear helmets which it would be illegal for motorcyclists to use.

New York with a helmet law has a much higher motorcyclist death rate than California which does not have the law.

Under conditions of a severe blow to the head, it has been found that the cushioning effect of helmets causes a "scrambling" of the brain.

Helmets are heavy, hot and put pressure on your temples. They squeeze the frames of the person's glasses and leave marks on his/her head and are decidedly painful. They're certainly not designed for people who must wear glasses.

The weight of the helmet puts a strain on your neck muscles, which coupled with the wind resistance at higher speed it gives you a bad stiff neck and usually a headache.

When riding on the freeway, the wind goes under the helmet, pushes it back and the neck strap chokes you.

Twenty-five percent of excess body heat is given off via the head. Severe fatigue results when the escape of excess heat is prevented by a helmet.

Motorcyclists do not like to wear helmets.

Only 12% of cyclists in one survey of 5,000 people favored laws requiring use of helmets.

Helmets are uncomfortable.

Helmets are expensive.

Helmets are inconvenient.

Motorcycle use should be encouraged because they consume less gas than cars. Requiring a helmet discourages use of a motorcycle.

Motorcyclists have been discriminated against. Autoists do not have to wear belts. Pedestrians and bicyclists do not have to wear helmets. The requirement is unjust.

Society should not adopt laws requiring people to protect themselves; nor laws telling them what to wear. Such laws are unreasonable and oppressive. They infringe on a person's freedom of choice.

Motorcycle helmets do not provide much protection in a crash.

A motorcyclist has to carry his helmet with him even after he leaves the motorcycle. For fear of theft of his helmet, he has to take it everywhere.

In comparison with other causes of death in the United States, motorcycle usage ranks very low. It is not one of our major public health problems.

Of the entire 50 states, Alaska has the record low of 9.2 deaths per 100,000. This cannot be solely attributed to the helmet law.

Administrative Regulations in effect on the effective date of this chapter. (Eff. 12/15/61, Reg. 3; am 8/10/62, Reg. 23; am 12/31/69, Reg. 31)

Authority: AS 28.05.030
AS 28.05.040

13 AAC 04.275. SAFETY CHAIN ON TOWED VEHICLE. A towed vehicle shall, after January 1, 1971, be coupled to the towing vehicle by means of a safety chain, chains, cable or equivalent devices in addition to the regular trailer hitch or coupling. This requirement does not apply to a semitrailer having a connecting device composed of a fifth wheel and kingpin assembly nor to a pole or pipe trailer or dolly. No more slack may be left in safety chains, cables or equivalent devices than is necessary to permit proper turning, and the safety chains, cables or equivalent device shall be connected to the towed and towing vehicle and to the drawbar so as to prevent the drawbar from dropping to the ground if the drawbar fails and shall be of sufficient strength to retain control of the towed vehicle in the event of failure of the regular hitch or coupling. (Eff. 12/31/69, Reg. 31)

Authority: AS 28.05.030

13 AAC 04.280. MOTORCYCLE, MOTOR SCOOTER—MIRRORS, GOGGLES, FACE SHIELD AND HELMET. (a) A person may not, on and after January 1, 1971:

(1) operate a motorcycle or motor scooter that is not equipped with a mirror on each side of the handlebars. The two mirrors shall be located so as to give the driver a complete view of the highway for a distance of at least 200 feet to the rear of the motorcycle or motor scooter;

(2) operate a motorcycle or motor scooter that does not have a windshield which rises at least 15 inches above the handlebars unless he wears goggles or a transparent face shield meeting the requirements of sec. 300 of this chapter;

(3) operate or ride upon a motorcycle or motor scooter unless he wears on his head a protective helmet meeting the requirements of sec. 300 of this chapter. The helmet shall be equipped with either a neck or chin strap which shall be fastened securely while the motorcycle or motor scooter is in motion and which shall be reflectorized so as to be visible from all distances between 600 and 100 feet.

(b) (a)(2) and (3) of this section do not apply to a person riding within an enclosed cab. (Eff. 12/31/69, Reg. 31)

Authority: AS 28.05.030

13 AAC 04.285. HELMET REQUIRED WHEN MOTORCYCLE OR MOTOR SCOOTER RENTED. (a) A person may not on and after January 1, 1971, rent a motorcycle or motor scooter to another person unless he also has available for rent a helmet meeting the requirements of secs. 280(a)(3) and 300 of this chapter.

(b) A motorcycle or motor scooter may not be rented to a person who does not have in his possession, or rent, an approved helmet. (Eff. 12/31/69, Reg. 31)

Authority: AS 28.05.030

13 AAC 04.290. MAXIMUM HEIGHT FOR HANDLEBARS. On and after January 1, 1971, a person may not operate a motorcycle or moter scooter on which the handlebars or grips, at their highest point, are more than 15 inches higher than the seat or saddle for the operator. (Eff. 12/31/69, Reg. 31)

Authority: AS 28.05.030

13 AAC 04.295. MOTORCYCLE AND MOTOR SCOOTER WINDSHIELD. A motorcycle or motor scooter windshield, to be recognized as a windshield, shall rise 15 inches above the highest point of the handlebars or grips, and shall be of glazing material meeting the requirements of sec. 235(b) of this chapter or clear plastic which need not be an approved type. (Eff. 12/31/69, Reg. 31)

Authority: AS 28.05.030

13 AAC 04.300. HELMET, GOGGLES AND FACE SHIELD STANDARDS. (a) The protective headgear or helmet required to be worn by a person riding on or operating a motorcycle or motor scooter as provided by secs. 280 and 285 of this chapter shall be manufactured to meet the standards provided by U.S. Standards Institute Safety Code Z 90.1--1966.

ALASKA ACCIDENT STATISTICS

from the

Department of Public Safety
Planning & Research
STATE OF ALASKA

Motorcycle Accidents	Persons With "A" Injury	Deaths
1971	58	4
1972	not available	not available
1973	56	4
1974	not available	2
1975	not available	7

DEPARTMENT OF PUBLIC SAFETY

Motor Vehicle Registration

Motorcycles Registered In Alaska in 1975

12809

ANSI Z90.1-1971
(Revises Z90.1-1966)

American National Standard
(formerly U.S. Standard)

specifications for protective headgear for vehicular users

Z90.1-1971

ANSI

ANSI
Z90.1-1971
Revision of
Z90.1-1966

American National Standard Specifications for Protective Headgear for Vehicular Users

Secretariat

Snell Memorial Foundation, Inc

Approved August 26, 1971

American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not a part of American National Standard Specifications for Protective Headgear for Vehicular Users, Z90.1-1971.)

On December 9, 1960, the Sports Car Club of America requested that the American Standards Association (now American National Standards Institute, Inc) initiate a project to prepare specifications for road users' helmets. A general conference was held at the ASA headquarters in April 1961 which was attended by representatives from various consumer groups, helmet manufacturers, testing organizations, and both the Army and Naval branches of the military service. The Safety Standards Board established Standards Committee Z90 and charged it with the responsibility for establishing a safety code for vehicular head protection. The scope of the committee was to establish safety requirements for head protection for automobile drivers engaged in high hazard activities or occupations, and for motorcyclists. Following nearly five years of deliberations by the committee, its resulting proposals were approved by the Safety Standards Board on June 22, 1966. Subsequent experience with the specifications as originally adopted indicated a need for certain clarification and simplification. The specifications have now been revised to incorporate such modifications as have been deemed appropriate by the committee. These modifications include a change of the scope of the committee. The committee is presently considering the expansion of its scope to include headgear protection for other high hazard activities.

There exists a great number of widely varying uses for protective headgear. The resulting differences in design requirements may result in very necessary compromise involving factors which include comfort, weight, visual, and auditory requirements as well as degree and extent of protection. It is therefore essential that any specific complete standard be applied or utilized only within the scope of its intended application.

Suggestions for improvement gained in the use of this standard will be welcome. These should be sent to the American National Standards Institute, Inc, 1430 Broadway, New York, N.Y. 10018.

The organizations which participated in this work and the names of their representative, as listed at the time this revised standard was submitted to Standards Committee Z90 for approval, are as follows:

George G. Snively, Chairman
Roderick H. Aya, Secretary

Organization Represented	*Name of Representative*
American Association for Automotive Medicine	C. O. Chichester
American Medical Association	Harold A. Fenner, Jr
American Power Boat Association	Clarence Roberts
American Safety Equipment Corporation	Joan M. Seymour
American Sports Company	John Bootsma
Approved Engineering Test Laboratories	Bert LaFontaine
Bell Toptex, Inc	Frank Heacox
California Highway Patrol	Ross Little
California Polytechnic Institute	Arthur James
Cougar, Inc	F. A. Rappleyea
Dayton T. Brown, Inc	Marshall Irving
E. D. Bullard, Company	Herbert A. Raschke
Daytona Sports Company	George Alston
D. S. Safety Helmet Corporation	Phillip K. Huff
General Electric Company	Curtis C. Jones
H.C Industries, Inc	John R. Hughes
Industrial Safety Equipment Association	Charles N. Sumwalt, Jr
MacGregor Company	Eli Schachet
Manufacturers Design, Inc	Daniel D. Webb
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Organization Represented	*Name of Representative*
National Safety Council	D. C. Lhotka
Riddell, Inc	Richard Medley
Safety Helmet Council of America	Gary B. Lovell
Snell Memorial Foundation	Roderick H. Aya
Sports Car Club of America	George G. Snively
Sterling Products Company	George L. Moschkau
Tiburon Little League	William Carroll
Underwriters' Laboratories, Inc	George H. Pope
University of Michigan	Verne Roberts
University of Texas, Austin	Paul C. Trickett
U.S. Department of the Army	A. L. Lastnik
U.S. Department of Naval Aviation	Channing Ewing
U.S. Testing Laboratories	J. Robert Tucker
Wayne State University	L. M. Patrick

Contents

SECTION PAGE

American National Standard Specifications for Protective Headgear for Vehicular Users

1. Scope, Purpose, and Requirements

1.1 Scope. These specifications and test methods apply to protective headgear for wear by drivers and passengers of surface vehicles and specifically exclude eye and face protective devices.

1.2 Purpose. This standard specifies minimum performance criteria and test methods, performed under fixed conditions, for protective headgear designed to mitigate the adverse effects of a blow to the head.

1.3 Requirements. Tests are conducted of the protective headgear assembly to ascertain compliance, under specific environmental conditions, with the following requirements:

(1) Impact attenuation properties of the protective headgear

(2) Penetration resistance

(3) Strength of the retention system and its attachments

2. Definitions

basic plane. A plane laid out on a specific reference headform[1] derived from the anatomic basic plane, or Reid's Baseline. (A plane at the level of the external opening of the ear and the floor of the bony rim of the eye socket.)

mid-sagittal plane. A longitudinal, or fore and aft, plane passing through the vertex of the headform, perpendicular to the basic plane, which geometrically bisects the headform.

projection. Any part that extends beyond the surface in abrupt fashion.

protective headgear. A device worn on the head, designed to mitigate the adverse effects of a blow to the head in the area specified elsewhere herein.

reference plane. A plane 2.36 inches (60 mm) ± 0.04 inch (1 mm) above and parallel to the basic plane, and which shall be located on each headform.

retention system. (Also referred to as "harness assembly.") The completed assembly by means of which the protective headgear is maintained in position on the wearer's head.

3. Construction

3.1 General. A protective headgear will consist of a hard, smooth outer surface containing the necessary means of attenuating impact energy and resisting penetration. Optional devices fitted to the protective headgear shall be so designed that they are unlikely to cause injury to the wearer in the event of an accident.

3.2 Projections. The assembled protective headgear shall have no permanent external projections greater than 3/16 inch (5 mm) in height.

3.3 Retention. The retention system shall be so constructed that when properly fastened, the protective headgear cannot be readily dislodged from its normal position on the wearer's head during impact conditions.

3.4 Peripheral Vision. The protective headgear shall provide peripheral visual clearance of a minimum of 120 degrees to each side of the mid-sagittal plane. This angle shall be measured on the standard headform[1] in the basic plane with its apex at the anterior surface of the headform where the mid-sagittal and basic planes intersect.

Medium and large size protective headgear will be tested on a single headform size. Other sizes of protective headgear of the same type will be approved if visual inspection shows the construction to be identical to those tested.

4. Materials

The materials used in the manufacture of the various parts of the protective headgear should be of durable

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[1] It was necessary for the purposes of these recommendations and in order to give requirements for the extent of protection to define artificial headforms, both to serve as a basis for instrumentation during tests, and to provide fixed parameters for measurement. It is realized that the variation of human head shape is such that the artificial headform may not conform exactly to the shape of any random sample human head, a considerable amount of anthropological data has been reviewed in order to decide the limiting dimensions, and the headform selected is considered suitable to allow for proper testing of protective headgear which will accurately fit approximately 95 percent of the population of all races.

Information concerning sources of the actual headforms or pattern thereof may be obtained by a request addressed to [illegible]

quality, that is, their characteristics should not undergo appreciable alteration under the influence of aging or of the circumstances of use to which the protective headgear is normally subjected, such as exposure to sun, rain, cold, dust, vibration, contact with skin, perspiration, or products commonly applied to the skin or hair.

5. Labeling

Every protective headgear offered for sale shall have durable labeling which will give the model designation and allow the identification of the manufacturer to be made. The labeling shall include the following:

(1) No protective headgear can protect the wearer against all foreseeable impacts. However, for maximum protection under this standard, the helmet must be of good fit and all retention straps must be securely fastened.

(2) This protective headgear is so constructed that the energy of a severe blow is absorbed through partial destruction of the headgear, though damage may not be visible to the naked eye. If it suffers such an impact, it should either be returned to the manufacturer for competent inspection or destroyed and replaced.

6. Extent of Protection

6.1 The extent of protection shall include all areas above the reference plane. None of the protective components of the headgear shall be inadvertently detachable, or detached under test impact.

6.2 The entire area of the protective headgear above the reference plane shall attenuate impact energy to at least the minimum requirements specified in Section 9.

7. Sampling for Testing

7.1 Condition and Attachments. For all testing, protective headgear shall be taken in the condition as offered for sale, and shall be accompanied by all attachments (other than eye protection devices) normally sold with the protective headgear. Such attachments shall not be installed on the helmet during testing.

7.2 Number of Samples. Four samples are required for testing. Each test sample, following exposure to its [illegible] environmental conditioning [illegible] tion set forth herein.

8. Conditioning for Testing

8.1 Order of Testing. The impact attenuation, penetration, and retention system tests set forth in Sections 9, 10, and 11 shall be conducted in ascending numerical order.

8.2 Time. Testing shall begin immediately after removal from the conditioning equipment as indicated in 8.4, 8.5, and 8.6. For actual testing, the maximum time during which the protective headgear may be out of the conditioning environment shall not exceed 5 minutes. It must then be returned to the conditioning environment for a minimum of 15 minutes before again being withdrawn. This process must be continued until a specific item has been put through all necessary testing.

8.3 Testing at Ambient Temperature. The first protective headgear shall be tested at ambient conditions as defined in 12.1 of this standard.

8.4 Low Temperature. The protective headgear shall be conditioned by being exposed to a temperature of − 10°C (14°F) ± 2°C (3.6°F) for not less than 4 hours nor more than 24 hours, in a controlled environmental temperature apparatus.

8.5 High Temperature. A third protective headgear shall be conditioned by being exposed to an air temperature of 50°C (122°F) ± 2°C (3.6°F) for a period of not less than 4 hours nor more than 24 hours, in a circulating air oven.

8.6 Water Immersion. A fourth protective headgear shall be immersed in water at a temperature of 25°C (77°F) ± 5°C (9°F) for a period of not less than 4 hours nor more than 24 hours.

9. Tests for Protective Headgear

9.1 Impact Energy Attenuation. Impact attenuation shall be measured by determining imparted acceleration to an appropriately instrumented standard headform (see footnote 1, page 7) dropped in a guided fall vertical within 1/2 inch (13 mm) per 15 feet (4.57 m) height upon a fixed rigid steel anvil base.

9.2 Acceptable Acceleration Levels

9.2.1 Any peak acceleration of the test headform, with any of the four preconditioned protective headgear, exceeding 400 G's shall be cause for failure. Acceleration shall be measured with an instrumenta[illegible] corrected for instrumentational accuracy.

9.2.2 Recorded accelerations in excess of 200 G's shall be cause for failure of the protective headgear if the duration of the acceleration at the 200 G level exceeds 2 ms. The time duration of acceleration will be measured with equipment accurate to ± 0.2 ms maximum and the reading shall not be corrected for instrumentation accuracy.

9.2.3 Accelerations in excess of 150 G's shall be cause for failure of the protective headgear if the duration of acceleration at the 150 G level exceeds 4 ms with instrumentation measuring duration as defined in 9.2.2.

9.3 Impact Description

9.3.1 Each protective headgear shall be impacted with two successive identical impacts (the centers of each paired impacts shall be located not more than 1/4 inch [6 mm] apart) in not less than four sites. At least two of these sites shall be upon a flat steel anvil and two upon a hemispherical steel anvil. The impact sites shall be above the reference plane and separated from each other by a distance not less than one-sixth of the maximum circumference of the protective headgear.

9.3.2 The flat steel anvil shall have a 5 inch (127 mm) minimum diameter and the hemispherical steel anvil shall have a 1.9 inch (48 mm) radius.

9.3.3 The impact energy utilized shall be 50 foot-pounds (6.91 kg meters) with the hemispherical steel anvil (54.5 inches ± 0.2 inch or 1340 mm ± 5 mm drop) and 66 foot-pounds (9.12 kg meters) with the flat steel anvil (72 inches ± 0.2 inch or 1.830 mm ± 5 mm drop).

9.4 Headform. The test headform shall be of low resonance magnesium alloy (K-1A) and shall weigh 11 + 0.2, – 0 lb (5 kg + 0.091, – 0 kg), which weight shall include the supporting arm.

9.5 Placement of Protective Headgear. The protective headgear shall be placed on the headform so that the reference plane on the headgear is coincident with the reference plane on the headform, prior to each drop. The protective headgear shall be secured to the headform and cross arm by its retention system so as to maintain this position during free fall.

9.6 Backup of Anvil. The steel anvil shall be backed up with a solid mass of at least 300 pounds which shall be faced with a steel plate of 1 inch (25.4 mm) minimum thickness and 1 ft² (0.1 m²) minimum surface area.

10. Penetration Test

10.1 Placement on Headform. The complete protective headgear shall be placed on a rigidly mounted metal headform whose surface shall be electrically conductive. If the protective headgear contains a "sling" or other adjustable sizing component, this shall be relaxed to its most extendable position.

10.2 Mode of Drop. The penetration test shall be conducted by dropping the penetration test striker onto the outer surface of the protective headgear anywhere above the reference plane, in a direction essentially perpendicular to the outer surface of the protective headgear. At least the tip of the striker shall be electrically conductive.

10.3 Failure Criterion. When tested in the above fashion, the protective headform shall be failed if demonstrable electrical contact is made between the penetrator and the conducting surface of the headform.

10.4 Number and Location of Blows. There shall be no less than two penetration blows applied to each of the preconditioned protective headgear (Section 7). Such blows shall be at least 3 inches (76 mm) apart and shall be located no less than 3 inches (76 mm) from the center of any impact points.

10.5 Conditions of Penetration Tests

10.5.1 The weight of the penetration test striker shall be 6 pounds, 10 oz + 0.1, – 0 lb (3.0 kg + 45, – 0 g).

10.5.2 The point of the striker shall have an included angle of 60 degrees ± 0.5 degrees and a cone altitude or height of not less than 1.5 inches (38 mm).

10.5.3 The radius of the striking point shall be 0.0197 inch ± 0.004 inch (0.5 mm ± 0.1 mm).

10.5.4 The hardness of the striking tip shall be a minimum of 60 Rockwell (Scale C).

10.5.5 The height of the fall shall be 118.11 inches ± 0.6 inch (3 m ± 15 mm), as measured from the striker point to the outer surface of the mounted protective headgear.

11. Test of Tensile Strength of Retaining System

11.1 Placement. The protective headgear shall be placed upon a test headform with the chin strap fastened over a device approximating the shape of the bony structure of the lower jaw. This shall consist of two metal rollers, each 1/2 inch ± 0.004 inch (12.7 mm ± 0.1 mm) in diameter, at a distance of 3 inches ± 0.04 inch (76.2 mm ± 1 mm) separation on center, which would serve to represent the jaw bone. The protective headgear shall [illegible] the headform so that the point of [illegible] gear will be subject to the same test as the strap itself.

11.2 Preload and Tension. The retaining system shall be tested for ultimate strength and for elongation under tension, as follows. After applying a 50 lb preload ± 1 lb (23 kg ± 0.5 kg) for no less than 30 s, an additional 250 lb – 0, + 5 lb (113.6 kg – 0, + 2.2 kg) weight or tension equivalent thereto shall be applied to the device retained by the chin strap for no less than 2 minutes. Any parting of the strap or its attachments, or elongation of more than 1 inch (25.4 mm) in the vertical distance of the chin strap from the helmet crown, as measured between preload and 300 lb (136 kg) load, shall result in failure. The retaining system shall be loaded to failure.

12. Preparation of Test Equipment

12.1 Equipment and Environment. All equipment shall be turned on and allowed to warm up for at least 30 minutes or until equilibrium is reached, whichever time is greater prior to testing.

The following environmental conditions shall prevail throughout the period of calibration and testing:

Temperature: 70-85° F

Relative humidity: 30-70 percent (22-30° C)

12.2 Instrumentation Check. The entire instrumentation system shall be checked before and after each series of tests by impacting a standardized calibrating medium[2] capable of producing an acceleration-time history of 400 G's, and a time duration of at least 1 ms duration at 200 G's. At least three such impacts shall be recorded before and after testing and made part of the test report. If the acceleration-time history is out of predetermined tolerance prior to test, the system shall be adjusted or repaired as necessary. If the post-test average of the three impacts differs from the pre-test average by more than 40 G's, the entire test series shall be discarded.

12.3 Record of Test. A record shall be made of each test impact and retained as a permanent record of the acceleration-time history.

[2]A calibrating medium found to be suitable is a one-inch Open Blue Modular Elastomer Programmer, available from Monterey Research Laboratory, P.O. Box 72, Monterey, California 93940, or equivalent.

13. Test Equipment

13.1 Headform. Standard headforms shall be used in testing and measurement. (See footnote 1, page 7.)

13.1.1 Center of Gravity of Headform. The center of gravity of the headform, including the cross arm, shall lie within a cone with axis vertical and forming a 10 degree included angle with the apex at the point of impact.

13.1.2 Combined Weight of Cross Arm and Headform. The combined weight of the cross arm and headform shall be 11 + 0.2, – 0 lb (5 kg + 0.091, – 0 kg).

13.1.3 Acceleration Transducer. The acceleration transducer shall be mounted with the sensitive axis aligned to within five degrees of true vertical when the headform is in the impact position.

13.1.4 Headform Size. Medium and large size protective headgear will be tested on the standard headform size. Small size headgear of the same type will be approved if visual inspection shows the construction to be essentially identical to those tested.

13.2 Low Temperature Box. A controlled, mechanically cooled temperature box of at least 2 X 2 X 2 feet (0.6 X 0.6 X 0.6 m) inside dimensions shall be available with controlled temperature capability of – 10° C (14° F) ± 2° C (3.6° F). It shall hold the prescribed temperature for a minimum of 24 hours.

13.3 High Temperature Box. A controlled temperature box of at least 2 X 2 X 2 feet (0.6 X 0.6 X 0.6 m) inside dimensions shall be available with controlled temperature capability of 50° C (122° F) ± 2° C (3.6° F). It shall hold the prescribed temperature for a minimum of 24 hours.

13.4 Acceleration Transducer. The acceleration transducers shall have a natural frequency of 20 000 Hz or greater and be capable of withstanding a 2000 G shock without damage.

13.5 Recording System. The recording system must match the frequency response of the accelerometer and the entire recording system shall be flat ± 1 dB over a minimum frequency band of 5 to 3000 Hz.

13.6 Reference Plane. The standard headform, on which the basic plane is marked, shall be positioned on a flat surface so that the basic plane is parallel to this surface. The reference plane shall be scribed on the helmet after it has been positioned on the test head so that the lowermost part of the leading edge at at the front of the helmet is 2.36 inches (60 mm) above the basic plane.

Appendix

(This Appendix is not a part of American National Standard Specifications for Protective Headgear for Vehicular Users, Z90.1-1971, but is included for information purposes only.)

A1. Apex

The apex of a helmet shall be a point on the upper sagittal plane, equidistant from the anterior and posterior portions of the reference plane.

A2. Quadrant Identification

The four quadrants of a helmet or headform are those portions of the helmet or headform, above the reference plane, delineated by the sagittal plane and a plane perpendicular to both the sagittal and the reference planes and which would pass through the center of the external ear openings. These quadrants are numbered as follows: 1) right front; 2) right rear; 3) left rear; 4) left front.

A3. Point Locations

A particular point on a helmet or headform may be described by designating its distance from the apex (called "A") from the anterior or posterior points of intersection of the sagittal and reference planes (called "AS" or "PS"), and from the right or left intersection of the lateral and reference planes (called "RL" or "LL").

For example, the description, "A3.5, AS.4, RL.2.25" would designate a point 3 and 1/2 inches from the apex, 4 inches from the front intersection of the sagittal and reference planes, and 2 and 1/4 inches above the right intersection of the lateral and reference planes.

A4. Measurements

All measurements referred to in this Appendix are chord distances (that is, in a direct line, and may be measured with dividers or similar equipment).

American National Standards

The standard in this booklet is one of nearly 4[illegible]te, formerly the [illegible]pproved to date by the American National Standards Institute, formerly the USA Standards Institute.

The Standards Institute provides the machinery for creating voluntary standards. It serves to eliminate duplication of standards activities and to weld conflicting standards into single, nationally accepted standards under the designation "American National Standards."

Each standard represents general agreement among maker, seller, and user groups as to the best current practice with regard to some specific problem. Thus the completed standards cut across the whole fabric of production, distribution, and consumption of goods and services. American National Standards, by reason of Institute procedures, reflect a national consensus of manufacturers, consumers, and scientific, technical, and professional organizations, and governmental agencies. The completed standards are used widely by industry and commerce and often by municipal, state, and federal governments.

The Standards Institute, u[illegible]er whose auspices this work is being done, is the United States clearinghou[illegible]d coordinating body for standards activity on the national level. It is a federation of trade associations, technical societies, professional groups, and consumer organizations. Some 1,000 companies are affilioted with the Institute as company members.

The American National Standards Institute is the United States member of the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the Pan American Standards Commission (COPANT). Through these channels American industry makes its position felt on the international level. American National Standards are on file in the libraries of the national standards bodies of more than 50 countries.

— For a free list of all American National Standards, write:

American National Standards Institute, Inc

1430 Broadway New York, N. Y. 10018

A STUDY OF

IDAHO MOTORCYCLISTS

INJURED IN

1974 ACCIDENTS

COMPILED BY: STATE OF IDAHO
TRANSPORTATION DEPARTMENT
TRAFFIC SAFETY COMMISSION

JANUARY, 1976

IDAHO TRAFFIC SAFETY COMMISSION
STATEHOUSE
BOISE, IDAHO 83720

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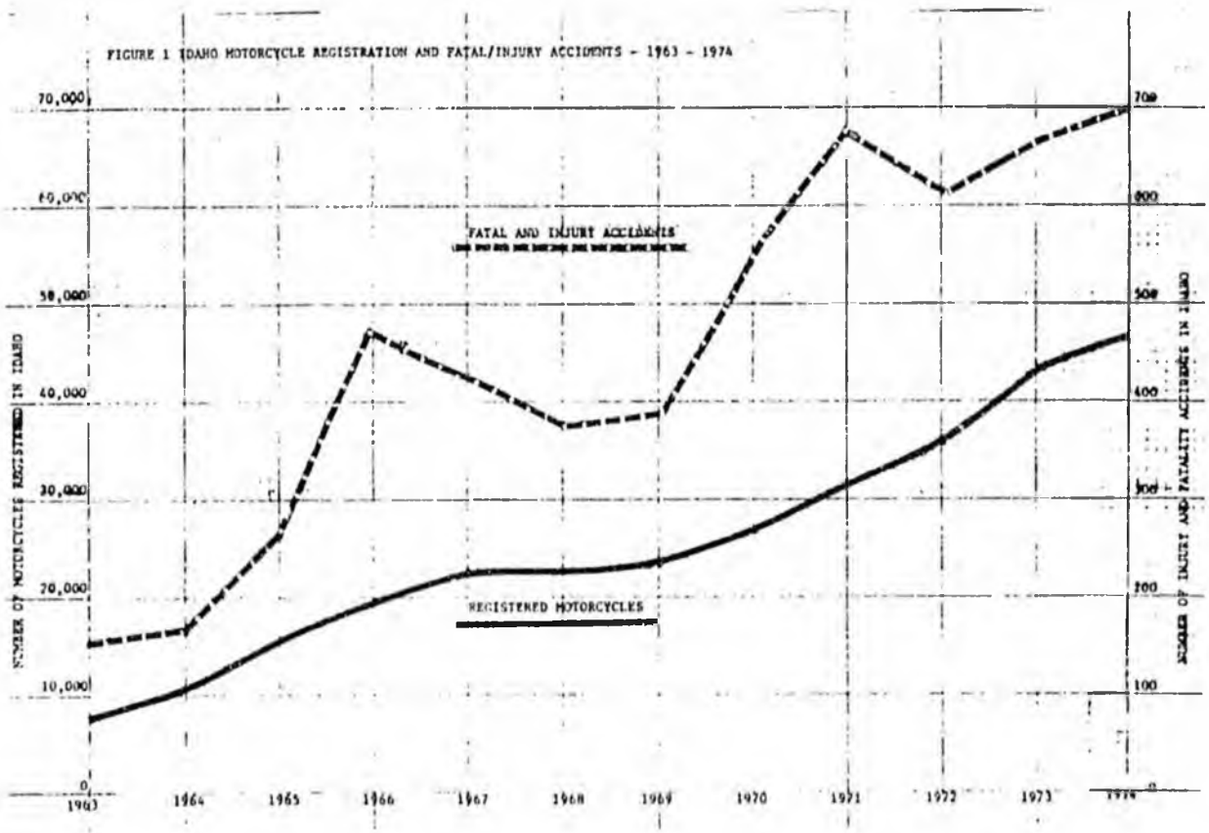
PREFACE

Idaho has experienced a tremendous increase in motorcycle activity in the past decade. This is reflected in the increased number of registered motorcycles and motorcycle accidents. During this period, the number of all registered motor vehicles approximately doubled, which in turn increased traffic density and exposure for Idaho motorcyclists. From 1963 to 1967, motorcycle registration trebled, then leveled off through 1969. From 1969 to 1974 the motorcycle population again doubled. During the leveling-off period there was a pronounced decline in motorcycle accidents followed by an increase as motorcycle registration rose in the seventies.



A mandatory helmet law was passed and effective January 1, 1968. It was in abeyance from August 1969 to May 1970 during a test for constitutionality. The law has been enforced since May 1970. Periodically, motorcycle groups have lobbied and demonstrated against the mandatory helmet law. While studies from other states tend to refute the arguments of spokesmen for opposition to the law, a need was indicated to determine experience and opinons of Idaho motorcyclists on the value of helmets, mandatory helmet law, and other related subjects.

INTRODUCTION

The population to be surveyed was defined as Idaho motorcyclists who had experienced a motorcycle injury accident in Idaho during 1974. Names, addresses, and injury severity codes were obtained from 1974 accident records. A total of 562 names were available for the survey. There were 260 individuals who had experienced injuries of severity code A (incapacitating injury), 225 people with injuries of severity B (non-incapacitating, evident injury), and 77 with injuries of severity C (non-evident, possible injury).

Responses to the survey are listed for each injury severity population with percentages based upon the number of respondents to the applicable item. Rounding of percentage figures to the tenth of a percent sometimes produces a total percentage slightly different from one hundred percent.

A survey form with a cover letter (Appendix A) and a stamped, self-addressed envelope were mailed to each of the 562 persons involved. Response results are shown in Table 1.

TABLE 1

SURVEY RESPONSE

NUMBER OF SURVEY FORMS	INJURY SEVERITY CODES			
	A	B	C	TOTAL
Mailed	260	225	77	562
Returned Undeliverable	18	4	2	24
Assumed Delivered	242	221	75	538
Response	91	74	28	193
Percent Response/Delivered	37.6%	33.5%	37.3%	35.9%

A more detailed discussion of the methodology, together with a critique of methodology and survey format, is available upon request from Idaho Traffic Safety Commission, Statehouse, Boise, Idaho 83720.

Information sought from the survey was in two categories - factual and opinion. Factual information was solicited on the first 12 items of the survey form (Appendix A) and opinion information was requested on the remainder of the items. Items 14 through 20 were deliberately written to encourage unanticipated comments.

The main object of the survey was to evaluate the common arguments of anti-helmet law advocates. Questions to be addressed were:

To what degree are anti-helmet law advocates representative of the Idaho motorcyclists who experienced an accident?
To what degree do helmets reduce injury?
To what degree do helmets aggravate injury?
To what degree and how do helmets contribute to accidents?
What is the distribution of head, neck and other injuries among helmet wearers who experienced an accident?

Secondary, but important purposes for the survey were:

Opinion polls on motorcycle related laws not in effect in Idaho
License law with requirements for:
a. Written exam
b. Off-road driving exam
c. Traffic driving exam
Eye protection law
Rear-view mirror law
Opinion poll on motorcycle training courses
Injury severity analysis by age and motorcycling experience
Medical costs and days lost by injury severity code
Annual motorcycle mileage

Another expected result of the survey was volunteered information. For this reason, no information was directly solicited on whether the helmet saved a life nor on the effect of automobile drivers in motorcycle accidents.

SUMMARY OF STUDY FINDINGS

This summary is for the benefit of those who are more interested in survey results than in detailed analysis. All findings are substantiated in the body of the study.

1. There were 7.67 motorcyclists strongly in support of the mandatory helmet law for every 1 strongly opposed to the law.

2. Of motorcyclists who commented on the mandatory helmet law, 77.3% were in favor of the law.

3. Of motorcyclists who wore helmets, 84.7% indicated that the helmet reduced injury and 8.7% voluntarily added that it saved their lives.

4. Neck injuries were very rare in the severity A (incapacitating) injuries.

5. Over half of the respondents were at least twenty years old.

6. Motorcyclists over 35 years old comprised 20.7% of the respondents.

7. A few motorcyclists (2.6%) had less than one month motorcycling experience, but 75.6% had more than one year motorcycling experience.

8. Analysis of medical costs and days lost by severity code indicates that the injury severity codes marked by investigating officers are accurate indications of injury severity.

9. The opinion survey was favorable to motorcycle licensing with written and traffic exams, but not favorable toward off-road driving exams.

10. The opinion survey was favorable toward motorcycle training courses, with reservations on funding and administration.

11. The opinion survey supported the importance of eye protection but was not favorable toward a law requiring full-time eye protection.

12. Annual motorcycle mileage estimates varied greatly with an average somewhere between 3500 and 4500 miles per year.

13. Single motorcycle accidents predominately occurred in rural areas during daylight hours, while motorcycle accidents involving a car or truck occurred mostly in urban areas during daylight hours.

14. There was a marked difference in urban and rural accidents by injury severity type. Over half of the A injury severity accidents occurred in rural areas, while B and C injury severity accidents occurred mostly in urban areas.

15. Automobile driver awareness of and courtesy toward motorcyclists was determined to be the primary single factor in motorcycle collisions.

MOTORCYCLE HELMETS

MANDATORY MOTORCYCLE HELMET LAW

ANALYSIS OF OPINION SURVEY

The opinion survey portion of the form consisted of open-end comments on laws concerning safety devices and on motorcycle training courses. Response to this method of questioning was varied with some respondents marking the subjects without comment. Only written comments were compiled for analysis. Comments were rated in four categories - strongly for, strongly against, mildly for, and mildly against. An example of comments on the helmet law follows:

Strongly Against	No Unconstitutional State has no right Morally wrong
Mildly Against	Shouldn't have to wear helmet Unnecessary Don't like it Other comments unfavorable
Strongly For	Yes A must Absolutely
Mildly For	Not opposed to concept of law, but favor certain exceptions. Examples: passengers in town, under certain speeds, in towns, in country.

TABLE 2

HELMET LAW OPINION SURVEY RESULTS BY INJURY SEVERITY AND PERCENTAGE

RATING	INJURY SEVERITY CODE			
	A (%)	B (%)	C (%)	TOTAL (%)
Strongly Against	7 (7.7)	6 (8.1)	2 (7.1)	15 (7.8)
Mildly Against	13 (14.3)	7 (9.5)	4 (14.3)	24 (12.4)
Mildly For	6 (6.6)	5 (6.8)	7 (25.0)	18 (9.3)
Strongly For	53 (58.2)	49 (66.2)	13 (46.4)	115 (59.6)
Not Stated	12 (13.8)	7 (9.5)	2 (7.1)	21 (10.9)
Total	91	74	28	193

TOTAL FOR 133 (77.3%)
TOTAL AGAINST 39 (22.7%)

Severity of injury does not seem to influence support for the law. Several comments indicated that the helmet was a necessity, but still opposed the law. Apparently, the advocates of helmet law repeal represent less than 8% of the accident-experienced motorcyclists.

RESPONSE ON MANDATORY MOTORCYCLE HELMET LAW BY AGE AND EXPERIENCE

Responses on the mandatory motorcycle helmet law were analyzed on the basis of age (under 20 vs. 20 and older) and motorcycling experience (less than three years vs. 3 years or more). Three years experience was used as the breaking point because those with less than three years experience had begun motorcycling after the helmet law was in full effect, so would presumably not resent the law quite as much as those who had been motorcycling before the law was in effect.

TABLE 3

RESPONSE ON MANDATORY MOTORCYCLE HELMET LAW BY AGE AND EXPERIENCE

	FOR	AGAINST	TOTAL
Total Population Who Commented on Law	133 (77.3%)	39 (22.7%)	172
Population Under 20 Years Old Who Commented on Law	67 (83.8%)	13 (16.3%)	80
Population 20 Years and Older Who Commented on Law	65 (73.0%)	24 (27.0%)	89
Population Under 3 Years Motorcycle Experience Who Commented on Law	62 (81.6%)	14 (18.4%)	76
Population With 3 Years or More Motorcycle Experience Who Commented on Law	68 (73.9%)	24 (26.1%)	92

Motorcyclists under 20 years of age showed a more favorable attitude toward the helmet law than did those 20 years and older.

Motorcyclists with less than three years experience showed a more favorable attitude toward the helmet law than did those who were already motorcycling when the law became effective. It should be noted that many of the motorcyclists with fewer years experience were also in the younger age group. However, it appears that opposition toward the helmet law is based to some extent in resentment toward a new law rather than the content of the law.

EFFECT OF HELMET ON SEVERITY OF ACCIDENT

One hundred and eighty-one respondents said they were wearing a safety helmet and ten said they were not. In answer to the opinion question on positive or negative effect of helmet, all but three helmet wearers gave their views.

TABLE 4

HELMET EFFECT - HELMET WORN, BY SEVERITY OF INJURY AND PERCENTAGE OF HELMET WEARERS

ANSWERS MARKED	INJURY SEVERITY CODE			
	A (%)	B (%)	C (%)	TOTAL (%)
Reduced Injury	79 (92.9)	57 (80.3)	19 (73.1)	155 (84.7)
Had No Effect	5 (5.9)	10 (14.1)	6 (23.1)	21 (11.5)
Aggravated Injury	0 (0.0)	2 (2.8)	3 (11.5)	5 (2.7)
Blank	1 (1.2)	2 (2.8)	0 (0.0)	3 (1.6)
Total	85	71	27 (26)*	184 (183)*

*One C injury severity respondent marked that the helmet reduced head injury but aggravated neck injury so the answer is logged for both. Lower numbers in parenthesis are base for percentages.

The question of helmets saving lives was not put on the survey form in order to avoid forcing the point. However, fourteen A injury severity and two B injury severity respondents, 8.7% of those wearing helmets, volunteered statements that the helmet saved their life.

It is apparent from the opinion survey on helmet safety value that not only do the majority of motorcyclists consider the helmet a valuable protective measure, but that appreciation of the helmet increases with accident severity.

HELMET CONTRIBUTING TO ACCIDENT

Eleven respondents indicated that the helmet may have contributed to the accident by interfering with vision, hearing, or both. There was no pattern to these accidents - four were in town with a car or truck, one was a single motorcycle in town, one was in a rural area with a car, one was in a rural area with another motorcycle, and two were single motorcycle in a rural area.

TABLE 5

INJURY ANALYSIS - PERCENTAGES ARE FOR INJURIES IN EACH CATEGORY

INJURY TO	INJURY SEVERITY CODE			
	A	B	C	TOTAL (%)
Head	31 (19.9)	12 (11.4)	1 (3.1)	44 (15.0)
Neck	3 (1.9)	6 (5.7)	6 (18.8)	15 (5.1)
Leg	61 (39.1)	47 (44.8)	16 (50.0)	124 (42.3)
Arm	36 (23.1)	26 (24.8)	5 (15.6)	67 (22.9)
Torso	19 (12.2)	12 (11.4)	4 (12.5)	35 (11.9)
Internal	6 (3.8)	2 (1.9)	0 (0.0)	8 (2.7)
Total	156	105	32	293

Of the fifteen respondents who indicated neck injuries, all marked that the helmet reduced injury, although one also marked that it aggravated neck

injury. Nine voted strongly for the helmet law, two voted mildly for, two voted mildly against, two abstained, and there were no votes strongly against the law.

TABLE 6

NECK INJURIES BY SEVERITY CODE
URBAN AND RURAL AND TYPE ACCIDENT

TYPE ACCIDENT	INJURY SEVERITY CODE			
	A	B	C	TOTAL
Urban				
Single Motorcycle	0	2	0	2
Motorcycle/Car (Truck)	1	3	5	9
Rural				
Single Motorcycle	2	1	0	3
Motorcycle/Car (Truck)	0	0	1	1

This data indicates that neck injuries from motorcycle-car/truck collisions are more prevalent in town, but a review of the 94 urban and 31 rural motorcycle-car/truck accidents (Table 21) indicates the percent incidence of neck injuries in urban areas to be 9.7%, and in rural areas to be 9.4%.

The low incidence of neck injuries does not support contentions that helmets generate neck injuries to the extent that their total safety value is cancelled or compromised.

HEAD INJURY EFFECT ON VALUE OF HELMET

Of the 31 A injury severity respondents who suffered head injuries, 25 were wearing helmets. Of these, 24 said that the helmet reduced injury and one said it had no effect. Of the 12 B injury severity respondents who suffered head injuries 10 were wearing helmets. Of these 9 said that the helmet reduced injury and one said that it aggravated injury. The one C injury severity who suffered head injury said that the helmet aggravated injury. The two respondents who stated that the helmet aggravated injury had only head injuries. The B injury severity respondent lost 3 days and had a medical expense of $550. The C injury respondent lost 1 day and had a medical expense of $75.

HELMET EFFECT - HELMET NOT WORN

Eight of the ten respondents who indicated that they were not wearing helmets suffered head injuries (6 A and 2 B severity) and they all indicated that the helmet would have reduced injury. Of the two non-helmeted motorcyclists without head injuries, the B severity respondent said that the helmet would have reduced injury and the C severity respondent said that the helmet would have aggravated injury.

MOTORCYCLE LICENSE LAW

The opinion survey on motorcycle license law was expanded to cover written examination, off-road driving examination, and traffic driving examination. There was general support for motorcyclist license law, with highly varied adaptations. This subject had the highest number of abstaining respondents.

MOTORCYCLE LICENSE LAW OPINION SURVEY
RESULTS BY INJURY SEVERITY AND PERCENTAGE

TABLE 7

WRITTEN EXAMINATION	INJURY SEVERITY CODE			
	A (%)	B (%)	C (%)	TOTAL
Strongly Against	11 (12.1)	10 (13.5)	5 (17.9)	26 (13.5)
Mildly Against	5 (5.5)	9 (12.2)	2 (7.1)	16 (8.3)
Mildly For	8 (8.8)	12 (16.2)	3 (10.7)	23 (11.9)
Strongly For	25 (27.5)	20 (27.0)	6 (21.4)	51 (26.4)
Not Stated	42 (46.2)	23 (31.1)	12 (42.9)	77 (39.9)
Total	91	74	28	193

TOTAL FOR 74 (63.8%)
TOTAL AGAINST 42 (36.2%)

Of the three examinations listed on the survey form, the written examination received the least opposition, although many felt that the regular driver's written examination was adequate. There were additional comments to the effect that answering questions doesn't prove driving ability and that the driver's written examination should have questions on it about rights of the motorcyclist in traffic.

TABLE 8

OFF-ROAD DRIVING EXAM	INJURY SEVERITY CODE			
	A (%)	B (%)	C (%)	TOTAL (%)
Strongly Against	20 (22.0)	18 (24.3)	7 (25.0)	45 (23.3)
Mildly Against	6 (6.6)	15 (20.3)	4 (14.3)	25 (13.0)
Mildly For	5 (5.5)	6 (8.1)	2 (7.1)	13 (6.7)
Strongly For	9 (9.9)	9 (12.2)	3 (10.7)	21 (10.9)
Not Stated	51 (56.0)	26 (35.1)	12 (42.9)	89 (46.1)
Total	91	74	28	193

TOTAL FOR 34 (32.7%)
TOTAL AGAINST 70 (67.3%)

The high opposition to the off-road driving examination is significant. There were favorable comments on off-road experience as an aid in defensive driving such as 'laying down' a motorcycle to avoid collision in traffic.

Another indication of the effect of off-road driving was the number of respondents who indicated they had been driving motorcycles since an early age. There were 31 whose age and driving experience indicated that they had started riding a motorcycle at ages ranging from 6 to 13. It is probable that the off-road experience on smaller motorcycles at an early age is good preparation for later traffic driving.

TABLE 9

TRAFFIC DRIVING EXAM

DRIVING EXAM	INJURY SEVERITY CODE			
	A (%)	B (%)	C (%)	TOTAL (%)
Strongly Against	9 (9.9)	14 (18.9)	5 (17.9)	28 (14.5)
Mildly Against	4 (4.4)	6 (8.1)	2 (7.1)	12 (6.2)
Mildly For	7 (7.7)	10 (13.5)	2 (7.1)	19 (9.8)
Strongly For	28 (30.8)	19 (25.7)	5 (17.9)	52 (26.9)
Not Stated	43 (47.3)	25 (33.8)	14 (50.0)	82 (42.5)
Total	91	74	28	193

TOTAL FOR 71 (64%)
TOTAL AGAINST 40 (36%)

Of the three examinations listed on the survey form, the traffic driving examination received the most support, with the general reservation that it should apply only to newly licensed motorcyclists.

EYE PROTECTION LAW

TABLE 10

EYE PROTECTION REQUIRED BY LAW OPINION SURVEY
RESULTS BY INJURY SEVERITY AND PERCENTAGE

EYE PROTECTION	INJURY SEVERITY CODE			
	A (%)	B (%)	C (%)	TOTAL (%)
Strongly Against	19 (20.9)	17 (23.0)	4 (14.3)	40 (20.7)
Mildly Against	15 (16.5)	17 (23.0)	7 (25.0)	39 (20.2)
Mildly For	6 (6.6)	6 (8.1)	3 (10.7)	15 (7.8)
Strongly For	24 (26.4	18 (24.3)	7 (25.0)	49 (25.4)
Not Stated	27 (29.7)	16 (21.6)	7 (25.0)	50 (25.9)
Total	91	74	28	193

TOTAL FOR 79 (55.2%)
TOTAL AGAINST 64 (44.8%)

The results of the opinion survey on eye protection indicate an unfavorable response to eye protection required by law. The general feeling was that motorcyclists will gladly use eye protection at higher speeds to reduce wind

irritation and the obvious hazard from bugs and dust, but would rather have a choice in urban traffic. The main adverse opinion on mandatory eye protection was that the value of the eye protection is greatly overshadowed in an urban traffic environment by the reduction in visibility. Glare and weather combined with visors create a visibility hazard. It appears that the great majority favor eye protection, but would not support a law making it mandatory at all times.

REAR VIEW MIRROR LAW

TABLE 11

REAR VIEW MIRROR REQUIRED BY LAW OPINION SURVEY
RESULTS BY INJURY SEVERITY AND PERCENTAGE

MIRROR	INJURY SEVERITY CODE			
	A (%)	B (%)	C (%)	TOTAL
Strongly Against	5 (5.5)	9 (12.2)	3 (10.7)	17 (8.8)
Mildly Against	5 (5.5)	7 (9.5)	5 (17.9)	17 (8.8)
Mildly For	17 (18.7)	11 (14.9)	2 (7.1)	30 (15.5)
Strongly For	41 (45.1)	37 (50.0)	14 (50.0)	92 (47.7)
Not Stated	23 (25.3)	10 (13.5)	4 (14.3)	37 (19.2)
	91	74	28	193

TOTAL FOR 122 (78.2%)
TOTAL AGAINST 34 (21.8%)

The opinions in the survey on rear view mirrors required by law were highly favorable for legislation. Those respondents who qualified their support to exclude off-road motorcycles were marked as 'mildly for', since they were strongly for the law for on road vehicles. It is probable that many of the negative votes were tied to off-road considerations.

MOTORCYCLE TRAINING COURSES

TABLE 12

MOTORCYCLE TRAINING COURSES OPINION SURVEY
RESULTS BY INJURY SEVERITY AND PERCENTAGE

TRAINING	INJURY SEVERITY CODE			
	A (%)	B (%)	C (%)	TOTAL (%)
Strongly Against	13 (14.3)	10 (13.5)	7 (25.0	30 (15.5)
Mildly Against	11 (12.1)	21 (28.4)	3 (10.7)	35 (18.1)
Mildly For	20 (22.0)	20 (27.0)	7 (25.0)	47 (24.4)
Strongly For	21 (23.1)	8 (10.8)	4 (14.3)	33 (17.1)
Not Stated	26 (28.6)	15 (20.3)	7 (25.0)	48 (24.9)
Total	91	74	28	193

TOTAL FOR 80 (55.2%)
TOTAL AGAINST 65 (44.8%)

The opinion survey on motorcycle training courses showed a slightly favorable response toward the training. The main reason for the even spread of opinion was probably due to the open comment format. Many responses were qualified on the subject of who would conduct the training, and whether it should be required of experienced drivers. There was some reaction that indicated unfavorable feeling toward a law requiring the training, but the general opinion was favorable to including motorcycle training in the driver education courses in schools.

Only seven respondents indicated that they had taken motorcycle training courses, and five of those supported the training (two abstained).

There was very definite support for the value of training of some sort before exposure to traffic. Suggestions ranged from formal training to buddy system checkout. There was general rapport on the theme that the motorcycle is different and more dangerous than an automobile.

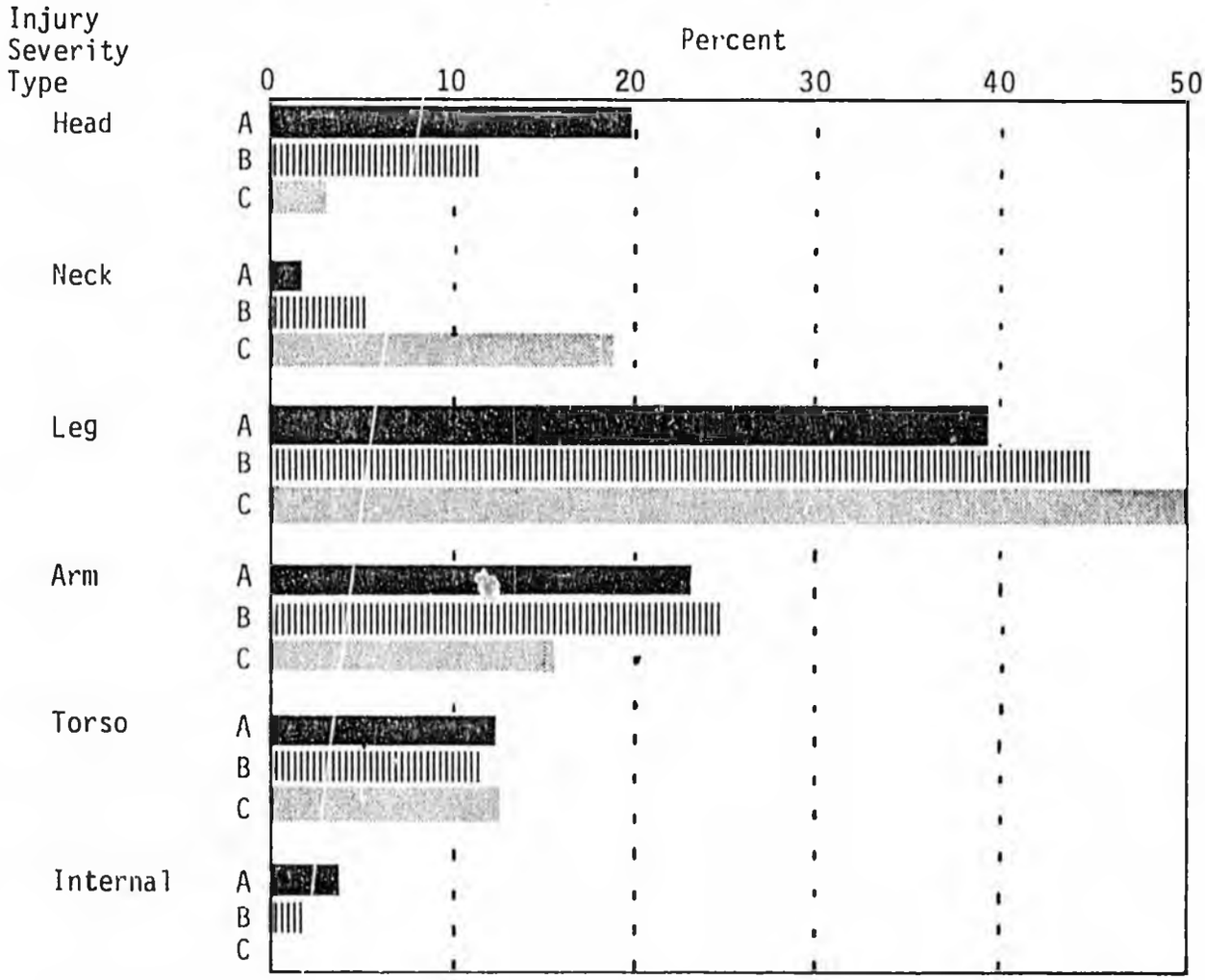
INJURY ANALYSIS

INJURY TYPE

The percentage comparison in type injury with severity code is shown in Figure 2. Leg injuries dominate all three categories of injury severity, with arm injuries holding second on A and B injury severity, and ranking third on C injury severity. Head and internal injuries dropped in lower severity injuries. Neck injuries were of lowest incidence on high severity injuries, rising next to the top of lowest severity injuries. Torso injuries held about the same relative position on all injury severities.

Figure 2

Relative Incidence of Type Injury
for Severity Codes A, B & C



AGE DISTRIBUTION

TABLE 13

AGE DISTRIBUTION BY SEVERITY OF INJURY AND PERCENTAGE

AGE	INJURY SEVERITY CODE					
	A (%)	B (%)	C (%)	TOTAL	NEB%[a]	ID%[b]
15 or less	11 (12.1)	14 (18.9)	6 (21.4)	31 (16.1)	5.8	12.1
16	7 (7.7)	11 (14.9)	4 (14.3)	22 (11.4)	8.3	10.6
17	8 (8.8)	6 (8.1)	4 (14.3)	18 (9.3)	9.1	8.0
18	5 (5.5)	3 (4.1)	3 (10.7)	11 (5.7)		7.9
					18.4*	
19	7 (7.7)	0 (0.0)	1 (3.8)	8 (4.1)		7.1
20-24	16 (17.6)	15 (20.3)	5 (17.9)	36 (18.7)	30.1	23.2
25-34	14 (15.9)	9 (12.2)	2 (7.1)	25 (13.0)	18.9	16.6
35 or more	21 (23.1)	16 (21.7)	3 (10.7)	40 (20.7)	8.4	11.2
Blank	2 (2.2)	0 (0.0)	0 (0.0)	2 (1.0)	1.0	3.4
Total	91	74	28	193		

a. Age distribution of 1150 motorcyclists surveyed in 1974 Nebraska study.[2]
b. Age distribution of all motorcycle injured for Idaho 1974.
* Nebraska study combined 18 and 19 year old data.

The age groups under 18 and 35 or older were apparently slightly more responsive to the survey than were those from 18 to 35 years old. Considering the difference in population being compared (Idaho survey respondents against total Idaho and Nebraska motorcycle injured) it becomes highly probable that the respondents represented a good sample of the injured population.

The higher percentage involvement of Idaho pre-16 year old motorcyclists, as compared to Nebraska, might be related to the Nebraska requirement that motorcyclists younger than 16 years old must be accompanied by a licensed motorcyclist on another motorcycle. Idaho law exempts motorcycles from this restriction.

Teenage respondents comprised 46.6% of the survey respondents and 45.7% of total Idaho 1974 motorcycle injured. Teenage drivers comprised only 26.3% of the drivers in all of the Idaho 1974 injury accidents. This indicates that teenagers have a greater percentage involvement in motorcycle accidents than in all motor vehicle accidents.

It is significant that over half of the motorcyclists in the survey respondents and for both the Idaho and the Nebraska surveys were over twenty years old.

Analysis of age and experience indicates that the age at which the motorcyclists started motorcycling varied from 5 to 56 years. Those who indicated that they started motorcycling at 20 or older compri d 29.6% of the respondents, while teenage beginners accounted for 55.6%.

Pre-teenager beginning motorcyclists made up 14.8% of the respondents. These were presumably off-road cyclists prior to the age of fourteen. This indicates that a large section of the teenage drivers today have developed experience and expertise in handling motorcycles prior to licensing age.

MOTORCYCLIST EXPERIENCE DISTRIBUTION

TABLE 14

DISTRIBUTION OF EXPERIENCE BY INJURY SEVERITY AND PERCENTAGE

EXPERIENCE (Months)	INJURY SEVERITY CODE				
	A (%)	B (%)	C (%)	TOTAL (%)	NEB%[a]
1 or less*	2 (2.2)	3 (4.1)	0 (0.0)	5 (2.6)	3%
1 - 3	1 (1.1)	3 (4.1)	1 (3.6)	5 (2.6)	9%
3 - 6	6 (6.6)	4 (5.4)	2 (7.1)	12 (6.2)	8%
6 - 12	5 (5.5)	10 (13.5)	7 (25.0)	22 (11.4)	12%
12 - 36	22 (24.2)	18 (24.3)	10 (35.7)	50 (25.9)	33%
Over 36	52 (57.2)	36 (48.6)	8 (28.6)	96 (49.7)	34%
Not Stated	3 (3.3)	0 (0.0)	0 (0.0)	3 (1.6)	1%
	91	74	28	193	

*Of the respondents with one month or less motorcycle experience, the A injury severity riders were on the second and sixth ride, and the B injury severity riders were on the first, twentieth, and fiftieth rides.

aPercentage distribution of 481 respondents in the Nebraska study.

TABLE 15

RANGE, MEDIAN, AND MEAN EXPERIENCE BY SEVERITY CODE (YEARS)

	INJURY SEVERITY CODE (SAMPLE SIZE)			
	A (88)	B (74)	C (28)	TOTAL (190)
Range	.08-35	.08-31	.17-9	.08-35
Median	3.0	2.5	2.0	3.0
Mean	5.19	4.9	2.64	3.8

It is apparent from analysis of experience distribution that injury severity is not related to motorcyclist experience. In both the Idaho and Nebraska studies, the percentage of 1 month or less and less than 6 months experience is roughly identical. There is no data on experience level of all Idaho motorcyclists available for comparison.

ESTIMATED MEDICAL COSTS

TABLE 16

ESTIMATED MEDICAL COST BY INJURY SEVERITY CODE
AND PROJECTIONS FOR TOTAL 1974 IDAHO MOTORCYCLE INJURED

	INJURY SEVERITY CODE (SAMPLE SIZE)			
	A (87)	B (73)	C (25)	TOTAL (185)
Range	$0-25,000	$0-10,000	$0-4,000	$0-25,000
Median	$ 1,000	$ 100	$ 60	$ 200
Mean	$ 2,581	$ 645	283	$ 1,503
Total	$ 224,610	$ 47,133	$ 7,371	$ 279,114
Projected Total of 562 Injured*	$ 671,248	$ 145,273	$ 22,702	$ 839,223

*Projection is computed by dividing total cost for each injury severity code by sample size and multiplying by population surveyed. Thus, total cost for A severity injuries ($224,610) is divided by sample size (87) and multiplied by survey size (260) to obtain projected total for 1974 Idaho severity code A injuries from motorcycle accidents ($671,248). The three injury severity code projections are then added for the projected total medical cost for the 562 injured who were surveyed.

ESTIMATED DAYS LOST

TABLE 17

DAYS LOST (FROM WORK OR SCHOOL) BY INJURY SEVERITY CODE
AND PROJECTION FOR TOTAL 1974 IDAHO MOTORCYCLE INJURED

	A (88)	B (73)	C (24)	TOTAL (185)
Range	0-510	0-478	0-180	0-510
Median	30	3	1	7
Mean	67.3	32.3	13.2	46.5
Total	5,919	2,361	316	8,596
Projected Total*	17,488	7,277	1,013	25,778

*Projected totals for each injury severity group are computed in the same manner as for medical costs. The three groups are then added to get projected total days lost for the 562 injured who were surveyed.

A secondary purpose of the survey was to obtain a general evaluation of the accuracy of the injury severity codes as marked by the investigating officer. It is evident from comparison of the ranges, medians, and means for medical costs and days lost that there is a high degree of accuracy. There were few anomalies present. Two A injury severity respondents and seven B injury severity respondents reported no medical costs plus no days lost due to the accident.

A further indication of the accuracy of the injury severity reporting can be seen by studying economic costs.

ECONOMIC COST

Economic costs are based upon cost for medical services, damage to property, and days lost from work. They do not include other societal costs such as suffering, community services lost, and cost to employer for replacement training. In view of the higher proportion of persons over 20 years old in injury severity categories A and B, an arbitrary dollar equivalent for a lost day wage was set as $50 while the C injury severity lost day cost was set as $30.

The projected values for the 562 in the surveyed population from Tables 17 and 18 were used, plus the average motorcycle damage costs for each category to arrive at an estimated economic cost to Idaho injured motorcyclists in 1974.

TABLE 18

ESTIMATED ECONOMIC COST BY INJURY SEVERITY CODE
FOR IDAHO INJURED MOTORCYCLISTS IN 1974

COST SOURCE	INJURY SEVERITY CODE			
	A	B	C	
Medical Expense	$ 671,248	$145,273	$22,702	$ 839,223
Wages Lost Expense	$ 874,400	$363,850	$30,390	$1,268,640
Motorcycle Damage	$ 120,453	$ 70,187	$24,516	$ 215,156
Total Economic Cost	$1,666,101	$579,310	$77,608	$2,323,019

TABLE 19

COMPARISON OF ECONOMIC COST PER INJURY -
IDAHO INJURED MOTORCYCLIST ESTIMATED ECONOMIC
COSTS AND NATIONAL SAFETY COUNCIL ESTIMATES FOR 1974

ESTIMATES	INJURY SEVERITY CODE		
	A	B	C
Idaho Estimates	$6,408	$2,575	$1,008
National Safety Council	$9,230	$3,030	$1,130

These two groups of figures should be compared with some reservation, since they do not represent identical situations. However, the similar rates of progression of cost with increased injury severity is an indication that the injury severity coding by accident investigators in Idaho is highly accurate.

It should be noted that this comparison is with the National Safety Council estimate economic costs for all motor vehicle accident injuries. Another

consideration is that two A injury severity and one B injury severity respondents reported themselves as still unable to work, and that one A injury severity and one B injury severity respondent reported expecting additional medical costs in the future. A third consideration is that the National Safety Council economic costs include insurance administration costs. In spite of some differences in the source of data, the comparison of the National Safety Council economic costs for the injury severity categories with the survey results further confirms the accuracy of injury severity coding by investigating officers.

ANNUAL MOTORCYCLE MILEAGE

Respondents who had been driving one year or more were asked to estimate their annual motorcycle mileage. This was a rough estimate, as evidenced by the multiple modes at 1,000, 2,000, 2,500, 3,000, 4,000 and 5,000 miles. The analysis of the distribution follows: (Sample size was 147)

TABLE 20

DISTRIBUTION OF MOTORCYCLE ANNUAL MILEAGE BY SEVERITY CODE

	INJURY SEVERITY CODE			
	A	B	C	TOTAL
Range	150-50,000	10-20,000	10-37,700	10-50,000
Median	2,500	3,500	2,000	2,500
Mean	4,850	4,121	4,763	4,561

Some estimates for annual mileage were unusually high and the possibility exists that some motorcyclists put down their total mileage for a period of years. For this reason, the central 90% of the mileage estimates were analyzed with the following results.

Range (90%)	250-15,000
Median (90%)	2,500
Mean (90%)	3,451

It is probable that the true average annual motorcycle mileage is between 3,500 and 4,500.

ACCIDENT ANALYSIS

TABLE 21

ACCIDENT TYPE BY SEVERITY, CODE, LOCATION, AND LIGHT CONDITIONS

ACCIDENT TYPE	INJURY SEVERITY CODE			
	A	B	C	TOTAL
SINGLE MOTORCYCLE				
Urban Daylight	3	3	0	6
Dawn/Dusk	1	2	0	3
Night	3	1	1	5
Rural Daylight	15*	9	1	25
Dawn/Dusk	4	1	0	5
Night	1	1	0	2

*One was run off road by car

ACCIDENT TYPE	INJURY SEVERITY CODE			
	A	B	C	TOTAL
MOTORCYCLE/MOTORCYCLE				
Urban Daylight	0	3	0	3
Dawn/Dusk	0	0	0	0
Night	0	0	0	0
Rural Daylight	1	1	0	2
Dawn/Dusk	2	0	0	2
Night	1	0	0	1

ACCIDENT TYPE	INJURY SEVERITY CODE			
	A	B	C	TOTAL
MOTORCYCLE/CAR-TRUCK				
Urban Daylight	25	34	13	72
Dawn/Dusk	4	4	4	12
Night	4	3	3	10
Rural Daylight	15	6	1	22
Dawn/Duck	5	2	1	8
Night	0	1	1	2

ACCIDENT TYPE	INJURY SEVERITY CODE			
	A	B	C	TOTAL
OTHER				
Urban Daylight	1	1*	0	2
Dawn/Dusk	0	0	0	0
Night	0	0	0	0
Rural Daylight	3*	2*	0	5
Dawn/Dusk	1*	0	0	1
Night	0	0	0	0

*One involved dog

Single motorcycle accidents in rural environments produce the highest ratio of A severity injuries. However, the urban area motorcycle collisions with cars or trucks are the primary source of motorcycle accident injuries of all injury severity categories, especially in daylight conditions. Factors that effect the motorcycle/automobile urban area daylight accidents are traffic density, visibility of the motorcyclists, awareness of automobile drivers, courtesy toward motorcycles, and the ability of the motorcyclists to weave through traffic and position themselves quickly and unexpectedly into blind spots.

It is apparent that C injury severity accidents are predominately in urban areas but it may be assumed that a high proportion of C injury severity accidents, and probably many B injury severity accidents, occur in rural areas but are un-reported.

TABLE 22

DISTRIBUTION OF URBAN AND RURAL ACCIDENTS
BY SEVERITY CODE AND PERCENTAGE

LOCATION	INJURY SEVERITY CODE			
	A	B	C	TOTAL
Urban	41 (45.1)	51 (68.9)	22 (78.6)	114 (59.1)
Rural	49 (54.8)	23 (31.1)	4 (31.1)	76 (39.4)
Not Stated	1	0 (0.0)	2 (7.1)	3 (1.6)

Rural accidents made up the highest percentage of A injury severity accidents, while urban accidents dominated the B and C injury severity population. Once again, it may be assumed that many C injury severity and some B injury severity accidents in rural areas are un-reported.

ADDITIONAL COMMENTS VOLUNTEERED

Respondents put additional comments on survey forms which they personally considered important enough to voluntarily submit. Some of the areas, such as automobile contribution to the accident and automobile drivers' attitudes, were deliberately omitted from the form to avoid forcing answers. Other areas were not considered when the survey form was designed.

COMMENT SUBJECT	NUMBER OF COMMENTS INJURY SEVERITY CODE			
	A	B	C	TOTAL
Automobile drivers are unaware of motorcycles, don't look, don't see them	13	16	4	33
Automobile drivers are aware of motorcycles, but ignore them, don't show courtesy, don't give right-of-way	12	5	3	20
Other vehicle was at fault	6	4	4	14
Road conditions, gravel, rocks, street barricades caused accident	1	3	0	4
Visibility of motorcyclists, light law, pennants bright clothing needed	3	8	0	11
Dog caused accident	2	2	0	4
Police bias against motorcyclists in accident investigation and in giving more tickets to motorcyclists. Extra insurance premiums because of higher exposure to traffic tickets	2	3	0	5
Motorcycle laydown ability valuable	3	2	0	5
Through with motorcycle in traffic	2	2	0	4
Motorcycle license rated for CC	1	1	0	2
Importance of body protection besides head	1	1	0	2
Motorcycle inspection law needed and enforced (Idaho law covers motorcycle inspection)	1	1	0	2

OBSERVATIONS AND RECOMMENDATIONS

MOTORCYCLE HELMET LAW

The overwhelming response in favor of the mandatory motorcycle helmet law yields the solid conclusion that advocates of repeal of the motorcycle helmet law are definitely not representing the accident experienced motorcyclists and very probably not speaking for the motorcycling public.

The question of constitutionality has passed the test of the United States Supreme Court so it would be presumptuous to address it in this study. There is little doubt about the high popularity of the law among the motorcycling public and especially the accident experienced segment.

MOTORCYCLE HELMETS

The results of the survey relating to the value of motorcycle helmets support the conclusions that helmets do save lives and reduce injury severity, that helmets have very little influence on increasing danger of neck injury, and that helmets seldom reduce hearing or vision to the point where they are an accident cause or even contributor. There is still room for improvement in helmet design in areas of weight, acoustics, and visibility. Studies by the National Highway Traffic Safety Administration have found that full coverage helmets (the most common in use) provide less than 3% lateral vision restriction from unhelmeted vision, and that a helmeted motorcyclist can hear a sound of interest as well as the driver of an automobile with the windows closed.[3,4] This problem is recognized at the national level and continual research is underway, so no local recommendation is offered in this study.

NECK INJURIES

Although the early motorcycle helmets might have provided some substance for the arguments on hazards of the helmet, the analysis of helmet effect on accidents and injury severity identifies these arguments as persistent myths. On the basis of the very few neck injuries, primarily in the minor non-incapacitating or non-evident injury accidents, a logical conclusion is that when helmeted motorcyclists acquired neck injuries, it is highly probable that the helmets prevented much more severe head injuries.

MOTORCYCLIST LICENSE

The motorcycle operator license law was generally well-received by the survey respondents with mixed reaction to license requirements. A rough summation of opinion is that a traffic driving test should be included for all initial licenses, but not for experienced motorcyclists. There is an indication that the present motor vehicle operator written examination, with motorcycle subjects included, would suffice for the written exam.

RECOMMENDATION 1 - The present Idaho motor vehicle operator and chauffeur written examinations should be analyzed to determine if motorcycle courtesy and motorcycle operation coverage can be enhanced by additions or changes in the questions.

EYE PROTECTION LAW

The main feature of the opinion survey results on eye protection required by law is that the total number against outnumbered those for the law. There was virtual unanimity on the value of eye protection on the open road due to danger from insects and other objects and also discomfort from wind blast. The respondents who were mildly against the law indicated this was mainly because they felt that individual judgment and circumstances should dictate use of glasses or visors in dense traffic, inclement weather and glare conditions. While it is possible to receive an injury from spun gravel or cinders in city traffic, it is unlikely that a serious accident would ensue. At road speeds, an injury to the eye could very easily cause a serious accident.

Only one respondent indicated receiving an eye injury from a single motorcycle accident caused by a blown tire. There was no case specified where an injury to the eye contributed to the accident. It is highly probable that most Idaho motorcyclists are using eye protection for comfort and safety, at least at higher speeds.

The Wisconsin study showed 95% of the 500 surveyed motorcyclists favored eye protection, but the question of mandatory full-time eye protection was not addressed. At the time of the survey Wisconsin had a law in effect that required a visor or glasses be worn at all times unless a windshield extended fifteen inches above the handlebars. This law allows motorcyclists, who do not want to use glasses or visors, the option of using a windshield.[5]

RECOMMENDATION 2 - An observation study of eye protection use by motorcyclists in various environments should be conducted to determine the extent of requirement for eye protection legislation.

REAR VIEW MIRROR LAW

The opinion survey on rear view mirrors required by law was highly favorable toward the law. Opposition, besides those who didn't want laws of any kind, was mainly due to resistance to rear view mirrors on off-road motorcycles. There was no indication from any respondent that rear view mirrors inflicted injuries in any accident. There was a low incidence of torso and internal injuries, and if the mirrors were causing injury there would have been a higher incidence.

RECOMMENDATION 3 - A count of motorcycles without rear view mirrors should be included in the observation surveys in Recommendation 2.

MOTORCYCLE TRAINING COURSES

There was general rapport that the motorcycle is different from the automobile, more difficult to drive, more dangerous, and that some form of initial training is essential. There was some unfavorable reaction toward a law requiring a motorcycle course, with comments on the bureaucracy involved.

There was general support for including motorcycle training in the high school driver education curriculum. Idaho high school driver education courses cover motorcycle safety and some schools offer on-cycle training on an optional basis.

A statewide system of motorcycle training is needed, but present resources do not allow for it. Possible instructor resources, besides present school and private driver education instructors are motorcycle dealers. Some dealers already offer instruction. Another source for the actual motorcycle driving instruction is the large body of capable, experienced Idaho motorcyclists. A thorough certification and monitoring program, supported by instructor certification fees, could produce a cadre of instructors to augment the on-cycle training, testing, and motorcycle certification of the motorcyclists. Students would pay for the training, which would reimburse the instructors for their certification fees and effort. In this way the private sector could participate and the expense of the motorcycle training and administration would be borne by those receiving the training. The cost of the motorcycle training would probably not exceed the cost of damage to the motorcycle alone from an accident.

RECOMMENDATION 4 - A feasibility study should be made of the resources available for motorcycle training and certification, and an analysis of costs and procedures for a self-supporting program developed.

INJURY ANALYSIS BY AGE AND EXPERIENCE

Over half of the respondents were over twenty years old. Fifty-seven percent of those thirty years old or older had been motorcycling five years or less. This indicates that we can expect some additions to Idaho motorcyclists to be from the older population in the future. Fuel economy considerations may cause more families to choose a motorcycle rather than a second automobile. While it can be surmised that an older beginning motorcyclist would seek out motorcycle training of some sort, it is apparent that motorcycle training requirements for motorcycle licensing should not be limited to the young.

It is also apparent that public information efforts toward motorcyclist safety must be designed with both teen-age and older motorcyclists in mind.

RECOMMENDATION 5 - Public information efforts toward motorcyclist safety should be conducted with older motorcyclists in mind as well as teen-agers.

ECONOMIC COST ESTIMATES

While the projected total economic cost for all Idahoans injured in 1974 motorcycle accidents ($2,323,019) may be viewed with some reservation, the costs indicated by the respondents alone is impressive. The apparently fine representation of the sample responding indicates that the projected estimate is reasonably accurate. Motorcycle injuries, like other injuries are both very painful and expensive.

MOTORCYCLE ANNUAL MILEAGE

Annual mileage estimates were solicited as a means of determining the average annual motorcycle mileage in Idaho. Results showed extreme ranges with an average of 4,561 miles per year. The average of the central 90% was 3,451 (eliminating the high and low 5%). It is probable that the true average lies somewhere between those values.

Vehicle miles is the main denominator for accident rate comparisons since it relates to exposure slightly better than population, number of registered vehicles, or number of licensed drivers. With the increase of motorcycles, small economy vehicles, and alternate fuels, gasoline consumption will become even less reliable as a cross check on vehicle miles deduced from traffic counts. Other methods of checking on vehicle mileage statistical estimates should be developed.

RECOMMENDATION 6 A study should be made at the national level on alternate methods of measuring vehicle miles and on alternate accident, fatality, and injury rate exposure denominators for interstate comparison and goals.

ACCIDENT ANALYSIS

An obvious conclusion that can be drawn from the survey responses is that motorcycles are more dangerous in many ways than automobiles. Many of the injuries would have been eliminated or minimized had the victim been protected by an automobile frame. Several accidents were due to road conditions and dogs that undoubtedly would not have even caused an accident to a more stable and protected vehicle. We have no way of knowing, of course, just how many accidents were avoided by the superior maneuverability of the motorcycle. The susceptability of the motorcycle to accidents and the high probability of injury to the motorcyclists still stands out.

The high incidence of motorcycle collisions with four wheel motor vehicles, especially in urban areas, is worth noting. Factors that impact these collisions are mainly traffic density, awareness of four wheel vehicle operators, courtesy toward motorcyclists, motorcycle visibility, and the ability of motorcyclists to maneuver quickly and unexpectedly into blind spots.

Motorcyclists should be aware of the value of high visibility. Headlights on in the daytime, bright motorcycle colors and clothing, and even bicycle-type pennants will increase their visibility. In many cases, a few seconds earlier notice could prevent accidents.

Other vehicle drivers must be aware of the motorcylists problems and keep a special watch out for them, as well as for other vehicles and pedestrians. Courtesy in honoring motorcyclists right-of-way would also reduce accidents. Traffic density is still on the increase in Idaho and is a general problem to be addressed with improved roadways, law enforcement, alternative means of travel, and public education, to cite a very few. The other factors, being based upon human behavior, lend themselves well to increased public information efforts.

RECOMMENDATION 7 - A public information program should be designed to stress motorcycle visibility, driver awareness of motorcyclist rights and problems, and motorcycle defensive driving. (This is not to exclude other problems. For example, a billboard stressing motorcycle visibility could include pedacyclist, pedestrian and even small car visibility.) Human interest news coverage of victims whose life patterns were severely altered as a result of motorcycle injuries could be very effective. Since these factors are common to all states, this program should be implemented with the national safety effort.

ADDITIONAL COMMENTS

The additional comments were listed on the assumption that they might have value since the respondents took the time and effort to volunteer them. The high incidence of involvement of other vehicle drivers as factors in accidents is significant and points out a driver attitude and motorcycle visibility problem.

The small number of motorcycle injury victims who indicated that they were through with motorcycling, especially in traffic, is significant. Several respondents were obviously not going to be motorcycling for a while due to injuries and still others may have quit motorcycling but didn't volunteer the information. Even so, the large number who apparently continued motorcycling after the accident indicates the obvious attraction of motorcycling and the estimated future growth of motorcyclists in the driving population.

Some complaints of motorcyclists indicate that they feel that motorcycles are too often viewed as an eccentric fad in transportation by other drivers, law enforcement officers, roadway and traffic sign designers, and the general public. Insurance costs due to increased exposure of motorcyclists to traffic citations are also an irritant.

In view of increasing traffic congestion, parking problems, fuel economy, and overall cost per mile of operation, motorcycles can be expected to play an increased role in Idaho transportation, and this role should be accepted and welcomed by everyone involved in transportation.

RECOMMENDATION 8 - The unique nature of motorcycles and the problems of motorcyclists should be given increased consideration in all traffic planning and roadway design.

FINAL OBSERVATIONS

The thirty-five percent response that was achieved in this survey is far better than most mail surveys could expect, but this was to a universe especially selected for presumed interest in the subject matter. All projections in this study onto populations other than the 193 respondents must be accepted with the realization that 345 similarly experienced motorcyclists did not respond. There is always the possibility that resentment to authority or repression of a traumatic accident memory may have influenced some to decline response. Indifference must account for much of the response lack The reasons why people fail to respond to mail surveys are beyond the scope of this study. On the assumption that people will go to more effort to oppose something that they dislike than they will to support something that they agree with, it can be surmised that the small percentage who were strongly opposed to the mandatory helmet law are more heavily represented in the respondents than in the surveyed universe.

It is further significant that many of the complimentary comments that were voluntarily written on the survey form were from respondents who were strongly against the mandatory helmet law and appreciated the opportunity to be heard. Any opponents of the helmet law in the non-respondent group evidently were not strongly opposed enough to respond.

The similar percentage response for all three injury severity code populations, age and experience range, and the variety of answers all point to the very high probability that this was a representative survey.

REFERENCES

This study was initiated after reference to a multitude of studies on the several safety aspects of motorcycles. It was determined that, in addition to Idaho data, a study was needed in the literature that included data from motorcyclists who had survived a motorcycle injury accident. During the design of the survey in early 1975, the Nebraska study, which had surveyed a very similar population, was received. For this reason, the Nebraska study is used in some comparisons.

The sources specifically referred to in the study are listed with their reference name as used in the study.

REFERENCE

1. *The Protective Value of Contemporary Motorcycle Helmets in the Prevention of Head Injuries*, University of Ottawa, Department of Mechanical Engineering, James A. Newman, May 1974.

2. *A Study of Motorcycle Traffic Accidents in Nebraska*, State of Nebraska, Department of Roads, Safety Division, January 1975.

3. *Field of View With and Without Motorcycle Helmets*, National Highway Safety Administration Technical Report DOT-HS-801-758, U.S. Department of Transportation Research and Development, Safety Research Laboratory, October 1975.

4. *Effect of Safety Helmets on Auditory Capability*, DOT-HS-801-759, U.S. Department of Transportation, Research and Development, Safety Research Laboratory, September 1975.

5. *Public Reaction to Motorcycle Regulations*, State of Wisconsin, Department of Motor Vehicles, Bureau of Highway Safety Promotion, undated but subject matter was legislation passed by the 1967 legislature.

A STUDY OF IDAHO MOTORCYCLISTS INJURED IN 1974

APPENDIX A

SURVEY FORM AND COVER LETTER

MOTORCYCLE SURVEY FORM

PLEASE DO NOT PUT YOUR NAME ON THIS FORM. CHECK OR FILL IN THE BLANKS.

AT THE TIME OF THE ACCIDENT:

1. I was _____ years old. _____ MALE _____ FEMALE
2. I had been driving a motorcycle for _____ years, _____ months.
3. (If answer to 2 was 1 month or less) This was my _____ time driving.
4. (If answer to 2 was 1 year or more) My estimated annual mileage is _____
5. I belonged to a motorcycle club. _____ YES _____ NO
6. I had taken a motorcycle training course. _____ YES _____ NO
7. Accident data:

_____ Month	_____ Daylight	_____ In town
_____ Day of Week	_____ Night	_____ Rural
	_____ Dusk or Dawn	

8. Type accident was:

_____ Single Motorcycle _____ Motorcycle/Car, Truck

_____ Motorcycle/Motorcycle _____ Other

9. Estimated dollar value damage to my motorcycle was $ _____
10. Estimated total number of days lost from work, school, or similar activity _____
11. Estimated total dollar value of the medical attention that I required as a result of the accident (In other words, how much it would cost someone who had to pay for all medical attention?) $ _____
12. My major injury/injuries: _____ head _____ neck _____ arm

_____ leg _____ torso _____ internal

13. I was wearing a helmet at the time of the accident.

_____ NO	_____ YES
I believe that the helmet would have:	I believe that the helmet:
_____ reduced injury	a. _____ reduced injury
_____ had no effect	_____ had no effect
_____ aggravated injury	_____ aggravated injury
	b. _____ contributed to accident by interfering with _____ vision

CONTINUED ON BACK OF SHEET

WRITE IN ANY COMMENTS THAT YOU HAVE ON THE FOLLOWING:

14. Mandatory motorcycle helmet law:

15. Motorcycle license law:

    a. Written exam:

    b. Off-road driving exam:

    c. Traffic driving exam:

16. Eye protection required by law:

17. Rear view mirror required by law:

18. Motorcycle training courses:

19. The experience of my accident changed my opinion on the subjects in questions 14 through 18.

	YES	NO
Helmet law:	_____	_____
License law;	_____	_____
Eye Protection law:	_____	_____
Rear view mirror law:	_____	_____
Motorcycle training courses:	_____	_____

20. Add any other comments that you wish:

FOR VALIDITY, RETURN MUST BE POSTMARKED NO LATER THAN 9-18-75. THANK YOU VERY MUCH FOR YOUR COOPERATION. PLEASE MAIL THIS FORM TO:

Idaho Traffic Safety Commission
Statehouse
Boise, ID 83720

STATE OF IDAHO

TRANSPORTATION DEPARTMENT STATEHOUSE BOISE, IDAHO 83720

September 5, 1975

The Idaho Traffic Safety Commission is vitally interested in getting a few facts and opinions from people who were involved in motorcycle injury accidents in 1974. Enclosed is a brief survey form and a stamped, self-addressed envelope for your convenience in returning the form.

The information that you provide will be completely separated from identification of you as an individual. The data will be part of a pool of information from hundreds of people. Your name has been used only to mail the survey form. Since we have no tie-in between your survey form and the accident report, we are asking for some data that could be obtained from the accident report form.

We are interested in as frank and correct information as you can furnish. Do not feel that the survey form is limiting your response. You can add any information or comments that you desire. The purpose of the designed form is to make your response convenient to you and not to try to direct your answers. While you may feel that you have little information to offer, be assured that your input, when merged with hundreds of others, will be of value to motorcycle safety and motorcycling in general.

We would greatly appreciate your participation in this project. Any additional information or opinions that you may have on this subject will also be welcome.

Due to statistical considerations, a prompt reply is essential for the survey to be valid. Your reply must be postmarked no later than the date marked at the end of the survey form.

Thank you.

Sincerely,

Pat Ehrlich

Pat Ehrlich
Administrator
Idaho Traffic Safety Commission

Reference to NHTSA Technical Note
DOT HS-801 137

A Motorcycle Safety Helmet Study

Safety Helmet Effectiveness 10

A comparison between head injury sustained by safety helmet users and nonusers in traffic accidents in rural areas of Illinois, on the basis of a standard accident speed for both groups of riders, revealed the following:

1. In general, when helmets were not used, fatal or serious head injury was 3 times greater and head injury of all types was twice as great.
2. Helmets dislodged from the rider's head during the course of an accident did not reduce head injury and helmets damaged by cracking or splitting during impact were only slightly effective in that fatal or serious head injury was reduced by only 20% over non-helmeted riders. As expected, helmets that had not been damaged or ejected proved the most effective.
3. Helmets significantly reduced head injury in all three of the accident speed ranges considered: 60% for speeds up to 30 mph, 52% for speeds between 31-50 mph, and 51% for speeds over 50 mph. However, these differences in helmet effectiveness were not significant and helmets were equally effective in all three speed ranges.
4. Helmets significantly reduced head injury at both seat positions on the motorcycle, 68% for passengers and 52% for operators, but the difference in helmet effectiveness between the two positions was not significant.
5. Helmets significantly reduced head injury in accidents involving either noncollision (by 57%) or collision (by 50%), but the difference in helmet effectiveness between the two types of accidents was not significant.

Reference to NHTSA Technical Note
DOT HS-801 836

Motorcycle Safety- The Case for Helmet Use

Motorcycle helmets do not increase incidence of neck injury in accidents.

It has been suggested that helmet use increases the incidence of fatal neck injury in motorcycle crashes (using data from a 1969 statistical analysis of motorcycle accidents in New York).[13] Actually, the incidence of neck injury in motorcycle accidents during 1966 and 1967 involved any type of neck injury, and most of these involved only complaints of pain with no visible signs of injury. Studies done recently in Nebraska,[14] California and Canada[15] show that the incidence of neck injury of any type occurs in less than two percent of all motorcycle crashes.

Motorcyclists have been wearing safety helmets for more than 30 years, and during this period a number of studies of injury patterns in motorcycle accident have been made. None support the claim that helmets increase fatal neck injuries. The neck injury issue has been used in opposition to helmet laws as an attempt to exploit a peripheral issue on which there is not a great deal of valid data. Consequently, the problem has been magnified far out of proportion.

In order to provide conclusive evidence which will resolve the issue once and for all, the University of California and the Los Angeles County Medical Examiner's Office, under contract with the NHTSA, are now undertaking in-depth analysis of all fatal motorcycle crashes in Los Angeles County. Post mortem examination of each helmeted and unhelmeted rider will be made to document the incidence of neck injury in each group. The results of these analyses will provide authoritative resolution of the neck injury issue.

Mandatory helmet use laws reduce the number of serious head injuries and fatalities resulting from motorcycle accidents.

It is a logical conclusion that if a mandatory helmet use law is passed, more people will wear helmets, and consequently fewer fatalities and fatal injuries will occur in motorcycle accidents. Researchers have tried to verify this by comparing motorcycle fatalities and head injuries before and after implementation of a mandatory helmet use law. Of particular interest is a Brisbane, Australia report[16] which utilized three groups -- one sample done before implementation of a helmet use law, and two samples done in the two years immediately following. This study found (see Table IV) (a) that a significant increase in helmet use by motorcyclists involved in accidents (as expected) and (b) a significant decrease in head injuries in the post-legislation group.

IV. Summary and Conclusion

In general, motorcycle helmet visual restrictions were smaller along the horizontal plane as compared to the vertical planes. The full coverage helmets produced relatively small reduction in the entire field of view. As expected, the full facial coverage helmets resulted in somewhat larger reductions. The two styles of full facial coverage helmets yielded significantly different fields of view. Goggles produced approximately the same lateral visual field as the most restricted helmet.

With regard to restriction of the total field of view in the horizontal plane, it can be concluded that full coverage helmets (the most common type in use) provide only minor restrictions, less than 3 percent from that of an unhelmeted person. The full facial coverage helmets designed to comply with the lateral vision requirements of the ANSI Z90.1 standard and FMVSS No. 218 provided a restriction in lateral vision only marginally more than the full coverage helmets (7.3 percent). The "worst case" helmet provided a restriction of 21.9 percent from the unhelmeted lateral field.

All helmets tested exceeded the maximum State licensing requirements of 140° total "peripheral" view in the horizontal plane. Also, all helmets were in general compliance (especially visual regulations) with DOT standards. Therefore, helmet selection in terms of acceptable visual field, appears to be a matter of personal preferance among the many available styles.

Reference to NHTSA Technical Note
DOT HS-801 759

Effect of Safety Helmets on Auditory Capability

SUMMARY

Wearing a protective helmet has little to do with whether or not a motorcycle driver will hear a particular sound of interest to him or her. While it is true that safety helmets do attenuate external sounds, the amount of such attenuation is inconsequential, even when coupled with the amount of age-related hearing loss that normally occurs with age. The major determiner of whether a given sound will be heard is the ratio between the intensity of that sound and the intensity of the masking noise generated by the motorcycle (i.e., the signal-to-noise ratio). Safety helmets have an inconsequential effect because they reduce the loudness of both the sound of interest and the motorcycle noise by an equal amount and hence do not alter the signal-to-noise ratio between the two. A helmeted motorcycle rider can hear a sound of interest approximately as well as a person in an automobile with the windows closed.

IDAHO STUDY

SUMMARY OF STUDY FINDINGS

This summary is for the benefit of those who are more interested in survey results than in detailed analysis. All findings are substantiated in the body of the study.

1. There were 7.67 motorcyclists strongly in support of the mandatory helmet law for every 1 strongly opposed to the law.

2. Of motorcyclists who commented on the mandatory helmet law, 77.3% were in favor of the law.

3. Of motorcyclists who wore helmets, 84.7% indicated that the helmet reduced injury and 8.7% voluntarily added that it saved their lives.

4. Neck injuries were very rare in the severity A (incapacitating) injuries.

5. Over half of the respondents were at least twenty years old.

6. Motorcyclists over 35 years old comprised 20.7% of the respondents.

7. A few motorcyclists (2.6%) had less than one month motorcycling experience, but 75.6% had more than one year motorcycling experience.

8. Analysis of medical costs and days lost by severity code indicates that the injury severity codes marked by investigating officers are accurate indications of injury severity.

9. The opinion survey was favorable to motorcycle licensing with written and traffic exams, but not favorable toward off-road driving exams.

10. The opinion survey was favorable toward motorcycle training courses, with reservations on funding and administration.

11. The opinion survey supported the importance of eye protection but was not favorable toward a law requiring full-time eye protection.

12. Annual motorcycle mileage estimates varied greatly with an average somewhere between 3500 and 4500 miles per year.

13. Single motorcycle accidents predominately occurred in rural areas during daylight hours, while motorcycle accidents involving a car or truck occurred mostly in urban areas during daylight hours.

14. There was a marked difference in urban and rural accidents by injury severity type. Over half of the A injury severity accidents occurred in rural areas, while B and C injury severity accidents occurred mostly in urban areas.

15. Automobile driver awareness of and courtesy toward motorcyclists was determined to be the primary single factor in motorcycle collisions.