NIOSH

Testimony to DOL

TESTIMONY OF THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH ON THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION'S NOTICE OF PROPOSED RULEMAKING ON OCCUPANT PROTECTION IN MOTOR VEHICLES

29 CFR Parts 1910, 1915, 1917, 1918, 1926, and 1928
Docket S-776-G

Presented at the OSHA Informal Public Hearing
January 8, 1991
Washington, D.C.

J. Donald Millar, M.D.
Assistant Surgeon General
Director
National Institute for Occupational Safety and Health

1.a

NIOSH staff presenting for Dr. Millar:

Bryan D. Hardin, Ph.D. Deputy Director	Office of the Director, Division of Standards Development and Technology Transfer (DSDTT)
Laurence D. Reed Acting Associate Director for Policy Development	Office of the Director, DSDTT
E. Lynn Jenkins Statistician	Injury Surveillance Section, Surveillance and Field Investigations Branch, Division of Safety Research
Michael J. Colligan, Ph.D. Chief	Direct Training Branch, Division of Training and Manpower Development

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. PB91-213132
4. Title and Subtitle NIOSH Testimony on Occupant Protection in Motor Vehicles by J. D. Millar, January 8, 1991			5. Report Date 1991/01/08
			6.
7. Author(s) NIOSH,			8. Performing Organization Rept. No.
9. Performing Organization Name and Address NIOSH			10. Project/Task/Work Unit No.
			11. Contract (C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address			13. Type of Report & Period Covered
			14.

15. Supplementary Notes

16. Abstract (Limit: 200 words) This testimony concerned the views of NIOSH regarding the proposed rule on occupant protection in motor vehicles and provided information which will assist OSHA in developing a final standard. NIOSH studies have indicated that motor vehicle traffic accidents are the leading cause of occupational deaths due to traumatic injuries. Driver safety awareness training designed to promote the use of safety devices as well as familiarization with other vehicle safety systems was an essential component in achieving full compliance with safety belt and helmet use requirements. Information was also presented which suggested that alcohol and drug use may play a role in occupationally related motor vehicle deaths and injuries. It was noted that NIOSH strongly supports the efforts of OSHA in proposing rulemaking in this area of occupational health and safety.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms NIOSH-Publication, NIOSH-Author, NIOSH-Testimony, Millar-J-D, Accident-prevention, Safety-engineering, Drivers, Bus-drivers, Truck-drivers, Automotive-industry, Safety-practices, Protective-measures

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages 16
	22. Security Class (This Page)	22. Price

I am Bryan D. Hardin, Deputy Director of the Division of Standards Development and Technology Transfer of the National Institute for Occupational Safety and Health (NIOSH). With me today are senior staff from NIOSH. NIOSH has reviewed the Occupational Safety and Health Administration (OSHA) proposed rule on occupant protection in motor vehicles and provides information in this testimony that we hope will assist OSHA in developing a final standard.

I. INTRODUCTION

NIOSH studies have shown that motor vehicle traffic accidents are the leading cause of occupational deaths due to traumatic injuries (Jenkins unpublished; Bell et al. 1990). The proposed rule would help reduce vehicle-related occupational deaths and injuries by requiring employers to ensure that workers use safety belts or motorcycle helmets while driving or occupying a motor vehicle on the job. Data on safety belt and motorcycle helmet use, summarized in this testimony, indicate that these safety devices are highly effective in preventing occupationally related motor vehicle deaths and injuries.

Driver safety awareness training designed to promote the use of these safety devices, as well as familiarization with other vehicle safety systems, is an essential component in achieving full compliance with safety belt and helmet use requirements. This training will help to promote safe driving by workers, both on and off the job.

NIOSH also presents data in this testimony indicating that alcohol and drug use may play a role in occupationally related motor vehicle deaths and injuries. NIOSH strongly supports OSHA in proposing rulemaking in this area.

II. NIOSH ESTIMATE OF DEATHS AND INJURIES

A. Total U.S. Deaths

NIOSH has determined, based on its National Traumatic Occupational Fatality (NTOF) data base, that motor vehicle traffic deaths are the leading cause of occupational deaths due to traumatic injuries (Jenkins unpublished; Bell et al. 1990). Analyses of the NTOF data base have identified an average of approximately 1310 work-related traffic deaths per year for the six-year period from 1980 through 1985. This figure represents 20.1% of the total number of identified work-related deaths caused by traumatic injuries.

The NTOF data base uses death certificates from each of the 50 states in the United States to enumerate occupationally related traumatic deaths. The NTOF numbers are dependent on the extent and validity of information provided on the death certificates. Whether a fatality is occupationally related is not always apparent because the work-

relatedness criterion for cause of death is not standardized and there are no national guidelines or quality control mechanisms regarding the completion of this item on death certificates. The reliance on death certificate information in NTOF results in a strong likelihood that occupational causation will be underreported, particularly for motor vehicle-related deaths. For example, state-specific studies in Massachusetts (MDPH 1989) and Colorado (CDH 1990) found that death certificates alone captured only 74% and 66%, respectively, of occupationally related motor vehicle deaths. Therefore, because of inherent underreporting of NTOF data, the numbers and rates presented in the Bell and Jenkins papers should be regarded as an underestimation of the number of occupationally related motor vehicle deaths occurring in the U.S. between 1980 and 1985.

State-specific studies in Maryland (Baker 1982), Colorado (CDH 1988), and Massachusetts (MDPH 1989) using multiple data sources find that motor vehicle traffic incidents are the leading cause of occupational injury death in each of those states. The percentage of occupational motor vehicle-related deaths ranges from 22.2% in Massachusetts to 25.0% in Maryland and 30.1% in Colorado. Acknowledging the suspected underreporting by death certificates, these state-specific, multiple data source findings lend credibility to a figure of at least 20.1% for the nation based solely on death certificates.

B. Drug and Alcohol Involvement in Work-Related Injuries and Deaths

1. *Alcohol*

The relationship between alcohol and drugs and work-related injuries, both fatal and nonfatal, has not been studied in detail on a national level (Smith and Kraus 1988). Biological monitoring information is not consistently available for fatal occupational injuries, and workers involved in nonfatal incidents are not generally tested for alcohol or drug use (Baker et al. 1982). Because death certificate data do not have uniform requirements for reporting blood alcohol concentrations (BACs), and because historically, workers involved in nonfatal incidents have not been tested for alcohol and drug use, there has not been adequate information reported to base conclusions about the role of alcohol in occupational motor vehicle crashes. However, various geographically based studies using medical examiner or autopsy information provide data that indicate alcohol may play a role in occupational motor vehicle fatalities (Baker et al. 1982; Copeland 1985; Sniezek and Horiagon 1989; Lewis and Cooper 1989).

In Maryland, Baker et al. (1982) reported a total of 148 deaths due to occupational injuries for 1978. BAC tests were performed in 85 (57%) of these 148 deaths. Detectable BACs were found in

13 (15%) of the 85 cases tested, with 9 (13%) cases having BACs of 0.08% or higher. Nine (69%) of the 13 cases with detectable BACs were road or nonroad, occupational, motor vehicle-related deaths. Six (46%) of the 13 cases with detectable BACs were road, occupational, motor vehicle-related deaths.

In Metro Dade County, Florida, Copeland (1985) studied all fatal occupational injuries occurring from 1979 through 1983. Of the 3773 deaths autopsied during that period, 147 were occupationally related, which included 25 (17%) occupational motor vehicle-related fatalities. BACs were ascertained for 18 (72%) of the 25 occupational motor vehicle-related deaths identified. Detectable BACs were reported in 5 (28%) of these 18 cases. In one of these 5 cases, the BAC was above 0.10%.

In Harris County, Texas, Lewis and Cooper (1989) studied fatal occupational injuries occurring in 1984 and 1985. Alcohol tests were performed on 173 (88.3%) of 196 occupational fatalities that were autopsied. Of the 173 cases, 33 (19%) were occupational motor vehicle-related deaths. A total of 23 (13%) of the 173 cases had detectable BACs. Sixteen (9.2%) of the cases had BACs of 0.10% or greater. Ten (44%) of the 23 cases with detectable BACs were occupational motor vehicle-related deaths.

In North Carolina, Sniezek and Horiagon (1989) reported that alcohol testing was performed on 813 (90%) of 902 occupational injury deaths in North Carolina, 1978 through 1984, in which survival time was less than six hours. Of the 813 tested, 89 (11%) had detectable BACs, 53 (60%) of which were 0.10% or greater.

2. *Drugs*

Drug testing was first reported in the Lewis and Cooper (1989) study for 172 (87.8%) of the 196 autopsied cases occurring in 1984 and 1985. Of those 172 occupational deaths, 33 (19%) were occupational motor vehicle-related fatalities. A positive drug screen was reported in 12 (7%) of the 172 autopsied cases. A positive drug screen indicated that the decedent had detectable traces of drugs having the "potential to alter physiologic functions needed to avoid injury." Occupational motor vehicle-related fatalities with positive drug screening accounted for 3 (25%) of the 12 cases with positive drug screen. Drugs may have played a role in these 3 (9%) of the 33 occupational motor vehicle-related fatalities autopsied. Only one case of illicit drug use was found in the study. The study authors indicated the need for more research into the relationship between drugs, especially prescription drugs, and work-related injury deaths. A prospective study is currently underway in Baltimore to ascertain drug and alcohol involvement for all occupationally injured

patients admitted to the Maryland Shock Trauma Unit (Soderstrom and Dischinger 1990).

C. Bicycle-Related Deaths

The NTOF data system identifies 18 occupationally related bicycle deaths during the period 1980 through 1985 (NIOSH 1989a). The age of the decedents ranged from 18 to 71 years and they were employed in a variety of occupations and industries. It is notable that 11 (61%) of these incidents occurred in 1984 and 1985, compared to a total of 7 (39%) in the previous 4 years, possibly indicating an emerging problem due to increased occupational bicycle use in urban delivery services.

The Insurance Institute for Highway Safety (IIHS) indicated that in 1989 a total of 821 riders died from bicycle-related injuries in occupational and nonoccupational crashes (IIHS 1990). Thompson et al. (1989) has estimated that 1300 bicycle riders per year die from bicycle-related injuries. It is not known what proportion of these crashes are occupationally related; however, the IIHS has reported that 51% of the bicyclists killed in 1989 were adults and 63% of the deaths occurred in urban settings (IIHS 1990). In Dade County, Florida, IIHS reported that 96% of the decedents died as a result of head and neck injuries. None of these decedents were wearing helmets.

III. DRIVER TRAINING AND SAFETY AWARENESS

In its preamble, OSHA has cited ample evidence of the effectiveness of seat belts or helmets in reducing the incidence of occupational motor vehicle-related injuries and death. For these devices to be effective, however, they must be properly worn. To assure their proper use, the following elements should be addressed:

1) Specified safe driving skills (e.g., proper vehicle handling) and information (e.g., company policy on seat belt use) must be imparted to the worker to ensure safety vehicle use.

2) The worker should be motivated to use protective devices in vehicles, and the employer should enforce the proper use of these devices on a continuing basis.

3) Management should provide the supervisor with an explanation of company policy regarding the mandatory use of seat belts or helmets, and should develop a program to ensure worker compliance with this regulation.

NIOSH testimony on training of workers are related to these elements.

A. Background

The current research literature (Goldstein 1975; Komaki et al. 1978; Sulzer-Azaroff and de Santamaria 1980; Cohen 1987) indicates effective safety training efforts in industry require, as a first step, an analysis of work conditions or operations to define those worker actions or behaviors that can influence exposure risks. These behaviors become the targets of the training program with instruction, demonstrations or "hands on" practice used to enhance learning and maximize application of the training in the work situation.

Motivation to support the application of training at work may include rewards provided by the employer contingent on the display of the sought-after behaviors, or establishing goals incorporating the new behaviors as incentives for their applications. The latter involves a plan for providing feedback to the workers on their performance. A National Safety Council (NSC) study (NSC 1989) of motor vehicle occupant protection programs among member companies indicates that management support is a crucial element of effective driver safety awareness programs. The NSC study also indicates that motivation plays a crucial role in the overall effectiveness of driver safety awareness programs.

The safety training and awareness provisions of the OSHA proposed rule have not addressed details as to what constitute an effective program. NIOSH has enclosed a study (Cohen & Jensen 1984) on lift-truck operator training that captures the essential points as noted above to illustrate some concrete ideas. Included in this study was a needs assessment step and task analysis to determine those recurrent forms of behavior that were to become the target for the training effort. (In this study 14 such actions were identified). Once selected, training procedures were established consisting of slide presentations demonstrating incorrect and correct behaviors, discussions inviting trainee participation, and sessions involving trainee practice on the safe behaviors. A peer modeling approach was used in the practice sessions wherein each trainee's performance was observed and scored by the others. Subsequent to the training, daily feedback was provided in the form of verbal and posted summaries of group performance and compared to goals which were previously set by the trainee group. Reflecting its effectiveness, the safe behaviors developed from this training program were found to endure after performance monitoring and feedback ceased.

B. Training and Seat Belt Use

There is an impressive body of evidence that seat belt use significantly reduces the personal injury associated with automobile accidents. Studies of U.S. motor vehicle crashes indicate that as many as 50-60% of serious auto injuries and fatalities are preventable through the use of safety belts (Ware et al. 1986). This

is consistent with findings in other countries where it has been found that the probability of fatal injuries could be reduced by 40% and serious injuries by 70% through the use of restraints by motor vehicle operators (Grime 1979).

A 50% reduction in fatalities and injuries from automobile crashes attributable to seat belt use was also estimated by the U.S. Department of Transportation (NHTSA 1983). Obviously, effective strategies for increasing the acceptance and use of seat belts could have a significant impact on reducing the injuries, fatalities, and costs (reported at 43,800 deaths, 3,500,000 injuries, and 60 billion dollars in 1985) of automobile crashes.

By far, the most dramatic increase in seat belt use has resulted from compulsory or mandatory policies. For example, where seat belt use was not compulsory, Zeigler (1986) observed drivers in 19 cities across the U.S. in 1975 and found a 23.3% baseline usage rate. Mortimer et al. (1990) report that the wearing of seat belts increased from 12-14% to over 50% in Illinois following the passage of a seat belt law. Similarly, an Insurance Institute for Highway Safety report (IIHS 1985) shows an average 50% usage rate among states having mandatory seat belt legislation.

There are two important factors in proper seat belt usage: the use of the belt, and the proper fitting of the belt. Studies indicate that the effectiveness of seat belts is recognized in the general population (Mortimer et al. 1990) and that educational programs are of limited effectiveness because the knowledge is already widespread. Knowledge of the potential risk associated with improperly fitted seat belts (Ryan 1975; Dempsey 1977; Carter 1977) has not been investigated.

There is a debate among experts on the proper method of motivating users of seat belts to achieve compliance beyond the 50% level that is achieved by general vehicle safety education and mandatory seat belt legislation (Zeigler 1986). One of the most effective studies (Kalsher et al. 1989) involved a check for seat belt use when workers arrived at their work facility. This program (characterized as a "disincentive program" by the authors) increased seat belt usage to 79% from an existing base level of 55%. An incentive program at a similar facility increased seat belt use from 51% to 61%. The incentive was participation in a lottery with substantial prizes. These studies strongly infer that a clear attitude of management commitment to seat belt use coupled with a periodic check for seat belt use would markedly improve compliance.

IV. FACTORS ASSOCIATED WITH DRIVER FATIGUE AND LOSS OF ALERTNESS

Factors associated with fatigue or loss of alertness should be considered in setting vehicle safety standards. In general, an individual is susceptible to fatigue-related errors, or loss of

efficiency, as time working at a task increases, or as the task becomes monotonous or overly repetitious (Davies et al. 1983). Because driving is often performed for long periods of time, operator susceptibility to fatigue or errors while driving can, under certain conditions, be quite high (Harris 1977). Therefore, OSHA should consider a limit on the number of work-related hours of driving. Long-haul truck drivers, for example, are limited to 10 consecutive hours of driving by U.S. Department of Transportation regulations [49 CFR 395].

Factors other than the number of hours of driving also can influence operator fatigue, loss of alertness, or can interact with hours worked to intensify reductions in operator alertness. Two major factors are the time of day at which work is performed, and the amount of sleep obtained (or lost) by the operator. With respect to time of day, it has been demonstrated that alertness is lowest between 2 a.m. and 6 a.m. because of the body's inherent biological rhythm (Colquhoun 1982; Monk and Folkard 1983). Significant loss of sleep will also compromise alertness (Johnson 1982), and often occurs in conjunction with night work, thus adding to the loss of alertness induced by biological rhythms (Akerstedt 1985). Again, operators performing tasks that are long or monotonous, such as driving, are particularly susceptible to the effects of sleep loss or daily low-points in biological rhythms (Riemersma et al. 1977). Consequently, if operators are required to drive at night, they may be at their lowest efficiency if they are not adapted to night work, or if they have lost sleep. At this time, however, there are no vehicle safety standards that account for time of day or loss of sleep.

Based on the available evidence, driving in the middle of the night (2 a.m. to 6 a.m.), driving more than 10 hours, being awake for more than 20 hours, or being deprived of more than 50% of normal sleep time in the previous 24 hours would contribute to a high risk of fatigue- or alertness-related driving errors. Combinations of these factors would increase that risk. The presence of one or several of these factors should alert the employer that extended periods of driving would be potentially hazardous.

V. RESPONSE TO SPECIFIC ISSUES

1. Vehicle Safety Inspection and Maintenance Programs

NIOSH is not aware of any literature on the relationship of vehicle maintenance to risk of injury. However, it is logical that well-maintained and inspected vehicles would operate more safely and would limit the number of defective or unsafe vehicles on the highways. Proper maintenance and inspection programs should thereby reduce highway incidents attributable to defective vehicles. It is also important to recognize that some motor vehicles operated for commercial purposes are subject to high-stress use involving heavy loads, off-road usage, or high mileage. All of these conditions

greatly accelerate the wear on brakes, steering, and suspension systems that may result in vehicular crashes.

2. Pre-Trip and Post-Trip Vehicle Inspection and Reports

The National Highway Traffic Safety Administration (NHTSA) recommends both pre-trip and post-trip vehicle inspections and routine maintenance in its standard (and forthcoming Guideline) (NHTSA unpublished) on school bus operations [23 CFR 402 Section 1204.4]. All motor vehicle fleets, regardless of vehicle type, would benefit from such safety review. NIOSH supports inclusion of inspections and routine maintenance in the final OSHA standard.

3. Employer Turnover and Training

NIOSH has no comment on this issue.

4. Proof of Training

NIOSH has no comment on this issue.

5. Impaired Driving Awareness Programs

As shown by NHTSA estimates in the OSHA preamble, alcohol and drug use are known to be important causal factors in overall motor vehicle crashes. Studies summarized in Section II.B. of this testimony indicate that alcohol and drug use may also be causal factors in occupationally related motor vehicle crashes. For these reasons, OSHA should include in its final rule a requirement for drug and alcohol awareness programs. These awareness programs would produce benefits not only in the occupational setting, but also would extend to nonwork-related driving as well.

6. Vehicle Overcrowding and 7. Vehicle Overloading and Safety Use

As NIOSH stated in its comments on OSHA's proposed rule on logging, all vehicles used for transporting workers should be equipped with seat belts for the driver and all passengers (NIOSH 1990a). Additionally, the number of passengers in a vehicle should be limited to the number of seat belts in that vehicle. OSHA should include this limitation for all vehicles and all industries covered by this standard.

8. Automatic Crash Protection and Other Engineering Controls Related to Occupant Protection

NIOSH encourages OSHA to include the concepts of intrinsically safe control measures in its final rule. This recommendation is based on the widely accepted preference for controlling occupational hazards by engineering measures (NIOSH 1989b; 1990b).

A system of controls is necessary to provide the reliability, flexibility, and protection that is necessary for vehicle safety. The design intent of this system should be twofold: first, to prevent crashes from occurring; second, if crashes do occur, to minimize their consequences to vehicle occupants. Of particular importance to NIOSH are the use of intrinsically safe controls (e.g., airbags). These types of controls inherently lower risk because they do not depend on worker intervention to be effective (NIOSH 1990c).

By contrast, extrinsically active controls (e.g., use of safe driving techniques) require more human intervention to function properly and have a greater risk of failure without the necessary support activities (e.g., maintenance) (NIOSH 1990c). Both intrinsically safe and extrinsically active controls are normally used as part of a complete control system. However, it is important to promote the use of intrinsically safe controls whenever possible to reduce the inherent level of risk in the system.

There are several types of controls that help prevent accidents by preventing the causal factors. One option is the use of anti-lock brakes. These represent an intrinsically safe control because they engage with no additional action required on the part of the driver. A second option is the use of a system that would require the operator to demonstrate a degree of dexterity prior to operating the vehicle, such as entering a numeric code into a keypad to unlock the steering column. This technology could protect against drivers who are severely impaired (e.g., by chemical intoxicants). The technology of keyless door locks is already in use on some vehicles. A third option is the requirement for ignition systems that cannot be activated unless seat belts are engaged. A fourth option is specifying vehicles with controls that are inherently easy to use and ergonomically well designed. For example, Consumer Reports routinely includes the layout and perceived ease of use of automotive controls in its evaluation of new vehicles. Mandatory safety training of drivers is an example of a very important extrinsically active control measure for preventing crashes, as is regular inspection and maintenance of vehicles.

A control system should also anticipate the possibility that a crash will occur. Air bags are an intrinsically safe control device for mitigating the consequences of many collisions. Automatic seat belts are another option, although they can more easily be defeated and hence are less intrinsically safe. The selection of vehicles that score well in crash tests (e.g., upper 50% of test results) is

another intrinsically safe control feature. The provision of first aid kits, of first aid training, and of a means of quickly calling for help (e.g., CB radios or cellular telephones) are other auxiliary control features that can enhance the responsiveness of extrinsically active control measures to mitigate the effects of incidents.

NIOSH recommends that OSHA require technologically feasible, performance-oriented control measures be implemented, including anti-lock brakes, air bags, and tests of driver competence on all new vehicles that are purchased for occupational use. Performance-oriented language (i.e., "or equivalent") may be appropriate to allow for technological innovation as long as the specific features of intrinsic safety that are to be used as the benchmark of equivalence are clearly presented.

9. Employer Enforcement of the Occupant Protection Program

NIOSH has no comment on this issue.

10. Occupant Safety Belt and Motorcycle Helmet Use

NIOSH has no comment on this issue.

11. Occupant Safety Belts

NIOSH has no comment on this issue.

12. Driver Safety Awareness

See comments in Section III.

13. Routine Drivers

See comments in Section III.

14. Computing Driver Safety Awareness Time

NIOSH has no comment on this issue.

15. Should Bicycles Be Considered in This Rulemaking?

Bicycle injuries and fatalities are similar to motorcycle injuries and fatalities in terms of the type and severity of injuries (Copes and Dickman 1990). OSHA has stated in its preamble estimates of the use and effectiveness of motorcycle helmets. NIOSH is aware of

additional studies on the use and effectiveness of protective headgear for bicyclists (Thompson et al. 1989; Thompson et al. 1990; Wasserman et al. 1988; Kraus et al. 1987; Copes and Dickman 1990). As identified from these studies, a common risk factor resulting in injuries and deaths among motorcyclists and bicyclists is that protective headgear is not worn. Therefore, NIOSH strongly recommends that OSHA require in its final rule that workers wear protective headgear while riding bicycles during their work duties.

This concludes our prepared testimony. We now would like to answer any questions that OSHA or other participants may have.

REFERENCES

Akerstedt T (1985). Adjustment of physiological circadian rhythms and the sleep-wake cycle to shiftwork. Chapter 15. Folkard S and Monk TH, eds. In: Hours of Work: Temporal Factors in Work-Scheduling. New York, NY: Wiley & Sons.

Baker SP et al. (1982). Fatal occupational injuries. JAMA 248(6):692-697.

Bell CA et al. (1990). Fatal occupational injuries in the United States, 1980 through 1985. JAMA 263:3047-3050.

Carter RE Jr (1977). Traumatic spinal cord injuries due to automobile accidents. Southern Med J 70(6):709-710.

CDH (1988). Occupational injury deaths in Colorado, 1982-1987. Results--Colorado population-based occupational injury and fatality surveillance system. Denver, CO: Colorado Department of Health, Health Statistics Section.

Cohen A (1987). Perspectives on self-protective behaviors and work place hazards. Weinstein ND, ed. In: Taking Care - Understanding and Encouraging Self-Protective Behavior. New York, NY: Cambridge University Press. Will be submitted when received.

Cohen HH and Jensen RC (1984). Measuring the effectiveness of an industrial lift truck safety training program. J Saf Res 15(3):125-135.

Colquhoun P (1982). Biological rhythms and performance. Chapter 3. Webb WB, ed. In: Biological Rhythms, Sleep, and Performance. New York, NY: Wiley & Sons.

Copeland AR (1985). Fatal occupational accidents--The five-year Metro Dade County experience, 1979-1983. JFSCA 30(2):494-503.

Copes WS and Dickman FB. Serious traffic related trauma: What can we learn from survivors? Washington, D.C.: Presented at the American Evaluation Association Annual Meeting, October 12, 1990.

Davies DR et al. (1983). Monotony and boredom. Chapter 1. Hockey R, ed. In: Stress and Fatigue in Human Performance. New York, NY: Wiley & Sons.

Dempsey EF (1977). Seat belt injury of the colon. New Zealand Med J 86(592):92-93.

Goldstein IL (1975). Training. Margolies BL and Kroes W, eds. In: The Human Side of Accident Prevention. Springfield, IL: Charles C. Thomas, pp. 92-113. Will be submitted when received.

Grime G (1979). A review of research on the protection afforded to occupants of cars by seat belts which provide upper torso restraint. Accident Analysis and Prevention 11:293-306.

Harris W (1977). Fatigue, circadian rhythm, and truck accidents. Mackie RR, ed. In: Vigilance: Theory, Operational Performance, and Physiological Correlates. New York, NY: Plenum Publishers, pp. 133-146.

IIHS (1990). Facts, 1990 edition. Fleming A (ed). Arlington, VA: Insurance Institute for Highway Safety.

Jenkins (unpublished). Motor vehicle traffic incidents: The leading cause of occupational injury death.

Johnson LC (1982). Sleep deprivation and performance. Chapter 5. Webb WB, ed. In: Biological Rhythms, Sleep, and Performance. New York, NY: Wiley & Sons.

Kalsher MJ et al. (1989). Safety belt promotion on a naval base: A comparison of incentives vs. disincentives. J Saf Res 20(3):103-113.

Komaki J et al. (1978). A behavioral approach to occupational safety: Pinpointing and reinforcing safe performance in a food manufacturing plant. J Appl Psychol 63:434-445. Will be submitted when received.

Kraus JF et al. (1987). Incidence, severity, and outcomes of brain injuries involving bicycles. AJPH 77(1):76-78.

Lewis RJ and Cooper SP (1989). Alcohol, other drugs, and fatal work-related injuries. JOM 31(1):23-28.

MDPH (1989). Traumatic occupational fatalities in Massachusetts, November 1986-October 1987. Boston, MA: Massachusetts Department of Public Health.

Monk TH and Folkard S (1983). Circadian rhythms and shiftwork. Hockey R, ed. In: Stress and Fatigue in Human Performance. New York, NY: Wiley & Sons.

Mortimer RG et al. (1990). Effects of incentives and enforcement on the use of seat belts by drivers. J Saf Res 21(1):25-37.

NHTSA (1983). Highway Safety Program Guidelines No. 17: Pupil Transportation Safety.

NIOSH (1989a). National traumatic occupational fatalities: 1980-1985. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 89-116.

NIOSH (1989b). Comments of the National Institute for Occupational Safety and Health on the Occupational Safety and Health Administration proposed rule on health standards; methods of compliance: 29 CFR Part 1910, Docket No. H-160, October 2, 1989. NIOSH policy statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health.

NIOSH (1990a). Testimony of the National Institute for Occupational Safety and Health on the Occupational Safety and Health Administration proposed rule on logging operations: 29 CFR Part 1910, Docket No. S-048, July 24, 1990. NIOSH policy statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health.

NIOSH (1990b). Testimony of the National Institute for Occupational Safety and Health on the Occupational Safety and Health Administration proposed rule on health standards; methods of compliance: 29 CFR Part 1910, Docket No. H-160, May 31, 1990. NIOSH policy statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health.

NIOSH (1990c). Comments of the National Institute for Occupational Safety and Health on the Occupational Safety and Health Administration proposed rule on process safety management of highly hazardous chemicals: 29 CFR Part 1910, Docket No. S-026, October 15, 1990. NIOSH policy statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Services, Centers for Disease Control, National Institute for Occupational Safety and Health.

NSC (1989). Follow-up study of workplace occupant protection programs among company members of the National Safety Council. Final report. Chicago, IL: National Safety Council. Prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration.

Riemersma JBJ et al. (1977). Performance decrement during prolonged night driving. Mackie RR, ed. In: Vigilance: Theory, Operational Performance, and Physiological Correlates. New York, NY: Plenum Press, pp. 41-58.

Ryan GA (1975). The performance of seat belts in severe crashes. Med J Australia 2(24):889-891.

Smith GS and Kraus JF (1988). Alcohol and residential, recreational, and occupational injuries: A review of the epidemiologic evidence. Ann Rev Public Health 9:99-121.

Sniezek JE and Horiagon TM (1989). Medical-examiner-reported fatal occupational injuries, North Carolina, 1978-1984. Amer J Indust Med 15:669-678.

Soderstrom CA and Dischinger PC (1990). Research proposal: The role of alcohol/drugs in occupational injuries. Baltimore, MD: National Study Center for Trauma and Emergency Medical Systems.

Sulzer-Azaroff B and de Santamaria CM (1980). Industrial safety and hazard reduction through performance feedback. J Appl Behavior Anal 13:287-295. Will be submitted when received.

Thompson DC et al. (1990). Incidence of bicycle-related injuries in a defined population. AJPH 80(11):1388-1390.

Thompson RS et al. (1989). A case-control study of the effectiveness of bicycle safety helmets. JOM 320(21):1361-1367.

Ware A et al. (1986). Seat belt use at work prevents accident costs, lost work time. Occup Health Saf, pp. 20-25.

Wasserman RC et al. (1988). Bicyclists, helmets and head injuries: A rider-based study of helmet use and effectiveness. AJPH 78(9):1220-1221.

Zeigler PN (1986). Observed safety belt and child safety seat usage at road intersections: 19-city survey results. Research notes. Washington, DC: Office of Driver and Pedestrian Research. National Highway Traffic Safety Administration, U.S. Department of Transportation. Will be submitted when received.