A STUDY OF THE EFFECTIVENESS OF A MOTORCYCLE DRIVER EDUCATION FILM LOOP PROGRAM FOR REDUCING FATAL CRASH INVOLVEMENT

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ABSTRACT

A STUDY OF THE EFFECTIVENESS OF A MOTORCYCLE DRIVER EDUCATION FILM LOOP PROGRAM FOR REDUCING FATAL CRASH INVOLVEMENT

By

Louis R. De Carolis

Statement of the Problem

The purpose of this study was to investigate (1) the effectiveness of the New Jersey Motorcycle Film Loop Program and supporting manual in reducing fatal crashes, and (2) the effectiveness of the New Jersey Motorcycle Film Loop Program and supporting manual in substituting for riding experience.

Methods of Procedure

The problem was investigated by reviewing the motorcycle fatal crash experience in New Jersey. Based on the findings of this investigation, five motorcycle driver education film loops were developed. A seventeen page supporting manual was also developed to supplement the film loops. In order to reach one hundred per cent of the new motorcycle licensees, permission was sought and gained from the New Jersey Division of Motor Vehicles to incorporate the educational program into the existing pre-licensing procedures. In addition, approval was received from the New Jersey Department of Education to offer the program to all public and private high schools who were willing to

include motorcycle driver education in their curriculum. In order to conduct a study of the effectiveness of the new materials in reducing fatalities, approval was sought and received from the New Jersey Department of Transportation to review all motorcycle fatality records that occurred during the period of January 1, 1971, to December 31, 1973. This review necessitated surveying 3,988 motor vehicle fatality cases in order to extract only the motorcycle fatalities. The 87 pertinent motorcycle fatality cases were entered into the matrix along with the number of new motorcycle licenses issued for the corresponding periods. From this data, a motorcycle licensee fatality crash rate was calculated. The pre-treatment rates were then compared with the post-treatment rates using four approaches to determine the effectiveness of the new materials. These comparisons were tested for statistical significance. In addition, other factors outside of the introduction of the treatment materials were reviewed for possible change that could have contributed to the reduction in motorcycle fatality rates.

The Major Findings

The major findings of this study were as follows:

1. A reduction of 40.4% was found in the overall 18 month comparison of the motorcyclist fatality rates during the post-treatment period as compared to the pre-treatment period. This reduction was found be statistically significant at the .05 confidence level. Thus, Hypothesis 1 was accepted.

2. A reduction of 39.3%, for the post-treatment period, was found in the seasonally identical 12 month comparison of the motorcycle

fatality rates. This reduction was found to be statistically significant at the .05 confidence level. Thus, Hypothesis 1a was accepted.

3. A reduction of 49.4% was calculated for motorcyclists holding their licenses from 1-3 months during the post-treatment period as compared to the motorcyclists in the pre-treatment period holding licenses for a similar period. This result was found not significant at the .05 confidence level. Thus, Hypothesis 1b, for the 1-3 months group, was rejected.

4. A reduction of 35% was calculated for motorcyclists holding their licenses from 4-6 months during the post-treatment period, as compared to the motorcyclists in the pre-treatment period, holding licenses for a similar period. This result was found not significant at the .05 confidence level. Thus, Hypothesis 1b, for the 4-6 months group, was rejected.

5. A reduction of 100% was calculated for motorcyclists holding their licenses from 7-9 months during the post-treatment period, as compared to the motorcyclists in the pre-treatment period, holding licenses for a similar period. This result was found not significant at the .05 confidence level. Thus, Hypothesis 1b, for the 7-9 months group, was rejected.

6. A reduction of 100% was calculated for motorcyclists holding their licenses from 10-12 months during the post-treatment period as compared to the motorcyclists in the pre-treatment period, holding licenses for a similar period. This result was found not significant at the .05 confidence level. Thus, Hypothesis 1b, for the 10-12 months group, was rejected.

7. The introduction of the treatment reduced, by 25%, the effect of rider experience on the motorcycle fatality rate. The result was found not significant at the .05 level of confidence. Thus, Hypothesis 2 was rejected.

8. Twenty-one variables were reviewed for possible influence on the fatality rates reduction; none were found to have varied over the study period.

It was determined that no significance was found at the .05 level of confidence for the 1-3 month, 4-6 month, 7-9 month, and 10-12 month groups because of the limited data which was available for statistical analysis. If the data were available in greater quantity, it was anticipated that significance at the .05 level of confidence would be achieved.

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By

ichard

Louis R. De Carolis

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CHAPTER I

INTRODUCTION

As a means of transportation, the motorcycle has the highest motor vehicle death rate based on 100 million miles traveled. In addition, the number of minor injuries, serious injuries, property damage, and economic loss due to disabilities, caused by motorcycle crashes, is inestimable. Thus, while medical science has conquered the ravages of many diseases, motor vehicle crashes and, more specifically, motorcycle crashes, have risen to become a nearly uncontrollable epidemic, calling for traffic safety prevention programs to harness this public tragedy.

Within the state of New Jersey little effort has been made to assist the motorcyclist to experience a safer riding career. Rather, it has become commonplace to merely suggest motorcycles be banned from the road. For example, the New Jersey Garden State Parkway, stretching the entire length of the state, prohibits motorcycle operation at all times. Another major roadway, however, has a different approach. The New Jersey Turnpike Authority does not allow motorcycle use on its roads during unsafe weather conditions or at times when it is considered in the best interest of the motorcyclist.

One organization which has promoted safer riding is the Motorcycle Industry Council of New Jersey. It has urged its member dealers

to offer training on basic riding skills with each sale. However, little evidence of any compliance exists.

Ray J. Marini, former Governor's Representative for Highway Safety in New Jersey, feels the dramatic increase in New Jersey's motorcycle fatalities is due to the growing number of motorcycles on our roadways and the lack of comprehensive motorcycle driver education.[1] Another proponent of this position, the National Highway Traffic Safety Administration, has conducted a survey which suggests that the education and training of new motorcyclists can substantially affect their subsequent crash experience.[2]

As an avid motorcyclist as well as an official in the field of traffic safety, the disproportionate fatality rate per 100 million miles of vehicle travel evoked an interest, on the part of the writer, that resulted in the writer's teaching, testing, and developing a motorcycle driver education program.

The National Highway Traffic Safety Administration urges each state to evaluate the training and educational opportunities available to motorcyclists both within, and outside of, their highway safety driver education programs. Further, the National Highway Traffic Safety Administration strongly encourages the states to develop a statewide motorcycle safety education and training plan.[3]

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[1]New Jersey Division of Motor Vehicles' Motorcycle Operator's Handbook, p. ii.

[2]Airborne Instrument Laboratory, "Motorcycle Safety" (a report prepared for the National Highway Safety Bureau, 1968).

[3]Highway Safety Program Standard Supplement 1 to Vol. 3 (Washington, D.C.: National Highway Traffic Safety Administration, November 19, 1971), p. 1.

To review numerically the rapid growth in the number and crash experience of motorcyclists is quite alarming. The number of registered motorcycles in the United States has increased from 575,000 in 1960 to about 980,000 in 1964 and to nearly 4,000,000 in 1972. Since 1960, motorcycle deaths have increased from 731 that year to 2,700 in 1972, an increase of 270%. In the single year between 1971 and 1972, fatalities rose by 16.2%. Presently, in the United States, the motorcycle mileage death rate for 1972 is estimated to be approximately 17 lives lost per 100,000,000 miles of motorcycle travel. This rate compares with the overall motor vehicle death rate of 4.5 lives lost per 100,000,000 miles, which includes pedestrian, nonoccupant, and occupant deaths.[4]

A possible explanation of this disproportionately high death rate for motorcyclists is suggested by the Motorcycle Safety Foundation. In a recent Audio Advisory Service tape from the American Driver and Traffic Safety Education Association, the Foundation reported that, "While death or injury is involved in only 10 per cent of automobile mishaps, a comparable figure for motorcycles is 80 per cent." Statewide studies in New Jersey,[5] Kentucky,[6] Kansas[7] and

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[4]National Safety Council, Accident Facts (Chicago: National Safety Council, 1973), p. 56.

[5]New Jersey Division of Motor Vehicles, Summary of Motor Vehicle Traffic Accidents--Motorcycles Only (Trenton: State of New Jersey, 1966).

[6]Kentucky State Police, Standard Summary of Motor Vehicle Accidents in Kentucky for 1968 Involving Motorcycles (Frankfort: Kentucky State Police, 1969).

[7]Traffic and Safety Department, Summary of Motor Vehicle Accidents Involving Motorcycles, 1966 (Topeka: State Highway Commission, 1967).

Vermont. The greatest numerically [illegible]

80 percent [illegible]

Vermont[8] suggest that 90.8 per cent, 87.9 per cent, 88.6 per cent, and 80.1 per cent, respectively, of all motorcycle crashes resulted in death or injury.

In the midst of what appears to be an upward spiralling of both motorcycle travel, and attendant fatalities, the National Highway Traffic Safety Administration indicated only a few states have initiated motorcycle driver safety education programs. One such program, the only example given, is the New Jersey Office of Highway Safety's Motorcycle Driver Education Film Loop Series. This program consists of five motorcycle film loops and a seventeen page supporting handbook. These materials are used in 320 of the 467 secondary driver education programs in New Jersey and at all nineteen driver licensing stations.[9] It is this program which is the focus of this study.

The Problem

There has been a rapid increase in the number of fatalities in New Jersey. Between the years 1968 and 1970, motorcyclist fatalities increased by 68%. During the comparable period, motorist fatalities declined by 6%. In spite of this rapidly increasing motorcycle fatality picture, little or no motorcycle driver education was conducted in New Jersey high schools, in commercial driver education programs, or at motor vehicle licensing stations.

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[8] Vermont Department of Motor Vehicles, Motorcycle Accidents in Vermont, Year 1966 (Montpelier: State of Vermont, 1967).

[9] Traffic Safety Programs, National Highway Traffic Safety Administration Activities and Accomplishments in Conformity with the Highway Safety Act of 1966, 1973, p. 25.

Recently, however, a motorcycle driver education program for all motorcycle license applicants in New Jersey was implemented during the treatment period of July 1, 1972 through December 31, 1973 to reduce the number of motorcycle fatalities. The motorcycle driver education program that was used consisted of five film loops and a seventeen page supporting handbook.

Importance of the Study

If the Motorcycle Driver Education Film Loop Series program is effective in reducing the fatality rate in New Jersey, then these educational materials can be used to reach the entire motorcyclist population in the state, including the motorcyclist who has had his license for more than eighteen months (the motorcyclists in New Jersey who are not covered as part of this current project). Additionally, the program can be utilized by other states in a manner similar to New Jersey's usage. The method for disseminating these materials to the total motorcyclist population in New Jersey might include educational television, dealer orientation programs, driver re-examination programs, and driver improvement schools.

The study will also investigate the effect of motorcycle driving experience on the fatal crash rate as compared to the effect of introducing the educational materials to determine if training can be effectively substituted for experience.

Assumptions of Study

One assumption of this study was that these materials will, in fact, be used by each and every motor vehicle licensing station in

New Jersey as a prerequisite to issuing motorcycle drivers' licenses. It was reasonable to make such an assumption because use of the materials by all motorcycle license applicants is required by the State of New Jersey. However, the administration of this requirement will be confirmed by spot checking each motor vehicle station to verify its utilization.

An educational assumption of this study was that the concepts and knowledge taught through the use of these program materials will affect the driving behavior of the motorcyclist, and will, as a direct result, reduce the motorcyclist's chances of having a fatal crash.

Hypotheses

The hypotheses for this study were:

Hypothesis 1

> The viewing of the motorcycle film loops and the studying of the corresponding supporting manual by all New Jersey applicants for a motorcycle driver license will significantly reduce the rate of motorcycle fatalities in the experimental group over an eighteen month study period.

Subordinate Hypothesis 1a

> The viewing of the motorcycle film loops and the studying of the corresponding supporting manual by all New Jersey applicants for a motorcycle driver license will significantly reduce the rate of motorcycle fatalities in the experimental group over a seasonally identical twelve month study period.

Subordinate Hypothesis 1b

> The viewing of the motorcycle film loops and the studying of the corresponding supporting manual by all New Jersey applicants for a motorcycle driver license will significantly reduce the rate of motorcycle fatalities in the experimental

groups holding their licenses for 1-3 months, 4-6 months, 7-9 months, and 10-12 months during the study period from January 1, 1971 through December 31, 1973.

Hypothesis 2

The introduction of the educational materials will reduce the effect of experience on the fatality rate by resulting in fatality rates for beginning motorcyclists which are equal to those for more experienced motorcyclists who did not receive the training.

Delimitations

This study was intended to show that providing the new motorcycle licensee with an educational program designed to illustrate and present countering concepts for the most frequent fatality-producing situations would cause a decrease in motorcycle fatalities. The motorcycle traffic fatalities of riders not licensed in New Jersey during the three year study period were not included as a part of this study because they were not affected by the treatment nor were they a part of the pre-treatment group. All motorcyclists selected for this study had to have been licensed in New Jersey during the period of January 1, 1971 and December 31, 1973 (inclusive), therefore the results of the study apply only to New Jersey motorcyclists during the study period. Because all data was extracted from the New Jersey Division of Motor Vehicles records, no fatal motorcycle crash which did not occur on a public street or highway within New Jersey was included. The entire study encompassed two time periods of eighteen months each, for a total of three years; the first eighteen month period was considered as the pre-treatment group, while the second eighteen month period was considered as the post-treatment group. Another delimitation of this

study which must be understood is that one of the controls of the study was time license held, not riding exposure, i.e. the number of miles traveled, place of travel, speed of travel, type of motorcycle used and time of day of travel. It should be emphasized that time license held and exposure are not the same; therefore it cannot be assumed that even though the time the license held for the pre- and post-treatment groups were identical, exposure may have been different.

Definition of Terms

Fatal Crash: An incident involving a motorcycle which results in one or more deaths within the calendar year of occurrence.

Motorcycle: A motorized vehicle having two wheels propelled by a five brake-horsepower engine or larger and which is capable of carrying one or two riders.

Accident Reports: A statewide law enforcement standardized form used to record 112 factors relating to the fatal crash.

Film Loop: A short continuous visual color film without sound, not exceeding four minutes.

Driver Re-examination: A method used to re-educate and re-examine each motorcycle license holder once every four years.

Driver Improvement School: A school intended to rehabilitate any driver who has accumulated six or more points on his New Jersey-held license.

Time-Series Experiment: The time series design is based on periodic measurements on a group both before and after the introduction of an experimental change. The results are indicated by a comparison of the pre-treatment and post-treatment measurements.

Special Study: An independent measurement of the effect of a variable through inquiries, interviews, or mathematical analysis.

Organization of the Remaining Chapters

This study was designed to test the effectiveness of a motorcycle driver education program on newly licensed operators. Consequently, the content was structured in a manner developed to fulfill the designated purpose.

In Chapter II, the pertinent literature relating to motorcycle driver education programs is given special emphasis.

Chapter III contains the development of the film loops and supporting guide. The data collection method is presented along with the experimental design of the study.

Chapter IV presents the analysis of the data. This data is presented in matrix and graph form. In addition, a test of statistical significance is included.

Chapter V contains a summary, the conclusions, implications, recommendation for further research, and a discussion.

CHAPTER II

A REVIEW OF RELATED LITERATURE

Introduction

In this chapter, the review of literature is presented. The review is divided into four sections: (1) the Societal Emergence of the Motorcycle and its Acceptance, (2) Overview of Motorcycle Training Programs, (3) Novice Motorcycle Training Programs, and (4) Instructor Motorcycle Training Programs.

In order to fully disclose the pertinent background information relevant to this study, an exhaustive review of the motorcycle literature was conducted. During the review of literature, numerous readings were conducted which were determined to be beyond the purpose and scope of this study.

The available literature concentrated on vehicle operation, operator protection, vehicle safety equipment, crash and driver characteristics, severity of motorcycle crashes, and the history of vehicle development. The information found in the aforementioned categories was contained most often in journals, pamphlets, manuals, speeches, and news articles rather than in published books. Throughout the review of literature, it was very apparent that single writings did not deal comprehensively with one subject matter. What was most prevalent was a constant mix of motorcycle topics within each piece of literature.

There was little evidence in the literature of a scientific investigation on the effectiveness of a motorcycle safety training program. Nor did the literature reveal any attempt to substitute a motorcycle safety training program for operator motorcycling experience. The following pages present as background information, a resume of literature reviewed as part of this study.

The Societal Emergence of the Motorcycle and its Acceptance

The first motorcycle emerged in 1869, more than one hundred years ago.[10] Since that time, intense vehicle development, large production, and wide use has provided riders of all nations with a convenient, economical, and reliable means of transportation. By the middle of the twentieth century, the two-wheel vehicle had found a permanent and acceptable position in the United States' social structure.[11] In 1960, there were 575,497 registered motorcycles, while, only seven years later, nearly two million vehicles were recorded registered.[12]

The rapid growth in popularity of two-wheel vehicles in this nation can be attributed to many factors, with low initial cost and

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[10] Cyril F. Caunter, Motor Cycles: A Technical History (London: Her Majesty's Stationery Office, 1970).

[11] American Automobile Association, Guide to Safe Motorcycling (Washington, D.C.: American Automobile Association, 1970), p. 5.

[12] National Safety Council, op. cit., p. 56.

economy of operation being significant factors.[13] In addition, a great deal of pleasure is derived from riding a motorcycle, which accounts for many purchases.[14]

However, while many advantages can be cited for the popularity of the motorcycle, there does exist profound evidence that motorcycling is more hazardous when compared to automobiles on a registration basis.[15]

On a mile-for-mile basis, when compared to automobiles, a motorcyclist's chances of being killed are about four times as great.[16] It is quite obvious that once a motorcycle crash occurs, the operator has far less protection that his automobile counterpart and is more likely to be fatally injured. It has been estimated that motorcycle injuries could amount to between 100,000-300,000 a year, with the greater majority being serious.[17]

The annual toll of motorcycle crashes increased to approximately 2700 riders killed per year by 1972. This represented a

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[13]Frank C. Young, "A Study of Selected Factors Related to Accident Involvement of Motorcycles in Ingham County, Michigan in 1971" (unpublished Ph.D. dissertation, Michigan State University, 1973).

[14]American Automobile Association, op. cit., p. 9.

[15]Duane R. Johnson, "A Case Study of Motorcycle Accidents in Three Illinois Counties" (unpublished Ed.D. dissertation, Michigan State University, 1968).

[16]Fred Potenza, "A Defensive Motorcycle Driver" (paper presented at the meeting of the Second International Congress on Automotive Safety, San Francisco, California, July, 1973).

[17]John J. O'Mara, "Contributory Factors in Motorcycle Casualty Accidents" (paper presented at the meeting of the Second International Congress on Automobile Safety, San Francisco, California, July, 1973).

feverish surge of more than 138 per cent over the preceding three-year period.[18]

Despite the fact that motorcycling has a burgeoning incidence of fatalities and injuries, motorcycle registration increased on an average of 18 per cent for the years 1971-1972. Furthermore, in 1967, Yamaha motorcycle dealers were told that each year there is potential for three million motorcycle purchases in the United States.[19]

Overview of Motorcycle Training Programs

Sixty-five per cent of the eligible public school students in 1967-1968 received a driver education course meeting minimum requirements. However, thousands of young people buying motorcycles are on their own when it comes to motorcycle instruction. This factor accounts for a large number of motorcycle operators experiencing crashes during their first few months of riding exposure.[20]

Although two-thirds of the eligible students receive a minimum regular driver education program across the nation, only 5,442 schools, as reported by twenty-five state departments of education, conduct some

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[18] National Safety Council, op. cit., p. 56.

[19] Universal Underwriters Insurance Company, "Facts on Cycle Safety that can Help You Sell" (speech delivered at Yamaha Dealer Schools, Kansas City, Missouri, 1967), p. 1.

[20] American Automobile Association, Motorcycling and Their Operation (Washington, D.C.: American Automobile Association, 1972), p. 1; Letter, Jack Casey (Program Administrator for Yamaha Learn to Ride Safety Program, Yamaha International Corporation) to Ray J. Marini (New Jersey Director of Motor Vehicles), March 8, 1974; Charles Hartman, "Motorcycles in the Schools," Concepts, VI, No. 2 (1973), 4.

type of motorcycle safety instruction within the driver education curriculum.[21]

In a national study conducted for the Motorcycle Industry Council Safety and Education Foundation by the American Driver and Traffic Safety Education Association, it was revealed that laboratory or actual vehicle instructional programs were offered in only one hundred seven schools. It was presumed that, in each of the one hundred-plus school programs, classroom instruction was a part of the total program. A major finding of the Foundation's study indicated that the lack of qualified teachers contributed to the limited growth of motorcycle instruction in the schools.[22]

An additional difficulty faced by educators wishing to supplement a motorcycle instructional course is the limited amount of audio-visual materials or other media for teaching motorcycle safety. Mr. J. C. Parkhurst, publisher of Cycle World magazine, was charged with the task of itemizing any and all types of teaching materials for safe motorcycling. He concluded his research by stating, "I have done as much research as possible and there isn't any."[23] McDole found in his research that, although there was a great deal of literature

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[21]American Driver and Traffic Safety Education, Motorcycle Safety Education Programs (Washington, D.C.: National Education Association), p. 7.

[22]Ibid., p. 4.

[23]J. C. Parkhurst, "Safety Promotion Helps" (speech delivered at the Air Force Industry Two-Wheel Motor Vehicle Safety Seminar, Norton Air Force Base, California, November, 1966).

on the automobile, motorcycle literature falls very short in comparison.[24]

The most sophisticated piece of teaching apparatus employed within motorcycle training programs surveyed was the motorcycle simulator. First invented by Mr. Bernard G. Nelson, it simulates the feel of a motorcycle in a stationary position.[25] A second simulator, produced by the Hartzell Corporation of St. Paul, Minnesota, teaches basic skills of motorcycling.

Unfortunately, the literature did not reveal any scientific studies indicating whether motorcycle driver education is beneficial or detrimental to safe driving. However, a number of documents strongly supported the fact that there was no substitute for a combination of motorcycle education and training experience as a method of training safe drivers.[26]

One study conducted by the United States Navy pointed to three hundred motorcycle crashes involving Navy men, who were responsible

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[24]Thomas L. McDole, "Development of a General Knowledge Test for Use in Motorcycle Operator Education and Evaluation Programs" (unpublished Ph.D. dissertation, Michigan State University, 1968).

[25]Bud Martin, "The Nelson Trainer," Cycle World (April, 1968), 72.

[26]Universal Underwriters Insurance Company, Handbook of the Driver Education Program for Motorbike Operators (Kansas City: Universal Underwriters Insurance Company, 1967), p. 14; Motorcycle Industry Council, Reading Before Riding (Washington, D.C.: Motorcycle Industry Council), p. 1; Highway Safety Program Standards (Washington, D.C.: National Highway Safety Bureau, January, 1969), p. 2.

for 75 per cent of the incidents. It was determined that the lack of operator training was the major causative factor.[27]

According to John J. O'Mara, there is little justification to infer that a motorcycle driver education program would reduce motorcycle rider deaths and injuries.[28] In fact, O'Mara further elaborated on this point by indicating that the offering of motorcycle driver education programs in public schools would principally lead to further motorcycle vehicle registrations with the almost certain result of more deaths and injuries.[29] Previously, it had been stated by Professor O'Mara that there were several ways of preventing injury and death on motorcycles, one of which is increased cyclist training.[30]

An Illinois study reported that in fatal motorcycle crashes, no single corrective solution could be found to apply to the crashes.[31]

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[27]Naval Safety Center, Division of Motor Vehicles, Motorcycle Safety Course (Norfolk, Virginia: Naval Safety Center, 1972), p. 11.

[28]John J. O'Mara, "Contributory Factors in Motorcycle Casualty Accidents" (paper presented at the meeting of the Second International Congress on Automotive Safety, San Francisco, California, July, 1973).

[29]Ibid.

[30]New York Times, February 27, 1967, p. 25.

[31]Francis S. Lorenz, "Fatal Motorcycle Accidents" (unpublished report delivered to the Governor's Official Traffic Safety Coordinating Committee, Springfield, Illinois, November 16, 1966), p. 2.

for 75 per cent of the incidents. It was [illegible] lack of

operator training

Everest[32] and Johnson[33] recognized that an inexperienced or untrained operator can be a hazard to himself and others on the road. Investigations by the National Safety Council have indicated that the danger associated with a motorcycle are not inherent in the machine itself.[34] The Council stressed that inexperienced motorcycle drivers find themselves more often in unsafe situations than does the mature or professional driver.[35]

A two-county Michigan study of motorcycle owners by Schlick recommended that, within motorcycle driver education programs, instructional methodologies be developed and implemented to help new riders develop personality traits which lead to accident-free motorcycle operation. Schlick concluded that a significant difference did exist between the accident and non-accident-involved male motorcycle owners in biographical characteristics.[36]

In a report resulting from a survey conducted by Airborne Instruments Laboratory for the National Highway Safety Bureau,

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[32]Frank K. Everest, Brigadier General, "A Call for Action" (opening remarks at the Air Force Industry Two-Wheel Motor Vehicle Safety Seminar, Norton Air Force Base, California, November, 1966).

[33]Duane R. Johnson, "What are you Doing about Motorcycle Education," Safety (May-June, 1969).

[34]Jay Peake, "Those Wild, Wild, Wheels," This Week, March 31, 1968, p. 4.

[35]Ibid.

[36]John E. Schlick, "A Comparison of Personality Factors and Selected Characteristics of Accident and Non Accident Involved Male Motorcycle Owners in Two Michigan Counties" (unpublished Ph.D. dissertation, Michigan State University, 1973).

education and training of all motorcycle operators were recommended. The survey indicated that no large statewide motorcycle education and training programs were being conducted for the novice to gain the proper instruction and riding experience.[37] The survey reported that most motorcyclists are self-taught, taught by a friend, or given minimal riding instruction by the motorcycle dealer.

A statistical summary of motorcycle fatalities occurring to both riders and passengers in the United States clearly pointed out that younger people, those in the age group of 15-24, were involved in two-thirds of the motorcycle fatalities. Both inexperience and the lack of skill were cited as being of greater importance in avoiding motorcycle crashes than in avoiding automobile crashes.[38]

There have been a number of small and varied motorcycle courses developed, printed, and implemented within our nation.[39] The most extensive program development appears to be occurring either at the university level or within state departments of education. More recently, the non-governmental and non-educational agencies have developed motorcycle program guides. Extensive course instructional manuals have been compiled by the University of Wisconsin,[40]

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[37] Airborne Instrument Laboratory, op. cit., p. 6.

[38] Metropolitan Life, "Motorcycle Accident Fatalities," Statistical Bulletin, LIV (August, 1973), 9-10.

[39] American Driver and Traffic Safety Education, op. cit., p. 4.

[40] Frazier Damron, ed., A Programmed Instruction Series for Motorcycle Riders and Instructors and Other Motorist Drivers, I-V (Madison: University of Wisconsin Press, 1972).

West Virginia Department of Education,[41] National Safety Council,[42] Explorer Scouts,[43], and the American Automobile Association.[44]

These courses, and others, all appear to contain primarily the same information, with differences appearing in the treatment of the content and breadth of coverage on specific topics.

The Motorcycle Safety Foundation has recently developed a motorcycle course, assisted by experienced curriculum specialists and experienced motorcycle operators. The course contains what is presently known about motorcycle operation.[45] The Foundation is now developing a research-based curriculum package for motorcycle riders, with the final program being performance-based for safe motorcycle operations.[46]

Novice Motorcycle Training Programs

A junior high school motorcycle safety rider course was offered to all thirteen and fourteen year olds. This was the lowest grade level motorcycle course found offered within a school system. The

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[41]Milton L. Bennett, Motorcycle Safety Education (Charleston: West Virginia Department of Education Press, 1971).

[42]National Safety Council, Motorcycle Supplement--Student Workbook and Defensive Driver's Manual (Chicago: National Safety Council, 1972).

[43]Stuart A. Wilkinson, Explorer Motorcycle Safety Training Program (La Mirada, California, 1969).

[44]American Automobile Association, Guide to Safe Motorcycling op. cit.

[45]Motorcycle Safety Foundation, The Beginner Rider Course (Washington, D.C.: Motorcycle Safety Foundation, 1974), p. 3.

[46]Ibid.

course entailed fifteen hours of classroom instruction and ten hours of practical instruction. As part of the program, student assistants, who were licensed motorcycle operators, aided in the instruction. These assistants provided the learners with traffic situations found in normal traffic patterns and accomplished their task on a driving range facility within Dallas County School System.[47]

In a study and analysis of motorcycle accident data based on Japan's crash experiences, motorcycle driver training is credited as an effective means in the prevention of motorcycle accidents. The Japanese government recognized that increased rider skill resulting from motorcycle training programs was a contributing factor in the substantial decrease in motorcycle crashes in 1972. As a result, the driver licensing procedure was revised to make the examination more comprehensive. Concurrently, enrollment in the formal eight-hour instruction given at a driver training school before a rider receives his license increased by 15 per cent.[48]

Promotion of motorcycle rider training programs increased sharply during 1972 in Japan's Niigata Prefecture. This increased activity was the result of two prior years of explosive increases in motorcycle crashes. Primarily involved in these crashes were older teenagers riding large engine motorcycles. It was stated by Mr. Hoshikazu Imatake of the Japan Traffic Safety Association that the causes of these crashes were due to insufficiencies in motorcycle

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[47]Motorcycle Safety Course in Dallas County, "Traffic Safety Newsletter of Alabama" (January-February, 1974), p. 3.

[48]Hiroshi Inayoshi, "Characteristics of Motorcycle Accidents in Japan" (paper presented at the Second International Congress on Automotive Safety, San Francisco, California, July , 1973).

operators' acquiring basic knowledge, techniques, and patterns for the safe operation of a motorcycle. At the end of 1972, motorcycle fatalities and crashes decreased. Although it was recognized that the motorcycle educational programs were not the sole factor in bringing about a decrease, they were cited as making a considerable contribution. Other factors, which were also cited as contributing to the decrease, were revision of the motorcycle license examination procedure and the helmet use campaigns.[49]

Mr. Yoshinao Sugie, an instructor at an all-male Japanese high school, conducted a motorcycle driver education program with startling results. His program, entailing printed instructional material, audio-visual supportive materials, and actual rider training, reached approximately three hundred students the first year. In 1965, and in previous years before the first year of the program, there were an average of sixty-five motorcycle creashes each year, which included two fatalities. During the next five years, as the program proceeded, crashes were reduced remarkably downward to twenty-nine in 1970. During the last four years of the program, there were no fatalities. In 1971, Mr. Sugie left the Hamamotsu High School of Technology, and the program ceased. Since the program has ended, the motorcycle crash and fatal experience has returned to the level at which the motorcycle driver education program was first inaugurated.[50] As a result of

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[49]Yoshikazu Imatake, "Promotion of Safety Riding Education Activities for Motorcyclists" (paper presented at the meeting of the Second International Congress on Automotive Safety, San Francisco, California, July, 1973).

[50]Yoshinao Sugie, "Motorcycle Safety Driving Education at a High School and its Results" (paper presented at the meeting of the Second International Congress on Automotive Safety, San Francisco, California, July, 1973).

Mr. Sugie's motorcycle educational program, data was collected which indicated that the number of motorcycle crashes and traffic violations were reduced by 50 per cent. This reduction, according to Mr. Sugie, was attained by imparting correct knowledge and technology to high school students.[51]

Yamaha, one of the leaders in the motorcycle industry, developed a national learn-to-ride program in response to an alarming rise in motorcycle fatality figures. This program was designed to increase rider knowledge of safe riding skills and techniques. Participating students who had never operated motorcycles comprised 65 per cent of the enrollees.[52] One essential part of the program materials was a rider safety manual which each participant received.[53]

A series of five motorcycle instruction units has been developed, based on the programmed instruction learning method used by the University of Wisconsin. The methodology used throughout the five-part series was designed to offer the student information in small, simple segments, progressing to more complex segments. Reinforcement, both positive and negative, was offered immediately after performance of either a skill exercise or written exercise. As the developers of this program cite, the immediate knowledge of a mistake has been proven

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[51] Ibid.

[52] Terry Tiernan, "The Yamaha Learn to Ride Safety Program" (paper presented at the meeting of the Second International Congress on Automotive Safety, San Francisco, California, July, 1973).

[53] Yamaha, Inc. Rider Safety Manual (Yamaha, Incorporated, 1973), p. 1.

to be an effective way to learn. The entire programmed series was designed to assist the student in learning and, especially, to aid in the retaining of all the learning material, including behaviors which will foster safe riding practices.[54]

One of the most comprehensive programs reviewed, one which lasted fifty hours, was the Explorer Motorcycle Safety Training Program. The program was considered so successful that a pilot course was developed for and implemented in the Los Angeles City Schools. As lengthy as the program was it was pointed out that the program should not be condensed. Each learning session entailed three hours, a time period proven to be appropriate for maximum learning without introducing fatigue.[55]

The United States Navy has felt obligated to include motorcycle safety into its overall safety program because of carefully studied motorcycle crashes. Of three hundred motorcycle crashes involving Navy men, it was concluded that the cyclists were responsible for 75 per cent of them. Furthermore, the lack of operator training was found to be the major causative factor.[56] The Navy program, utilizing several references and instructional aids, included four hours of classroom instruction and three hours of driving range experience.[57]

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[54] Damron, op. cit., p. iii.

[55] Wilkinson, op. cit., p. 1.

[56] Naval Safety Center, op. cit., p. 11.

[57] Ibid., p. 7.

Instructor Motorcycle Training Programs

A Motorbike Driver Education Instructor's Kit has been developed by the Universal Underwriters Insurance Company for the use of driver education teachers in conducting a supplemental driver education course for motorcycle operators. Within the kit is an instructor's guide, a student handbook, completion certificate card, safety quiz, and practice driving evaluation forms. It is pointed out in the kit that the qualifications of an instructor should be the same as those of a certified driver education teacher, with the understanding of theory and operations of motorcycling being understood.[58]

Recently, the Canadian Safety Council viewed an alarming acceleration of deaths, injuries, and crashes involving motorcyclists. The statistics in Canada showed that novice riders, in their first few months of riding, were vastly more prone to crashes. As a result of these figures pointing to the need for motorcycle training programs, the Canadian Safety Council inaugurated a three-phase training effort. The first phase was to train chief instructors from each province. They, in turn, would train course instructors. Finally, the course instructors would then be immediately available to work with local groups of novice riders. A National Advisory Committee, representing industry and governments, with input from various provincial safety councils, developed these two-instructor training programs.[59]

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[58]Universal Underwriters Insurance Company, Motorbike Driver Education Program Instructor's Kit (Kansas City: Universal Underwriters Insurance Company, 1966).

[59]Safety Canada, Ottawa, March, 1973, p. 6, col. 1.

Instructor Maintenance Training Courses

1971 A

A motorcycle instructor program, conducted during the summer of 1973, was sponsored by the Motorcycle Safety Foundation. The Foundation held eight separate graduate workshops primarily for higher education instructors involved in traffic safety. Many of the 120 individuals completing the graduate workshop were employed as State Education Department specialists, traffic safety educators, and military safety officers. All participants who did complete the workshop were expected to qualify a minimum of 20 teachers during the next school year.

The eight workshops had two main objectives: to develop or improve motorcycle instructional capabilities and generate a cadre of instructors willing to teach and qualify other instructors as motorcycle teachers.

The workshops covered the following areas: basic instruction in motorcycling, educational programming and curriculum development, and problem identification involving various vehicle mixes on the roadway.[60]

The Yamaha International Corporation offered on March 30 and 31 of 1974 an inaugural motorcycle driver education instructor training program. The program was held at Keene State College, Keene, New Hampshire. The intent of the program was to teach the one hundred participating driver education instructors the following:

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[60]Hartman, op. cit., p. 5.

1. How to ride a motorcycle safely.

2. How to use the Yamaha twelve-hour Motorcycle Rider Education Curriculum.

3. How to work with the motorcycle dealers and local civic groups to establish the support needed to initiate and carry through the Yamaha Rider Education Curriculum.

After the instructors' workshop, it was expected that each participant, returning to his community as a certified instructor, would initiate a motorcycle safety program.[61]

Summary

The review of the literature has presented some degree of unanimity relative to the present status of motorcycle safety education. Although motorcycling is a hazardous means of travel when compared to other modes of movement, few comprehensive motorcycle safety education programs are being conducted nationwide. Presently some educators, the private motorcycle industry, and some researchers feel motorcycle safety education is the best possible means of curbing the high recurring motorcycle crash incidents. Furthermore, there is an apparent lack of motorcycle instructor preparatory programs presently available.

The literature also disclosed that no scientific evaluation of a motorcycle safety education program was ever conducted. Hence, the need, purpose and methodology for this study was apparent.

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[61] Yamaha International Corporation, Yamaha Motorcycle Rider Education Course (Buena Park, California, 1974), p. 1.

Presented in the following chapter is a description of the design and methodology used to conduct the study, procedure for data collection, and treatment of data.

CHAPTER III

DESIGN AND METHODOLOGY

The purposes of this study were to investigate: (1) the effectiveness of the New Jersey Motorcycle Film Loop Program and supporting manual in reducing fatal crashes, and (2) the effectiveness of the New Jersey Motorcycle Film Loop Program and supporting manual in substituting for riding experience.

Hypotheses

The hypotheses for this study were:

Hypothesis 1

> The viewing of the motorcycle film loops and the studying of the corresponding supporting manual by all New Jersey applicants for a motorcycle driver license will significantly reduce the rate of motorcycle fatalities in the experimental group over an eighteen month study period.

Subordinate Hypothesis 1a

> The viewing of the motorcycle film loops and the studying of the corresponding supporting manual by all New Jersey applicants for a motorcycle driver license will significantly reduce the rate of motorcycle fatalities in the experimental group over a seasonally identical twelve month study period.

Subordinate Hypothesis 1b

> The viewing of the motorcycle film loops and the studying of the corresponding supporting manual by all New Jersey applicants for a motorcycle driver license will significantly reduce the rate of motorcycle fatalities in the experimental

groups holding their licenses for 1-3 months, 4-6 months, 7-9 months, and 10-12 months during the study period from January 1, 1971 through December 31, 1973.

Hypothesis 2

The introduction of the educational materials will reduce the effect of experience on the fatality rate by resulting in fatality rates for beginning motorcyclists which are equal to those for more experienced motorcyclists who did not receive the training.

Program Initiation

In 1971, the New Jersey Office of Highway Safety, in conjunction with the Department of Education, initiated a study of the motorcycle situation in the state of New Jersey, under the direction of the writer. A preliminary investigation showed that not only were the number of licensed motorcycle operators growing at a rapid rate, but in New Jersey, during the period from 1968 to 1970, motorcycle fatalities increased by 68 per cent. Over the same period, passenger car fatalities declined by 6 per cent.

Based on the evident need for motorcycle safety education, the writer began the tasks of designing, supervising the preparation of, and, finally, implementing a motorcycle safety program suitable to New Jersey's needs.

Medium Selection

The selection of the instructional medium, the film loop, was based on an analysis of the tasks to be taught and the anticipated types of utilization requirements in classrooms and driver qualification centers.

With respect to the tasks to be taught, the major objective in media selection was to simulate the actual application of the skills to be taught in the real world environment as closely as feasible. This objective was considered of paramount importance because it was felt that the closer the quality of the simulation, the greater the probability that the gained skills would be transferred to actual on-the-road behavior. Based on the closeness of the simulation, it was decided to use motion pictures, taken in the actual on-road environment.

With respect to the utilization requirements, the film loop approach was selected for the following reasons:

Classroom Utilization

1. The film loop format is silent while being used, thus allowing teacher/student interaction while the loop visually reinforces and directs the discussion.
2. The film loop format allows for continuous replaying of a particular skill or technique without requiring any rewinding or rethreading which would disrupt the discussion.
3. The film loop format allows the motorcycle skills and techniques to be presented individually in learning modules, thus allowing the discussions to focus on one topic at a time without having extraneous visual material at the same time.

Individual and Driver Qualification Center Utilization

1. The film loop format provides individual cassettes which require no initial film threading and which can be inserted into the film loop projector only in the proper manner. Thus, individuals unfamiliar with threading projectors can successfully operate the film loop approach. This ease of operation allows individual library study, remedial work, and utilization in driver qualification centers without constant supervision or aid.
2. The silent approach also supports the ability of the loops to be utilized in libraries and driver qualification centers, since a sound track would prove too disrupting. Subtitles were added to the film to replace, to some extent, the need for explanations normally put on the sound track.
3. The film loop format provides for individual differences in rate of learning by offering continuous repetition of motorcycling skills and techniques. This is important because only the individual viewer can truly indicate when he or she has learned the specific techniques and has understood their application.

To determine loop content, a review of the New Jersey motorcycle fatality reports was conducted to determine the most frequent types of motorcycle fatal crashes and their associated causes. The review led the researcher to categorize New Jersey motorcycle fatal

crash report into the most frequently occurring causes. Thus the review showed that 60 per cent of all fatal motorcycle crashes in New Jersey occurred at intersections. The remaining 40 per cent were divided among lane position, passing (one and two motorcycles), following distance (two second rule), and special hazards (railroad tracks, gravel, returning to pavement, obstructed visibility, two riders). Therefore, one entire film loop was devoted to intersections, while the remaining four film loops were a collective treatment of the other fatality-producing situations. An effort was made to limit the scope of the program by excluding skills and situations not related to fatalities in order to focus the program on fatality reduction.

The entire program was filmed during the prime motorcycling months. The writer, having eleven years experience as a cyclist, was the primary motorcycle operator. The second motorcyclist, when necessary, was also an experienced rider. Each two-wheel vehicle was mechanically checked out for safe operating condition before each maneuver.

Each loop required between 100 and 300 feet of film, of which collectively, less than 160 feet were used in the final production of the five loops.

Before shooting at each location, police clearance was obtained. Several trial runs were conducted in order to provide the most explicit camera angles. After all the material was photographed, long hours of editing produced the original print for viewing and final approval prior to mass reproduction.

Supportive Manual

The manual was designed and written to support these film-loop presentations by giving the reader an understanding of the importance of each skill and a more detailed statement of instructional points than possible in the limited space for subtitles. After film and manual preparation, both were reviewed and edited by selected New Jersey traffic safety officials who had motorcycle riding experience.

Film Loop and Manual Structure

The following is a detailed description of the development of the final film loops and supporting manual.

Film loop topics representing the highest fatal-crash-producing incidents included are: Intersections, Lane Positions, Following Distance--Two-second Rule, Passing and Special Hazards.

The description of each topic includes General Comments, Tasks, Objectives, Instructional Points, Settings, Camera Positions, and Special Notations.

Intersections

General Comments

In New Jersey, sixty per cent of all motorcycle crashes occur at intersections. In many of these incidents the cyclist thought he had the right of way and therefore proceeded, thinking that the motorist would stop. However, no matter who was right, the cyclist is the one who paid the greater penalty. Many motorists are guilty of trying to beat a red light, rolling through a stop sign, trying to beat another

driver through an intersection, or just plain not seeing a motorcycle (especially where there are parked cars to block the view). Whatever the reason for the crash, and whoever is responsible for the crash, the cyclist will always pay the greater penalty. On a motorcycle, the right of way is something never taken but always given, and the assumption is that the motorist does not see the cyclist. Even when the cyclist is able to establish eye contact with another driver, he must not assume the other driver will stop.

Tasks

1. Single vehicle straight ahead at four way intersection.
2. Single vehicle left turn at four way intersection.
3. Single vehicle right turn at four way intersection.

Objectives

1. Illustrate car turning left in front of motorcycle proceeding straight ahead.
2. Demonstrate vehicle pulling in front of motorcycle turning left.
3. Show proper right turn procedure, emphasizing body and cycle lean.
4. Demonstrate proper method for carrying a package.

Instructional Points

Proceeding straight ahead at intersection:

1. Reduce speed

driver through an intersection, or just plain run into a motorcycle

(especially where

the

2. Check traffic, first on the left (the closest approaching vehicle), then on the right, and finally straight ahead.
3. Always be prepared to stop.

Left turn at intersection:

1. Check traffic and signal (hand signals improve visibility).
2. Move to proper lane.
3. Reduce speed, applying rear brake first for stability and activating the brake light.
4. Look ahead for unusual road hazards (gravel, sand, leaves, manhole covers, painted intersection stripes that can be very slippery).
5. Always be prepared to stop.
6. Turn into proper lane position

NOTE: Never carry anything on your lap, on the tank, or in your hands while operating a motorcycle (especially a young child). This cyclist has tied his packages on the back of the motorcycle.

Right turn at intersection:

1. Check traffic and signal.
2. Move into proper lane position.
3. Look ahead for:
    a. pedestrians
    b. cars which could turn in front from cyclist's left.

c. unusual road hazards

d. parked cars

4. Never turn inside the turning arc of a car turning right in front.

5. Do not pass cars on right which are stopped in front.

6. Swing wide enough to avoid hitting the curb with the foot rest.

NOTE: The cyclist leans to turn rather than "hard steering" with his handlebars. In a 90° turn to either the left or right, perhaps 80 per cent of the turn is accomplished by shifting the body weight rather than hard steering with the handle bars, as one would steer with the wheel of a car.

Setting

1. Four way intersection with traffic in country setting.
2. One automobile to perform driving errors.
3. Roadway clearly marked with traffic control indicators.
4. Wide shoulders on all roadways.
5. Speed under 20 miles per hour.

Camera Positions

1. Stationary position on each scene.

Special Notations

1. Police clearance needed.
2. Loud speaker to coordinate movements.
3. Zoom and wide-angle camera lenses.

Lane Positions

General Comments

The primary objective in selecting a normal riding position in a lane is to achieve maximum visibility (see) as well as be most visible to other drivers (be seen). By riding in the left tire track, the cyclist is better able to see beyond the car in front of him to oncoming traffic and possible hazards, as well as beyond the car behind him when checking for cars moving up to pass. In addition, riding in the left tire track puts the operator away from hazardous activities along the side of the road and away from accumulated debris in the center of the lane.

Two other suggestions to increase the cyclist's chances of being seen are to always ride with his headlights on and to put retro-reflective tape on the sides and rear of his helmet.

Task

1. Single vehicle maintaining a safe lane position both within the country and city.

Objectives

1. Demonstrate proper lane position.
2. Illustrate blind spots.
3. Show how to avoid hazards on the right.
4. Demonstrate how to avoid parked car dangers.
5. Show how a proper lane position urges vehicles not to pass when there is oncoming traffic.

Instructional Points

Ride in the left tire track in order to:

1. Avoid oil spills, glass, gravel, and other debris which tend to accumulate in the center of the lane.
2. Stay out of the blind spots of the motorist in front of the cyclist. When the cyclist can see the driver's side view mirror and his rear view mirror through his rear window, the cyclist is not in the driver's blind spot.
3. Avoid unexpected hazards on the right side of the lane where trees, disabled vehicles, and other obstructions can block the cyclist's view.
4. Avoid the additional city hazards of motorists leaving their parked cars, pedestrians jaywalking, and children playing beside the street.
5. Urge motorists who are passing to treat a cycle as another car and therefore encourage them to use another whole lane to pass rather than trying to squeeze by, forcing the cycle and cyclist off the road to the right.

Settings

1. Two lane undivided country road.
2. Two lane city street with curve and heavy traffic.
3. Scene casting heavy shadows.

4. Speed--country, 25-35 mph; city, 15-25 mph.

5. Dry pavement.

Camera Positions

1. Rear of vehicle--tailgate.

2. Roof of vehicle.

Special Notations

1. One motorcycle and one vehicle off pavement.

2. Large parked vehicle dark in color.

3. Hidden driveway.

4. Wide-angle lens used to minimize apparent camera movement.

5. Headlight on for increased visibility.

6. Bright colored jacket.

Following Distance--Two-second Rule

General Comments

The two-second rule is a technique of setting the proper following distance which is usually more accurate than the one car length for each ten miles per hour method (since most people have difficulty in accurately estimating distances). The two-second rule is applied by selecting a fixed object on or by the road and then counting for a time period of two seconds, beginning as the vehicle in front passes the fixed object. If, by the end of the two-second interval, the second vehicle has not passed the fixed object, that vehicle is far enough behind the first vehicle to allow the safety margin needed to stop in an emergency. Note that if both vehicles

are traveling at thirty miles per hour (44 feet per second), two seconds would allow 88 feet or about 30 feet per 10 miles per hour. This interval rate (30 feet per 10 miles per hour) is maintained at all speeds.

The two-second rule works just as well for cars as for motorcycles. It is recommended that the time interval be increased to three or four seconds during bad weather conditions or for any other deterioration of road conditions. It is important to emphasize to cyclists that they should not become overconfident at lower speeds because of possible braking advantages that motorcycles may hold over cars. They must remember that the vehicle behind them will not be able to stop as quickly as the motorcycle can stop. At higher speeds, it is very difficult to stop a motorcycle in an emergency because of the possible loss of control. By always allowing the safety margin provided by the two-second rule, the cyclist will have the time necessary to look ahead for unusual road hazards such as pot holes, slippery surfaces (oil, water, metal sewer lids, leaves, paint strips, ice, snow), pedestrians between parked cars, and road bumps.

Tasks

1. Single vehicle following.

Objectives

1. Demonstrate two-second following distance.
2. Illustrate safety margin.

Instructional Points

1. Select a fixed object on or by the road side--examples: road signs, tar marks, dash marks, changes in road color.

CAUTION: Do not pick an object which forces the cyclist's eyes away from driving scene.

2. As vehicle in front passes the fixed object, begin counting for an interval of two seconds (saying the words one-thousand-one, one-thousand-two, representing approximately two seconds.

3. If the cyclist is able to count two seconds before his motorcycle passes the fixed object, he has allowed enough distance for an emergency stop.

Setting

1. Two lane undivided highway.
2. Obvious road color contrast.
3. Dry pavement.
4. Bright sun.
5. Speed--20-25 mph.

Camera Position

1. Front hood of a vehicle at motorcycle eye level.

Special Notations

1. No motorcycle required.
2. Gyroscopic lens needed.
3. Police clearance needed for outside of vehicle riding.

4. Allow nearly three seconds for following distance to make instructional points apparent.
5. Select change in pavement color as fixed object because of lack of depth perception of camera lens.

Passing One and Two Motorcycles

General Comments

Passing with a motorcycle is basically the same as passing with a car; however, the cyclist must realize that he is less visible than are other types of vehicles. Therefore he must always assume that he is not seen and be prepared for the vehicle in front to turn in his path (especially slow moving vehicles) or to drift over into his lane. These dangers are greatest when the cyclist is in the vehicle's blind spot, that point at which the cyclist is not able to see the car's rear view mirror through the rear window. The cyclist should not linger in this blind spot when passing.

Cyclists must never pass slow moving cars by squeezing between two lanes of traffic or by riding on the shoulder of the road. The other drivers do not expect a motorcycle to be there and may unconsciously drift in front of the cyclist's path or make a right turn, leaving him without an escape path. In addition, when cars are stopped in a traffic jam, a motorist, at any time, might decide to get out of his car to look ahead to see what is holding up traffic, not expecting a motorcycle to be squeezing through. Under New Jersey law, these passing techniques are illegal, as well as being unsafe.

When two motorcycles are proceeding together, the motorcycle in the left tire track should always be slightly ahead of the motorcycle in the right tire track. By riding in an offset position, the cyclists are avoiding possible contact with each other (often resulting in interlocked handle bars) should there be a sudden gust of wind, an unexpected need for swerving to avoid a hazard, or a motorist who pulls over into the cyclists' lane too quickly, squeezing them to the right. When planning to pass, the two cyclists should switch tire track positions as part of the passing maneuver in order to minimize the passing time and distance required. The lead cyclist in the left tire track is the one to plan and initiate the pass, since he is better able to see ahead.

Tasks

1. Single motorcycle passing.
2. Two motorcycles passing.

Objectives

1. Demonstrate proper passing procedure.
2. Demonstrate passing vehicle blind spot.
3. Illustrate offset riding positions for two motorcyclists riding together.

Instructional Points

One Motorcycle:

1. Check traffic and signal (turn head to check blind spot sometimes created by poor mirror adjustment).

2. Proceed to pass, tapping the horn as you pass through the motorist's blind spot (only tap horn when in the country, as required by the New Jersey Motor Vehicles Law). For passing, use nearest tire track of passing lane, avoiding possible hazardous center strip.
3. Check to left for possible escape paths should an emergency arise (defensive driving).
4. After passing, signal to pull in.
5. Before pulling in, the cyclist should turn his head to check that the passed vehicle is far enough behind to allow him to return to the lane without obstructing that vehicle's progress.
6. Return to the left tire track and proceed.

Two Motorcycles:

1.	Cycle #1	Check traffic and signal.
2.	Cycle #1	Proceed to pass.
	Cycle #2	Switch from right tire track to left tire track (better visibility).
3.	Cycle #1	Complete pass, returning to left tire track.
4.	Cycle #2	Proceed to pass (same procedure as Cycle #1).
	Cycle #1	Switch from left tire track to right tire track.

5. Cycle #2 — Complete pass, returning to left tire track.

6. Cycle #2 — Pull slightly ahead of Cycle #1, completing the pass and reversal of positions.

Setting

1. Four lane divided highway.
2. Dry pavement.
3. Sun shining.
4. Motorcycle lights on.
5. Small car to be passed.
6. Speed--40-55 mph.

Camera Position

1. Tailgate of station wagon.

Special Notations

1. Two motorcycles--350 cc or larger.
2. Police clearance for film shooting on roadway.
3. Contrasting second motorcycle.
4. Zoom lens.

Special Hazards

General Comments

Any change in the road surface constitutes a potential hazard to the motorcyclist. Even going from a cement surface to a black top may momentarily cause the cyclist some uncertainty. Some examples of more hazardous changes in road surfaces include metal surfaces (railroad

tracks, sewer lids, bridge gratings), loose surfaces (broken pavement, gravel, sand, dirt), and slippery surfaces (wet, oily, snowy, icy, leaf covered). It is always best to avoid riding on these hazardous surfaces, but not always possible. When the cyclist cannot avoid the hazard, he should slow down, try to meet the hazardous surface head-on (i.e., at 90° angle), try to keep his motorcycle as upright as possible, and once on the hazard, try not to change direction or speed. When the hazard is a pot hole or a bump, the cyclist, if proceeding at low or moderate speeds, can reduce the impact of the initial contact by standing on the motorcycle pegs (thus raising slightly off the seat) and using his legs as shock absorbers.

Another type of road condition which must be classified as a hazard is terrain that obstructs visibility, such as hills and curves. These road conditions are hazardous because they block the cyclist's view of the oncoming traffic. To minimize these hazards, the cyclist should switch his normal riding position from the left tire track to the right tire track to allow for oncoming traffic which might drift over into the cyclist's lane. This safety precaution should also be used during fog, rain, snow, and any other situation in which visibility is obstructed. NOTE: It is critical under these conditions to have your lights on to make the motorcycle more visible and to be extra alert for potential hazards on the right side of the road.

Task

1. Single vehicle maneuvers involving potentially hazardous situations.

Objectives

1. Demonstrate correct method of crossing railroad tracks.
2. Illustrate the safe method of turning onto a slippery surface.
3. Show danger of cornering.
4. Illustrate proper procedure for returning to pavement with a significant lip at the road edge.
5. Demonstrate appropriate procedure for riding up a hill or around a curve.
6. Show proper method of carrying a second passenger.

Instructional Points

Railroad Tracks:

1. Check both vehicle and rail traffic (note cyclist turning his head to check vehicle traffic).
2. Signal to slow down.
3. Prepare to cross the tracks as close to a right angle as the flow of traffic permits to minimize the effects of the slippery surface and to avoid having the wheels catch in the depression surrounding the rails.
4. Return to the left tire track after crossing.

Gravel:

1. Check traffic and signal to slow down.
2. Approach the gravel in a straight line (and therefore with the motorcycle in an upright position).

Returning to Pavement:

1. When proceeding into the turn, glance ahead for unexpected pavement hazards such as dirt, sand and gravel.
2. If your motorcycle leaves the pavement:
   a. proceed off the road, slowing down gradually
   b. gain control
   c. check traffic and return to pavement, taking care not to catch the front wheel on the pavement edge.

Obstructed Visibility:

1. Move from left tire track to right tire track.

Two Riders:

1. Provide passengers with helmet, eye protection. and other protective gear in accordance with New Jersey law.
2. Require passenger to put feet on the footrests (no sidesaddle riding).
3. Require passenger to hold on and instruct passenger to lean with operator on curves.

Setting

1. Railroad tracks not crossing roadway at ninety degrees.
2. Stone driveway.
3. Intersection with sand and gravel at turning point. Also, sharp shoulder onto which turn is to be made.

4. Steep hill offering no visibility beyond crest.
5. Sharp curve with very limited visibility ahead of motorcycle.

Camera Position

1. Front hood of vehicle for railroad crossing, hill and curve.
2. Stationary for intersection and driveway turn.
3. Closing scene of two riders taken from the side at stationary position.

Special Notations

1. Two riders and protective gear.
2. Police clearance needed for roadside scenes.
3. Traffic spotter needed.
4. High boots to be worn.

Program Goals

When this program was instituted, the Governor's Representative for Highway Safety established two primary goals. These were: (1) reduce motorcycle fatalities, and (2) reach 100 per cent of the new motorcyclists.

To implement these goals, the program was installed in three hundred twenty high schools and every Driver Qualification Center.

High School Implementation

It was decided to place the program in every New Jersey public and private high school which would agree to incorporate the materials into their driver education program. One hundred forty-seven secondary schools chose not to incorporate the program into their existing

driver education curriculum. Placement in the high schools' programs was made because it was felt that the driver education teacher holding a New Jersey driver education teaching endorsement was the only choice and most logical choice to most effectively teach the concepts and knowledge being presented. The attendant class discussions and sub-group interactions ensured a higher level of understanding and acceptance of the skills relevant to the reduction of motorcycle fatalities.

A serious weakness in the high school implementation, however, was that some students were not taking driver education, and older motorcycle license applicants, who had already graduated from high school, would also not be exposed to the material.

Driver Qualification Center Implementation

As a result of the limitations in the high school implementation, the program was installed at all nineteen Driver Qualification Centers across the state. Since New Jersey has a single license concept for motorcycle operators, the installation ensured the satisfaction of the second goal of 100 per cent coverage. It was felt that, although the program might not be as effective when viewed individually as when viewed during groups and having group discussions, nevertheless, for those who had not seen the material before, there would still be a substantial learning experience. For those who had seen the loops in the classroom, the second viewing would serve as additional reinforcement. Additionally, the seventeen page supporting manual was distributed at the Driver Qualification Centers. This manual provided another review for added long-term recall, and allowed

the license applicant to prepare for the written examination for his motorcycle permit. Further, the motorcycle license examination was rewritten to correspond to the film loop program.[62] The total cost of the program, which included twenty-one projectors and cases, twenty-five film loop sets, and fifty thousand supporting manuals, amounted to $10,000. Toward the end of the first year in operation, additional costs of $500 were incurred to replace expended projector lamps.

Selection of the Experimental Design

The treatment of the data utilized a design known as one group time-series experiment. In essence, the time-series design methodology is the presence of a periodic and equivalent sample of the universe which would provide a baseline against which to compare the effects of the experiment variables during a comparable period of time.[63] The selection of the one group time-series design was made after consulting with a research consultant employed by Michigan State University, Office of Research Consultation. It was mutually determined that the selected experimental design offered the least threat of a non-valid conclusion.[64]

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[62]Letter, William M. Fitzmaurice, Lt. (New Jersey Division of Motor Vehicles Enforcement Bureau) to Louis R. De Carolis (Manager, New Jersey Office of Highway Safety), March 20, 1974.

[63]Donald T. Campbell and Julian C. Stanley, Experimental and Quasi-Experimental Designs for Research on Teaching (Chicago: Rand McNally and Company, 1963), pp. 171-246.

[64]Letter, Robert A. Carr (Research Consultant with Michigan State University School for Advanced Studies) to Louis R. De Carolis, August 1, 1973.

Procedure for Data Collection

The design of the study was to collect fatality data and numbers of new motorcycle licensees, by quarters, beginning January 1, 1971, and ending on December 31, 1973. The data was gathered under the form headings as shown in Figure 3.1 below and was summarized in the matrix shown in Figure 3.2.

Motorcyclist Number	Time of Fatality			Birth Date	Driver License No.	License First Issued		
	Month	Day	Year			Month	Day	Year

Figure 3.1.--Raw data form.

Each square of this matrix (Figure 3.2) contained the following information:

1. The number of fatalities in the quarter.
2. The number of new licensees in the quarter.
3. The fatality rate for each quarter calculated by dividing the number of fatal crashes by the number of one thousand new licenses issued for the quarter.

The procedure for collecting and recording the data was conducted in the following manner. First, a manual search was performed on all New Jersey Motor Vehicles fatal crashes during the study time period. This involved the handling of approximately four thousand fatal

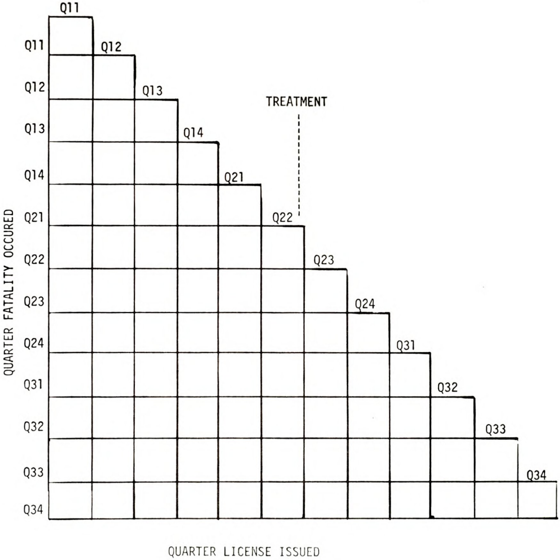

Figure 3.2.--Matrix.

crash cases. From these cases, 169 motorcycle fatal files were extracted. Upon reviewing each file, the specific data was transposed onto the Raw Data Form. At all times, the names of each case and each individual's association to the case were kept confidential with the highest priority. This close guardianship of the fatality records was necessitated by New Jersey State law.[65]

All of the information regarding each fatality was found within the records of the Bureau of Accident Records and Research, Department of Transportation. Prior clearance to review these documents was obtained from Department of Transportation official, Mr. D. W. Gwynn, Director, Division of Research and Development.

Second, from the Raw Data Sheet, the license numbers of the motorcyclists were checked against the Division of Motor Vehicles records in order to disclose if they had indeed received their licenses during the thirty-six month study period. This function of the data-gathering procedure was completed by reviewing numerous microfilms depicting new motorcycle licensee applications. In this manner, the exact date on which the first motorcycle license was issued was determined. When the information was located, it was recorded on the Raw Data Sheet. For many fatalities, it was found that, although the fatality occurred during the study period, the first motorcycle license was issued prior to January 1, 1971. Also, several fatalities had no

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[65] New Jersey Department of Law and Public Safety, Division of Motor Vehicles, Motor Vehicles and Traffic Regulations, Title 39 of the Revised Statutes (Trenton: New Jersey Department of Law and Public Safety, Division of Motor Vehicles, October, 1971), p. 69.

original motorcycle license application due to the fact that they were operating the two-wheel vehicle with no motorcycle license.

Third, an inquiry with the New Jersey Division of Motor Vehicles provided the total number of new motorcycle licenses issued during each month of the thirty-six month period. This information, and the number of fatalities for those who received their first motorcycle license during the study period, were then recorded in the matrix. With these two pieces of information, a fatality crash rate was calculated.

Treatment of Data

The fourth step involved a comparison of the fatality rates over the 18 months following treatment with corresponding data from the 18 months prior to treatment to determine the overall effect of the treatment over the entire 36 months of the study as required by Hypothesis 1. The data was presented in Table 3.1 (see page 56). The table presents the number of quarters being compared, the total number of licenses issued over the entire 18 month pre-treatment and 18 month post-treatment study periods, the total number of fatalities for the same study periods, and finally, the corresponding fatality rates. For each of these comparison categories, the difference between the pre- and post-treatment periods is shown, and the per cent difference is calculated.

The selection of quarters for comparison was determined by the available post-treatment quarters of data. For each post-treatment quarter, the corresponding pre-treatment quarter was selected. The

TABLE 3.1.--Six-quarter summary comparison of pre- and post-treatment data.

	Pre-treatment Group	Post-treatment Group	Difference	% Difference
Number of Quarters				
Total Number of Licenses Issued				
Total Number of Fatalities				
Fatality Rate				

corresponding quarters selected are outlined in the matrix presented in Figure 3.3 (page 57).

The pre- and post-quarter selections were based on the following two assumptions:

1. The first quarter fatality rates were relatively comparable to fourth quarter fatality rates.
2. The second quarter fatality rates were relatively comparable to third quarter fatality rates.

These assumptions were made because license acquisitions were relatively high for the second and third quarters, and relatively low for the first and fourth quarters.

The pre- and post-treatment fatality rates were then compared to determine if, at the .05 level of confidence, there was a statistically significant difference. For the purpose of the statistical calculation only, this comparison took the form of assuming the null

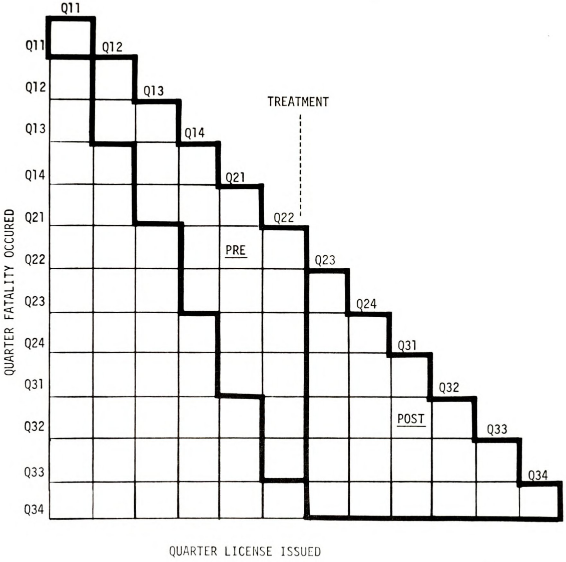

Figure 3.3.--Corresponding quarters matrix.

hypothesis that the pre- and post-treatment fatality rates were not different, and applying the following statistical test for differences between proportions to verify the validity or invalidity of the null hypothesis:[66]

$$Z = \frac{\hat{P}_1 - \hat{P}_2}{\sqrt{\frac{\hat{P}_1\,(1-\hat{P}_1)}{N_1} + \frac{\hat{P}_2\,(1-\hat{P}_2)}{N_2}}}$$

where $\hat{P}_1$ = the pre-treatment fatalities divided by the pre-treatment population,

$\hat{P}_2$ = the post-treatment fatalities divided by the post-treatment population,

N_1 = pre-treatment population, and

N_2 = post-treatment population.

The fifth step involved a seasonally identical comparison of the fatality rates over a 12 month period, the maximum period possible for identical period comparison, to determine if a significant reduction in the fatality rate was achieved as a result of the treatment. This comparison was made to determine if the seasonal assumptions made in the fourth step comparison led to an erroneous conclusion as to the effectiveness of the treatment.

The data was presented in Table 3.2 shown on page 59. This table presents the number of quarters being compared, the total number

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[66] John E. Freund, ed., Modern Elementary Statistics (Englewood Cliffs, N.J.: Prentice-Hall, 1962).

TABLE 3.2.--Four-quarter summary comparison of pre- and post-treatment data.

	Pre-treatment Group	Post-treatment Group	Difference	% Difference
Number of Quarters				
Total Number of Licenses Issued				
Total Number of Fatalities				
Fatality Rate				

of licenses issued over the 12 month pre-treatment period and the 12 month post-treatment period, the total number of fatalities for the same study periods, and finally, the corresponding fatality rates. For each of these comparison categories, the differences between the pre- and post-treatment periods is shown, and the per cent difference is calculated. The seasonally identical quarters selected are outlined in the matrix presented in Figure 3.4.

The pre- and post-treatment fatality rates were then compared for statistical significance, using the identical procedures outlined in the fourth step.

The sixth step involved transposing the calculated rates from the matrix as shown in Figure 3.2 to a graphic display as shown in Figure 3.5 on page 61. The plotted fatality rates represented licensees who held their licenses for the same length of time, both during the pre- and post-treatment periods.

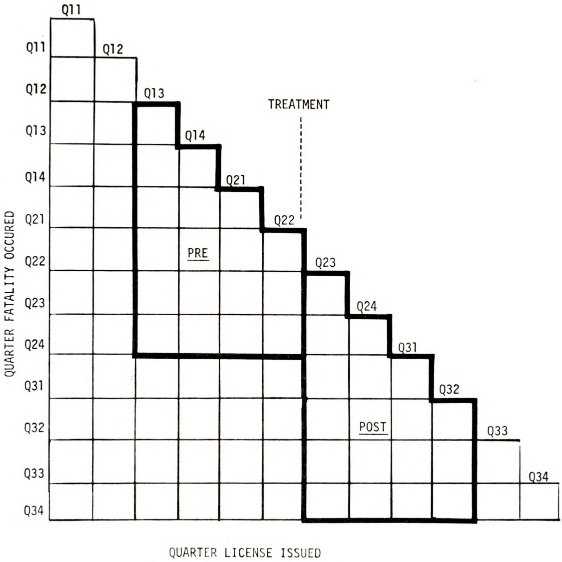


Figure 3.4.--Seasonally identical quarters matrix.

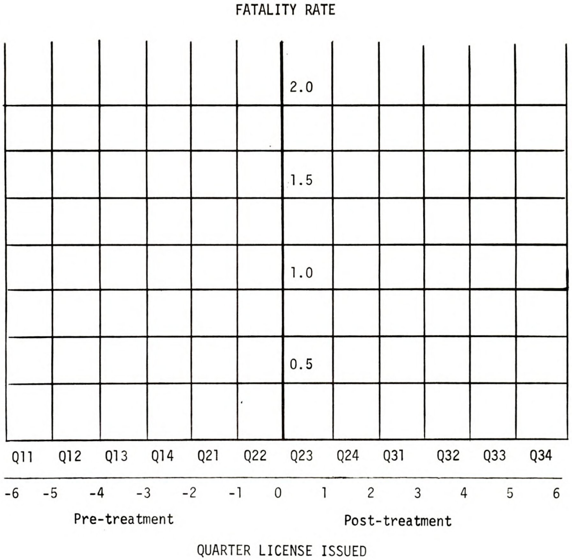


Figure 3.5.--Calculated rates graph.

It was necessary to have separate graphs to plot rates for those licensees who held their licenses from one to three months, four to six months, seven to nine months, and ten to twelve months. Graphs are not shown for the thirteen to fifteen months and sixteen to eighteen months because it was determined there would be only two points and one point of data respectively, after treatment, thus not providing sufficient information for analysis. The Michigan State University research consultant was advised of this step and concurred.

For each quarter, regression lines were fitted to the data plotted before treatment and to the data plotted after treatment. The mathematical technique to be used to fit the regression lines was the Criterion of Least Squares formulas shown below.

Formula #1 $$\hat{\beta}_1 = \frac{\sum_{i=1}^{N_1} (X_i Z_i) - N_1 \overline{X}_1 \overline{Z}_1}{\sum_{i=1}^{N_1} (Z_1^2) - N_1 (\overline{Z}_1)^2}$$

Formula #2 $$\hat{\alpha}_1 = \overline{X}_1 - {}_1\overline{Z}_1$$

The value $\hat{\beta}$ represents the slope of the line in the equation for a straight line $X_i = \hat{\beta}_1 Z_i + \hat{\alpha}_1$ and $\hat{\alpha}_1$ is the X_i intercept. The slope of each line indicates the trend of the fatality rate. The intercept of each line indicates the level of the fatality rate.

For each graph, the slope and intercept values for the line before and the line after treatment were then compared to determine if, at the .05 level of confidence, there was a statistically significant difference. For the purpose of the statistical calculation only, It was necessary

those licensees who

to six months.

are

this comparison took the form of assuming the null hypothesis that they were not different, and applying the following statistical test to verify the validity or invalidity of the null hypothesis:

$$t_1 = \frac{\hat{\beta}_1 - \hat{\beta}_2}{\sqrt{\dfrac{1}{\sum\limits_{i=1}^{n_1}(Z_i-\bar{Z}_1)^2} + \dfrac{1}{\sum\limits_{j=1}^{n_2}(Z_j-\bar{Z}_2)^2}}} \cdot \sqrt{\frac{n_1 + n_2 - 4}{\left[\sum\limits_{i=1}^{n_1}(X_i-\hat{\alpha}_1-\hat{\beta}_1 Z_i)^2\right] + \left[\sum\limits_{j=1}^{n_2}(X_j-\hat{\alpha}_2-\hat{\beta}_2 Z_j)^2\right]}}$$

$$t_2 = \frac{\hat{\alpha}_1 - \hat{\alpha}_2}{\sqrt{\dfrac{\sum\limits_{i=1}^{n_1}(Z_i^2)}{n_1\sum\limits_{i=1}^{n_1}(Z_i-\bar{Z}_1)^2} + \dfrac{\sum\limits_{j=1}^{n_2}(Z_j^2)}{n_2\sum\limits_{j=1}^{n_2}(Z_j-\bar{Z}_2)^2}}} \cdot \sqrt{\frac{n_1 + n_2 - 4}{\left[\sum\limits_{i=1}^{n_1}(X_1-\hat{\alpha}_1-\hat{\beta}_1 Z_i)^2\right] + \left[\sum\limits_{j=1}^{n_2}(X_j-\hat{\alpha}_2-\hat{\beta}_2 Z_j)^2\right]}}$$

Through the foregoing steps, 4, 5, and 6, Hypothesis 1 and Subordinate Hypotheses 1a and 1b, respectively, were tested.

Hypotheses

The hypotheses for this study were:

Hypothesis 1

The viewing of the motorcycle film loops and the studying of the corresponding supporting manual by all New Jersey applicants for a motorcycle driver license will significantly reduce the rate of motorcycle fatalities in the experimental group over an eighteen month study period.

Subordinate Hypothesis 1a

The viewing of the motorcycle film loops and the studying of the corresponding supporting manual by all New Jersey applicants for a motorcycle driver license will significantly reduce the rate of motorcycle fatalities in the experimental group over a seasonally identical twelve month study period.

Subordinate Hypothesis 1b

The viewing of the motorcycle film loops and the studying of the corresponding supporting manual by all New Jersey applicants for a motorcycle driver license will significantly reduce the rate of motorcycle fatalities in the experimental groups holding their licenses for 1-3 months, 4-6 months, 7-9 months, and 10-12 months during the study period from January 1, 1971 through December 31, 1973.

Hypothesis 2

The introduction of the educational materials will reduce the effect of experience on the fatality rate by resulting in fatality rates for beginning motorcyclists which are equal to those for more experienced motorcyclists who did not receive the training.

Study of Variables

Treatment

Figure 3.6 lists and describes all of the variables, other than the test variable, which could have affected the number of fatalities occurring in the three years covered in the study. Each of these variables was reviewed in the study to determine if there was a significant change which might have affected the data.

The first step in accounting for each variable was to direct specific letters to the individual or agency who would have a statewide knowledge of the variable's status, and if any change was noted, its impact on motorcycle fatality experience during the study period. Upon receipt of a reply, a determination was made whether to pursue the variable further or to accept the authority's explanation.

Since there were no significant changes indicated in this investigation process, the results of the data treatment remained as calculated.

List of Variables	Investigation Source
I. Introduction of new motorcycle driver education materials in the following areas:	
1. Secondary classroom.	Department of Education
2. Motorcycle dealer programs.	New Jersey Motorcycle Industry Council
3. Commercial driver education programs.	New Jersey Commercial Driving School Association
4. Driver improvement schools.	Division of Motor Vehicles
5. Adult driver education programs.	Department of Education
6. Mass communication campaign.	Office of Highway Safety
II. Changes in the New Jersey motorcycle operator population between pre-treatment and post-treatment group.	
1. Shift in the age distribution between the post- and pre-treatment groups.	Division of Motor Vehicles
2. Change in the ratio of male/female licensees in the pre-treatment group compared to the post-treatment group.	Division of Motor Vehicles
3. Shift in the marital status between the pre-treatment and post-treatment groups.	Division of Motor Vehicles
III. Changes in New Jersey Motor Vehicle legal requirements to operate a motorcycle between the pre-treatment groups and the post-treatment groups.	
1. Changes in the physical requirements of the motorcycle as related to safety.	Division of Motor Vehicles
2. Changes in the required protective wearing apparel for the motorcyclist.	Division of Motor Vehicles
3. Changes in motorcycle drivers' license examinations, both written and oral, and the driving test.	Division of Motor Vehicles
4. Changes in traffic enforcement emphasis toward motorcycle operators in New Jersey law enforcement agencies, including police emphasis and legal penalty range under the law.	New Jersey Police Traffic Officers Association
IV. Changes in the physical characteristics of the motorcycle as related to safety between the pre-treatment and post-treatment groups.	Division of Motor Vehicles
V. Changes in the availability of emergency medical services during the pre-treatment period as compared to the post-treatment period.	
1. Changes in the number of rescue squad units in New Jersey.	Office of Emergency Medical Services
2. Changes in equipment on emergency rescue vehicles.	Office of Emergency Medical Services
VI. Changes in road conditions during the post-treatment period as compared to the pre-treatment period.	
1. Change in available monies for highway maintenance.	Department of Transportation
2. Drastic changes in weather conditions between pre-treatment and post-treatment periods.	U.S. Department of Commerce, National Oceanic and Atmospheric Administration
VII. Changes in the accident reporting system during the study period.	New Jersey Traffic Records Task Force

Figure 3.6.--List of variables.

Summary

In Chapter III, the need for the development of the five film-loop series was presented. The chapter related in detail the program design. Each of the five film loops was described under the headings of: General Comments, Tasks, Objectives, Instructional Points, Settings, Camera Positions, and Special Notations.

Final sections of this chapter described the selection of the experimental design, procedure for data collection and analysis. The study variables were also listed in this third chapter.

In the following chapter the findings of this study are presented. Included are: (1) resulting summary data based on the collection of all motorcycle fatalities for 1971, 1972, and 1973; (2) data used to identify those motorcycle fatalities occurring during 1971, 1972, and 1973 where motorcycle licenses were granted during the same years; (3) the number of new motorcycle licenses issued during each of the 36 months of the study period; (4) placement of data within the matrix; (5) development of the fatality rates; (6) comparison of data for Hypothesis 1 and Subordinate Hypotheses 1a and 1b; (7) statistical analysis of the data; (8) review of variables; and (9) comparison of data for Hypothesis 2.

CHAPTER IV

ANALYSIS OF THE DATA

The design and methodology of this study were presented in the preceding chapter; in this chapter, an analysis of the data is presented. The chapter is organized into the following sections: (1) resulting summary data based on the collection of all motorcycle fatalities for 1971, 1972, and 1973; (2) data used to identify those motorcycle fatalities occurring during 1971, 1972, and 1973 where motorcycle licenses were granted during the same years; (3) the number of new motorcycle licenses issued during each of the 36 months of the study period; (4) placement of data within the matrix; (5) development of the fatality rates; (6) comparison of data for Hypotheses 1, 1a, and 1b; (7) statistical analysis of the data; (8) review of variables; and (9) comparison of data for Hypothesis 2, showing average rates for motorcyclists receiving and holding licenses during identical time period.

Resulting Summary Data Based on the Collection of All Motorcycle Fatalities for 1971, 1972, and 1973

The collection of the data was initiated at the New Jersey Department of Transportation, Division of Research and Development. For the study years of 1971, 1972, and 1973, all 3,988 New Jersey motor vehicle fatality reports were reviewed. During the review, each of the

motorcycle fatalities occurring during the study period was extracted and copied. The results are summarized on the raw data form in Appendix A in a manner maintaining the needed confidentiality of each motorcycle fatality as required by New Jersey State Motor Vehicle law.

Data Used to Identify Those Motorcycle Fatalities Occurring During 1971, 1972, and 1973 Where Motorcycle Licenses Were Granted During the Same Years

The raw data form was taken to the New Jersey Division of Motor Vehicles where each motorcycle license number was used to gain access to the original motorcycle licenses application stored on microfilm. This procedure was used to determine which of the 169 motorcycle operators involved in fatal crashes had received their initial licenses during the study period. This inquiry produced a list of 87 persons who did receive their initial motorcycle driver's licenses during the study period, including a record of the actual date of issuance. The list is contained in Appendix B.

The Number of New Motorcycle Licenses Issued During Each of the Twelve Quarters of the Study Period

The New Jersey Division of Motor Vehicles also provided the total number of new motorcycle licenses issued during each of the twelve quarters of the study period. The results are recorded in Table 4.1 by quarter and year.

Placement of Data Within the Matrix

The motorcyclists who received their licenses during the study period and then were involved in fatal motorcycle crashes during that same period of time were then placed in the appropriate quarters in the

TABLE 4.1.--The number of new motorcycle licenses issued during each of the twelve quarters of the study period.

Quarter	Year	Total Number of New Motorcycle Licenses Issued
1st	1971	1,855
2nd	1971	9,341
3rd	1971	7,376
4th	1971	2,209
1st	1972	1,695
2nd	1972	9,991
3rd	1972	7,146
4th	1972	1,849
1st	1973	2,329
2nd	1973	9,509
3rd	1973	6,465
4th	1973	2,332

matrix. Additionally, the total number of new motorcycle licenses issued was placed in the appropriate matrix locations. The completed data matrix is presented in Figure 4.1. In this matrix the first group of numbers are individually numbered fatalities while the number on the last line reports new motorcycle licenses issued for that quarter.

QUARTER LICENSE ISSUED

QUARTER FATALITY OCCURED

	1st Qtr. 1971	2nd Qtr. 1971	3rd Qtr. 1971	4th Qtr. 1971	1st Qtr. 1972	2nd Qtr. 1972	3rd Qtr. 1972	4th Qtr. 1972	1st Qtr. 1973	2nd Qtr. 1973	3rd Qtr. 1973	4th Qtr. 1973
1st Qtr. 1971	2,3,6 1855											
2nd Qtr. 1971	1855	10,16,19 20,21,23 9341										
3rd Qtr. 1971	1855	24,26,30 32,34,37 9341	28,38 7376									
4th Qtr. 1971	1855	9341	7376	42,49,50 2209		TREATMENT						
1st Qtr. 1972	1855	9341	52 7376	2209	51 1695							
2nd Qtr. 1972	1855	56,58 9341	7376	60 2209	59,63 1695	62,64,65 66,67 9991						
3rd Qtr. 1972	1855	79,102 9341	71,72,80 7376	89,104 2209	85,90,91 1695	75,78,81 87,101, 105 9991	92,93, 94,95 7146					
4th Qtr. 1972	1855	107 9341	106,110 7376	2209	1695	112 9991	7146	111 1849				
1st Qtr. 1973	1855	9341	7376	2209	1695	9991	7146	116 1849				
2nd Qtr. 1973	131 1855	9341	134,136, 138 7376	2209	1695	127 9991	7146	1849	119 2329	120,129 130,133 135,139 9509		
3rd Qtr. 1973	1855	9341	164 7376	163 2209	150 1695	145 9991	149,162 7146	1849	2329	147,148 152 9509	143,151 153,156 161 6465	
4th Qtr. 1973	1855	166 9341	7376	2209	1695	169 9991	168 7146	1849	2329	9509	6465	2332

Note: The first group of numbers is individually numbered fatalities while the number on the last lir reports new motorcycle licenses issued for that quarter.

Figure 4.1.--Placement of data within matrix.

Development of the Fatality Rates

After the 87 individual motorcycle fatalities were properly entered into the matrix along with the total number of new motorcycle licenses issued for each quarter, a fatality crash rate was calculated. The rate was calculated in order to develop comparable figures for all quarters under study. It adjusts for varying numbers of new motorcycle licenses issued per quarter. The following calculation illustrates the derivation of the rate for the third quarter, 1973:

$$\text{Fatality Rate} = \frac{\text{\# of Fatals in 3rd Quarter, 1973}}{\text{1,000 new licenses issued in 3rd quarter, 1973}}$$

$$\text{Fatality Rate} = \frac{\text{5 Fatals}}{\text{6.465 1,000 licenses issued}}$$

$$\text{Fatality Rate} = 0.77$$

This calculation was made for each quarter and entered into the matrix. The completed matrix is shown in Figure 4.2. In this matrix, the first group of numbers are the individually numbered fatalities. The second line reports motorcycle licenses issued for that quarter, while on the last line, developed motorcycle fatalities rates are shown.

Comparison of the Data for Hypothesis 1 Over the 18 Months Before and After Treatment

In Table 4.2 (on page 73) a comparison of the fatality rates over the 18 months following treatment with corresponding data from the 18 months prior to treatment is presented to determine the overall

QUARTER FATALITY OCCURED \ QUARTER LICENSE ISSUED	1st Qtr. 1971	2nd Qtr. 1971	3rd Qtr. 1971	4th Qtr. 1971	1st Qtr. 1972	2nd Qtr. 1972	3rd Qtr. 1972	4th Qtr. 1972	1st Qtr. 1973	2nd Qtr. 1973	3rd Qtr. 1973	4th Qtr. 1973
1st Qtr. 1971	2,3,6 1855 1.62											
2nd Qtr. 1971		10,16,19, 20,21,23 9341 0.64										
3rd Qtr. 1971		24,26,30 32,34,37 9341 0.64	28,38 7376 0.27									
4th Qtr. 1971				42,49, 50 2209 1.36		TREATMENT						
1st Qtr. 1972			52 7376 0.14		51 1695 0.59							
2nd Qtr. 1972		56,58 9341 0.21		60 2209 0.45	59,63 1695 1.18	62,64,65 66,67 9991 0.50						
3rd Qtr. 1972		79, 102 9341 0.32	71,72,80 7376 0.41	89,104 2209 0.91	85,90,91 1695 1.77	75,78,81 87, 101, 105 9991 0.60	92,93, 94,95 7146 0.56					
4th Qtr. 1972		107 9341 0.11	106,110 7376 0.27			112 9991 0.10		111 1849 0.54				
1st Qtr. 1973								116 1849 0.54				
2nd Qtr. 1973	131 1855 0.54		134,136 138 7376 0.41			127 9991 0.10			119 2329 0.43	120,129 130,133 135,139 9509 0.63		
3rd Qtr. 1973			164 7376 0.14	163 2209 0.45	150 1695 0.59	145 9991 0.10	149,162 7146 0.28			147,148 152 9509 0.32	143,151 153,156 161 6465 0.77	
4th Qtr. 1973		166 9341 0.11				169 9991 0.10	168 7146 0.14					2332 0.00

Note: The first group of numbers is the individually numbered fatalities. The second line reports new motorcycle licenses issued for that quarter, while on the last line, developed motorcycle fatalities rates are shown.

Figure 4.2.--Calculated rates matrix.

TABLE 4.2.--Eighteen month summary comparison of pre- and post-treatment data.

	Pre-treatment Group	Post-treatment Group	Difference	% Difference
Number of Quarters	21	21	0	0%
Total Number of Licenses Issued	32,467	29,630	2,837	-8.7%
Total Number of Fatalities	44	24	20	-45.5%
Overall Fatality Rate	1.36	.81	.55	-40.4%

effect of the treatment over the entire 36 months of the study as required by Hypothesis 1.

The table presents the number of quarters being compared, the total number of licenses issued over the entire 18 month pre-treatment and 18 month post-treatment study periods, the total number of fatalities for the same study periods, and, finally, the corresponding fatality rates. For each of these comparison categories, the difference between the pre- and post-treatment periods is shown and the per cent difference is calculated.

This table indicates that the total number of licenses issued dropped 2,837 (-8.7%) from the pre- to the post-treatment period. Motorcycle fatalities, however, decreased by 20 for a 45.5% reduction and the motorcycle death rate decreased by .55 for a reduction of 40.4%. This reduction in the fatality rate was tested for statistical

TABLE 4.2.--Eighteen month summary
data

(see

Number

significant at the .05 confidence level. The statustical test showed that the result was, in fact, significant at the .05 confidence level (see Appendix C). Thus, Hypothesis 1 was accepted.

The 21 pre- and 21 post-quarters summarized in Table 4.2 are outlined in the matrix presented in Figure 4.3. In this matrix the first group of numbers is the individually numbered fatalities. The second line reports new motorcycle licenses issued for that quarter, while on the last line, developed motorcycle fatality rates are shown.

Comparison of the Data for Subordinate Hypothesis 1a Over Seasonally Identical 12 Month Pre- and Post-Periods

In Table 4.3, a seasonally identical comparison of the fatality rates over a 12 month period, the maximum period possible for identical period comparison, is presented to determine if a significant reduction in the fatality rate was achieved as a result of the treatment. This

TABLE 4.3.--Twelve month summary comparison of pre- and post-treatment data.

	Pre-treatment Group	Post-treatment Group	Difference	% Difference
Number of Quarters	18	18	0	0%
Total Number of Licenses Issued	21,271	20,833	438	-2.0%
Total Number of Fatalities	32	19	13	-40.6%
Fatality Rate	1.50	0.91	0.59	-39.3%

QUARTER LICENSE ISSUED

QUARTER FATALITY OCCURED	1st Qtr. 1971	2nd Qtr. 1971	3rd Qtr. 1971	4th Qtr. 1971	1st Qtr. 1972	2nd Qtr. 1972	3rd Qtr. 1972	4th Qtr. 1972	1st Qtr. 1973	2nd Qtr. 1973	3rd Qtr. 1973	4th Qtr. 1973
1st Qtr. 1971	2,3,6 1855 1.62											
2nd Qtr. 1971		10,16,19 20,21,23 9341 0.64										
3rd Qtr. 1971		24,26,30 32,34,37 9341 0.64	28,38 7376 0.27									
4th Qtr. 1971				42,49, 50 2209 1.36		TREATMENT						
1st Qtr. 1972			52 7376 0.14	PRE	51 1695 0.59							
2nd Qtr. 1972		56,58 9341 0.21		60 2209 0.45	59,63 1695 1.18	62,64,65 66,67 9991 0.50						
3rd Qtr. 1972		79,102 9341 0.21	71,72,80 7376 0.41	89,104 2209 0.91	85,90,91 1695 1.77	75,78,81 87, 101,105 9991 0.60	92,93, 94,95 7146 0.56					
4th Qtr. 1972		107 9341 0.11	106,110 7376 0.27			112, 9991 0.10		111, 1849 0.54				
1st Qtr. 1973								116 1849 0.54				
2nd Qtr. 1973	131 1855 0.54		134,136 138 7376 0.41			127 9991 0.10			119 2329 0.43	120,129 130,133 135,139 9509 0.63		
3rd Qtr. 1973			164 7376 0.14	163 2209 0.45	150 1695 0.59	145 9991 0.10	149,162 7146 0.28	POST		147,148 152 9509 0.32	143,151 153,156 161 6465 0.77	
4th Qtr. 1973		166 9341 0.11				169 9991 0.10	168 7146 0.14					2332 0.00

Note: The first group of numbers is the individually numbered fatalities. The second line reports new motorcycle licenses issued for that quarter, while on the last line, developed motorcycle fatality rates are shown.

Figure 4.3.--18 months pre- and post-treatment outlined matrix.

table presents the number of licenses issued over the 12 month pre-treatment period and the 12 month post-treatment period, the total number of fatalities for the same study periods, and, finally, the corresponding fatality rates. For each of these comparison categories, the difference between the pre- and post-treatment periods is shown, and the per cent difference is calculated.

This table shows that the fatality rate dropped by 39.3% after treatment was initiated when measured over a 12 month period. This reduction in the fatality rate was tested at the .05 confidence level. The statistical test showed that the results were, in fact, significant at the .05 confidence level (see Appendix D). Thus, Hypothesis 1a was accepted.

The 18 pre- and 18 post-quarters summarized in Table 4.3 are outlined in the matrix presented in Figure 4.4 that follows. In this matrix the first group of numbers represents the individually numbered fatalities. The second line reports new motorcycle licenses issued for that quarter, while on the last line quarterly motorcycle fatality rates are shown.

Comparison of the Data for Subordinate Hypothesis 1b Showing Average Rates for Motorcyclists Receiving Licenses During Identical Time Periods

In the following Tables 4.4, 4.5, 4.6, and 4.7, the fatality rates for licensees holding their licenses for 1-3 months, 4-6 months, 7-9 months, and 10-12 months, respectively, are presented. Each table shows the six quarters before treatment and the corresponding quarters after treatment. An average fatality rate was calculated for the pre-treatment quarters and the post-treatment quarters for each of the

QUARTER LICENSE ISSUED

QUARTER FATALITY OCCURED	1st Qtr. 1971	2nd Qtr. 1971	3rd Qtr. 1971	4th Qtr. 1971	1st Qtr. 1972	2nd Qtr. 1972	3rd Qtr. 1972	4th Qtr. 1972	1st Qtr. 1973	2nd Qtr. 1973	3rd Qtr. 1973	4th Qtr. 1973
1st Qtr. 1971	2,3,6 1855 1.62											
2nd Qtr. 1971		10,16,17, 20,21,23, 9341 0.64										
3rd Qtr. 1971		24,26,30, 32,34,37 9341 0.64	28,38 7376 0.27			TREATMENT						
4th Qtr. 1971				42,49, 50 2209 1.36								
1st Qtr. 1972			52 7376 0.14	PRE	51 1695 0.59							
2nd Qtr. 1972		56,58 9341 0.21		60 2209 0.45	59,63 1695 1.18	62,64,65 66,67 9991 0.50						
3rd Qtr. 1972		79,102 9341 0.21	71,72,80 7376 0.41	89,104 2209 0.91	85,90,91 1695 1.77	75,78,81 87,101 105 9991 0.60	92,93,94 95 7146 0.56					
4th Qtr. 1972		107 9341 0.11	106,110 7376 0.27			112 9991 0.10		111 1849 0.54				
1st Qtr. 1973								116 1849 0.54				
2nd Qtr. 1973	131 1855 0.54		134,136 138 7376 0.41			127 9991 0.10		POST	119 2329 0.43	120,129 130,133 135,139 9509 0.63		
3rd Qtr. 1973			164 7376 0.14	163 2209 0.45	150 1695 0.59	145 9991 0.10	149,162 7146 0.28			147,148 152 9509 0.32	143,151 153,156 161 6465 0.77	
4th Qtr. 1973		166 9341 0.11				169 9991 0.10	168 7146 0.14					2332 0.00

Note: The first group of numbers are the individually numbered fatalities. The second line reports new motorcycle licenses issued for that quarter, while on the last line, developed motorcycle fatality rates are shown.

Figure 4.4.--12 months seasonally identical pre- and post-treatment outlined matrix.

TABLE 4.4.--Comparison of the data for Subordinate Hypothesis 1b showing average rates for motorcyclists holding licenses for an identical period of time for 1-3 months.

Period License Acquired	Fatality Rate	Average Fatality Rate for 6 Quarters	Per Cent Change from Prior 6-Quarter Period
1st Quarter 1971	1.62		
2nd Quarter 1971	0.64		
3rd Quarter 1971	0.27		
4th Quarter 1971	1.36		
1st Quarter 1972	0.59		
2nd Quarter 1972	0.50		
6-Quarter Average		0.83	--
Treatment Begins			
3rd Quarter 1972	0.56		
4th Quarter 1972	0.54		
1st Quarter 1973	0.00		
2nd Quarter 1973	0.63		
3rd Quarter 1973	0.77		
4th Quarter 1973	0.00		
6-Quarter Average		0.41	49.4%

TABLE 4.5.--Comparison of the data for Subordinate Hypothesis 1b showing average rates for motorcyclists holding licenses for an identical period of 4-6 months.

Period License Acquired	Fatality Rate	Average Fatality Rate for 6 Quarters	Per Cent Change from Prior 6-Quarter Period
1st Quarter 1971	0.00		
2nd Quarter 1971	0.64		
3rd Quarter 1971	0.00		
4th Quarter 1971	0.00		
list Quarter 1971	1.18		
2nd Quarter 1972	0.60		
6-Quarter Average		0.40	--
Treatment Begins			
3rd Quarter 1972	0.00		
4th Quarter 1972	0.54		
1st Quarter 1973	0.43		
2nd Quarter 1973	0.32		
3rd Quarter 1973	0.00		
4th Quarter 1973	--		
6-Quarter Average		0.26	35%

TABLE 4.6.--Comparison of the data for Subordinate Hypothesis 1b showing average rates for motorcyclists holding licenses for an identical period of time for 7-9 months.

Period License Acquired	Fatality Rate	Average Fatality Rate for 6 Quarters	Per Cent Change from Prior 6-Quarter Period
1st Quarter 1971	0.00		
2nd Quarter 1971	0.00		
3rd Quarter 1971	0.14		
4th Quarter 1971	0.45		
1st Quarter 1972	1.77		
2nd Quarter 1972	0.10		
6-Quarter Average		0.41	--
Treatment Begins			
3rd Quarter 1972	0.00		
4th Quarter 1972	0.00		
1st Quarter 1973	0.00		
2nd Quarter 1973	0.00		
3rd Quarter 1973	--		
4th Quarter 1973	--		
6-Quarter Average		0.00	100%

TABLE 4.7.--Comparison of the data for Subordinate Hypothesis 1b showing average rates for motorcyclists holding licenses for an identical period of time for 10-12 months.

Period License Acquired	Fatality Rate	Average Fatality Rate for 6 Quarters	Per Cent Change from Prior 6-Quarter Period
1st Quarter 1971	0.00		
2nd Quarter 1971	0.00		
3rd Quarter 1971	0.00		
4th Quarter 1971	0.91		
1st Quarter 1972	0.00		
2nd Quarter 1972	0.00		
6-Quarter Average		0.15	--
Treatment Begins			
3rd Quarter 1972	0.00		
4th Quarter 1972	0.00		
1st Quarter 1973	0.00		
2nd Quarter 1973	--		
3rd Quarter 1973	--		
4th Quarter 1973	--		
6-Quarter Average		0.00	100%

tables. The average fatality rates for each table were derived by taking the sum of the fatality rates for both the pre-treatment and post-treatment periods, dividing each period's summation by the total number of quarters. In addition, a percentage change in the average fatality rate was then calculated for the post-treatment period as compared to the pre-treatment period. The percentage change was developed for each table by subtracting the post-treatment from the pre-treatment rate and then dividing by the pre-treatment rate.

Table 4.4 shows the average rates for motorcyclists holding licenses for an identical period of time for 1-3 months. This table indicates the pre-treatment average for the motorcyclists who held their licenses for only 1-3 months was 0.83 fatalities per 1,000 licensees. For the post-treatment group, the average rate was 0.42. The per cent reduction was calculated to be 49.4% for motorcyclists holding their licenses from 1-3 months during the pre-treatment period as compared to the motorcyclists in the post-treatment period, holding licenses for a similar period. This reduction in the 1-3 month fatality rate comparison was tested at the .05 confidence level and the statistical test showed no significance at this level (see Appendix E). Thus, Hypothesis 1b, for the 1-3 months group, was rejected.

Presented in Table 4.5 (on page 79) are the fatality rates for licensees holding their licenses for 4-6 months during the six quarters before treatment and for the corresponding quarters after treatment. An average fatality rate for both periods is shown along with the fatality rate percentage change from the pre-treatment period as compared to the post-treatment period.

The pre-treatment average for the motorcyclists who held their licenses for 4-6 months was 0.40 fatalities per 1,000 licensees. For the post-treatment group, the average rate was 0.26. A reduction of 35% was calculated for motorcyclists holding their licenses from 4-6 months during the pre-treatment period, as compared to the motorcyclists in the post-treatment period, holding licenses for a similar period. This reduction in the 4-6 month fatality rate comparison was tested at the .05 confidence level and the statistical test showed no significance at this level (see Appendix E). Thus, Hypothesis 1b, for the 4-6 months group, was rejected.

In Table 4.6 (on page 80) the fatality rates for licensees holding their licenses for 7-9 months are presented for the six quarters before treatment and for the corresponding quarters after treatment. An average fatality rate for both periods is shown. Also, the fatality rate percentage change from the pre-treatment period, as compared to the post-treatment period, is presented.

The pre-treatment average for the motorcyclists who held their licenses for 7-9 months was 0.41 fatalities per 1,000 licensees. For the post-treatment group, the average rate was 0.00. The per cent reduction was calculated to be 100% for motorcyclists holding their licenses from 7-9 months during the pre-treatment period as compared to the motorcyclists in the post-treatment period, holding licenses for a similar period. The reduction in the 7-9 month fatality rate comparison was tested at the .05 confidence level and the statistical test showed no significance at this level (see Appendix E). Thus, Hypothesis 1b, for the 7-9 months group, was rejected.

Presented in Table 4.7 (on page 81) are the fatality rates for licensees holding their licenses for 10-12 months during the six quarters before treatment and for the corresponding quarters after treatment. An average fatality rate for both periods is shown as well as the fatality rate percentage change from the pre-treatment period as compared to the post-treatment period.

The pre-treatment average for the motorcyclists who held their licenses for 10-12 months was 0.15 fatalities per 1,000 licensees. For the post-treatment group, the average rate was 0.00. A reduction of 100% was calculated for motorcyclists holding their licenses from 10-12 months during the pre-treatment period as compared to the motorcyclists in the post-treatment period, holding licenses for a similar period. This reduction in the 10-12 months fatality rate comparison was tested at the .05 confidence level and the statistical test showed no significance at this level (see Appendix E). Thus, Hypothesis 1b, for the 10-12 months group, was rejected.

Review of the Variables

Introduction of New Motorcycle Driver Education Materials

Listed in Table 4.8 are six groups in New Jersey that had the capability during the study period to introduce or utilize new motorcycle driver education learning materials. Each group contacted, as indicated in Table 4.8, stated that, for their group, there were no changes in the statewide motorcycle driver education materials used during the study period.

TABLE 4.8.--Introduction of new motorcycle driver education materials.

Variable	Data Gathering Techniques	Results
Secondary classroom	Contacted Dept. of Education	No change
Motorcycle dealers	Contacted Motorcycle Industry Council	No change
Commercial driving schools	Contacted Driving School Association	No change
Driver improvement	Contacted N.J. Division of Motor Vehicles	No change
Adult driver ed. schools	Contacted Dept. of Education	No change
Mass communication	Contacted N.J. Office of Highway Safety	No change

Changes in the New Jersey Motorcycle Operator Population Between Pre-Treatment and Post-Treatment Groups by Age

A numerical comparison of licensed motorcycle operators by groups was performed for the pre-treatment and post-treatment group. The results gathered from the N.J. Division of Motor Vehicles is indicated in Table 4.9. The table indicates a 2.4% decrease in motorcycle license holders from the pre- to the post-treatment group.

TABLE 4.9.--Change in the New Jersey motorcycle operator population between the pre-treatment and the post-treatment group by age.

Age	Pre-treatment Motorcycle License Holder		Post-treatment Motorcycle License Holder		Difference
17-24	15,327	60.1%	13,394	57.7%	-2.4%
25+	10,178	39.9%	9,827	42.3%	-2.4%

Change in the Ratio of Male/Female Licensees in the Pre-Treatment Group Compared to the Post-Treatment Group

Presented in Table 4.10 is a comparison of male/female licensees in the pre-treatment group and post-treatment group. Data gathered from the New Jersey Division of Motor Vehicles indicated a 1.6% decrease for male motorcycle licensees from the pre-treatment period to the post-treatment period. Female licensees increased 1.6% from the pre-treatment period to the post-treatment period.

TABLE 4.10.--Change in the ratio of male/female licensees in the pre-treatment group compared to the post-treatment group.

	Pre-treatment		Post-treatment		Difference
Male	24,023	94.2%	21,305	92.6%	-1.6%
Female	1,381	5.8%	1,718	7.4%	+1.6%

Shift in the Marital Status Between the Pre-treatment and Post-treatment Groups

An inquiry to the New Jersey Division of Motor Vehicles disclosed that the marital status of motorcycle license applicants is not recorded. This is similarly true for all New Jersey licensed motor vehicle operators.

Change in the Ratio of Male:Female Licenses in the Pre-treatment Group Compared to the Post-Treatment Group

Post

Presch

Licens

Changes in New Jersey Motor Vehicle Legal Physical Requirements to Operate a Motorcycle Between the Pre-treatment Groups and the Post-treatment Groups

The Chief of Automotive Engineering Standards for the New Jersey Division of Motor Vehicles was requested to cite any changes in physical requirements and protective wearing apparel for the study period. Table 4.11 indicates no changes.

TABLE 4.11.--Changes in New Jersey motor vehicle legal physical requirements to operate a motorcycle between the pre-treatment groups and the post-treatment groups.

	Pre-treatment	Post-treatment
Physical requirements for motorcyclists	No change	No change
Wearing apparel	No change	No change

Changes in Motorcycle Driver License Examinations, Both Written and Oral, and the Driving Test

An inquiry to the New Jersey Division of Motor Vehicles Enforcement Bureau indicated that there were no changes in the licensing requirements for motorcyclists during the study period except for the addition of the treatment.

Changes in Traffic Enforcement Emphasis Toward Motorcycle Operators by New Jersey Law Enforcement Agencies, Including Police Emphasis and Legal Penalty Range Under the Law

The New Jersey Police Traffic Officers' Association indicated through their President that there were no policy changes in either the motorcycle enforcement efforts or legal penalties toward motorcyclists during the study period.

Changes in the Physical Characteristics of the Motorcycle as Related to Safety Between the Pre-treatment and Post-treatment Groups

An inquiry to the New Jersey Division of Motor Vehicles revealed that although turn signals were never required on New Jersey registered motorcycles, as of January 1, 1973, all motorcycles sold in the United States were required to have functioning turn signals. Further discussion with the Division and subsequent calls to many New Jersey motorcycle dealers indicated that although turn signals were not required in New Jersey, substantially all vehicles were equipped with them. As a result, there does not appear to be any substantial change in turn signal equipped motorcycles during the study period.

Changes in the Availability of Emergency Medical Services as It Relates to the Number of Rescue Squad Units and Equipment During the Pre-treatment Period as Compared to the Post-treatment Period

The Office of Emergency Medical Services in the Department of Health responded to this inquiry by indicating that their records would not allow them to arrive at an accurate conclusion. Further

investigation, through the New Jersey First Aid Council, revealed minimal changes in these areas during the study period.

Changes in Road Conditions During the Post-treatment Periods as Compared to the Pre-treatment Period

The Chief of the Bureau of Traffic Engineering stated that there have been no substantive changes in the procedures used in highway maintenance by any jurisdiction in New Jersey.

Changes in Weather Conditions Between Pre-treatment and Post-treatment Periods

An inquiry to the United States Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service Office in Trenton, New Jersey, through the meteorologist in charge, indicated little significant change in weather conditions during the pre-treatment period when compared to the post-treatment period. The information that was surveyed pertained to temperature, precipitation (including snow and ice pellets), relative humidity, wind, and sunshine.

Changes in the Accident Reporting System During the Study Period

New Jersey Traffic Records Task Force responded to this variable quite emphatically by indicating that there have been no changes in the New Jersey accident reporting system during the three year study period.

Comparison of the Data for Hypothesis 2 Showing Average Rates for Motorcyclists Receiving and Holding Licenses During Identical Time Period

To determine if the treatment reduced the fatality rate of new motorcyclists to rate levels achieved by the same group as riding experience was acquired, average rates for four pre-treatment periods were compared to the corresponding rates of the post-treatment periods. These average fatality rates were transferred from Tables 4.4, 4.5, 4.6, and 4.7 to Table 4.12. In addition, the table indicates the per cent increase or decrease for each group when compared to the immediately preceding group. During the pre-treatment 4-6 month group, a 51% fatality rate decrease occurred from the prior 1-3 month group. An increase of 2.5% was noted during the 7-9 month group over the prior 4-6 month group. Further, a 63% fatality rate drop from the 7-9 month group was recorded for the 10-12 month group.

TABLE 4.12.--Comparison of the data for Hypothesis 2 showing average rates for motorcyclists receiving and holding licenses during identical time period.

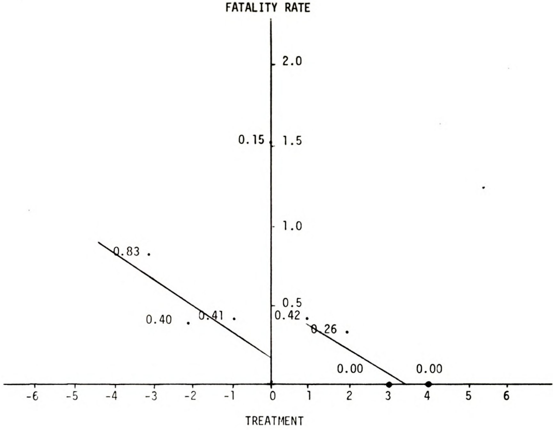
Quarterly Groups Average Rate	Pre-treatment			Post-Treatment		
	Crashes	Rate	% Drop From Prior Quarter of Experience	Crashes	Rate	% Drop From Prior Quarter of Experience
1- 3 months	20	.83	--	16	.42	--
4- 6 months	14	.40	-51.8%	5	.26	-38.1%
7- 9 months	6	.41	+ 2.5%	0	.00	-100.0%
10-12 months	2	.15	-63.4%	0	.00	0.0%

For the identical monthly groups of 4-6 months, 7-9 months, and 10-12 months in the post-treatment period, percentage fatality drops from the prior quarterly group were recorded at -38.1%, -100%, and -100%, respectively.

The graph presented in Figure 4.5 illustrates that the slope of the line best fitting the post-treatment data is 25% less than the slope of the line best fitting the pre-treatment data. The lesser slope indicates that the pre-treatment motorcyclists reduced their fatality rates 25% faster than the post-treatment motorcyclists. This result was tested at the .05 confidence level. The statistical test showed no significance at the .05 confidence level (see Appendix F and Table 4.12). Thus, Hypothesis 2 was rejected.

Summary

The statistical comparison of the data for Hypothesis 1 over the 18 month periods before and after treatment was calculated and explained in detail in Appendix C. Based on this analysis, Hypothesis 1 was accepted. The statistical comparison of the data for Subordinate Hypothesis 1a over seasonally identical 12 month pre- and post-treatment periods was calculated and explained in detail in Appendix D. Based on this analysis, Subordinate Hypothesis 1a was accepted. The statistical comparison of the data for Subordinate Hypothesis 1b was calculated for licensees holding their licenses for 1-3 months, 4-6 months, 7-9 months, and 10-12 months. Based on these analyses, Subordinate Hypothesis 1b was rejected. A review of the 21 variables was conducted. In addition, a statistical comparison of the data for



QUARTER LICENSE ISSUED

Pre-treatment equation: $X_i = -.20\ Z_i + .14$

Post-treatment equation: $X_i = -.15\ Z_i + .55$

% reduction in post-treatment slope: 25%

STATISTICAL SIGNIFICANCE TESTS

For slopes: $T_1 = .7576578$ Not significant at .05 level

For intercepts: $T_2 = 2.5781967$ Not significant at .05 level

Figure 4.5.--Pre-/post-treatment fatality rate comparison for motorcycle licensees receiving and holding their licenses during identical time periods.

Hypothesis 2, showing average rates for motorcyclists receiving and holding licenses during identical time periods, was developed and explained in detail within Appendix F. Based on this analysis, Hypothesis 2 was rejected.

An analysis of the data was presented in Chapter IV. Chapter V will contain the Summary, Conclusions, Implications, Recommendations for Further Research, and a Discussion.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

An analysis of the data was presented in the preceding chapter. The concluding chapter contains: (1) a summary, (2) conclusions, (3) implications, (4) recommendations for further research in closely related areas to the findings, and (5) a discussion.

Summary

The primary purpose of this study was to (1) determine if the motorcycle driver education film loop program and seventeen page supporting manual was effective in reducing the motorcycle fatal crashes occurring to New Jersey motorcycle licensees, and (2) investigate the effect of the motorcycle driver education film loop program on the inexperienced motorcyclists in order to see if the educational materials were an effective substitute for riding experience.

The Methods of Procedure

The problem was investigated by reviewing the motorcycle fatal crash experience in New Jersey. Based on the findings of this investigation, five motorcycle driver education film loops were developed. A supporting manual was also developed to supplement the film loops. In order to reach one hundred per cent of the motorcycle licensees, permission was sought and gained from the New Jersey Division of Motor

Vehicles to incorporate the educational program into the existing pre-licensing procedures. In addition, approval was received from the New Jersey Department of Education to offer the program to all public and private high schools who were willing to include motorcycle driver education in their curricula. In order to conduct a study of the effectiveness of the new materials in reducing fatalities, approval was sought and received from the New Jersey Department of Transportation to review all motorcycle fatality records that occurred during the period of January 1, 1971, to December 31, 1973. This review necessitated surveying 3,988 motor vehicle fatality cases in order to extract only the motorcycle fatalities. The 87 pertinent motorcycle fatality cases were entered into the matrix along with the number of new motorcycle licenses issued for the corresponding periods. From this data, a motorcycle licensee fatality crash rate was calculated. The pre-treatment rates were then compared with the post-treatment rates using four approaches to determine the effectiveness of the new materials. These comparisons were tested for statistical significance. In addition, other factors outside of the introduction of the treatment materials were reviewed for possible change that could have contributed to the reduction in motorcycle fatality rates.

The Major Findings

The major findings of this study are as follows:

1. A reduction of 40.4% was found in the overall 18 month comparison of the motorcyclist fatality rates during the post-treatment period as compared to the pre-treatment period. This reduction was

found to be statistically significant at the .05 confidence level. Thus, Hypothesis 1 was accepted.

2. A reduction of 39.3%, for the post-treatment period, was found in the seasonally identical 12 month comparison of the motorcycle fatality rates. This reduction was found to be statistically significant at the .05 confidence level. Thus, Hypothesis 1a was accepted.

3. A reduction of 49.4% was calculated for motorcyclists holding their licenses from 1-3 months during the post-treatment period as compared to the motorcyclists in the pre-treatment period holding licenses for a similar period. This result was found not significant at the .05 confidence level. Thus Hypothesis 1b, for the 1-3 month group, was rejected.

4. A reduction of 35% was calculated for motorcyclists holding their licenses from 4-6 months during the post-treatment period, as compared to the motorcyclists in the pre-treatment period, holding licenses for a similar period. This result was found not significant at the .05 confidence level. Thus, Hypothesis 1b, for the 4-6 months group, was rejected.

5. A reduction of 100% was calculated for motorcyclists holding their licenses from 7-9 months during the post-treatment period, as compared to the motorcyclists in the pre-treatment period, holding licenses for a similar period. This result was found not significant at the .05 confidence level. Thus, Hypothesis 1b, for the 7-9 months group, was rejected.

6. A reduction of 100% was calculated for motorcyclists holding their licenses from 10-12 months during the post-treatment period as compared to the motorcyclists in the pre-treatment period, holding licenses for a similar period. This result was found not significant at the .05 confidence level. Thus, Hypothesis 1b, for the 10-12 months group, was rejected.

7. The introduction of the treatment reduced, by 25%, the effect of rider experience on the motorcycle fatality rate. The result was found not significant at the .05 level of confidence. Thus, Hypothesis 2 was rejected.

8. Twenty-one variables were reviewed for possible influence on the fatality rates reduction; none were found to have varied over the study period.

Conclusions

This study presented four statistical analyses of pre-treatment and post-treatment data on the effect of a motorcycle driver education program on fatality reduction. The first analysis, utilizing the full range of post-treatment data available over the entire 18 months of the study, as called for by Hypothesis 1, demonstrated statistically, at the .05 confidence level, that the program was effective in reducing the fatality rate. This reduction was calculated to be 40.4%. It can be concluded, based on the findings, that a motorcycle traffic safety education program, as New Jersey utilized in all 19 Driver Qualification Centers, can significantly decrease motorcycle fatal crashes. Furthermore, it must be understood that a reduction of 40.4%, over the 18 month

treatment period, can only be realized by reaching 100% of all new motorcycle licensees during the pre-licensing interval.

The second analysis, for Hypothesis 1a, utilizing 12 months of post-treatment data, and a seasonally identical 12 months of pre-treatment data, provided the most clearly identical comparison of the pre-treatment and post-treatment data, and demonstrated a 39.3% reduction in the fatality rate. The close proximity of the 39.3% reduction to the 40.4% reduction indicated the reasonableness of the two assumptions made in the first analysis: that the fatality rates for the first and fourth quarters were comparable, and that the fatality rates for the second and third quarters were comparable. The second analysis resulted in the acceptance of Hypothesis 1a for a seasonally identical 12 month study. This finding clearly demonstrated that New Jersey should continue the motorcycle film loop program. Additionally, through the analysis of the 12 month seasonally identical pre- and post-treatment data, it can be concluded that the program was indeed effective.

The third analysis involved stratifying the population and the number of fatalities by amounts of experience, i.e., 1-3 months, 4-6 months, 7-9 months, and 10-12 months. In all four calculations, although substantial reductions of 49.4%, 35%, 100% and 100%, respectively, were demonstrated, the reductions were found to be not significant at the .05 level of confidence. The insignificance of these reductions appears to have resulted from the stratification of the data, which, in turn, reduced the numbers of fatalities per experience grouping. Specifically, what took place was that in the

1-3 month group 20 fatal crashes occurred in the pre-treatment period as compared to 16 in the post-treatment period. For the 4-6 month group, 14 fatal crashes occurred in the pre-treatment period as compared to 5 in the post-treatment period. In the 7-9 month group, 6 fatal crashes occurred during the pre-treatment period as compared to none in the post-treatment period. Finally, for the 10-12 month period, 2 fatal crashes occurred during the pre-treatment period as compared to no fatal crashes in the post-treatment period. Therefore, the study was not able to confirm that the materials were effective with specific experience groups where defined into less than 12 months units, and therefore, Hypothesis 1b was rejected.

The analysis testing Hypothesis 2 involved comparing the rate of reduction of the fatality rates in order to determine if the program was successfully substituting for experience on the road. Although the analysis did indicate that the rate of decline in fatality rates was reduced by 25%, thus indicating the possibility that the program was indeed substituting for riding experience, the result was found not significant at the .05 confidence level. Therefore, Hypothesis 2 was rejected.

The results of additional investigations of 21 other variables, other than the introduction of the treatment, indicated that there were no other variables that changed during the 36 month study period.

Based on this study, for the time period of January 1, 1971, to December 31, 1973, within the state of New Jersey, this investigation

indicated that the only factor that could have accounted for the significant 40.4% reduction in the fatality rate was the introduction of the treatment.

Implications

There are several implications of this study for traffic safety educators and traffic safety administrators both in their states as well as at the federal level.

1. Driver education can demonstrate meaningful fatal crash reductions if teachers and administrators are willing to study the effects of traffic safety education.

2. In the face of rapidly increasing motorcycle fatality rates across the country, well designed and tightly focused educational materials such as this film loop program can reduce motorcycle fatality rates.

3. Substantial emphasis should be placed in isolating the high-frequency-fatal-crash-producing situations when designing traffic safety programs in order to increase the probability of achieving reductions in fatality rates.

4. Increased emphasis should be placed on more statewide motorcycle safety education programs.

5. Additional effort should be made to broaden the means of disseminating motorcycle safety education to reach all new and experienced motorcycles.

6. Federal and state monies should continue to be made available for funding the development and implementation of traffic safety education programs directed toward fatality reduction.

7. Traffic safety educators should seek to achieve the synergetic effects of bringing private industry and all possible governmental agencies together to combat traffic safety problems.

indicated that the only factor

nificant 40.4% reduction

Recommendations for Further Research

Based on the findings of this study, further research is recommended in the following areas:

1. A similar study should be conducted based on motorcycle crash experience.

2. A statewide study of motorcyclists should be conducted in order to determine if their driver license point accumulation for automobile operation can be used as an indicator of their safe or unsafe motorcycle operation.

3. A study to determine the effectiveness of different educational approaches on safe motorcycle operation is needed.

4. A similar study should be undertaken to ascertain if a program geared to automobile operation would have a positive effect on motorcycle fatal crash involvement.

5. A study to determine the effectiveness of a New Jersey Division of Motor Vehicles driver improvement program specifically designed for motorcyclists should be considered.

6. A study should be conducted to determine if, after implementation of the motorcycle film loop educational program, a shift in the type of fatal crash has occurred. Such a movement might warrant additional film loop materials to cover these areas.

7. A survey of new motorcyclists should be conducted in order to disclose if there are additional film loop topics that would be helpful to a safe riding career beyond the highest fatal-crash-producing situations already covered.

Discussion

If traffic safety eduation is to play a meaningful role in the reduction of motorcycle fatal crashes, it is imperative that curricula be developed based on fatal crash data or, better still, motorcycle crash data. This type of information is the basic management tool that can consistently lead traffic safety educators and program

administrators to positively affect the escalation of two-wheel vehicle fatal mishaps.

The results of this study have indicated that, even on a statewide basis, the introduction of a traffic safety education program can curb the upward spiral of motorcycle fatalities. It would seem desirable, in order to further confirm this study's findings, that a similar research project be conducted elsewhere in the United States.

In addition to illustrating the power of motorcycle driver education to reduce fatality rates, the program illustrated the potential effectiveness of statewide implications in attacking a major traffic safety problem.

The combined efforts of private industry in supplying motorcycles and filming capability, and government units in providing crash data (Department of Transportation), educational time in the classroom (Department of Education and local school systems), education time at licensing stations for 100% coverage of new motorcyclists (Division of Motor Vehicles), and funding to provide the materials (New Jersey Office of Highway Safety through funding by the National Highway Traffic Safety Administration) made a comprehensive traffic safety approach possible.

The researcher was able to tailor the educational materials precisely around the fatal-crash-producing situations in New Jersey, and then was able to distribute and achieve implementation in all driver qualification centers in the state. Additionally, the researcher was able to follow the effects of the program over a significant period

of time--three years--and was able to gain access, because of the large scale of the study, to relevant, discrete information concerning other factors beside the educational program under study, which could have influenced the motorcycle fatality rate.

The researcher found the undertaking of a statewide project was, in fact, a much larger effort than originally anticipated; and yet, as the results confirm, the largeness of the project was the only way to isolate the multitude of variables that affect traffic fatalities. In addition, the cooperation displayed by private industry in the development of professional grade materials built on traffic safety needs indicated to the researcher that other states should be more demanding that broad scope traffic safety education materials be uniquely designed to meet local fatal crash concept requirements, if their goal is fatality reduction.

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APPENDICES

APPENDIX A

RESULTING SUMMARY DATA BASED ON THE COLLECTION OF ALL MOTORCYCLE FATALITIES FOR 1971, 1972, AND 1973

APPENDIX A

RESULTING SUMMARY DATA BASED ON THE COLLECTION OF ALL MOTORCYCLE FATALITIES FOR 1971, 1972, AND 1973

Motorcycle Number	Time of Fatality Mo.-Day-Yr.	Birth Date Mo.-Day-Yr.	Age	Driver's License Number
1	2-4-71	10-x-49	21	S8331-15173-10494
2	2-21-71	11-7-46	24	L151354-Permit
3	3-5-71	9-5-52	18	L811735-Permit
4	3-16-71	11-6-38	32	M9221-74065-11386
5	3-27-71	2-18-47	24	R4078-10079-02472
6	3-28-71	10-24-35	35	L4720-65561-10352
7	3-29-71	8-x-51	19	K0530-41000-08516
8	4-10-71	2-x-44	27	R4078-38386-02445
9	4-10-71	3-x-52	19	F4169-27886-03524
10	5-1-71	7-x-52	18	K723455-Permit
11	5-1-71	12-x-49	21	K5061-74068-12495
12	5-15-71	6-x-36	33	B7142-40774-06374
13	5-25-71	3-x-42	29	L2932-27883-03424
14	6-5-71	10-x-50	20	I4806-247 (Pennsylvania)
15	6-5-71	1-x-51	20	B9454-27865-01514
16	6-9-71	12-x-48	22	L225254-Permit
17	6-11-71	11-19-48	22	I3584-167 (Pennsylvania)

Motorcycle
Number

Motorcycle Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number
18	6-11-71	2-x-49	22	V0407-07561-02494
19	6-13-71	3-3-51	20	L332488-Permit
20	6-20-71	1-25-52	19	L233921-Permit
21	6-24-71	3-19-47	24	J0450-15671-03472
22	6-25-71	10-14-52	18	N2367-7141-0520 (Quebec)
23	6-27-71	8-7-50	20	L282340-Permit
24	7-2-71	8-x-48	22	L135956-Permit
25	7-4-71	6-x-38	33	D9403-58200-06382
26	7-5-71	5-12-49	22	K990478-Permit
27	7-6-71	12-12-38	32	No license
28	7-15-71	1-x-52	19	L382043-Permit
29	7-17-71	2-x-53	18	T2759-78586-02534
30	7-28-71	4-x-51	20	P4525-78571-04514
31	8-3-71	10-x-51	19	B8680-68632-10515
32	8-8-71	1-x-48	23	S3176-43361-01482
33	8-10-71	12-14-49	21	No license
34	8-12-71	3-29-47	24	B6686-19361-03472
35	8-13-71	8-30-41	29	No license
36	8-18-71	10-x-48	22	G7303-30285-10484
37	8-27-71	5-9-53	19	M6506-61963-05532
38	8-29-71	7-25-38	33	L386470-Permit
39	9-11-71	7-19-42	29	W2087-40765-07428
40	9-26-71	3-27-55	16	No license

Motorcycle Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo-Day-Yr.	Age	Driver's License Number
41	9-29-71	5-2-48	23	L2514-43174-05484
42	10-14-71	8-8-50	21	L728531-Permit
43	10-16-71	11-x-37	33	R6720-05300-11372
44	10-18-71	12-1-46	24	13001-416 (Pennsylvania)
45	10-26-71	12-x-45	25	D9021-19277-12452
46	10-30-71	3-x-34	37	G2644-74077-03342
47	11-9-71	3-x-42	29	L4018-17300-03424
48	11-14-71	2-x-21	50	S0007-17200-02212
49	11-30-71	7-27-54	17	C0763-17367-07544
50	12-9-71	8-23-53	18	L681437-Permit
51	1-20-72	4-x-54	17	K6393-74071-04542
52	1-21-72	3-12-50	21	M2432-77962-03504
53	2-13-72	8-6-51	20	A9465-72263-08515
54	4-7-72	10-x-46	25	C7286-65571-10462
55	5-2-72	1-19-50	22	2184077 (N. Carolina)
56	5-4-72	6-3-52	19	M0456-74071-06522
57	5-6-72	9-9-39	32	No license (Delaware resident)
58	5-10-72	11-27-51	20	B7154-43364-11514
59	5-11-72	3-12-33	39	L149941-Permit
60	5-13-72	12-x-53	18	L4246-65562-12532
61	5-19-72	1-26-51	21	H6272-73373-01514
62	5-19-72	9-3-54	17	K2407-27365-09542
63	5-19072	9-3-54	17	K2407-27365-09542

Motorcycle Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number
64	5-21-72	8-12-47	24	L694241-Permit
65	5-29-72	3-23-44	25	M1610-15686-03474
66	6-3-72	2-x-52	20	L757155-Permit
67	6-7-72	9-x-37	34	M0619-77562-09374
68	6-13-72	2-11-55	17	L722940-Permit
69	6-28-72	5-x-47	25	V0424-12079-05474
70	7-2-72	2-x-35	38	S1716-27866-02352
71	7-3-72	9-x-42	29	W0637-65866-09425
72	7-4-72	2-23-47	25	H0477-15179-02475
73	7-7-72	4-23-49	23	P6256-27900-04492
74	7-9-72	8-15-52	19	C6180-66865-08522
75	7-10-72	3-x-55	17	G0917-65574-03552
76	7-15-72	3-18-47	25	W2832-27483-03474
77	7-16-72	1-10-40	32	C01316-88870-130832-40 (New York)
78	7-18-72	7-22-54	17	L725119-Permit
79	7-21-72	10-11-52	19	C6431--3572-10524
80	7-21-72	6-9-37	35	K9146-41068--6372
81	7-22-72	4-12-50	22	L758445-Permit
82	7-28-72	1-21-52	20	K2407-15371-01522
83	8-1-72	11-x-50	21	L21555-05041-7615 (Florida)
84	8-2-72	6-x-54	18	S4440-65866-06542
85	8-2-72	3-25-53	19	L63797-Permit
86	8-3-72	7-9-50	22	M6437-16479-07502

Motorcycle Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number
87	8-4-72	10-x-44	27	L843647-Permit
88	8-7-72	2-23-52	20	No license
89	8-7-72	12-x-49	22	B4613-27900-12492
90	8-9-72	3-x-43	29	S9580-19283-03434
91	8-10-72	5-x-54	18	L9665-15383-05542
92	8-11-72	10-x-50	21	G5271-23563-10502
93	8-11-72	10-16-46	25	N2196-74066-10464
94	8-12-72	11-27-53	18	V0450-39761-11532
95	8-12-72	4-x-44	25	G2265-01767-04442
96	8-12-72	6-x-51	21	V6144-65866-06515
97	8-12-72	2-x-51	20	V0942-48700-52512
98	8-19-72	9-2-41	30	092-807-794 (Connecticut)
99	8-24-72	Not reported	23	Not reported
100	8-25-72	10-25-29	43	06-581-471 (Pennsylvania)
101	8-25-72	2-x-55	17	H0934-66474-02254
102	9-4-72	3-x-54	18	K6219-38379-03544
103	9-7-72	7-6-49	23	B7507-09371-01542
104	9-23-72	3-x-54	18	H9138-54477-03542
105	9-26-72	8-x-46	26	T0964-38367-08462
106	10-1-72	8-x-48	24	B0013-54471-08484
107	10-8-72	3-11-47	25	B0808-63882-03475
108	10-9-72	8-x-42	30	B6162-19271-08424
109	10-10-72	8-2153	19	I0450-05375-08536

Motorcycle Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number
110	10-15-72	8-21-48	24	F4734-07564-08486
111	10-19-72	10-x-54	21	F0662-41061-10514
112	10-25-72	1-30-50	22	L987587-Permit
113	12-16-72	9-17-38	34	M015130-Permit
114	12-22-72	11-x-54	18	06036-01982-11544
115	1-18-73	2-14-51	22	P6805-52566-02514
116	2-24-73	4-11-43	29	E4644-31661-04432
117	3-11-73	1-28-43	30	11843-633 (Pennsylvania)
118	3-29-73	1-x-44	29	I7692-26700-01442
119	4-6-73	1-x-56	17	H6015-66861-01562
120	4-13-73	2-13-56	17	L792548-Permit
121	4-14-73	10-14-53	19	S5778-65883-10534
122	4-19-73	9-3-32	42	U5487-69066-09304
123	4-22-73	4-14-50	23	V523-51531-9290 (Michigan)
124	4-20-73	1-28-51	22	C2585-52171-01516
125	5-6-73	9-10-53	19	B6516-40777-09532
126	5-11-73	4-16-52	21	B6846-54479-08512
127	5-14-73	12-15-49	23	R4778-40763-12494
128	5-20-73	12-23-52	20	M234998-Permit
129	5-26-73	12-25-52	20	T3495-60374-12522
130	6-1-73	9-27-55	17	L233-918-Permit
131	6-3-73	4-29-14	59	S1744-12000-04142
132	6-5-73	3-22-49	24	13675091 (Pennsylvania)

Motorcycle Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number
133	6-6-73	11-21-48	24	M347133-Permit
134	6-7-73	5-1-47	26	L0928-78555-05472
135	6-11-73	11-4-52	20	R6500-74000-11524
136	6-12-73	7-x-54	18	M4450-66473-07542
137	6-16-73	5-4-47	26	J01695-55764-813234
138	6-24-73	8-12-53	19	W0831-78565-08532
139	6-30-73	6-9-37	36	M408410-Permit
140	7-6-73	10-8-52	20	15098577 (Pennsylvania)
141	7-8-73	5-x-51	22	15735321 (Pennsylvania)
142	7-12-73	10-x-52	20	P0612-09683-10524
143	7-14-73	10-30-54	18	D2604-30263-10545
144	7-15-73	11-x-45	27	S5778-61368-11454
145	7-16-73	8-x-52	20	C6420-69473-08522
146	7-28-73	10-25-55	17	No license
147	7-28-73	6-x-53	20	M4227-74077-06535
148	7-29073	2-18-36	37	K9057-09400-02263
149	7-30-73	6-7-48	25	F7170-12086-06482
150	7-31-73	5-x-49	24	H4494-38371-05494
151	8-20-73	6-9-43	30	M475331-Permit
152	8-27-73	11-x-39	33	C6236-01700-11392
153	8-29-73	9-x-54	18	B9346-65861-09544
154	9-1-73	9-x-44	29	B7129-40771-09444
155	9-1-73	4-x-48	25	V4692-41065-04484

Motorcycle Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number
156	9-1-73	6-23-54	19	S1397-45977-06545
157	9-2-73	1-x-41	32	P6784-32975-01415
158	9-3-73	8-x-52	21	B6368-29286-08524
159	9-3-73	2-16-49	24	M0901-19261-02494
160	9-3-73	122-54	19	16297227 (Pennsylvania)
161	9-4-73	5-10-46	27	M525091-Permit
162	9-8-73	3-x-41	32	C6161-00168-53412
163	9-9-73	7-18-54	19	C3290-15671-07544
164	9-9-73	1-19-39	34	M6481-09371-01392
165	10-10-73	Not avail.	20	D2368-41071-09532
166	10-20-73	10-14-52	21	M9221-38366-10524
167	10-21-73	3-x-46	27	202-761-327 (Connecticut)
168	10-27-73	11-13-52	20	L2960-54477-11524
169	11-4-73	1-x-49	24	R4255-68882-01495

APPENDIX B

DATA USED TO IDENTIFY THOSE MOTORCYCLE FATALITIES

OCCURRING DURING 1971, 1972, AND 1973 WHERE

MOTORCYCLE LICENSES WERE GRANTED DURING

THE SAME YEARS

APPENDIX B

DATA USED TO IDENTIFY THOSE MOTORCYCLE FATALITIES OCCURRING DURING 1971, 1972, AND 1973 WHERE MOTORCYCLES LICENSES WERE GRANTED DURING THE SAME YEARS

Motorcycle Fatality Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number	Date License Issued Mo.-Day-Yr.
2	2-21-71	11-7-46	24	L151354-Permit	2-5-71
3	3-51-71	9-5-52	18	L811735-Permit	2-20-71
6	3-28-71	10-24-35	35	L4720-65561-10352	1-21-71
10	5-1-71	7-x-52	18	K723455-Permit	5-1-71
16	6-9-71	12-x-48	22	L225254-Permit	4-18-71
19	6-13-71	3-3-51	20	L332488-Permit	5-28-71
20	6-20-71	1-25-52	19	L233921-Permit	5-27-71
21	6-24-71	3-19-47	24	J0450-15671-03472	6-3-71
23	6-27-71	8-7-50	20	L282340-Permit	6-21-71
24	7-2-71	8-x-48	22	L135956-Permit	5-8-71
26	7-5-71	5-12-49	22	K990479-Permit	5-25-71
28	7-15-71	1-x-52	19	L382043-Permit	7-14-71
30	7-28-71	4-x-51	20	P4525-78571-04514	4-27-71
32	8-8-71	1-x-48	23	S3176-43361-01482	4-14-71
34	8-12-71	3-29-47	24	B6686-19361-03472	6-30-71

Motorcycle Fatality Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number	Date License Issued Mo.-Day-Yr.
37	8-27-71	5-9-53	19	M6506-61963-05532	4-3-71
38	8-29-71	7-25-38	33	L386470-Permit	7-30-71
42	10-14-71	8-8-50	21	L728531-Permit	10-1-71
49	11-30-71	7-27-54	17	C0763-17367-07544	10-21-71
50	12-9-71	8-23-53	18	L681437-Permit	11-19-71
51	1-20-72	4-x-54	17	K6393-74071-04542	1-18-72
52	1-21-72	3-12-50	21	M2432-77962-03504	7-28-71
56	5-4-72	6-3-52	19	M0456-74071-06522	6-12-71
58	5-10-72	11-27-51	20	B7154-43364-11514	6-24-71
59	5-11-72	3-12-33	39	L149941-Permit	3-28-72
60	5-13-72	12-x-53	18	L4246-65562-12532	10-14-72
52	5-19-72	9-3-54	17	K2407-27365-09542	4-30-72
63	5-19-72	6-x-47	24	M1190-64383-06474	3-28-72
64	5-21-72	8-12-47	24	L694241-Permit	4-27-72
65	5-29-72	3-23-47	25	M1610-15686-03474	4-12-72
66	6-3-72	2-x-52	20	L757155-Permit	4-22-72
67	6-7-72	9-x-37	34	M0619-77562-09374	4-22-72
71	7-3-72	9-x-42	29	W0637-65866-09425	7-14-71
72	7-4-72	2-23-47	25	H0477-15179-02475	7-20-71
75	7-10-72	3-x-55	17	G0917-65574-03552	5-25-72
78	7-18-72	7-22-54	17	L725119-Permit	5-26-72
79	7-21-72	10-11-52	19	C6431-03571-10524	4-3-71
80	7-21-72	6-9-37	35	K9146-41068-06372	7-29-71

Motorcycle Fatality Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number	Date License Issued Mo.-Day-Yr.
81	7-22-72	4-12-50	22	L758445-Permit	4-28-72
85	8-2-72	3-25-53	19	L636797-Permit	3-6-72
87	8-4-72	10-x-44	27	L843647-Permit	6-25-72
89	8-7-72	12-x-49	22	B4613-27900-12492	12-7-71
90	8-9-72	3-x-43	29	S9580-19283-03434	3-18-72
91	8-10-72	5-x-54	18	L9665-15383-05542	1-10-72
92	8-11-72	10-x-50	21	G5271-23563-10502	7-24-72
93	8-11-72	10-16-46	25	N2196-74066-10464	7-31-72
94	8-12-72	11-27-53	18	V0450-39761-11532	7-20-72
95	8-12-72	4-x-44	25	G2265-01767-04442	7-28-72
101	8-25-72	2-x-55	17	H0934-66474-02254	6-23-72
102	9-4-72	3-x-54	18	K6219-38379-03544	4-22-71
104	9-23-72	3-x-54	18	H9138-54477-03542	11-12-71
105	9-26-72	8-x-46	26	T0964-38367-08462	6-30-72
106	10-1-72	8-x-48	24	B0013-54471-08484	9-29-71
107	10-8-72	3-11-47	25	B0804-63882-03475	4-16-71
110	10-15-72	8-21-48	24	F4734-07564-08486	7-20-71
111	10-19-72	10-x-54	21	F0662-41061-10514	10-10-72
112	10-25-72	1-30-50	22	L987587-Permit	6-30-72
116	2-24-73	4-11-43	29	E4644-31661-04432	10-24-72
119	4-6-73	1-x-56	17	H6015-66861-01562	1-19-73
120	4-13-73	2-13-56	17	L792548-Permit	4-26-73
127	5-14-73	12-15-49	23	R4778-40763-12494	4-26-72

Motorcycle Fatality Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number	Date License Issued Mo.-Day-Yr.
129	5-26-73	12-25-52	20	T3495-60374-12522	4-23-73
130	6-1-73	9-27-55	17	L233918-Permit	4-19-73
131	6-3-73	4-29-14	59	S1744-12000-04142	11-11-71
133	6-6-73	11-21-48	24	M347133-Permit	6-1-73
134	6-7-73	5-1-47	26	L0938-78565-05472	8-10-71
135	6-11-73	11-4-52	20	R6500-74000-11524	5-1-73
136	6-12-73	7-x-54	18	M4450-66473-07542	8-12-71
138	6-24-73	8-12-53	19	W0831-78565-08532	7-12-71
139	6-30-73	6-9-37	36	M408410-Permit	6-2-73
143	7-14-73	10-30-54	18	D2604-30263-10545	7-9-73
145	7-16-73	8-x-52	20	C6420-69473-08522	6-7-72
147	7-28-73	6-x-53	20	M4227-74077-06535	6-11-73
148	7-29-73	2-18-36	37	K9057-09400-02263	7-12-72
149	7-30-73	6-7-48	25	F7170-12086-06482	7-12-72
150	7-31-73	5-x-49	24	H4494-38371-05494	3-3-72
151	8-20-73	6-9-43	30	M475331-Permit	6-1-73
152	8-27-73	11-x-39	33	C6236-01700-11392	4-11-73
153	8-29-73	9-x-54	18	B9346-65861-09544	8-31-73
156	9-1-73	6-23-54	19	S1397-45977-06545	7-2-73
161	9-4-73	5-10-46	27	M525091-Permit	8-31-73
162	9-8-73	3-x-41	32	C6161-00168-53412	8-14-72
163	9-9-73	7-18-54	19	C3290-15671-07544	12-13-71
164	9-9-73	1-19-39	34	M6481-09371-01392	7-14-71

Motorcycle Fatality Number	Time of Fatality Mo.-Day-Yr.	Birthdate Mo.-Day-Yr.	Age	Driver's License Number	Date License Issued
166	10-20-73	10-14-52	21	M9221-38366-10524	6-16-71
168	10-27-73	11-13-52	20	L2960-54477-11524	8-7-72
169	11-4-73	1-x-49	24	R4255-68882-01495	6-23-72

APPENDIX C

STATISTICAL SIGNIFICANCE TEST FOR

18 MONTH COMPARISON

APPENDIX C

STATISTICAL SIGNIFICANCE TEST FOR
18 MONTH COMPARISON

To determine statistical significance of the comparisons between the 18 month pre-treatment and corresponding 18 month post-treatment fatality rates, at the .05 level of confidence, the "Z distribution" test for differences between proportions and a one-tailed test was used. The one-tailed test was sufficient for the purposes of this analysis since the researcher was only interested if a post-treatment reduction was significant. For the purposes of this analysis, $\hat{p}_1 < \hat{P}_2$ and $\hat{P}_1 = \hat{P}_2$ are both not significant; where $\hat{p}_1$ = the pre-treatment fatalities divided by the pre-treatment population, and $\hat{P}_2$ = the post-treatment fatalities divided by the post-treatment population.

The statistical approach tests whether the post-treatment fatality rate is significantly less than the pre-treatment rate:

Ho: $\hat{P}_1 = \hat{P}_2$

Ha: $\hat{P}_1 > \hat{P}_2$

and uses the following formula to determine the Z value:

$$Z = \frac{\hat{P}_1 - \hat{P}_2}{\sqrt{\dfrac{\hat{P}_1(1 - \hat{P}_1)}{N_1} + \dfrac{\hat{P}_2(1 - \hat{P}_2)}{N_2}}}$$

where value N_1 = the pre-treatment population, and

N_2 = the post-treatment population.

For the purposes of the statistical calculations only, the Ho is the null hypothesis or $\hat{P}_1 = \hat{P}_2$. The Z value formula was evaluated as follows:

$$Z = \frac{.00136 - .00081}{\sqrt{\dfrac{(.00136)\ (1 - .00136)}{32{,}467} + \dfrac{(.00081)\ (1 - .00081)}{29{,}630}}}$$

$$Z = 2.092$$

This Z value was then checked against the Z values in the mathematical Z value tables for a normal distribution and a one-tailed test at the .05 confidence level (Z value of 1.645). Since the calculated Z value of 2.092 was geater than 1.645, the null hypothesis had to be rejected in favor of Hypothesis 1.

APPENDIX D

STATISTICAL SIGNIFICANCE TEST FOR 12 MONTH COMPARISON

OF SEASONALLY IDENTICAL PERIODS

APPENDIX D

STATISTICAL SIGNIFICANCE TEST FOR 12 MONTH COMPARISON OF SEASONALLY IDENTICAL PERIODS

To determine statistical significance of the comparison between the 12 month pre-treatment and the seasonally identical 12 month post-treatment fatality rates, at the .05 level of confidence, the "Z distribution" test for differences between proportions and a one-tailed test was used. The one-tailed test was sufficient for the purposes of this analysis since the researcher was only interested if a post-treatment reduction was significant. For the purposes of this analysis, $\hat{p}_1 < \hat{P}_2$ and $\hat{P}_1 = \hat{P}_2$ are both not significant, where $\hat{p}_1$ = the pre-treatment fatalities divided by the pre-treatment population, and $\hat{P}_2$ = the post-treatment fatalities divided by the post-treatment population.

The statistical approach tests whether the post-treatment fatality rate is significantly less than the pre-treatment rate:

Ho: $\hat{P}_1 = \hat{P}_2$

Ha: $\hat{P}_1 > \hat{P}_2$

and uses the following formula to determine the Z value:

$$Z = \frac{\hat{P}_1 - \hat{P}_2}{\sqrt{\frac{\hat{P}_1(1 - \hat{P}_1)}{N_1} + \frac{\hat{P}_2(1 - \hat{P}_2)}{N_2}}}$$

where value N_1 = the pre-treatment population, and

N_2 = the post-treatment population.

For the purposes of the statistical calculations only, the Ho is the null hypothesis or $\hat{P}_1 = \hat{P}_2$. The Z value formula was evaluated as follows:

$$Z = \frac{.00150 - .00091}{\sqrt{\frac{(.00150)\ (1 - .00150)}{21{,}271} + \frac{(.00091)\ (1 - .00091)}{20{,}833}}}$$

$$Z = 1.747$$

This Z value was then checked against the Z values in the mathematical Z value tables for a normal distribution and a one-tailed test at the .05 confidence level (Z values of 1.645). Since the calculated Z value of 1.747 was greater than 1.645, the null hypothesis had to be rejected in favor of Hypothesis 1.

APPENDIX E

STATISTICAL SIGNIFICANCE TEST FOR COMPARISON OF 1-3 MONTHS, 4-6 MONTHS, 7-9 MONTHS AND 10-12 MONTHS PERIODS

APPENDIX E

STATISTICAL SIGNIFICANCE TEST FOR COMPARISON OF 1-3 MONTHS, 4-6 MONTHS, 7-9 MONTHS AND 10-12 MONTHS PERIODS

To determine statistical significance for the comparisons of pre- and post-treatment rates for the 1-3 month period, the 4-6 month period, the 7-9 month period, and the 10-12 month period, the first step was to plot the data for each set of quarter comparisons, and calculate and plot the straight lines that best fit each set of data.

In order to facilitate the plotting of the data and the calculation of the lines, the following notations assignments were made:

Let first quarter 1971 (Q_{11}) = -5
second quarter 1971 (Q_{12}) = -4
third quarter 1971 (Q_{13}) = -3
fourth quarter 1971 (Q_{14}) = -2
first quarter 1972 (Q_{21}) = -1
second quarter 1972 (Q_{22}) = 0
third quarter 1972 (Q_{23}) = 1
fourth quarter 1972 (Q_{24}) = 2
first quarter 1973 (Q_{31}) = 3
second quarter 1973 (Q_{32}) = 4
third quarter 1973 (Q_{33}) = 5
fourth quarter 1973 (Q_{34}) = 6

For the pre-treatment, let

X_i = the fatality rate,

Z_i = the time period,

$\hat{\beta}_1$ = the slope of the line, and

$\hat{\alpha}_1$ = the intercept of the line.

For the post-treatment, let

X_j = the fatality rate,

Z_j = the time period,

$\hat{\beta}_2$ = the slope of the line, and

$\hat{\alpha}_2$ = the intercept of the line.

The equation for the pre-treatment line best fitting the data is

$$X_i = \hat{\beta}_1 Z_i + \hat{\alpha}_1 ,$$

and the equation for the post-treatment line best fitting the data is

$$X_j = \hat{\beta}_2 Z_j + \hat{\alpha}_2 .$$

The formulae to calculate the equation parameters (the slope and the intercept) utilize the "criterion of the least square" approach and are:

For pre-treatment:

$$\hat{\beta}_1 = \frac{\sum_{i=1}^{n_1}(X_i Z_i) - n_1 \bar{X}_1 \bar{Z}_1}{\sum_{i=1}^{n_1}(Z_i^2) - n_1(\bar{Z}_1)^2}$$

$$\hat{\alpha}_1 = \overline{X}_1 - \hat{\beta}_1 \overline{Z}_1 \ .$$

For post-treatment:

$$\hat{\beta}_2 = \frac{\sum_{j=1}^{n_2} (X_j Z_j) - n_2 \overline{X}_2 \overline{Z}_2}{\sum_{j=1}^{n_2} (Z_j^2) - n_2 (\overline{Z}_2)^2}$$

$$\hat{\alpha}_2 = \overline{X}_2 - \hat{\beta}_2 \overline{Z}_2 \ .$$

For each of the quarter comparisons, the slopes and then the intercepts of the two lines were compared statistically to determine if, at the .05 confidence level, there were statistically significant differences. This statistical comparison was made using the "t distribution" with $n_1 + n_2 - 4$ degrees of freedom and a two-tailed test. This approach tests first whether the slopes of the two comparable lines are significantly different:

Ho: $\hat{\beta}_1 = \hat{\beta}_2$

Ha: $\hat{\beta}_1 < \hat{\beta}_2$

and uses the following formula to determine the t_1 (t for testing slopes) value:

$$t_1 = \frac{\hat{\beta}_1 - \hat{\beta}_2}{\sqrt{\dfrac{1}{\sum_{i=1}^{n_1}(Z_i-\bar{Z}_1)^2} + \dfrac{1}{\sum_{j=1}^{n_2}(Z_j-\bar{Z}_2)^2}}} \cdot \sqrt{\frac{n_1 + n_2 - 4}{\left[\sum_{i=1}^{n_1}(X_i-\hat{\alpha}_1-\hat{\beta}_1 Z_i)^2\right] + \left[\sum_{j=1}^{n_2}(X_j-\hat{\alpha}_2-\hat{\beta}_2 Z_j)^2\right]}}$$

The next test is whether the intercepts of the two comparable lines are significantly different:

Ho: $\hat{\alpha}_1 = \hat{\alpha}_2$

Ha: $\hat{\alpha}_1 \neq \hat{\alpha}_2$

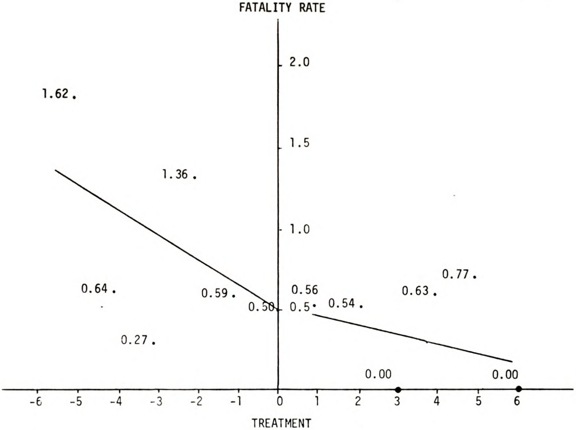
and using the following formula to determine the t_2 (t for testing intercepts) value:

$$t_2 = \frac{\hat{\alpha}_1 - \hat{\alpha}_2}{\sqrt{\dfrac{\sum_{i=1}^{n_1}(Z_i^2)}{n_1\sum_{i=1}^{n_1}(Z_i-\bar{Z}_1)^2} + \dfrac{\sum_{j=1}^{n_2}(Z_j^2)}{n_2\sum_{j=1}^{n_2}(Z_j-\bar{Z}_2)^2}}} \cdot \sqrt{\frac{n_1 + n_2 - 4}{\left[\sum_{i=1}^{n_1}(X_1-\hat{\alpha}_1-\hat{\beta}_1 Z_i)^2\right] + \left[\sum_{j=1}^{n_2}(X_j-\hat{\alpha}_2-\hat{\beta}_2 Z_j)^2\right]}}$$

The t_1 and t_2 values were then checked against t values in the mathematical t value tables for $n_1 + n_2 - 4$ degrees of freedom and for a two-tailed test at the .05 confidence level.

None of the calculated t values were equal to or greater than the table t values, and, therefore, the Ho hypotheses could not be rejected, indicating no statistical significance based on the statistical test utilized.

Figures E.1, E.2, E.3, and E.4 that follow present the summary graphs, best fit lines, and calculated t values for each quarter of analysis.



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Pre-treatment equation: $X_i = -.13\ Z_i + .50$

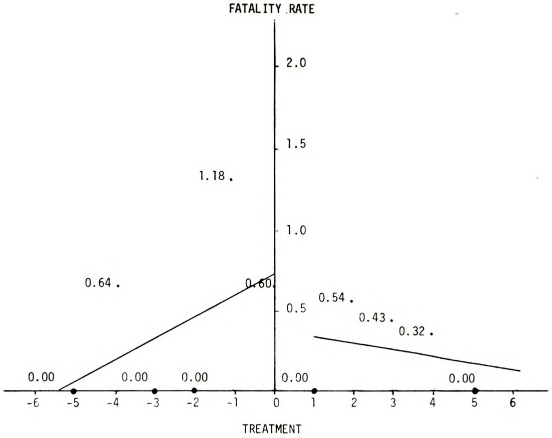
Post-treatment equation: $X_j = -.04\ Z_j + .56$

STATISTICAL SIGNIFICANCE TESTS

For slopes: T_1 = .5891584 - Not significant at .05 level

For intercepts: T_2 = .1126042 - Not significant at .05 level

Figure E.1.--Pre-/post-treatment fatality rate comparison for motorcycle licensees holding their licenses for 1-3 months.



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Pre-treatment equation: $X_i = .13\ Z_i + .73$

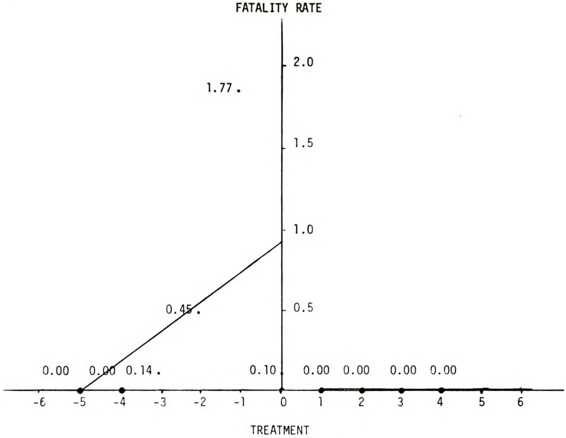
Post-treatment equation: $X_j = -.02\ Z_j + .32$

STATISTICAL SIGNIFICANCE TESTS

For slopes: T_1 = .6929796 - Not significant at .05 level

For intercepts: T_2 = .8035104 - Not significant at .05 level

Figure E.2.--Pre-/post-treatment fatality rate comparison for motorcycle licensees holding their licenses for 4-6 months.



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Pre-treatment equation: $X_i = .17\ Z_i + .85$

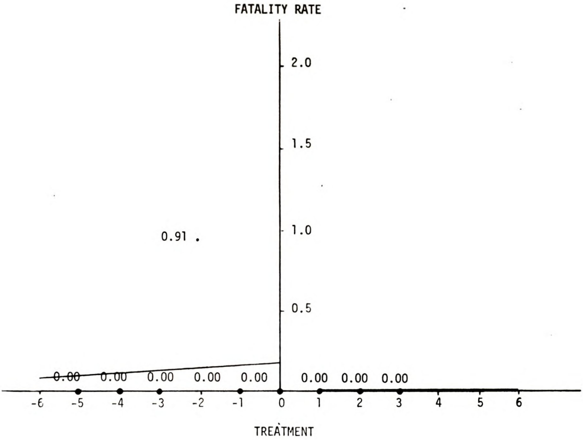
Post-treatment equation: $X_j = 0\ Z_j + 0$

STATISTICAL SIGNIFICANCE TESTS

For slopes: $T_1 = .6081798$ - Not significant at .05 level

For intercepts: $T_2 = 1.0839381$ - Not significant at .05 level

Figure E.3.--Pre-/post-treatment fatality rate comparison for motorcycle licensees holding their licenses for 7-9 months.



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Pre-treatment equation: $X_i = .03\ Z_i + .22$

Post-treatment equation: $X_j = 0\ Z_j + 0$

STATISTICAL SIGNIFICANCE TESTS

For slopes: $T_1 = .1090016$ - Not significant at .05 level

For intercepts: $T_2 = .3532405$ - Not significant at .05 level

Figure E.4.--Pre-/post-treatment fatality rate comparison for motorcycle licensees holding their licenses for 10-12 months.

APPENDIX F

STATISTICAL SIGNIFICANCE TEST FOR
LICENSEES HOLDING LICENSES FOR
EQUAL LENGTHS OF TIME

APPENDIX F

STATISTICAL SIGNIFICANCE TEST FOR LICENSEES HOLDING LICENSES FOR EQUAL LENGTHS OF TIME

To determine statistical significance for the comparisons of pre- and post-treatment average fatality rates, the first step was to plot the average rates for licensees holding licenses for equal lengths of time, and then to calculate and plot the straight lines that best fit the data. In order to facilitate the plotting of the data and the calculation of the lines, the following notation assignments were made:

Let	pre-treatment 1-3 month period	= -3
	pre-treatment 4-6 month period	= -2
	pre-treatment 7-9 month period	= -1
	pre-treatment 10-12 month period	= 0
	post-treatment 1-3 month period	= 1
	post-treatment 4-6 month period	= 2
	post-treatment 7-9 month period	= 3
	post-treatment 10-12 month period	= 4

For the pre-treatment, let

X_i = the fatality rate,

Z_i = the time period,

$\hat{\beta}_1$ = the slope of the line, and

$\hat{\alpha}_1$ = the intercept of the line.

For the post-treatment, let

X_j = the fatality rate,

Z_j = the time period,

$\hat{\beta}_2$ = the slope of the line, and

$\hat{\alpha}_2$ = the intercept of the line.

The equation for the pre-treatment line best fitting the data is

$$X_i = \hat{\beta}_1 Z_i + \hat{\alpha}_1$$

and the equation for the post-treatment line best fitting the data is

$$X_j = \hat{\beta}_2 Z_j + \hat{\alpha}_2 \ .$$

The formulae to calculate the equation parameters (the slope and the intercept) utilize the "criterion of least squares" approach and are:

<u>For pre-treatment</u>:

$$\hat{\beta}_1 = \frac{\sum_{i=1}^{n_1}(X_i Z_i) - n_1 \bar{X}_1 \bar{Z}_1}{\sum_{i=1}^{n_1}(Z_i^2) - n_1(\bar{Z}_1)^2}$$

$$\hat{\alpha}_1 = \bar{X}_1 - \hat{\beta}_1 \bar{Z}_1 \ .$$

For post-treatment:

$$\hat{\beta}_2 = \frac{\sum_{j=1}^{n_2}(X_j Z_j) - n_2\overline{X}_2\overline{Z}_2}{\sum_{j=1}^{n_2}(Z_j^2) - n_2(\overline{Z}_2)^2}$$

$$\hat{\alpha}_2 = \overline{X}_2 - {}_2\overline{Z}_2 \cdot$$

The two lines were compared to determine if, at the .05 confidence level, there were statistically significant differences. This statistical comparison was made using the "t distribution" with $n_1 + n_2 - 4$ degrees of freedom and a two-tailed test. The approach tests first whether the slopes of the two comparable lines are significantly different:

Ho: $\hat{\beta}_1 = \hat{\beta}_2$

Ha: $\hat{\beta}_1 \neq \hat{\beta}_2$

and using the following formula to determine the t_1 (t for testing slopes) value:

$$t_1 = \frac{\hat{\beta}_1 - \hat{\beta}_2}{\sqrt{\dfrac{1}{\sum_{i=1}^{n_1}(Z_i-\overline{Z}_1)^2} + \dfrac{1}{\sum_{j=1}^{n_2}(Z_j-\overline{Z}_2)^2}}} \cdot \sqrt{\frac{n_1 + n_2 - 4}{\left[\sum_{i=1}^{n_1}(X_i-\hat{\alpha}_1-\hat{\beta}_1 Z_i)^2\right] + \left[\sum_{j=1}^{n_2}(X_j-\hat{\alpha}_2-\hat{\beta}_2 Z_j)^2\right]}}$$

The next test is whether the intercepts of the two comparable lines are significantly different:

Ho: $\hat{\alpha}_1 = \hat{\alpha}_2$

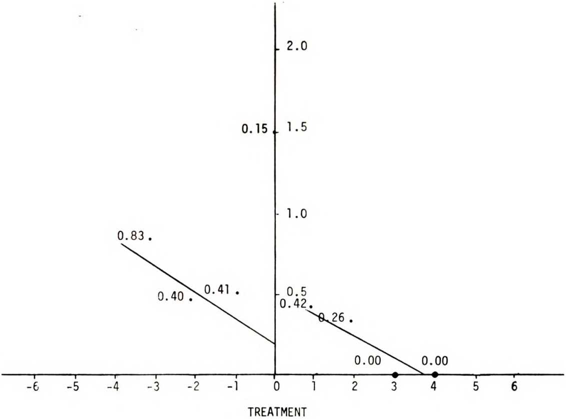
Ha: $\hat{\alpha}_1 \neq \hat{\alpha}_2$

and using the following formula to determine the t_2 (t for testing intercepts) value:

$$t_2 = \frac{\hat{\alpha}_1 - \hat{\alpha}_2}{\sqrt{\dfrac{\sum_{i=1}^{n_1}(Z_i^2)}{n_1\sum_{i=1}^{n_1}(Z_i-\bar{Z}_1)^2} + \dfrac{\sum_{j=1}^{n_2}(Z_j^2)}{n_2\sum_{j=1}^{n_2}(Z_j-\bar{Z}_2)^2}}} \cdot \sqrt{\frac{n_1 + n_2 - 4}{\left[\sum_{i=1}^{n_1}(X_1-\hat{\alpha}_1-\hat{\beta}_1 Z_i)^2\right] + \left[\sum_{j=1}^{n_2}(X_j-\hat{\alpha}_2-\hat{\beta}_2 Z_j)^2\right]}}$$

The t_1 and t_2 values were then tested against t values in the mathematical t value tables for $n_1 + n_2 - 4$ degrees of freedom and for a two-tailed test, at the .05 confidence level. Neither of the calculated t values were equal to or greater than the table t values, and therefore the Ho hypothesis could not be rejected indicating no statistical significance based on the statistical test utilized.

Figure F.1 that follows presents the summary graph, best fit lines, and calculated t values.



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Pre-treatment equation: $X_i = -.20\ Z_i + .14$

Post-treatment equation: $X_j = -.15\ Z_j + .55$

STATISTICAL SIGNIFICANCE TESTS

For slopes: $T_1 = -.7576578$ - Not significant at .05 level

For intercepts: $T_2 = 2.5781967$ - Not significant at .05 level

Figure F.1.--Pre-/post-treatment fatality rate comparison for motorcycle licensees receiving and holding their licenses during identical time periods.