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SYMPOSIUM ON DRIVING EXPOSURE

Final Report

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16. Abstract

The Symposium on Driving Exposure was held June 18-20, 1973. Summaries of the sessions are presented, including current status in the field of driving exposure, problem areas in driving exposure research, problem areas in obtaining exposure data, and future plans for exposure research and data collection. Conclusions include a consensus that a national exposure program should be established; that further research is needed on exposure measures and classifications, data collection and sampling plans, and induced exposure; and that states should be involved in the national program. The basic recommendation is that NHTSA should begin planning for a national exposure-data collection and research program, to be fully operational in 1977.

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INTRODUCTION

The Symposium on Driving Exposure was held in Silver Spring, Maryland, on June 18-20, 1973. This report presents a summary of the symposium discussions, plus recommendations for future programs in driving-exposure research and data collection.

The purpose of the symposium is expressed in the following paragraphs from the contract statement of work.

> "Recent research in the field driving exposure has demonstrated the importance of information describing the nature and quantity of travel (e.g., vehicle miles) within various classifications of the highway transportation system. Exposure data, when coupled with traffic accident data provides a unique means for calculating comparative accident rates for those classifications. The accident rates in turn can provide a superior means of evaluating highway safety countermeasures.
>
> Although the state of the art in driving exposure research is advancing rapidly, there is no apparent plan to coordinate future research in the field. While the number of researchers currently active in the field is small, they have not had an opportunity to reach a consensus on future research needs. Others who wish to enter the field have few guidelines for initiating projects. A symposium on the topic of driving exposure is an ideal way to resolve these problems."

The four sections immediately following summarize the four basic sessions of the symposium:

> Current Status in the Field of Driving Exposure
> Problem Areas in Driving Exposure Research
> Problem Areas in Obtaining Exposure Data
> Future Plans for Exposure Research and Data Collection

The final section includes recommendations by the author for future driving exposure programs, based on ideas from the symposium and other sources.

CURRENT STATUS IN THE FIELD OF DRIVING EXPOSURE

Concepts and Past Research

A presentation on current concepts of driving exposure and the state of the art in driving-exposure research was given by Carroll*, as outlined in Table 1. It was emphasized that there is as yet no commonly accepted, comprehensive definition of exposure. However, most implicit definitions used in the past by various authors relate exposure to the occurrence of traffic hazards or the risk of accident. It was suggested that future definitions should consider the relationship between exposure and traffic conflicts, and also the possibility of differentiating between amount and intensity of exposure. Driving distance--in terms of miles of travel--remains the most commonly used and accepted "direct" measure of exposure. Certain "indirect" measures such as fuel consumption, population, numbers of licensed drivers, and numbers of registered vehicles are used occassionally. However, other measures such as driving time, traffic volume or conflicts should be considered. Measures such as passenger distance or time should also be considered in terms of exposure to injury as distinguished from exposure to accident.

Gross exposure, or total accumulated exposure, for a certain area over a given time period, is of little use in studying highway safety problems. Because of this, it is extremely important that exposure data be carefully classified according to the different types travel, types of drivers and vehicles, and types of roadways and environments. Through precise exposure classifications, it is possible to gain insights into the accident causation processes. In recent years, research in driving exposure has emphasized the determination of unique exposure classifications. Research at The University of Michigan under contract

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* All name references are symposium participants; see Appendix A.

Table 1

CONCEPTS OF DRIVING EXPOSURE

Definitions: occurrence of hazards
risk of accident
dangerous traffic events

Amount vs. Intensity

Exposure Measures - direct and indirect

Classification of Exposure

Uses: Problem Identification and Countermeasure Evaluation
prediction of accidents
interpretation of accident data
accident rates
independent analysis

System Views a) exposure as an input, a process, or an output
b) a sequence: exposure-conflict-accident-injury
c) elements of the highway transportation system
d) the highway safety "matrix"

Induced Exposure

Other Concepts: instantaneous vs. cumulative
individual vs. aggregate
discrete vs. continuous
microscopic vs. macroscopic

Exposure Functions: dimensions, weighting, normalized indicies

FH-11-7293 led to the recommendation of seven variables which should be used to classify exposure data: driver age, driver sex, vehicle type, vehicle make, model year, road type, and day/night. While these variables provide the most unique classifications for broad investigation of exposure and accidents, they do not preclude other variables for specialized studies.

Basic uses of exposure data are the identification of highway safety problems and evaluation of countermeasures. For these uses, the most straightforward purpose of exposure data is as the denominator in well-classified accident rates. However, exposure data may also be used in the prediction of accidents and interpretation of existing accident data. Exposure data may also be used independently for analysis of travel trends. Finally, it was noted that "induced exposure" data (derived solely from accident data) may be used in the same ways as noted above for direct exposure data.

Parts of Table 1 dealing with System Views, Other Concepts, and Exposure Functions may be useful in future studies of exposure definitions and measures.

In discussion following the presentation, participants covered many topics of exposure concepts, with greatest emphasis on exposure classifications, data uses, and data reliability. Waller noted good exposure-data classifications may preclude a need to differentiate between amount and intensity in exposure measures. Eldridge and Waller indicated the applicability of exposure data to post-crash, as well as pre-crash and crash phases of accidents. Joksch emphasized the need for correspondence between numerators and denominators of accident rates. He and Burg also noted that accidents and accident rates are not proportional to exposure. Burg emphasized the need to consider a practical value of exposure data to administrators. Cerrelli noted the potential for evaluating system performance within classes. O'Neall indicated the desirability of good experimental design in collecting exposure data. Carlson agreed, noting the value of studies within subsets of the driving environment in addition to global studies. Burg questioned the need for broad,

nationwide studies unless they aid performance modification (e.g. older drivers in backing accidents). Waller defended broad studies as a way of identifying situations with high risk, i.e. leads as to where to conduct more specific studies. Carr suggested an approach to exposure analysis, somewhere in between the broad study and the controlled experiment, as most useful to administrative decision makers. Wiener noted various uses of exposure data in decisions regarding social policies, e.g. transit for the elderly. Reinfurt and Koch indicated the need to change certain percentage variables in the Michigan study to correspond to actual classes. Comments were made on the drawbacks inherent in self-reporting of exposure data. Joksch indicated that a time period of the last 30 days may be best for self-reporting estimates. Waller indicated an imperfect correlation between self-reporting and odometer readings, and differences therein with respect to sex and age. Koch and White indicated certain possibilities for cross-checking of exposure estimates. Burg indicated possible systematic biases affecting the validity and reliability of person's mileage estimates. Waller suggested the need to study reliability of mileage estimation through samples of re-estimates. Joksch noted the quandary of similar exposure values for dissimilar classes. Woods noted the lack of evidence regarding the usefulness of exposure data within narrow classes. Recht raised the question of resource allocation without such evidence. The effects of alcohol on highway safety was noted as a case where narrowed studies are useful. Carlson pointed out, however, that it is unclear what kind of exposure measure is needed for drinking-driving studies, and cited a case where mileage is not a good predictor.

Needs for Exposure Research

A presentation on the needs for future research on driving exposure was made by Cerrelli. Three main points were emphasized:

1. The need for a generally acceptable definition of exposure and a basic unit of measure. Efforts should be made immediately to narrow down on such a definition, and compromise will be needed. This

is especially important for the gross type of research analysis that must be conducted at the national level.

2. The need to establish meaningful classifications of driving exposure. Basic classes are type of travel, drivers, vehicles, roadways and environmental. Within these basic classes, it is necessary to determine to what level of detail the classifications should be defined.

3. The need to select effective methods for obtaining necessary exposure data. Many data-collection methods have been employed under contract, but it is still necessary to narrow them down for optimum cost-effectiveness with respect to selected exposure measures and classifications.

Cerrelli indicated that these are realistic needs which can be satisfied by a well-coordinated effort. He also expressed the desirability of a continuing series of national symposiums on driving exposure.

Waller indicated the difficulty in arriving at a single, generally accepted definition of exposure, but Cerrelli emphasized that the need is to narrow down the definitions or measures, as applicable to a limited number of situations. Carroll suggested a broad definition--frequency of traffic events which create a risk of accident--as an inclusive starting point for narrowing the definitions. Carr said that the definitions must be workable, though admitting his personal preference (set of probability density functions varying with risk of loss) is unworkable under most conditions. Carr also felt that vehicle-miles is a politically acceptable exposure measure, good for gross work. Joksch suggested the possibility of different exposure definitions for one-vehicle and two-vehicle accidents. He also suggested a standardized mile as an exposure measure, divided according to national distributions of speeds, volumes, driver and vehicle types, road types, and environments; data for such a measure would be obtained from roadside observations, sampled by location and time, and from follow-up studies using license plate numbers. There was a great deal of discussion on this idea, including

reservations about the feasibility of sampling, measuring speed, identifying drivers, and methods of obtaining coordinated follow-up information. Woods suggested obtaining odometer readings on all vehicles at the time of registration. Eldridge mentioned the technique of remuneration to obtain good responses. Anderson suggested that all necessary information might be obtained at the roadside, rather than relying on follow-ups. Carlson and Waller mentioned the good cooperation experienced in previous roadside surveys. The questions of legality of stopping drivers for roadside surveys was raised by Carr. Identification of age and sex of drivers from photographs was suggested. White noted that Joksch's method would provide relative rather than absolute measures. Carlson defended the relative measure, and noted that sites could be selected to represent certain populations.

Current Research Directions

A presentation on current research in North Carolina was made by Waller. A wide variety of exposure studies have been conducted at The University of North Carolina, primarily to obtain data for use in analyzing accident involvement phenomena. Because many different exposure data collection methods have been used, a great deal is being learned coincidentally about these methods. One approach was to tie in with the origin-destination studies of the State Highway Commission each summer. The Commission has collected special information on surveyed vehicles (race, sex, and age estimate of driver and front passenger, plus license plate number) in addition to regular data (vehicle type, day of week, time of day, type of highway, number of trips). In comparisons of trips and accidents, young drivers and old drivers were over-represented in accidents, for all times of day. Older vehicles were also overinvolved. There was also a distinct overrepresentation of accidents from 12 to 6 a.m. Future analysis using the same type of data will deal with culpability in accidents. North Carolina studies have also used driver license stations for collecting estimates of annual driving (by interview) and previous day's mileage (by

questionnaire). The problem of representing beginning drivers by this method was noted. Comparison of the annual data with the O-D data showed good agreement. Another approach has been the collection of odometer readings at vehicle inspection stations, over a two-year period. Readings were matched using VIN. Adjustments were made for recycling of odometers. In some states, odometer rollbacks would be a problem. In the future, it may be possible to link registration files with odometer readings at inspection. Koch mentioned the desirability of obtaining odometer readings more frequently than annually, such as everytime gasoline was purchased by credit card. Every three months might be often enough. Burg suggested odometer readings on a roadside survey. Waller suggested that the reliability of readings or estimates will improve as the general public becomes accustomed to the exposure collection programs. Woods mentioned a trend toward synthetic O-D studies, based on the extreme stability of certain groups, year after year. However, base data must be revised periodically. Carlson noted that good sampling strategies for exposure data will allow similar extensions of occassional gross exposure collection programs.

PROBLEM AREAS IN DRIVING EXPOSURE RESEARCH

Goals of Driving Exposure Research

The discussion on goals was opened by Cerrelli, who posed several questions: should we have goals?, should they be short-term or long-term?, should they deal with the national scale or specific research studies?, to how much detail should exposure measures be defined?, should data collection be done through existing state channels or by a new survey organization?

There was a general consensus that goals would be useful in planning future exposure research and data collection efforts. The goals are needed either by NHTSA or the highway safety research community. Whether the goals should be formally stated or only tacitly agreed upon was not mentioned.

White and Carr contended that the intended uses of exposure information must be the basis of goals. Breedon also agreed, but noted that off-the-shelf exposure data will be useful for many as yet undefined problems. Joksch felt that exposure data should be obtained at all administrative levels where accident data is currently obtained, or where it will be obtained in the future. Breedon emphasized the need for a computer system that would provide ready answers to administrators based on current exposure data. Cerrelli suggested continuous monitoring of exposure at both national and state level. Fleischer felt that goals for exposure research should be linked directly to specific countermeasure programs; however, he would proceed with a program to provide public relations reporting of general exposure trends. Cerrelli urged that any effort on exposure data for special studies be comprehensively organized to avoid duplication.

Measures of Exposure and Classification Variables

This was a very brief discussion, inasmuch as the previous discussions had already chanced to focus on these topics. Tables 2 and 3 were presented as sets of exposure-measure and classification variable alternatives. Driving distance (vehicle miles) was generally accepted as the exposure measure for a national data base. The classification variables in the top group, derived from the Michigan study, were generally accepted as ones needed in a national data base. However, it was still felt that more research should be done regarding exposure measures and classification variables.

Induced Exposure

This discussion was led by Carr and Joksch. Carr said that induced exposure data cannot be used for countermeasure evaluation, but it is more useful for its learning value in identifying problems that might not be identified from direct exposure data or accident statistics. Joksch said that the induced exposure models which use both one-vehicle and two-vehicle crash data are questionable because the two types occur in different environments. He also said they fail to account for the complex process in two-vehicle crashes, and that assigning culpability to one vehicle overlooks the opportunities of avoidance by both vehicles. Joksch tested the existing models with Hartford data and found that none explained the sex distributions actually driving. Joksch said that his model ties induced exposure to conflict situations. Koch suggested that age and sex distributions of drivers who witnessed accidents might be a good indicator of exposure. Carr suggested that maybe all the answers that induced exposure can produce, have been produced. Joksch said induced exposure will have continuing value with respect to new vehicles. Cerrelli described his analysis using reversed induced exposure model, whereby culpability

Table 2

MEASURES OF EXPOSURE

DRIVING DISTANCE (VEHICLE MILES)
DRIVING TIME (VEHICLE HOURS)
OCCURRENCE OF TRAFFIC CONFLICTS (FREQUENCY)
FUEL CONSUMPTION (GALLONS)
NUMBER OF REGISTERED VEHICLES
NUMBER OF LICENSED DRIVERS

PEDESTRIAN DISTANCE (WALKING MILES)
PEDESTRIAN TIME (WALKING HOURS)
NUMBER OF ROAD CROSSINGS

TRAVEL DISTANCE (PASSENGER MILES)
TRAVEL TIME (PASSENGER HOURS)

Table 3

EXPOSURE VARIABLES

DRIVER	VEHICLE	ROAD	ENVIRONMENT
DRIVING ON JOB	VEHICLE TYPE	ROAD TYPE	DAY/NIGHT
DRIVER SEX	MODEL YEAR		
DRIVER AGE	VEHICLE MAKE		
USE OF VEHICLE	VEHICLE SIZE	WET/DRY	URBANIZATION
KNOWLEDGE OF ENGINE	VEHICLE MODEL		
	VEHICLE HORSEPOWER		POPULATION
INCOME	NUMBER OF CYLINDERS		
SOCIO-ECONOMIC SCALE	ENGINE DISPLACEMENT		
EDUCATION			
NUMBER OF VIOLATIONS			
MARITAL STATUS			
OCCUPATION			
ALCOHOL USE	VEHICLE WEIGHT	LANE NUMBER	SPEED
		LANE WIDTH	
SEAT-BELT USE	POWER STEERING	PAVEMENT TYPE	VOLUME
DRIVER EDUCATION	POWER BRAKES	SEGMENT ALIGN-MENT	WEATHER
		SIGNALIZATION	TIME OF DAY
		INTERSECTIONS	DAY OF WEEK
		SPEED LIMIT	

ratios can be found if direct exposure is known. White and Carroll said an effort should be made to compare induced exposure with direct exposure. The question of combining direct and induced exposure data was also raised.

Techniques of Exposure Data Analysis

A presentation was made by Koch on several approaches that may be used in the analysis of exposure data. Table 4 lists some of the analysis problems and techniques available. The discussion centered on the determination of exposure classification variables, primarily through the AID algorithm. Koch also pointed out the sometimes advantages of a slower process where all variable tabulations are produced for each subgroup in the data, and successive classification variables are chosen by the analyst, and where a backward elimination process can produce an AID-like tree chart. There was also discussion about methods for combining exposure data from different sources. The method of Shah requires there be some independent variables in common between two data sets, and that the marginal distributions of the common variables be consistent. Adjustments to force such consistency may weaken the validity of results. McRae gave a brief description of future plans for exposure data studies by Statistics Canada.

Table 4

ANALYSIS OF EXPOSURE DATA

Problems: Determining Significant Classification Variables
Comparing Exposure Measures as Accident Predictors
Comparing Reliability of Exposure Data Sources
Comparing Exposure Estimates with Respect to:
degree of classification
time period of estimation
Combining Direct-Exposure Data Sets
Combining Direct and Induced Exposure Data

Techniques: Analysis of Variance
Regression Models
Factor Analysis
AID - Automatic Interaction Detection

PROBLEM AREAS IN OBTAINING EXPOSURE DATA

This discussion dealt with data sources, sampling design, and methods of exposure-data collection. Possible alternatives within these topics are listed in Tables 5 and 6. Most of the discussion focused on exposure data for gross, national representation. Carroll emphasized a preference for drivers as a basic source of data, whether by estimation or readings of their odometers. McDole described the national exposure survey at Michigan in 1970, including the random selection of states, counties, and licensing stations, and the interview techniques. Carroll described the trip-log survey of driving exposure currently underway among licensed drivers in Michigan. McDole mentioned various methods of improving response rates and correcting for response biases, e.g. reminder letters and follow-up postcards for odometer readings. He noted that non-respondents tended to be rural, young, lower economic and educational level, and more likely to have violations and accidents on their records. Waller suggested illiteracy as a possible non-response cause. The need for cooperation of licensing office personnel was noted. Carroll described a set of small surveys in Michigan for comparing accuracies of various data collection methods. With trip-log odometer readings assumed as the most accurate method, mailed one-day estimates were judged as reasonably accurate, but telephone-interview estimates were poor. Carroll suggested a state-by-state sampling as very feasible for national representation of exposure, followed by comparison with the National Accident Summary. Waller cautioned about current variances in accident-record policies among states. Carroll suggested improved national standards for accident reporting, and also for drivers' mileage estimates at the time of license renewal. Fleischer noted the costs of implementing such standards, and suggested NHTSA should consider it on a cost effectiveness basis with respect

Table 5

POTENTIAL SOURCES OF EXPOSURE DATA

- DRIVERS
- ODOMETER READINGS
- TRAFFIC COUNTS
- GASOLINE SALES
- INSURANCE RECORDS
- LICENSE RECORDS
- REGISTRATION RECORDS

SAMPLING DESIGNS

- NATIONAL
  - Random Sample from National Driver Registry
  - Household sample
  - Longitudinal panel of new vehicles
  - Sample of roadway locations
  - Sample of insurance company records
- STATE-BY-STATE
  - Random sample of licensed drivers
  - Household sample
  - Random sample of vehicle owners
  - Sample of roadway locations
  - Total gasoline sales by county

Table 6

METHODS OF DATA COLLECTION

Contact with drivers by:
- mail
- phone
- home visit
- roadside survey
- licensing office
- registration office
- insurance agents

Recording of data by:
- interview
- questionnaire
- trip log
- single odometer reading

SOME ALTERNATIVE DATA COLLECTION PLANS

DRIVER ESTIMATES (INTERVIEW, MAIL SURVEY, OFFICE QUESTIONNAIRE)
- GROSS ESTIMATES
- ESTIMATES BY CLASSIFICATIONS
- RECENT TRIP RECALL

ODOMETER READINGS (BY DRIVER, INSPECTOR, RESEARCH OBSERVER)
- GROSS DIFFERENCES -- longtime period
- PERIODIC DIFFERENCES -- Daily, weekly, etc.
- DRIVER TRIP LOGS

COMBINATION OF DRIVER ESTIMATES AND ODOMETER READINGS

TRAFFIC OBSERVATIONS -- excludes driver classifications

to the value of exposure data to decision makers in each state. Eldridge said that NHTSA is definitely moving in the direction of a national sample. One approach being suggested is the establishment of Highway Safety Measurement Areas (HSMA). These would not involve all states initially, but as they saw the potential feedback value to them, they would want to be involved. Carr agreed that feedback is desired by local areas, and noted a program in Canada that will provide information to the provinces. However, administrators require understandable information, and will not be enthused unless the feedback is useful for their own decision-making needs. Woods and Fleischer noted the existing abundance of data which is not used for local needs. Burg suggested that leadership of forward-looking states may show the usefulness of exposure data. Waller suggested that O-D studies may augment driver licensing station interviews by getting young drivers and those without licenses. Fleischer suggested that national data gathering techniques might be selected by noting the feasible alternatives, limiting kinds of exposure data to those which fit the alternative, then working back to an optimum combination. Carlson noted the importance of being able to link exposure data from special studies to the national data base. Kahane and Eldridge discussed the feasibility of using personnel engaged in routine national sampling to obtain data for special studies by careful coordination. Burg emphasized the need to select good exposure measures before proceeding with selection of data-collection methods. He suggested research to weed out measures which aren't valuable. Recht suggested the use of commercial firms to collect exposure data through existing samples (panels of households, etc.). Carr indicated that households may be an unsatisfactory sample base. Eldridge suggested the possibility of a stratified sample of car purchasers.

FUTURE PLANS FOR EXPOSURE RESEARCH AND DATA COLLECTION

This discussion focused on future exposure programs on a national scale. There was general consensus--though not unanimous--that a national program should be established as soon as posible, beginning with research directed toward such a program, and leading to a national exposure data base which can evolve and improve as conditions permit. There was also a general consensus that special studies requiring exposure data for evaluation of countermeasures should be part of a future program, and that unique exposure measures for such studies should be able to make use of the national data base. Thus, though there may be a single exposure measure in the national program, it should be defined with enough flexibility in itself, and in its classifications, for compatibility with a reasonable range of special exposure measures.

Burg suggested that future research should follow logically from projects now underway. These include the O-D and license station projects of Waller et. al. at North Carolina, the project investigating combinations of available data sources by White at Research Triangle, and the trip-log survey of Carroll in Michigan. Eldridge noted plans by NHTSA to sponsor MITRE for development of a national sampling plan for pedestrian and bike accidents; this is seen as a first step toward a comprehensive plan for sampling among all reported traffic accidents nationally. The Highway Safety Measurement Area plans would include both accident and exposure data. Perhaps resources now used for Multi-Disciplinary Accident Investigation teams should be converted to a plan for accident investigation based on a probability model, though some teams could be retained for high-priority clinical investigations. Several people indicated that sufficient data on pedestrian, bike, and motorcycle accidents are needed in a national program. Carroll noted a need for exposure-to-injury data. White suggested possible use of methods used in previous National Transportation Surveys by FHWA. Problems of injury analysis were noted, in terms of poor accident reporting by seated position and weaknesses

in the KABCO injury code. Fleischer suggested that NHTSA should call into question all current accident data requirements before adding more. Carlson noted that obtaining really good accident data put too much of a burden on police at accident scenes. He suggested designating certain police as professional accident investigators who would go only to certain randomly selected accident scenes. Recht suggested the use of FDA's National Electronic Injury Surveillance System for accident-injury reporting. Reinfurt described the value of the North Carolina newsletter to police and other administrators in gaining their cooperation. Carroll suggested that NHTSA should sponsor research into alternative methods of exposure data collection. Burg and Joksch expressed support for vehicle miles as a measure of exposure, though Burg indicated the need for more research on other measures. Joksch also suggested that induced exposure analysis should be part of the national program. There is a need to compare direct and induced exposure results in various classifications. Carlson emphasized that specific objectives of the states should be used as a basis for selecting exposure measures. Anderson suggested well-classified driving time may be a better predictor of accidents than vehicle miles. Joksch again suggested a standard vehicle mile, divided according to 10-20 critical type situations only (i.e. it would not include actual proportions of low-risk driving exposure). Carlson and Anderson noted the problems in this scheme with respect to proper weighting of various situations. Kahane and Fleischer noted its problems with respect to meaningfulness in public relations, but Fleischer nevertheless found it appealing for application to countermeasure evaluations. Carr noted that if the Joksch method is well-classified, the result is "shapshots" of the driving population. Burg and Fleischer felt that research on exposure measures and data-collection methods should be done in parallel. White felt that current types of exposure sources will not be sufficient for ultimate needs. Several participants commented on the possibility of improving the methods of using gasoline sales as an indicator of exposure, and there was general pessimism in this area.

In the afternoon continuation of this discussion, emphasis remained on future programs on a national scale. Much of the discussion duplicated previous ideas in greater detail. Thus, only a few of the more unique suggestions are reported. Fleischer suggested that NHTSA should establish a national figure of merit with respect to exposure, for periodic reporting to Congress and the public; this would not be used for countermeasure evaluation. Another approach would be to begin on the exposure data program at the national level (i.e. nationally representative, but not state by state) in order to get gross data, and after it was fairly well established, redesign the sample on a state-by-state basis so that feedback would be available for state needs. Anderson noted a likely variance in state needs which would preclude standardized classes. Carlson felt compromises should be made. Carroll said that the first year or so of state-by-state programs could be done under national sponsorship until states were ready to participate based on the value seen by them. He also suggested that the first year of a national survey could incorporate auxiliary studies regarding alternative data collection methods, with superior methods being fully adopted in later years. Several participants agreed that the first year should be very simple in terms of measures and limited classifications. Eldridge indicated an early need for data on sobriety and seat belt use. She also suggested 3-4 years as a time period required to get a national program started. Fleischer noted that NHTSA is the only prospective sponsor of exposure research. Eldridge indicated NHTSA's need for potential contractors who can supply research on an as-needed basis. Woods suggested the use of tape recorders in vehicles for noting odometer readings as road types change, etc. Waller noted that out-of-state drivers aren't captured in license station surveys. Koch said that national sample sizes should be as large as possible, perhaps 25,000 or more. He also noted that instrumented cars are being used in large numbers for certain studies, and might be used for exposure data.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions were derived from symposium proceedings:

1. Exposure data is needed in highway safety research, along with accident data, to permit identification of problem areas and evaluation of countermeasures.

2. The most pressing need for exposure data is for a comprehensive data bank at the national level, though consideration must still be given to exposure data needed for special studies.

3. A comprehensive national program of exposure data collection and analysis should be established, and planning for such a program should begin immediately.

4. The primary use of exposure data is as the denominators in calculations of accident rates within meaningful classes of corresponding accident and exposure data.

5. For general purposes, vehicle miles of travel should be used as a measure of driving exposure, but further research is needed with regard to exposure measures, not only for general purposes but also for special studies. This includes not only exposure to accident but also exposure to injury.

6. Meaningful classifications of exposure data are extremely important. The independent variables driver age and sex, vehicle type, make and model year, road type, and day/night should be used for basic classifications. Further research is needed with regard to other classification variables for both general purposes and special studies.

7. Though exposure measures for special studies may differ from a standard national measure, the special studies should still be linked to the national data bank through consistent classifications and sampling designs.

8. More research should be performed on induced exposure models including testing with respect to direct exposure data, and on methods of combining induced and direct exposure data.

9. More research should be performed on methods for collection of exposure data with emphasis on the following alternatives: tie-in with origin-destination studies, mailed one-day trip logs (trip-by-trip odometer readings), mileage estimates via license-station interviews, roadside surveys using either mileage estimates or odometer readings (or both).

10. Research should be performed on methods of sampling for nationally representative exposure data, both on an overall basis and a state-by-state basis.

11. Strong consideration should be given to exposure-data sampling using the same sampling plan soon to be derived for determining areas for the Highway Safety Measurement Area (HMSA) program.

12. Though the aforementioned research needs (exposure measures, classifications, induced-exposure, collection methods, sampling) are inter-related, effort should begin on each of them independently as soon as possible, as a prelude to more comprehensive research.

13. Sponsorship of a national exposure-data program should be provided by NHTSA, though states may be included in cooperative sponsorship eventually.

14. Whether or not states are involved in a national exposure-data program, they should each be provided with feedback, i.e., any results which pertain specifically to their own state.

15. It may take as long as three or four years to make a national exposure data collection program fully operational, on an annual basis.

16. In order to expedite the availability of a national exposure data file, a program should begin as soon as possible to provide nationally representative exposure data from any convenient sampling base, with the intention of switching to an improved sampling base later, perhaps state-by-state.

The basic recommendation of this report is that NHTSA begin planning immediately to implement a coordinated national program of exposure-data collection and research based on the conclusions above. A realistic goal of the program would be to establish a fully operational exposure data collection plan, providing national representation of exposure on an annual basis, beginning with the calendar year 1977. The necessary professional resources to assist NHTSA in achieving this goal are available in the highway safety research community. The necessary resources within NHTSA, in terms of funding and internal NHTSA organizational structure, must be assured by a strong policy commitment. The following scenario is recommended as a means of tapping and building the necessary resources.

1973 Action

1. Continue planning within the Mathematical Analysis Division, based on a thorough review of this report, the previous planning report under FH-11-7293, and current findings of the RTI study.

2. Issue brief contract(s) for consultation in 1973 planning.

3. Prepare contract for a 1974 national survey of exposure as described below.

4. Begin determination of appropriate organization within the Office of Accident Investigation and Data Analysis to promote the idea of a national exposure program within NHTSA and to develop strategies for achieving that goal. The appropriate organization at this point may be the Mathematical Analysis Division (because of its past involvement), the Accident Investigation Division (because exposure data must correspond to accident data), a joint effort of the two divisions, or a special task force within the Office.

1974 Action

1. Continue trip-log survey in Michigan to allow comparisons of 1973 and 1974 data.

2. Continue research in North Carolina concerning uses of available exposure data sources, to the extent that directions are consistent with above conclusions.

3. Sponsor a contract for a 1974 national exposure survey based on driver mileage estimates in a random sample of license stations.

4. Develop and issue small research contracts on exposure measures, classifications, sampling, data collection, and induced exposure.

5. Invite proposals for brief special studies, requiring exposure data and dealing with important problems such as drinking-driving or seat belt usage.

6. Sponsor another symposium on driving exposure.

7. Sponsor research directed toward an optimum sampling plan for HMSA's or another plan for national sampling that will provide corresponding sets of both accident and exposure data.

8. The Office of Accident Investigation and Data Analysis should initiate policy discussions within NHTSA to promote a national exposure program and to establish an internal organizational structure responsible for the program. This may involve both the Research Institute and Traffic Safety Programs.

1975 Action

1. Sponsor a contract for a 1975 national exposure survey which is essentially a continuation of the 1974 contract, except that a transition will be included whereby NHTSA becomes more directly involved in part of the operations.

2. Continue promising research from the previous year. Complete research on data collection methods for national program, and establish methods to be used in pilot survey in 1976. Sponsor research on uses of exposure data.

3. Continue research on sampling plan, for HMSA or other national sampling plan, and establish sampling plan to be used in pilot survey in 1976.

4. Sponsor research on procedures for establishing a national exposure data bank.

5. Sponsor another symposium on driving exposure.

1976 Action

1. Conduct a pilot survey under direct management of NHTSA, using sampling plans and data collection methods selected in previous research. Begin effort to implement

data bank procedures using incoming survey data. Sponsor a contract for consultation and assistance on the pilot survey.

2. Sponsor research for comparison of 1974 and 1975 exposure data, for use in final modifications in an operational survey plan.

3. Continue promising research from the previous year, aimed at continuing improvements in the national exposure program and special studies linked to the national program.

4. Sponsor another symposium on driving exposure.

1977 Action

A fully operational, national exposure-data collection program should begin in 1977 under direct management of NHTSA. The data should be inserted in an exposure data bank providing convenient access for rapid analysis of exposure classes and merging with associated accident data. The responsible NHTSA office should continue planning for improvements in the national exposure program, especially in terms of involvement of appropriate state agencies. The office should also coordinate further research sponsored by NHTSA which requires data from the exposure data bank. There should be a vigorous program to promote the use of exposure data in highway safety research, and at all appropriate administrative levels.

The rationale for these recommendations are three-fold: good exposure data is <u>needed</u> for highway safety research as soon as possible; it is technically <u>feasible</u> for NHTSA to implement a national program by 1977; and the <u>ground work</u> of research and practice in data collection must be built continually in the next three years to meet the goal.

Appendix A

SYMPOSIUM PARTICIPANTS

Ted Anderson - CALSPAN
David Breedon - National Highway Traffic Safety Administration
Albert Burg - University of California at Los Angeles
William Carlson - The University of Michigan
Brian Carr - Ontario Department of Transport
Philip Carroll - The University of Michigan
Ezio Cerelli - National Highway Traffic Safety Administration
Vince Darago - National Highway Traffic Safety Administration
Marie Eldridge - National Highway Traffic Safety Administration
Jerry Fleischer - University of Southern California
Joseph Jeffrey - National Highway Traffic Safety Administration
Hans Joksch - Center for Environment and Man
Charles Kahane - National Highway Traffic Safety Administration
Gary Koch - University of North Carolina
Thomas McDole - The University of Michigan
Murray McRae - Statistics Canada
Brian O'Neall - Insurance Institute for Highway Safety
Paul Ponce - National Highway Traffic Safety Administration
Kenneth Poole - Research Triangle Institute
Jack Recht - National Safety Council
Donald Reinfurt - University of North Carolina
Patricia Waller - University of North Carolina
S.B. White - Research Triangle Institute
Earl Wiener - University of Miami
Donald Woods- Texas A&M

Appendix B

CONTRACT TASKS

a. Prepare plans for a three-day symposium on driving exposure, including schedules, formats and agendas of all sessions.

b. Select participants for the symposium on the basis of experience in the driving exposure field, issue invitations and make necessary arrangements for travel and accomodations for at least fifteen participants.

c. Make arrangements with all participants for active roles in the symposium as speakers, panel members, and contributors to a final workshop on future research programs.

d. Prepare a state-of-the-art report on driving exposure as resource material.

e. Make all other necessary arrangements, and conduct the symposium, with special attention to completion of plans for future research programs in the final session.