Effectiveness Paper
Bicyclist Safety Programs

January 1982

(Re: NHTSA Docket 81-12; F. R. Vol. 46, No. 168,
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U. S. Department of Transportation
National Highway Traffic Safety Administration

CONTENTS

EXECUTIVE SUMMARY

For the last several years, almost 1,000 bicycle/motor vehicle fatalities occured annually. According to the Fatal Accident Reporting System (FARS) data indicate 964 cyclists died in 1980. Estimates of bicycle motor-vehicle injuries vary from about 60,000 to 80,000. Some survey data suggests that these estimates are low. Perhaps as many as two-thirds of the bike car accidents go unreported to the police and about half of these are severe enough to require medical treatment. The National Accident Sampling System (NASS) data put the number of injured cyclists at 80,000 per year.

Data pertaining to bicycle/motor-vehicle accidents are generally inadequate to identify specific problems and design effective countermeasures.

In a landmark study 3/ conducted for NHTSA, a total of 753 nonfatal and 166 fatal bike/motor-vehicle accidents were analyzed and 36 unique accident types were identifiedby Dr. Ken Cross. Twenty-five of the most frequently occurring accident types accounted for 87 percent of the fatal cases and 93 percent of the nonfatal cases. Seven of the frequently occurring accident types together accounted for 49 percent of the fatal and 52 percent of the nonfatal cases.

A major conclusion of this NHTSA study is: the causes of the vast majority of bicycle/motor vehicle accidents are behavioral. And a general conclusion is: except for intoxicated motorists, most bicyclists' function failures represent aberrant behavioral errors while few motorists' failures do. As

an example, of the seven frequently occurring accident types, wrong way bicyclist riding (as a contributing cause) was identified in 14%, 33%, 66%, 14%, and 25% respectively in five of the accident types. It is of interest to note another accident type (motorist turn-merge at an intersection controlled by a traffic signal) involving a right turn on red by the motorists. In all cases of this type (in the NHTSA Study) the motorist came to a complete stop at the intersection, searched for traffic approaching from the left and proceded to make a right turn on red. The motorist failed to observe the cyclist before entering the intersection. Eighty-five percent of the cyclists were riding facing traffic; i.e., the wrong way.

Bicyclist safety is a joint responsibility of the National Highway Traffic Safety Administration (NHTSA) and the Federal Highway Administration (FHWA). The NHTSA focus is oriented toward improving the behavior of the users-both cyclists and drivers, while the FHWA focus is on bicycling facilities such as separate bike paths; bike lanes on a roadway; or, bikeway signs, signals, and markings.

Bicycling programs and related activities have existed for a long time. However, evaluations for effectiveness in accident reductions have occurred only recently. Results of several projects are presented which indicate that a variety of solutions exist for a series of bike/motor-vehicle accident types; and, results can be achieved in accident reduction. Protests cited cover: community bicycle programs; enforcement/court/rodeos; safety town; bicycle monitors; and, a bikeways master plan.

Examples are given of programs which promise effectiveness in accident reduction. These programs cover: in-school and on-bike training/education; cyclist/motor-vehicle accident countermeasures (training, safety messages, and model regulations); conspicuity; films based on NHTSA research; statewide bicycle and bikeways program; and protective clothing and equipment for cyclists.

In addition, there are programs which assist in increasing efficiency and enhancing cost reduction. FHWA, NHTSA, and others are working on projects and materials (some of which have been made available to State and communities) such as: training programs regarding bicycle considerations in the urban areas; a checklist instrument for assessing the safety relevance of cyclist programs; construction of bicycling facilities; bicycle/motor/vehicle accident types; and, methods for classification.

Twelve of almost 700 entries to Docket 81-12 are related to bicyclist safety programs. Five of the entries contained specific project and effectiveness information. The others were generally supportive. Evidence of accident reduction effectiveness has been provided by Eugene Oregon; Madison, Wisconsin; Nassau County, New York; and the State of Minnesota. Information about programs which provide promise of effectiveness was provided by Illinois, Michigan, and North Carolina. Each of these programs is described in sections of the paper.

Effectiveness Paper: Bicyclist Safety

I. Scope of the Problem

For the last several years, almost 1,000 bicycle/motor vehicle fatalities occured annually. According to the Fatal Accident Reporting System (FARS) data indicate 964 cyclists died in 1980. Estimates of bicycle motor-vehicle injuries vary from about 60,000 to 80,000. Some survey data suggest that these estimates are low. Perhaps as many as two-thirds of the bike car accidents go unreported to the police and about half of these are severe enough to require medical treatment. The National Accident Sampling System (NASS) data put the number of injured cyclists at 80,000 per year.

Major findings of the National Highway Traffic Safety Administration (NHTSA) "Pedestrian and Bicycle Safety Study" 1/ related to bicycling were these: "There is insufficient awareness of the socio-economic and environmental impact of the role of the bicyclist in the mobility system; bicycle programs are often low priority items, consequently, the allocation of staff time and funds is not consistent with safety requirements and needs; there is a nationwide lack of uniformity of laws and ordinances pertaining to bicycle safety; within law enforcement agencies, there is a lack of formal statements describing violations and there are few policies and procedures for dealing with bicyclists; and, few data exist on the frequency, type, location, and other characteristics of crashes and on the effects of enforcement on frequency of violations and accidents."

Relating to the foregoing study's finding on data needs, an example is given by a traffic engineer in his analysis 2/ of one State's accident report data. While the bicycle is defined as a vehicle in the State, it is treated as a pedestrian for the purpose of accident reporting; "Type of Collison" data is inadequate or not meaningful; no "Vehicle Maneuver" is given in the vehicle section of the report; no "Direction of Travel" is coded for bicycle; and, no "Vehicle Condition" is coded for the bicycle.

Added to the foregoing, across the nation, the vehicle's (bicycle) "Driver Condition" is generally not reported - particularly as it relates to alcohol use, experience as a cyclist, and whether or not the cyclist ever participated in a bicyclist safety education course. Data pertaining to bicycle/motor-vehicle accidents are generally inadequate to identify specific problems and design effective countermeasures.

In a landmark study 3/ conducted for NHTSA, a total of 753 nonfatal and 166 fatal bike/motor-vehicle accidents were analyzed and 36 unique accident types were identified by Dr. Ken Cross. Twenty-five of the most frequently occurring accident types accounted for 87 percent of the fatal cases and 93 percent of the nonfatal cases.

Seven of the frequently occurring accident types together accounted for 49 percent of the fatal and 52 percent of the nonfatal cases. They are: bicyclist rides straight out of a driveway or alley--without stopping or slowing--and collides with a motor vehicle (6.7 percent fatal and 5.7 percent nonfatal); bicyclist fails to slow or stop at an intersection controlled by a stop sign

(7.8 percent fatal and 10.1 percent nonfatal); motorist attempting to enter a roadway from a commercial driveway (no fatals and 5.3 percent nonfatal); motorist enters an intersection from a roadway controlled by a stop sign (1.2 percent fatal and 10.2 percent nonfatal); motor vehicle overtook and collided with a cycle going in the same direction (24.6 percent fatal and 4.0 percent nonfatal); bicyclist initiates a left hand turn without searching to the rear or signalling and collides with an overtaking motor vehicle (8.4 percent fatal and 8.4 percent nonfatal); motorist makes a left hand turn and collides with a bicyclist approaching from the opposite direction (no fatals and 7.6 percent nonfatal).

A major conclusion of this NHTSA study is: the causes of the vast majority of bicycle/motor vehicle accidents are behavioral. And a general conclusion is: except for intoxicated motorists, most bicyclists' function failures represent aberrant behavioral errors while few motorists' failures do. As an example, of the foregoing seven accident types, wrong way bicyclist riding (as a contributing cause) was identified in 14%, 33%, 66%, 14%, and 25% respectively in five of the accident types. It is of interest to note another accident type (motorist turn-merge at an intersection controlled by a traffic signal) involving a right turn on red by the motorist. In all cases of this type studied by Cross, the motorist came to a complete stop at the intersection, searched for traffic approaching from the left and proceded to make a right turn on red. The motorist failed to observe the cyclist before entering the intersection. Eight-five percent of the cyclists were riding facing traffic; i.e., the wrong way.

Further, the NHTSA study indicates that: contrary to popular beliefs, bicycle/motor-vehicle accidents are seldom the direct or indirect result of roadway surface defects, debris on the roadway surface, sewer grates, bicycle defects or failures, motor vehicle defects or failures, riding double, bicycle too large or too small for the operator, bicycle handling skill deficiencies, hostile acts by motorists, high risk acceptance by bicyclists, or the bicyclist's deficient knowledge of traffic laws and ordinances. The non behavioral factors that are the most important contributors to bicycle/motor vehicle accidents include visual obstructions, narrow roadways, (selected locations), darkness, conspicuity of bicycles, and the vertical dimension of the bicycle/cyclist unit. It is estimated that 35 percent of the bicyclist fatalities each year result, in part, from the lack of cyclist/bicycle conspicuity.

II. Program Overview

Bicycle safety programs are a joint responsibility of the National Highway Traffic Safety Administration (NHTSA) and the Federal Highway Administration (FHWA). The NHTSA focus is oriented toward improving the behavior of the users-both cyclists and drivers, while the FHWA focus is on bicycling facilities such as separate bike paths; bike lanes on a roadway; or, bikeway signs, signals, and markings.

Based on a comprehensive identification of the bicyclist problem in terms of accident types, NHTSA is pursuing the development and test of countermeasures to decrease their frequency. Three approaches--cyclist training, safety messages for cyclists, and cyclist traffic safety regulations--are currently

being developed as countermeasure areas. Additionally, support procedures--program development guidance, accident typing methods, and a proposed Manual on Accident Reduction for Cyclists--are being developed for State and local use.

The FHWA focus for bicycle safety is on the highway, the bikeway, and the environment through the application of traffic engineering practices which include design, construction, signs, signals, and markings. The bicycle is a legitimate mode of personal transportation and the FHWA is responsible for ensuring that cyclists are appropriately considered in the planning, design, construction, and operation of highways under its' jurisdiction. The same considerations are encouraged by State and local agencies for facilities within their jurisdictions.

Full consideration is given by the FHWA field offices to the safe riding areas for bicycle traffic on all Federal-aid highway projects. Highway design configurations have been shown to be significant factors involved in cyclist safety. Roadway design, delineation, signs, markings, and the use of traffic control devices affect the safety of both the cyclist and the vehicle driver. The FHWA encourages construction of bicycle facilities (paths, lanes, and shared roadways) as part of the regular Federal-aid highway program. The construction of a bicycle facility may be approved if the facility will not impair the safety of the cyclist or motorist, the facility connects with existing cyclist facilities, or is a part of a proposed bicycle system, and if it is expected the facility will have sufficient use in comparison to cost to justify its construction and maintenance.

Efforts are made to minimize the detrimental effects on all highway users when they share a common facility. The existing highway system is used for bicycle transportation when it is safe, practicable and feasible.

The objective of the FHWA research effort is to develop more effective criteria and guidelines for safe and efficient facilities for bicyclists along the highway. The approach of this effort is to develop fundamental insights into the nature of travel by bicyclists and to then use this information to evaluate design solutions and develop and test new ones. Guidelines based on these solutions will be formulated. Specific countermeasures for bicyclist operational safety problems will be tested.

III. Effectiveness of Programs, Projects and Countermeasures

Bicycling programs and related activities have existed for a long time. However, evaluations for effectiveness in accident reductions have occurred only recently. Results of several projects are presented in this section. Projects which show promise for accident reduction are presented in the following section.

Community Bicycle Safety Programs

In response to Docket 81-12, Minnesota's program was described 6/ as follows: Forty-two Minnesota communities received Federal highway safety grants through the Minnesota Department of Public Safety and the Minnesota Department of Education from 1979-81. This funding has helped communities establish and

implement comprehensive bicycle safety programs on the premise that an intense program of bicycle safety education followed by a strong enforcement program would result in reduced numbers of bicycle accidents, injuries, and fatalities, and improved bicycle driving.

These programs typically included teachers providing classroom instruction in the various aspects of bike safety. This is followed by playground instruction on driving skills and maintenance usually conducted by local police, State troopers and county extension agents assisted by volunteers from community organizations such as PTA, 4-H, Scouts, Jaycees, Kiwanis, Lions, VFW, and Optimists. These organizations and local businesses also perform other functions such as sponsoring, publicizing, and staffing summer bike rodeos, carnivals, races, and tours.

In some communities enforcement is done by police officers, community service officers or reserves. Most cities, however, hire young people to enforce bicycle traffic laws during the biking season. These "bike patrols" usually ride 10-speed bikes, wear uniforms, and patrol the community issuing warnings and citations for violations. They also work as educators, teaching bike safety to groups of youths in schools and summer park and recreation programs or talking informally to individuals and small groups they encounter in their daily rounds.

While adult violators are issued regular traffic tickets and sent to traffic court, juvenile violators are typically issued a citation and a letter is sent to parents requesting the child's presence at a Bike Violator's Seminar,

the function of which is to re-educate violators regarding bicycle traffic laws. The approach is positive and educational rather than punitive. The judicial system becomes involved when repeat offenders and juveniles refusing to attend seminars are referred by their police departments to juvenile court. In a special bike court a judge talks to juveniles and their parents about the importance of obeying bike laws and then decides on a penalty for the violation. This may be a fine, or an order to attend a seminar, or a work squad assignment.

The communities sizes include small towns under 1,000 population, suburbs with 25-50,000, and Minneapolis with 370,000. Grants to the cities over the three years totalled $215,000, which was matched with $283,000 in local funds and services. Police and bike patrols worked 62,000 hours making 55,000 enforcement contacts while 133,000 students were instructed in bike safety by the above mentioned personnel.

The accident reduction results of these Minnesota community efforts were as follows:

- 1979--The funded communities showed no fatalities and a 13 percent decrease in accidents from 1978. Statewide there were 14 fatalities, a decrease of 9 (39 percent) from 1978 and 33 percent below the previous 10-year average of 21. Crashes also dropped 86 (7 percent) from 1978 and injuries decreased by 112 (10 percent).

- o 1980--Twelve (50 percent) of the funded communities showed reductions in bike accidents ranging from 15 percent to 100 percent in small communities which had no accidents in 1980. There was a fatality in one of the communities. The 21 communities which conducted bike enforcement programs showed an overall 18 percent reduction of bicycle accidents. Statewide there were 19 fatalities, up from the previous year but still well below the 10 year average.

- o 1981--During the first 9½ months, data from 35 community programs show an overall 40 percent decrease in accidents from 1980. Fatalities in these communities have decreased from 5 in 1980 to 3 this year. Statewide there have been 5 fatalities with 10 weeks left in the year. Data from previous years show 2 or fewer fatalities in November and zero in December.

Although accident reduction is the primary goal of the community bicycle safety programs, other benefits have resulted. These include:

1. Improved police/community relations

2. Increased cooperation between community agencies and organizations

3. Increased communication between Minnesota communities

4. Improved adult/teen relations

5. Teens increasing civic responsibility

6. Renewed awareness of the importance of traffic safety

Communities have also reported reductions in pedestrian injuries and vandalism and improved reporting on fire, emergency medical services (EMS), and other domestic emergencies in conjunction with bicycle enforcement.

In accordance with the seed money concept, many of Minnesota's community bicycle safety programs are maintained with 100 percent local funding after their grant eligibility expires. In 1981, 12 such community programs continued to function. Of the 28 communities funded in 1981, 19 have plans to continue and six are presently working to secure local funding for 1982. An additional 12 communities will continue with local funding.

Since November of 1979, Minnesota has employed a full-time bike safety coordinator under a 402 highway safety grant. The coordinator's office is at the University of Minnesota, Agricultural Extension Service. The role of the coordinator includes processing community bike safety program proposals, working with community program personnel, providing training for teachers, police, and bike patrols, and establishing a statewide communications network whereby information from the various State agencies can reach people in local communities.

Enforcement/Court/Rodeos

Information excerpted from an Illinois Transmittal 7/ to NHTSA Region V, indicates that during 1979, Skokie Illinois, received Section 402 funds to complete its third year of a Bicycle Safety Patrol Program. Bicycle related accidents were reduced 22 percent over the 3-year funding period.

Eight college students were provided with 40 hours of training. This training was also shared with bicycle enforcement officers from Morton Grove and Northbrook, Illinois.

During an 11 week on-the-job period, the 8 Skokie patrols made over 8,000 contacts, and handed out thousands of copies of the Illinois Bicycle Rules of the Road pamphlet. Only 47 citations were issued, but 2,109 written and 3,534 verbal warnings were issued. In addition, 2,376 bicycles were registered and 3 bicycle rodeos were conducted. Of 36 accidents during 1979, only 14 were attributed to the bicyclist's failure to obey the law.

Safety Town

A review of entry number 089 in Docket 81-12 provides the following 8/:
In Nassau County, New York, a Children's Safety Town complex was constructed and a corresponding training program was developed in 1972 with Federal funding assistance. Each school year, almost 50 percent of Nassau County's third grade students visit Safety Town.

The Accident Prevention Bureau, Nassau County Police, completed an in-depth study of bicycle accidents which occurred in Nassau County from 1972 through 1977.

Of 125 bicycle accidents occurring during 1975, 4.8 percent of the involved 7-11 year old cyclists were trained at Safety Town. During 1976, of 231 bicycle accidents, 2.6 percent of the involved 7-12 year old cyclists were trained at Safety Town. Of 331 bicycle accidents during 1977, one cyclist of the 7-13 year old group was involved.

Studies of the statistical data indicated that of all bicycle accidents which occurred in Nassau County during 1972-77 involving bicyclists between 7 and 13 years old, 51 students (5.2 percent) were from the group trained at Children's Safety Town. The remaining 94.8 percent of the involved students were not trained at Children's Safety Town.

Bicycle Monitors

Wisconsin's response 9/ to Docket 81-12 included the following information: A 3 year (1978-80) Madison, Wisconsin, program, conducted during May through October annually, consisted of 8 to 12 monitors whose responsibilities included contacting and educating bicyclists and pedestrians; and enforcing city ordinances pertaining specifically to pedestrian and bicyclist violations.

The number of annual bicycle accidents has more than tripled since the 1960's. Eighty-three percent of reported bicycling accidents involved cyclist injuries

during 1980. There has been a steady increase in the percentage of 15-24 year old involvements--53 percent in 1980. (Starting in May 1980, a Municipal bus Strike lasted 13 weeks.)

In the 3 year period preceding this project, the number of bicycling related citations issued per year declined by 31 percent, while bicycle accidents increased 7 percent per year. For the 1978 project period (June-October) there was a 16.7 percent decrease in pedestrian and bicycle related accidents compared to the same period in 1977. The total reported bicycle accidents represent 3 percent of all reported traffic accidents.

During the third year of the program, the monitors initiated an effective program to increase bike registration. This enforcement effort was so effective that there was a 141 percent increase in the number of registered bicycles (1980 vs. 1979). A total of $57,000 was generated--up from $31,000. Annual project costs ranged from $20,000 to $52,000 with the 1981 estimate at $45,000.

Bikeways Master Plan

In 1979, the Oregon Traffic Safety Commission funded, with Section 402 monies, the writing of the evaluation of the Eugene Bikeways Master Plan. 10/

As stated in Docket 81-12, city staff used bicycle volume counts and bicycle accident reports to establish accident rates for various sections of the street network.

Eugene's 18th Avenue Route is presented as an example of bicycle facilities effecting accident reduction. The average "before bike-lanes" accident rate for 1974-1978 was 7.4 accidents per 100,000 bicycle miles. In 1980, the accident rate for 18th Avenue was 2.6 accidents per 100,000 bicycle miles.

Eugene is experiencing serious accidents primarily on streets without bicycle facilities. The Master Bikeways Plan includes community-wide education, enforcement, and bicycle parking.

In summary, this section on "Effectiveness" highlights examples of a variety of countermeasures which are beneficial either individually or combined with each other.

IV. Programs Which Promise Effectiveness in Accident Reduction

There are some programs, projects, or countermeasures which are prime candidates for achieving accident reduction. There is a need for more data, additional testing, and rigorous evaluation in some cases. Some examples are presented here.

Training/Education

In Missoula, Montana, during the 79-80 school year, a large-scale field test was conducted of a comprehensive bicyclist training curriculum comprised of both in-class and on-bike elements. The evaluation 4/ consisted of an on-bike behavioral test administered before and after training. In addition, a comprehensive written examination was given to all students.

The experimental sample consisted of over 600 4th grade students and was broken down into four randomly selected groups of subjects: a no-treatment control group, and three additional groups which received either the short, medium, or full version of the course.

Results indicate that the training received during the course was effective in producing superior on-bike performances as well as higher scores on the written examination. Behaviors specifically taught during the course showed a significant increase from pre to post testing. No significant group differences in other, more general, bicycling skills were found. Performance on the written examination increased as a function of the amount of training received.

Opinion data, collected from the teachers involved, indicated overall satisfaction with the course. The majority also indicated a willingness to teach the course again and a desire to incorporate the program into existing curricula. Data related to accident reduction are now being collected and analyzed.

The total cost (Section 402 dollars) for the Missoula City project was $25,000 ($10,000 1st year and $15,000 2nd year) and covered course material, supplies, and staff development. The cost of providing instructors and instruction hours was provided by the local school districts. In addition, many volunteer hours were donated to the project. During 1980, all 4th graders in Missoula took the course. For 1981, the course was expanded to a statewide program. 5/

Cyclist/Motor-Vehicle Accident Countermeasures

NHTSA research into cyclist/motor-vehicle accidents led to the identification of a large number of accident types. Given the existence of these specific problems, attention was then directed at developing solutions for them. Specifically, a project was conducted to develop prototype countermeasures in the areas of training programs, public information and education materials, and model traffic safety regulations directed at particular types of cyclist accidents. 12/ The same developmental steps taken in the successful pedestrian safety countermeasure areas were followed in the bike project. The results of this effort are ten safety messages, eight traffic safety regulations, and four training programs. All are in prototype form (i.e., not produced in final form) and should be fully developed and tested in the field before being implemented on a nationwide basis. A listing of the countermeasures by area follows:

Training 12/ (Volume I)

- Anti-Rideout Program: Informs parents of the dangers inherent in the rideout situation for young riders and the ways to avoid it.

- Stop/Search Training: Teaches children to stop and search left-right-left while walking or riding their bicycle across the street.

- Training Program for: Bicyclist in the Fourth Grade. — Addresses all accident types and focuses on making bicyclists of this age group sufficiently skilled and knowledgeable to ride in traffic properly and safely.

- Police Officer Training: — Informs police personnel about the known bicycle accident problem types and encourages them to take compensatory enforcement action.

Public Information and Education Materials 12/ (Volume II)

- T.V. PSA Message Boards

  Anti-Rideout
  Stop Sign Intersection
  Visual Screens
  Wrong Way Bicyclist
  Cyclist "Trapped" Signalized Intersection
  Driver Awareness
  Bicyclist Awareness/Crossing Motorist
  Bicyclist/Parked Cars
  Cyclist Unexpected Left Turn
  Riding to the Right of Traffic

o Radio PSAs

Wrong-Way Bicyclist/Motorist

Bicyclist "Trapped"/Motorist

Motorist Anti-Driveout

General Driver Awareness

Model Traffic Safety Regulations 12/ (Volume III)

Bicycle Conspicuity

Bicyclist Use of the Highway

Highway Entry

Minimum Age Requirements for Bicyclists

Removal of Visual Obstructions

Prohibit Riding Bicycles on Sidewalks

Bicycle Safety Patrol and Violation Disposition

Conspicuity (Visibility)

One ongoing NHTSA-sponsored project 13/ deals with enhancing the conspicuity of both pedestrians and cyclists. The output of this project will include the identification of conspicuity-enhancing materials for both daytime and nighttime use. The next step will be to test the most promising ones for their accident-reduction effectiveness. It should be pointed out that campaigns to increase the conspicuity of pedestrians to reduce nighttime accidents have yielded some positive results, especially abroad (e.g., Norway) where the use of such materials has met with positive public acceptance.

Bicyclist Safety Training Program--"It's Your Move"

Since March 1979, The Travelers Insurance Companies have offered "It's Your Move"--a public service bicycle safety training program 14/ drawing on the findings of the NHTSA study in which Cross 3/ identified new bike/motor vehicle accident types and countermeasure approaches.

The highlight of this 4-6th grade program is a 16-minute film designed to help make youngsters more aware of the dangers of riding bicycles in traffic and to teach them how to anticipate and respond to some of the most common types of traffic hazards.

"It's Your Move" is available on a free loan basis. It is offered with teacher's discussion guides for both pre and post viewing; prototypes of forms for student testing; teacher's critiques; and, student's comments for use in evaluating the program.

Bicyclist Safety Education--"The Beginning Years," and "Stop, Search, and Assess"

Fiesta Films 15/ announced, in March 1981, the release of two new films based on research sponsored by NHTSA 3/ and a report sponsored by the AAA Foundation for Traffic Safety. 15a/ Dr. Ken Cross, who did the NHTSA research and wrote the AAA report, identified bike/motor-vehicle accident types and recommended specific countermeasure approaches for particular target groups.

"The Beginning Years" concentrates on the majority (75 percent) of the high danger situations for primary grade bicyclists. In live action and animation, "Stop, Search, and Assess" shows the most common types of accidents for elementary and adult bicyclists and discusses the behavioral errors that contribute to these accidents.

Statewide Bicycle and Bikeways Program

In January 1974, the North Carolina Bicycle and Bikeways Program 16/ was created within the North Carolina Department of Transportation and Highway Safety. The Bicycle Program (BP), following the outline of the Bicycle and Bikeways Act, is responsible for all aspects of bicycle concerns in the State.

The BP assists local areas in the development and construction of local bike routes along with developing a statewide bikeway system. The BP has published policies, procedures, and standards for bicycle programming and has developed bikeway demonstration projects and safety training programs. The BP is also responsible for approving any bicycling event held on state-maintained roads.

For safety assistance to touring cyclists, the BP has mapped out over 500 miles of road in the State. Examples of activities include over 25 individual and distinct types of projects (the majority of them funded under Section 402) administered by a three person staff.

Recently, a $30,000 multi-year project was funded to develop a Bicycle Law Enforcement Manual. This was completed by the University of North Carolina

Highway Safety Research Center. The manual and enforcement program was to be tested in two selected communities. Current funding uncertainties have delayed implementation of the tests.

Comprehensive Bicyclist Education Program

A research study 11/ subjected the Comprehensive Bicyclist Education Program (CBEP), developed by Mountain Bicyclists' Association (MBA), to a field test to evaluate both the in-class and on bike components (MBA staff made extensive use of existing accident analysis data, in particular, the NHTSA study completed by Dr. Ken Cross of Anacapa Sciences). The following criteria were evaluated to determine program effectiveness:

- Increased student knowledge.
- Increased student on-bike riding skills.
- Acceptance of the program by participating students, teachers, and administrators.
- Feasibility of program for future widespread implementation.

Students in both experimental and control groups were administered a pre/post-test for both the in-class knowledge and awareness, and the on-bike skill development. In addition, attitudinal surveys were conducted with teachers, administrators, and participating students.

The actual field test for the program took place in the spring of 1981 in 7 elementary schools from the metropolitan area of Denver, Colorado. Over 700 students participated, representing 4th, 5th, and 6th grades at five suburban and two urban schools. Major findings of the evaluation process indicate:

- Increased knowledge related to cycling and safety.

- Acceptability by administrators with impetus for program implementation usually provided by the teacher.

Although this research study evaluated one specific bicyclist education program, much of what was learned can be used to evaluate the effectiveness of other programs and materials as well.

The finding that frequent riding experience and riding with parents do not contribute to increased skills is an important factor in determining the need for a CBEP-type curriculum. Evidently, students are developing incorrect riding behavior by themselves and through modeling of their parents' behavior on bikes. There appears to be a definite need to encourage the development of awareness of correct riding skills and an opportunity to practice them to help reduce incorrect behaviors.

Scanning proved a difficult task for students to master; perhaps additional practice will remedy this. Clear signals given in advance also proved troublesome to many students.

Students also found the street simulation on the playground or parking lot to be too unrealistic. Efforts should be made to conduct this third module (on bike) on a residential street whenever posssible, especially with a traffic mix using bicycles. A real street situation will also assist students in practicing some correct behaviors which they seem to resist as a result of prior learning. An example would be not making left turns from the far right lane, possibily the result of learning to stay out of traffic at all times.

Two useful skills that students seemed to learn fairly easily were emergency stopping and the rock dodge. As many bicycle-only accidents are the result of losing control of the bike, both these skills should prove beneficial.

Overall, the material appears well suited for 4th, 5th and 6th grades with in-class worksheets and on-bike skills building receiving high marks from participants.

Whether such a program will produce a reduction in accidents or long term changes in attitudes towards cycling and lifetime physical fitness remains beyond the scope of this study.

The indication by students that they talked more with their parents and other students about cycling, as a result of participating in the course, can be considered a hopeful sign.

Protective Clothing and Equipment for Cyclists

In an NHTSA study 3/, Cross's analysis revealed that 76.4 percent of the injuries were body-surface injuries, 17 percent were skeletal injuries, and 6 percent were internal non-skeletal injuries. The relative incidence of the most frequently occurring types of injuries is shown in Figure 1. It can be seen that abrasions and bruises together accounted for nearly two-thirds of the injuries while about 11 percent of the injuries were lacerations. Considering next the skeletal injuries, it can be seen that 7.5 percent of the injuries were fractures, 5.6 percent were sprains, 2.7 percent were concussions, .9 percent were dislocations, and .6 percent were broken teeth. Nearly 5 percent of the injuries were aches and pains in the muscles and joints, and slightly over one percent were ruptures of subcutaneous tissues, arteries, vessels, or organs.

FIGURE 1

Distribution of injury types for bicyclists in the non-fatal sample

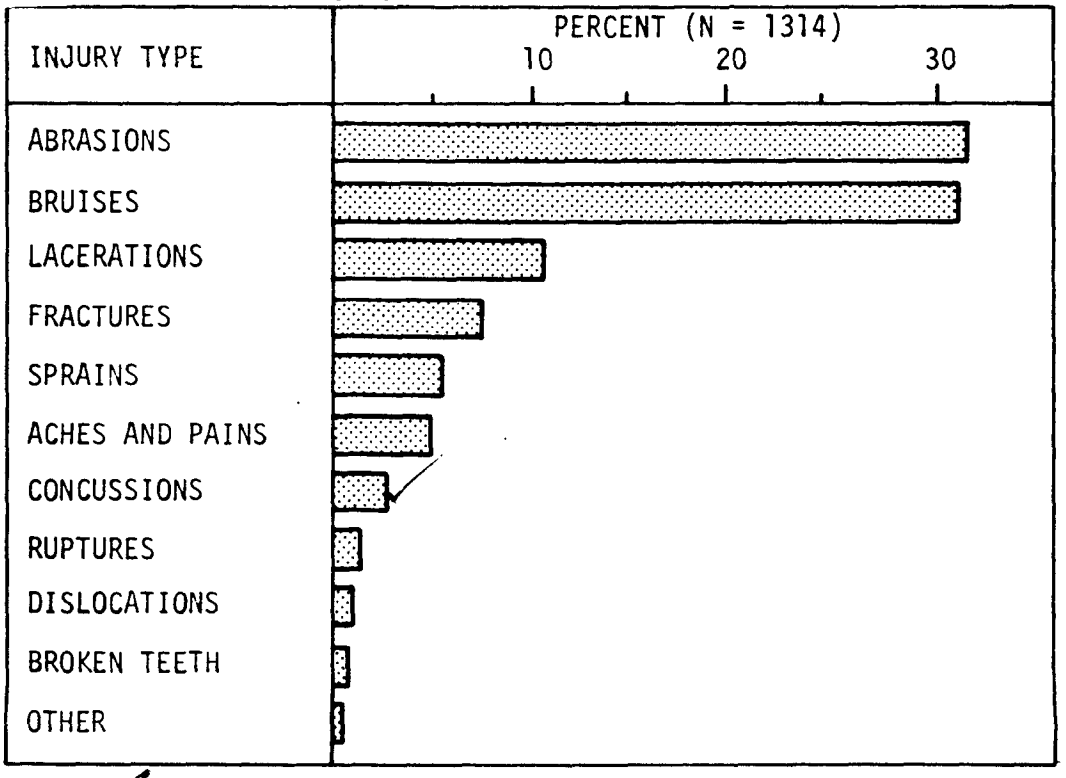

Figure 24. Distribution of injury types for bicyclists in the non-fatal sample.

The finding that about three-fourths of the injuries were body-surface injuries suggests that protective clothing has the potential for reducing or eliminating many of the types of injuries sustained by the bicyclist. Protective clothing also has the potential for reducing or eliminating concussions and possibly other types of fractures as well.

The distribution of type of injury found in this study is highly similar to the distribution of type of injury sustained by bicyclists treated in the National Electronic Injury Surveillance System (NEISS) hospital emergency rooms during the period between 1969 and 1974. In the NEISS sample, it was found that abrasions, bruises, and lacerations accounted for about 70 percent of the injuries, fractures accounted for approximately 13 percent of the injuries; skull fractures were evident in less than .5 percent of the cases, while concussions and organ injuries occurred in less than 3 percent and .4 percent of the cases, respectively. Information obtained from death certificates indicates that head and neck injuries were present in 80 percent of the fatal cases. (U.S. Consumer Product Safety Commission, 1975.)

The primary reason for examining the location of injuries is to evaluate the potential of different types of protective clothing for reducing the number and severity of injuries resulting from bicycle/motor-vehicle accidents. Actually, the padding of various parts of the body could be incorporated into one or two separate garments. Figure 2 shows the proportion of body-surface injuries that would be affected by protective clothing that would pad or otherwise protect specific body regions.

FIGURE 2
Potential of various types of protective clothing for reducing body-surface injuries

TYPE OF PROTECTIVE CLOTHING	BODY-SURFACE INJURIES AFFECTED (N=1001)
Knee Padding	14.1%
Helmet	11.0%
Elbow Padding	9.2%
Face Guard	8.0%
Shin Padding	6.6%
Foot/Ankle Protection	6.5%
Gloves/Mittens	6.3%
Hip Padding	6.3%
Shoulder Padding	3.6%
Inner Thigh Padding	1.0%

It can be seen that knee padding has the potential for eliminating or reducing more than 14 percent of the body-surface injuries. Since many of these injuries are abrasions and lacerations, it is possible that a heavy material covering the knees would effect a significant reduction in the severity of injuries to the knee.

A helmet covering the upper skull has the potential for reducing injuries by 11 percent; another 8 percent reduction could be realized by affixing a face guard on the helmet that would serve to protect the fact, teeth, and chin of the bicyclist.

Effective elbow padding could reduce the number of body-surface injuries by as much as 9.2 percent. Shin padding, foot/ankle protection, gloves/mittens,

and hip padding each has the potential for reducing body-surface injuries by more than 6 percent. Shoulder padding could reduce body surface injuries by as much as 3.6 percent; and, protection of the inner thigh could reduce body-surface injuries by about one percent.

The percentage values shown in Figure 2 are based only on body-surfac injuries. It is possible that protective clothing would also effect a reduction in the number of skeletal injuries and other internal injuries. For instance, a helmet with a face guard has the potential for reducing the number of concussions and lost or broken teeth; effective footwear could reduce the number of ankle sprains and fractures; and effective gloves could reduce the number of fractures to the hands and fingers.

Statewide Effort in Bicycling Safety

According to information submitted to Docket 81-12, Michigan's quarter million dollar 3 year bicycling safety project was conducted on a statewide basis. 17/ The program included statewide instructor training, corporate commuter projects, bike patrols, bicyclist clubs, and community action groups.

Almost $40,000 was spent on evaluating this project which an outreach of almost 33,000 persons. The evaluation was designed by the Lansing (MI) School District's Evaluation Division. Measurement focused on a state-wide comparison of trained and untrained bicyclists. There is some evidence of accident decrease. The evaluation has not been completed but the results look promising.

V. Programs Which Have Potential for Increasing Efficiency or Enhancing Cost Reduction

Bicycle Considerations in Urban Areas--Training Program (FHWA-National Highway Institute)

The primary purpose of this bicycle planning and design course is to provide local, State, and Federal traffic engineers and transportation planners with the information, skills and tools they need to plan and design various types of bicycle facilities (such as bike paths or lanes used exclusively by cyclists or shared with motorists) in their respective communities. The course outlines how local, State, and Federal agencies can plan, design, implement, and operate bicycle facilities and programs.

Through the course, participants become more capable of identifying the needs and recognizing problems of cyclists; proposing applicable planning, design and/or program strategies to enhance cycling as a mode of travel; evaluating existing and proposed bicycle programs and facilities; and integrating cyclist considerations into the total transportation planning, design, and implementation process. Safety needs and problems are discussed throughout the course.

Safety Assessment Methods

A project is underway 18/ to develop a checklist instrument for assessing the safety relevance (to known cyclist accident problem types and solutions) of existing, non-NHTSA developed cyclist programs. The checklist instrument and supporting materials will be made available for use by States and localities

so that they can perform their own safety assessment of cyclist programs. It is anticipated that such an instrument will be a valuable tool for a program administrator in selecting an appropriate program.

A Real-World Bicyclist Performance Measure

A reliable and valid measure of the behavior of bicyclists in normal traffic is urgently needed for progress in bicycle safety. A measure was developed based on observations by trained coders. The instrument was shown to be both sensitive and reliable and is equally useful for measuring adult bicycling behavior. This study 19/ was supported by the California Department of Education with funding from the California Office of Traffic Safety assisted by funding from NHTSA.

Types of bicycling behavior identified as critical for safety were drawn from accident and reseach data and a model of safe operator behavior. The reliability of observations depends on unambiguous definition of types of behavior and avoidance of information overload as well as intensive training. Only those types of behavior that occur frequently and are critical for safety are included.

Three types of locations are used: (a) controlled intersections where the major variable is path; (b) midblock entrance; and (c) uncontrolled intersections where the variable of concern is search. Coding each type of location requires using a different form. Inter-coder reliability was very high for all forms.

This technique was used to evaluate the bicycle-riding behavior of approximately 600 elementary school children and more than 3,000 junior high school students on two occasions. This is the most extensive survey of bicycle riding behavior available. It shows a very high error rate for all maneuvers and the greatest numbers of errors occurring on left turns and in search patterns.

Construction of Bicycling Facilities

Section 134 of the 1976 Federal-Aid Highway Act allows the use of Federal-aid highway funds to construct bicycle and pedestrian facilities independent of regular highway projects. It should be noted that funds are not reserved exclusively for bicycle or pedestrian facilities, but are, in fact, highway funds which may be used for highways, bikeways, and walkways at the option of State transportation agencies.

Bicycle-Accident Typing

NHTSA has developed a bike-accident typing system 20/ which classifies police accident reports of bike/motor-vehicle crashes into the accident types developed for NHTSA by Dr. Ken Cross.

The typing systems are designed for use when special studies or projects are initiated by States or communities. Two forms of the typing/classification system exist. One is called a Manual Accident Typing system (MAT/Bikes) which has a coder determine the accident type by following a step-by-step procedure for reviewing each accident report. The second form--Computer

Accident Typing (CAT/Bikes)--is appropriate where large numbers of accidents occur and the coder has a computer facility available. In CAT, the coder answers a series of questions based upon data in the police accident report, and the computer program "types" the accident. Each of the systems will be available in a materials package consisting of: a Slide/Tape Training Program with a Practice Cases Booklet, a Coder's Handbook, and an Administrator's Guide.

While the primary purpose of the systems is to have a locality identify its particular bike accident problems, the ultimate use comes from selecting countermeasures (training programs, safety messages, or regulations) which are specific to solving these particular problems.

Guide for Bicycle Facilities

The FHWA has developed this guide 21/ which provides information on the development of facilities to enhance and encourage safe bicycle travel. Among the facilities discussed are bicycle paths, bicycle routes, bicycle lanes and shared roadways (where the bicycle shares the travel lane with other vehicles). The guide includes information to help provide for bicycle traffic in all riding environments. It presents information to be considered in designing a facility which is sensitive to the needs of both bicyclists and other highway users.

An overview of planning considerations is included as well as a discussion of types of facility improvements and factors to consider when locating a

facility. Suggestions also given for use when constructing or improving highways and when designing or constructing bicycle facilities. Recommendations are included regarding the operation and maintenance of facilities for bicycles. The guide will assist State and local agencies in implementing a wide variety of bicycle projects.

VI. Responses to Docket 81-12

Twelve of almost 700 Docket entries are related to bicyclist safety programs. (See Figure 3.) Five of the entries contained specific project and effectiveness information. The others were generally supportive. Evidence of accident reduction effectiveness has been provided by Eugene Oregon; Madison, Wisconsin; Nassau County, New York; and the State of Minnesota. Information about programs which provide promise of effectiveness was provided by Illinois, Michigan, and North Carolina. Each of these programs is described in preceding sections of this paper.

There is an indication that evaluations of cyclist behavior and total cycling programs can be accomplished and will provide objective assessments of accident reduction effectiveness. These evaluations and assessments are now at the threshold of availability for users.

FIGURE 3

Commentor			Response to Docket 81-12				
Officials State/Local		Other	Subject Addressed	V. Neg.	Neg.	Pos.	V. Pos.
			Accident reduction				
2	1		o community-wide project				3
	1		o enforcement program				1
	1		o safety town				1
1	1	4	Generally supportive			3	3
		1	Evaluation measure for cyclist behavior			1	
TOTALS: 3	4	5				4	8

VII. References

1/ NHTSA: Pedestrian/Bicycle Safety Study, Highway Safety Act of 1973 (Section 214); DOT-HS-801-383; March 1975.

2/ Baumgaertner, W.E., (Professional Engineer): Improving Bicycle Accident Reporting and Analysis; ITE Newsletter; Summer, 1980.

3/ NHTSA: A Study of Bicycle/Motor Vehicle Accidents; Identification of Problem Types and Countermeasure Approaches; DOT-HS-803-315; September 1977.

4/ Walkenback, J., Ph.D., and Hewitt, E.: Missoula (Montana) Bicyclist Training Program--Final Evaluation Report; July 1980.

5/ Johnson, C.G.: Project Monitoring/State and Community Section 402 Programs; NHTSA Region VIII; memo dated June 12, 1981.

6/ Wagner, S.K.: Response to Proposed Rules; University of Minnesota; October 23, 1981, Docket 81-12-N-01-434.

7/ Transmittal to NHTSA Region V: Illinois Department of Transportation/Skokie, Illinois--Final Report; September 18, 1979.

8/ Nassau County Police Department: Response to Proposed Rules: Bicycle Accident Study; June 1978; Docket 81-12-N-01-089.

9/ Madison (Wisconsin) Police Department: Response to Proposed Rules; Pedestrian Bicycle Monitor Program Report, August 1981; Docket 81-12-N-01-201.

10/ Gleason, Mike: Eugene (Oregon) Bikeways Master Plan; City Manager letter to Docket 81-12-N-01-481; October 28, 1981.

11/ Williams-McBean, Mary Jane: Evaluation of An Elementary School Comprehensive Bicyclist Program; Denver Psychological and Educational Associates under contract to Mountain Bicyclists Association; Draft of Study Report; August 3, 1981.

12/ NHTSA: Identification and Development of Courtermeasures for Bicyclist/Motor-Vehicle Problem Types: Volume I, Methods and Training Program Description; Volume II, Public Information and Education Methods; and Volume III, Model Regulations; DOT-HS-01726.

13/ NHTSA: Conspicuity for Pedestrians and Bicyclists; Definition of the Problem, Development and Test of Countermeasures, Contract DTNH 22-80-C-07052 (study underway).

14/ The Travelers Insurance Companies, Marketing Services Department: Personal Communication to NHTSA Pedestrian/Cyclist Branch; November 1979.

15/ Fiesta Films: Personal Communication to NHTSA's Pedestrian/Cyclist Branch; June 1981.